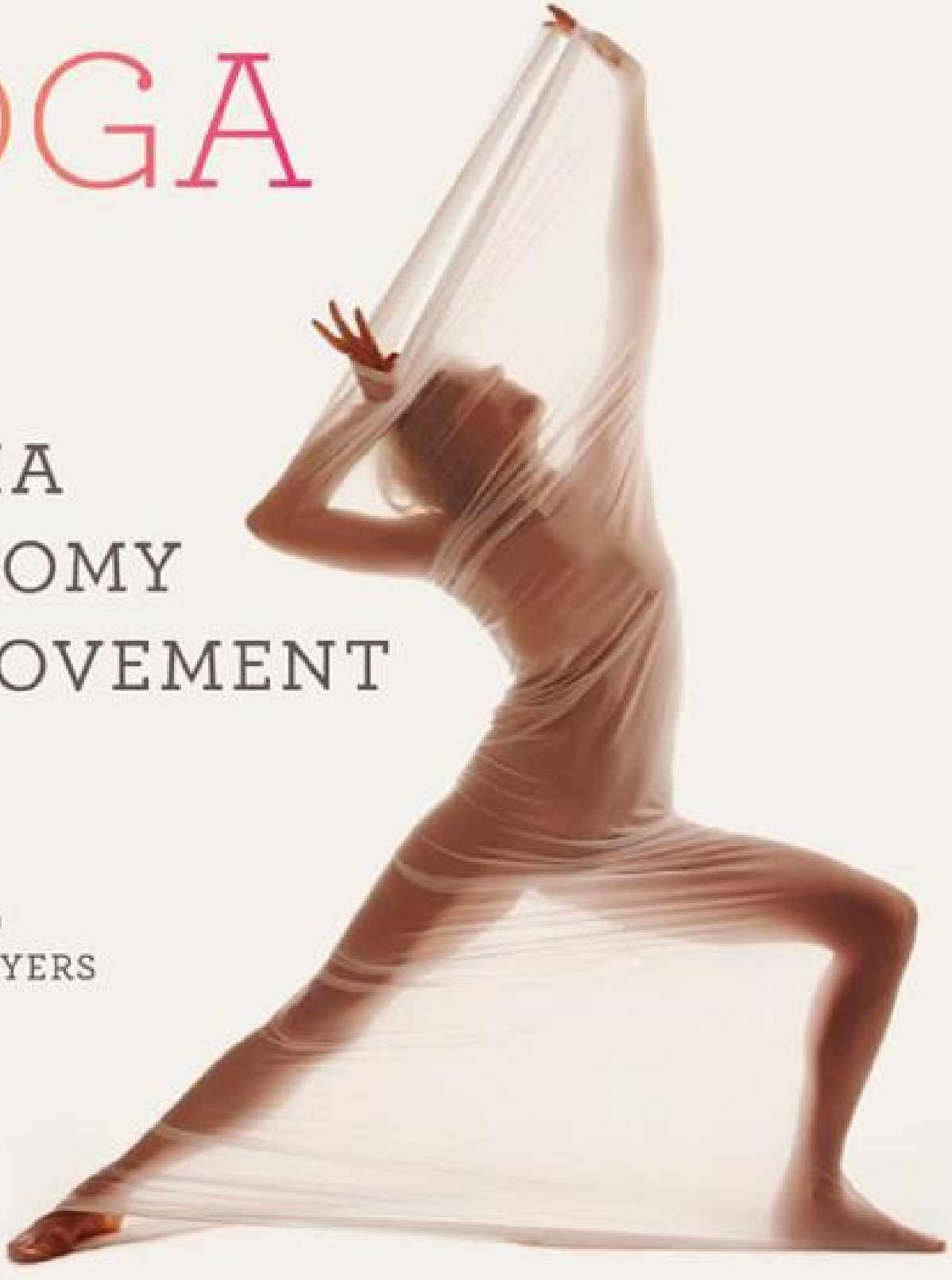
YOGA

FASCIA ANATOMY *and* MOVEMENT



FOREWORD
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Dedication

To my wonderful parents, Stephani and William; to Caroline in deepest gratitude; to Ben for the questions about science; and to Steven, without whom there would be no art.

Foreword

Yoga, along with martial arts and dance – all of which stretch back into the mists of pre-history – is certainly among the earliest organized attempts to change a person by means of body movement. Even though modern psychotherapy has largely abandoned a body-centred approach in favour of talk therapy and increasing amounts of pharmaceuticals, the positive effects of exercise on the psyche – Juvenal's *mens sana in corpore sano* – have been acknowledged for centuries. Yoga, at least in the developed texts and adepts, goes well beyond these general benefits that come from engaging the mind in a coordinated pumping of the muscles. It claims (and in my experience, often delivers) to advance our psychophysiology into positive territory, away from self-centred, fear-based chemistry to a more serene, objective and fully present state of bodymind.

The modern flowering of yoga owes a great deal to the late B.K.S. Iyengar, a lion of a man who wrestled both the postures and the breathing practices of yoga into an understandable and graduated discipline. Even current forms of yoga that have rejected the particulars of his practice owe him a deep debt – without him there would be no "art of contemporary yoga". With him, and with the interest that has followed and branched out from his work, yoga has taken many forms, and over the course of my working life has gone from a few hippies contorting themselves in an ashram to the current ubiquity of yoga classes in nearly every gym, village hall, street corner, and even school athletic programmes, corporate retreats, and senior centres. Yoga itself has diversified into hundreds of branches, ranging from the athletic Ashtanga to the flowing Vinyasa to Iyengar's precise positioning to more meditative approaches. These days, we are spoilt for choice in which yoga to choose for ourselves.

Inevitably, then, yoga comes up against science – "Prove it!" say the researchers. Joanne Avison – not a researcher in the laboratory sense, but rather a re-searcher – is uniquely positioned to help us understand the research we have already, as well as provide a framework to understand the studies to come. Joanne's background includes many years of teaching yoga in a variety of contexts, and with her quick mind and her ability to write clearly, this book provides the contemporary teacher and practitioner of yoga with a frankly astounding tour of current thinking that blends the spiritual with the scientific, and the sacred with the intensely practical.

Fascia – that long-ignored biological fabric that shapes us – has now become a buzzword, often used with more enthusiasm than understanding. This book takes on the developmental significance of what Dr Robert Schleip calls the "neuromyofascial web" in all its glory, without bogging the reader down in the details of anatomy or biochemistry, which are relevant to "afascianado" or biomechanist, but not necessary to daily practice.

The tradition of yoga has a great deal to teach us, but in another way these ancient texts and forms are entirely irrelevant. Industrialized, electronified humanity faces a challenge – a whole series of challenges – never before encountered by any previous era. One of these challenges is the loss of self-sense, a sense of alienation from the body and its whispered but essential messages, dulled in the roar of the planes, trains and automobiles, the blare of radio, TV and Internet, and the sheer weight of the number of people on this intricate planet. We must face the challenge of how we educate our children to move and feel in the

natural world, and create a programme of what I have called “Kinesthetic Literacy” for this hyper, data-rich, information-poor era.

Read this book no matter what form of yoga you practice or teach – in fact, read this book if you happen to have a body. You will be pulled along a merrily flowing stream of ancient and contemporary thought, and you will emerge with a fresh explanation of why the many new interpretations of yoga can be so important in the revivification of our body and mind.

Thomas Myers 2014
tom@anatomytrains.com

Preface

I began my yoga training aged seven, sitting beside my mother in a church hall in the mid-sixties, wondering why the man at the front was wearing white pyjamas.

Scintillate, scintillate global vivific
Fain would I fathom thy nature specific
Loftily poised in the ether capacious
Strongly resembling a gem carbonaceous

At sixteen I learned a form of meditation in a centre for the deaf in London and remained fascinated by sign language, by communicating with my hands. Meditation for me was like drinking water; something so much a part of my life that I could not understand why anyone would want to talk about it! After a broad and wonderful education in England and France (languages, sciences, fine art) and a career that included the artisan craft of the chocolatier and being a resident author for a large publishing house, a back injury in my early thirties re-introduced me to yoga and anatomy. Little did I imagine that understanding the various properties of chocolate (a substance that responds and changes structure with movement, manipulation, temperature and intention) would one day be the foundation for understanding the fascial matrix of the human body.

I was originally trained in Vanda Scaravelli's intelligent, feminine approach to yoga. Among my teachers were men and women who worked directly with her. John Stirk and Peter Blackaby brought anatomy and biomechanics from their osteopathic backgrounds, while Elizabeth Pauncz, Pat Sparrow, Diane Long and others each contributed their own way of bringing out *our* way of developing a practice. One day I realised that there is no such thing as "the posture" and that each pose is unique to each one of us. I set out alone to make sense of that.

My profound desire to understand the difference between the anatomy books and what happens in the classroom was not easily satisfied. For instance, why did everyone do *trikonasana* differently? If they all had the same organisation as the anatomy books suggested, how did such a various abundance of beings-in-bodies do these wonderful postures, meditations and breath work and get such different things out of them? How did a body work out whether to contract a lateral rotator or bend to balance? Why did everyone I asked have a different answer?

I had disparate pieces of a jigsaw that none of the workshops and seminars I attended could fit together. When I met Tom Myers in 1998 I studied Structural Integration, becoming a teacher and adopting Anatomy Trains as a means to translate from body bits to continuities. Many hours spent in the sacred space of the human dissection laboratory raised yet more questions. What could explain the gap between the accepted science of biomechanics and the reality of living people doing yoga? Why did it remove pain and improve performance in some bodies but seem to make it worse in others, unless …? Unless what? What was the elusive common denominator? Could it be the fascia?

Working in manual practice changed my hands into finely-tuned sensors that could eventually read

"body-Braille" fluently. I realised that every person has their own soft-tissue dialect, and a light began to dawn. Structure, form and function are not so far away from *self-expression*. It eventually became obvious that we each write our own life story physically in our gestures and demeanour; our own archetypal movement signatures. The being in the body, whether meditating or metabolizing, is there in continuously joined-up "body-writing". Yoga movements are a way of gaining physical literacy; we can learn to read and write in an elegant hand, each from a uniquely personal human perspective.

Fascia, the connective tissue *tensional* matrix holding every miniscule part of us together, from cells to skin, is the very fabric of our architecture. Indeed, it is the context from which we self-assemble as embryos – and carry on developing right through to elderhood. Until relatively recently fascial tissue was cut away in the anatomy laboratories in order to reveal the "important parts" – as if these could move, metabolise and manage us without its assistance. This is like removing the cement holding the bricks of a church together. As a structure in space and time, the building will not stand up very well (or contain anything) without the connecting, binding material between the building blocks. We abide by special geometries of living, biologic (non-linear) structures. However, the stuff in between, the "transanatomical substrate", is still holding us together as one whole being, moving exactly the way we do.

Fascia, for me, describes this "in-between" hidden world of body architecture; the sacred geometry of beings in bodies. It accommodates each of us, regardless of age, ability, politics or origins. I do not see auras or angels or anatomical cogs in a movement machine. I simply *recognise* the common tissue denominator of our form and love translating it for someone doing yoga in terms of their own animation. Whatever your favoured style of yoga, I hope this book encourages you to become your own guide or guru and understand more about how we sense our way into form (we have been doing it since we were conceived!). It may contribute to *making sense* of what *does not* make sense if you exclude the fascia from the anatomical body story. Like the identical poems at the beginning and end of this preface, I truly hope it points some fingers at the stars and asks a bit about the hidden mysteries of the sky in which they shine.

Twinkle, twinkle little star
How I wonder what you are
Up above the world so high
Like a diamond in the sky

In awe and wonder at the sacred nature of form, and a simple translation of the opening poem.

Joanne Sarah Avison

Acknowledgements

The list of acknowledgements is longer than this summary; forgive me if you are not mentioned personally.

First and foremost my parents, Stephani and William, without whom I wouldn't be here; your loving guardianship remains so precious to me. Ben, Caroline, Jim and Sasha-dog, I cherish all that you are for me, every day. A special word to Poupette, with love, and to all my family (you know who you are). To Malcolm, for all that we created and for the artisan skills of the chocolatier! Little did I know how much I was learning about the liquid crystal nature of soft matter.

My dear friends and broader family; without your loving listening and encouragement this wouldn't have happened. In no particular order Philippa King, Tracie Morrison, Jo Ellis, Jane Priddis, Annie Waite-Gilmer, Linda d'Antal, Trish McElhone, Gilly (Bean) Smith, Diane Ward, Shane McDermott, Alex Filmer-Lorch, Martin Gordon, Amanda Baker, Susie Llewelyn, Andy Forsey, Karel Aerssons, Petra Gommers, Evelyn Bowles, Ruth Vinuela, Jeni Dodson, Tracey Mellor, Nicola Brooks, Stella O'Shea, Adam Clements, Paul Kaye. To Eileen de Herdman and Doreen Thobigele (Sesi Wami) may they rest in peace with so much love.

Professionally I thank all my teachers; those from whom I have learned by design and those from whom I have learned, by default, (what not to do). My profound thanks to each of the graduates at Art of Contemporary Yoga for teaching me more than you learned and for going out into the world the way you have; raising your game and mine. It was a privilege to work with Philippa, Alex, Linda, Diane and Steven to create such a field of Grace for us all. That includes the graduates in Tübingen for their patience while we translated my metaphors into German. To the lovely participants in my Friday Class, now in Sarah's safe and capable hands and to all my loyal clients and colleagues; Thank you each. (Especially Gerlinde, Gilly B, Stephani and William, Frances and Phil for attending so many classes/sessions for so many years!).

A special word for Pat Sparrow; may she rest in peace and know that her down-to-earth and spirited teaching influenced me hugely. Tom and Quan Myers; your advice to "seek my own author-ity" and here it is. Robert Schleip, without whom this book would not have happened, for your patience and enthusiasm to ignite the project and join the dots in the network in all aspects of "fascianating" fascia. To Dr Stephen Levin and Susan Lowell for their devoted assistance at every corner on biotensegrity. To which end no small thanks go to Tom Flemons, Kenneth Snelson and Graham Scarr for the various gifts of explanations, corrections, models and consideration. Jaap van der Wal for the generous gift of time and references in reading the work. Leonid Blyum and Danielle-Claude Martin for endless encouragement. On which note a very special thank you to Professor Darrell Evans. When this work began as Associate Dean at Brighton and Sussex Medical School (and Professor of Developmental Biology) your patience in all things anatomical and embryological was frankly saintly. Now as Vice-Provost (Learning and Teaching) at Monash University, Melbourne; you found the time in a demanding schedule to check Chapter 5 (which nearly drove me mad) and help me bridge some of the gaps between academia and the movement classroom with access to your lectures, research and magical margin notes! Thank you for a vertical learning curve. To Dr Wilbour Kelsick for support and devotion to all things applied and heart-centred in health and human performance.

Since the book went to proofing, the passing away of B K S Iyengar, brings me to an observation about the matriarchy behind Restorative Yoga. This incredible man taught Vanda Scaravelli one-to-one and their combination of masculine and feminine perspectives brought forth the realm we enjoy working in today. My thanks and gratitude to both and the legacy they left behind in their protégés. I have had the privilege of working with both Elizabeth Pauncz and Diane Long, so my thanks and love to each of you. John Stirk and Peter Blackaby have also inspired me and encouraged my deep fascination with anatomy and biomechanics. Actually, it was more frustration – which ignited the questions contained herein. My deepest appreciation to Caroline Myss for personally and professionally giving me the confidence to take those questions about the physical body and raise them to the level of the sacred and mystical in down-to-earth, real ways that I treasure. Thank you for your Grace and wisdom and to David Smith for taking it out into the world and answering my emails!

To Phil and Patricia to say thank you for Bill Corsa my “special agent”, without all of you I would have struggled more and giggled less. To Stephanie Pickering for her meticulous care and loving attention as midwife to every chapter. Vicky Dokas for exquisite design; including the cover on this book. Samira and Katie, what wonderful models you were for the “fascia tubes” – thanks to you both and to David Woolley, the photographer and everyone for the pictures. Sarena Wolfaard, my huge appreciation for your guidance, patience and warmth; Bruce Hogarth for such attention to detail and everyone at Handspring, including the reviewers that have each been so generous with their time and comments in reading this work. A very special thank you to Linda d’Antal for being so patient in modeling postures for me to reference in many of the illustrations. To your clients and Jo Ellis for more of the same and Martin Gordon for artistic guidance.

Last, but by no means least, one of my oldest friends and dearest companions in life; Steven Kingsnorth. You ensured that I stuck with it, followed it all through, nurtured and literally fed me when I was lost in translation or just needing fresh air for inspiration. Without you there would be no art and no art of contemporary yoga from which to tell this story. My love and profound gratitude always and in all ways.

In deep gratitude and awe

Joanne Sarah Avison
Brighton, England 2014

Contents

PART ONE

Activating the intellectual mind: behind the new paradigm

CHAPTER

1

The Art of Contemporary Yoga

"Out beyond ideas of right doings and wrong doings, there is a field. I will meet you there"[1]

Rumi (1207–1273)

Yoga means different things to different people. It can be as complex and as straightforward as the individuals who practise it. It relies as much on its inherited wisdom as it retains exceptional relevance and value in a modern culture.

There are as many different styles of yoga and perspectives on yoga as there are people to interpret them. There are fast and slow practices, dynamic and static aspects, different cultures and applications. Some yogic forms embrace only physical postures, while others emphasise a more meditative approach. Any yoga teacher training includes philosophy and technique, ethics and practice, anatomy and physiology, as well as work on meditative approaches and the broader quest for expanding awareness and conscious understanding of what it is to be alive in a body. In truth, yoga can become as far reaching, profound and multi-faceted as we can. It seeks to account for body, mind and being as a context for health and vitality on many levels. Whether your interest is therapeutic or dynamic, for strength or stillness, there is far more to the art of yoga than a series of exercises or shapes-in-space on a mat.

Yoga has evolved from ancient principles that have never separated body, mind and being from each other, as we have in the West. We do not leave our minds at the desk, our hearts outside the door, and take only our functioning anatomical parts to the yoga class. Rather, we engage our many different aspects and faculties to arrive (and leave) whole and complete. We activate ourselves as one animated form, unique and essentially self-motivated.

Yoga is about movement and quality of motion as well as the power to be still in that moment of now. Much of its value resides in the ability to expand awareness and attention beyond the mind and its intellectual processing, to a state of presence in the body. Once that state accumulates we can begin to learn stillness through poise and balance, practising the art of relaxing in quiet reflection. This brings with it the ability to quieten mind chatter (*chitta vritti*) and begins to show us how yoga goes beyond thinking and individual movements as postures. It can be fun, acting as a kind of portal to accumulating vitality.

Movement is not an intellectual process, and nor is meditation. Both are heart-felt practices of a being in a body. Our intellect, or thinking mind, is just one of our many gifts; yoga gives us access to all our aspects. These include the thinking body, the moving body, the instinctive body and the emotional body, with all its sensory and intuitive abilities to experience *embodiment*.

Anatomy of the Body

When we begin to study how the body is formed, we (particularly in the West) tend to veer away from whole embodiment, preferring to examine the detail of how the body can be separated or broken down into its component parts. We turn to various works based on long-held knowledge in the fields of anatomy, physiology and biomechanics. This approach requires the naming of our parts, understanding our physical systems and explaining how we move. We learn which parts are where (topography), we explain the systems in which those parts function (biology and chemistry), and describe the movement (locomotive) apparatus and how it works under various aspects of biomechanical and neurological theory. Muscle–bone–joint anatomy is the foundation on which we base our understanding of any movement modality. Understanding the being inside the moving body is largely assigned to the separate study of psychology.

To understand how we do the postures, we focus on the musculoskeletal system to remember which muscles move which bones via their specific attachments. By learning how the nervous system works and assigning specific nerves to each muscle, we can work out which actions do which movements and understand the postures accordingly. Or can we?

Musculoskeletal System

Once we have learned the basics of muscles and bones, we name the ligaments that attach the bones of the skeleton to each other, and the tendons that attach the muscles to those bones, and we find out how, between them, they activate the various types of leverage at the different types of joint. This is what is known as the musculoskeletal system. We study its form and its function.

> I was in my early thirties, three years into learning yoga on a more formal basis, trying to make sense of anatomy. Having been trained by osteopaths, I considered anatomy and biomechanics to be a high priority, but could not understand why there was such a rift between the books and the people actually doing yoga in my classroom. Into this confusion walked Tom Myers. He stood in front of a large group of yoga teachers and announced to us all that “there ain’t no muscle connected to no bone, nowhere, in no body”. To give you a context, this was the late 1990s, in Brighton, England. Not only was this man apparently committing anatomical heresy, he was doing it with a big grin and an American accent. It shifted a few notions and ignited a curiosity in me that has only grown since.

In this system, each muscle has a name and position, an origin, an insertion (or distal and proximal attachment) and an action assigned to it, related to which nerve activates its particular designated behaviour(s). The whole suite of muscle–bone–joint anatomy combines to motivate a system of levers and pendulums that allows our bodies to move around. We can choose whether to follow up on the biomechanics of those levers first, or the nervous system that apparently innervates their respective functions. In either case, it becomes progressively more complex and difficult to divide topics up, or work out what overlaps what and which functions belong to which system. We require ever more complicated rules, for more detailed fragments. The ability to make sense of the wholeness that arrives in the classroom becomes increasingly elusive.

In yoga books on anatomy, these principles are usually presented via poses (asanas), with a related image showing which muscles are contracted, which stretched, and the point at which they are individually attached in their so-called “antagonistic pairs”. Similarly, in the anatomy of the breath, we study the principles of the organs and muscles of breathing: how they attach to and move the rib cage and diaphragm, which muscles are for accessory breathing, and so on. A great deal has been learned, taught and written about from this particular perspective. However, it is a persepctive that largely excludes a key feature, which is the *roles* the fascia has beyond its capacity to act as a packaging and connecting tissue.

The importance of fascia has become clearer and more differentiated only comparatively recently. “Fascia” is the name given to a specific (and variable) kind of connective tissue that is the subject of a rapidly increasing amount of research with regard to its range, capabilities and characteristics.[2] The fascia is what we might call the “stuff in-between” that in traditional dissection has mostly been removed. It has been treated more as a kind of inert packaging material that gets scraped away in order to properly present the more important items, considered to be the muscles, joints, bones and materials of the musculoskeletal system. We will see in the following chapters how this situation arose and what it is that is so vitally important about this exceptional fabric of the body.

What is Fascia?

The difficulty in answering that question is twofold. The first concern is that fascia is so many things. The second is that if fascia really is so many things, with such a tremendous influence on so much of our body, movements and systems, then how has it been overlooked, in terms of its significance, for so many centuries? These are good questions to consider, and this first part of the book will attempt to answer them.

We will discover that the increasing knowledge about the fascia is creating a sea change, transforming our understanding of anything to do with the body. The scale of this effect is big enough to be described as a paradigm shift. It revolutionises our view of anatomy since modern technology reveals that fascia is not only ubiquitous (everywhere), but sensory in nature (see Ch. 9) and crucial to any part of any muscle connecting to any part of any bone in its locality (not to mention its neighbouring muscles). We begin to learn how very important the fascia is to understanding anatomy and movement since it is the universal tissue of relationship between all our parts. What is more inspiring, however, is that we will find it begins to make perfect sense of the very wholeness that the ancient principles of yoga endorse and espouse.

Fascia could be described as the fabric of our form. It literally joins every single part of us together, from the finest level of detail within us, between the cells, to the outermost layer of the skin in which we are wrapped. In some places it is so fine it cannot be seen by the naked eye, while in others it forms thick, layered sheets making up a named entity such as the thoracolumbar fascia, which supports the lower and mid back. In some anatomical representations of the body it is presented in white against red muscles. What is usually less obvious is that it is invested throughout those muscles and forms the layers between them. It is continuous with, rather than separate from, the tendinous attachments, and much more besides.

The fascia is essentially made up of collagen and elastin fibres bound together to form a variety of tissues. (The fascia also includes reticulin, which is immature collagen.) Together these tissues form a tensional matrix that contains every part of us. Fascia includes tendinous sheets (aponeuroses) and chords (tendons), connecting webs (some strong and some gossamer-like) and the boundaries that distinguish one part from another. It includes various types of tissues with different densities. They contribute to the form of joints, attachments, relating membranes and continuous connectivity throughout our bodies. It has been suggested that the entire body is made up of variations on this tissue theme: that bone is a calcified form of fascia at its thickest, hardest and most compressed, while cartilage comes next, with high hyaline content, then ligament, then tendon, then myofascia containing numerous muscle fibres.[3] These issues of exactly what is and what is not fascia are now being thoughtfully debated. It is the main building material in our bodies, varying in thickness and density, extending even to the softest and most delicate of membranes, such as the eardrum. Whether or not there is universal agreement about exactly what is or is

not fascia (as distinct from connective tissue), this view represents a huge shift in perspective, from the individual components to the wholeness of the architecture holding them together.

All fascia is connective tissue. However, not all connective tissue is fascia. Blood is considered to be a connective tissue, but it is not fascia. (The distinction is made between biology and biomechanics.) There are detailed discussions of the naming of different fascial tissues and academic considerations for what can and cannot be called fascia. However, many of the pioneers of what is called fascia research seek a global term for these connective tissues to restore a perspective of wholeness to the living body that correlates with the experience of manual therapy and movement.[5] *In vivo* examination (see Chs 2 and 3) reveals that fascia is continuously connected and related throughout our systems, from micro to macro levels of scale. This will be explored and referenced throughout Part 1.

Whatever the different parts of it are named (and there is much conjecture around this – see Ch. 3), the fascia certainly forms what can only be described as a matrix that surrounds everything, connects everything, yet paradoxically *disconnects* everything. In other words, it distinguishes one part of our body from another, since everything is wrapped in it. It also holds together the extracellular matrix, that is, the fluid domain in which the cells that make up our organs and parts reside. The fascia contains them and our bodily "colloids and emulsions"[4] in its variety of expressions as the basic tissue of our whole structure, or human architecture.

The fascia envelops every organ; it is part of what forms our vessels (the dura of the nerve vessels, the tunicae of the blood vessels) and keeps them in place. It covers the muscle fibrils at its finest, the fibres in their bundles and the whole muscle forms, as well as groups of muscles. It forms the back of the skin, the soft sliding layer between the skin and underlying structures. It forms the architecture of the heart, the lungs, the viscera, the brain and sensory organs, indeed, of our entire body form. If the rest of us were to be removed, we would remain recognisably us, with just our fascia forming a ghost of our entire body in its finest detail and fullness. All of these fascial structures have individual names, and some are studied from different perspectives, for their distinct roles in the body. Although they are studied under the designation of separate systems, however, they are not experienced that way.

What has perhaps been sometimes overlooked when fascia is removed post mortem is this universal connectivity. Study of fascia does not replace musculoskeletal anatomy but includes, enhances and evolves it. From a yoga perspective, studying what we could call "fascial anatomy" (variously, if unofficially, termed osteo-myofascial and neuro-myofascial anatomy) makes complete sense of yoga and brings the art of yoga into a powerful contemporary focus and holistic relevance.

Figure 1.1 shows the different types of connective tissues considered by Schleip and colleagues to be included in the term fascia:

"a more encompassing definition of the term fascia was recently proposed as a basis for the first Fascia Research Congress (Findley & Schleip 2007) and was further developed (Huijing & Langevin 2009) for the following congresses. The term fascia here describes the 'soft tissue component of the connective tissue system that permeates the human body'. One could also describe these as fibrous collagenous tissues which are part of a bodywide tensional force transmission system."[6]

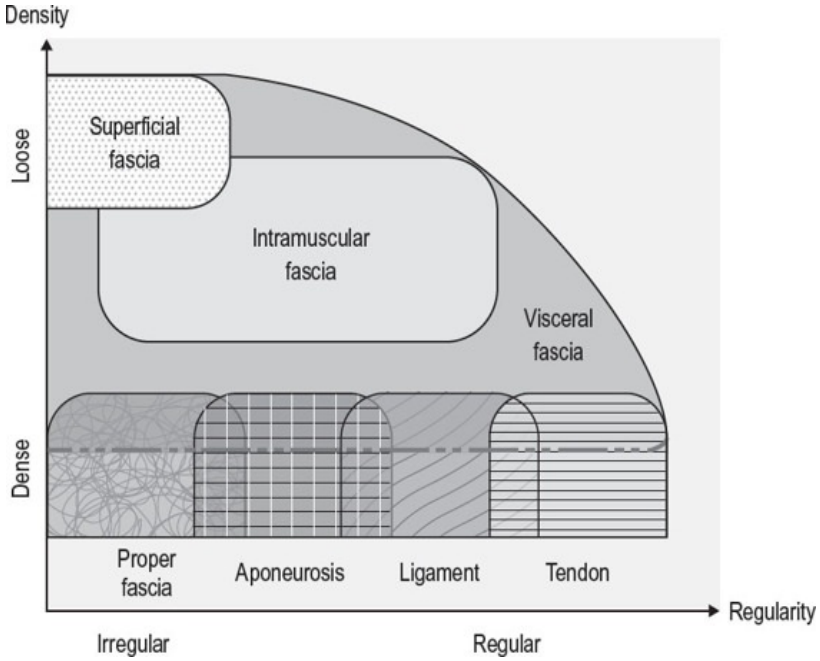

Figure 1.1
This image shows the different types of connective tissues considered to be included in the term fascia. Image reproduced with kind permission from Robert Schleip, fascialnet.com.

Collagen fibres can have different densities and directional alignments depending upon which kind of fascial tissues they express. This is influenced by what we do, how we do it, and how frequently we do it (i.e. the usage patterns or local loading history) as well as locality in the body and the amount of body weight used in a particular tissue. Ligaments and tendons in the ankle, for example, will always be stronger and therefore denser than visceral fascia. (This will be explored further in Ch. 3.)

Traditionally, the “white stuff” (fascia and connective tissue) and the “yellow stuff” (adipose tissue, or fat) are removed in the anatomy laboratory in order to provide “clean” dissection and reveal the important parts for the study of anatomy of the locomotor system. Biomechanics, anatomy and the related physiological basis of structure and function have all been, at least in part, deduced in the absence of this “in-between” fabric or wrapping. Historically, it has been assigned to the cadaveric bins.

Far From Inert

This does not mean that the subject of fascia is not taught in anatomy classes. It refers to the much larger context in which fascia is routinely removed in order to reveal the underlying or embedded structures, and thus there is a possibility that its full significance can be overlooked. Once the tissue has been thrown away, it cannot be reinstated as a part of the whole structural integrity. It is into this gap that the contemporary research has revealed a new recognition of the roles, importance and variation in fascial tissues in terms of our functions and their relationships to structure (and vice versa).

The fascia is now considered to be far from simply an inert packaging material or just a discreet unit, such as the thoracolumbar fascia or other specific parts of dense fascial fibres to be found in the body. Fascia also occupies the incredibly complex world of the “in-between” and forms a single, body-wide, tensional network in all dimensions. The organs, vessels, muscles and bones are contained within it. The fascia could be described as the common denominator of our unified form. Until recent decades, the idea that its removal was effectively distorting the theories of structure, function and locomotion upon which the study of human movement has been (and still is) built in the West would have been too challenging. Now the fascia can no longer be ignored, as we continue to experience the ever increasing body of

research that is gradually changing the basis of medical practice and of movement and manual therapies. Studies of this entity are igniting new questions and transforming the foundations upon which classic theories of anatomy, physiology and biomechanics are based. Additionally, fascial anatomy makes complete sense of the study of yoga in all its contemporary forms. It is a system that unifies the body, upgrades our appreciation of movement and confers exactly the kind of wisdom and congruency we seek in the study of yoga. From the postures (yogasana) to the ability to manage various physiological systems (i.e. respiration and more refined practices of self-management) to meditation, the fascia plays an intimate role in our human experience.

The significance of the fascia to studies of the human body has been quite astonishingly underestimated given that (1) it is alive and anything but passive, (2) it is a sensory organ (see Ch. 9), (3) it is literally everywhere and (4) it is continuous throughout our form, on every scale, joining and relating everything to everything else.

This combination of characteristics amounts to the recognition of the fascia as the master of our sense of where we are in space. This sense is additional to the commonly held belief that we are five-sensory creatures. It is developing as the basis of our sixth, very important sense: the one that tells us where we are relative to our environment and ourselves at any point in time. This is known as proprioception.

Proprioception

> "Proprio" comes from the Latin propius, meaning "one's own", and "ception" comes from perception. So the translation of proprioception is one's own, or self, perception. Innate to the term is its meaning as a sensory feedback signalling system (Ch. 9). The word "appropriate" comes from the same origins. So, a self-appropriate practice is one in which our proprioceptive sense guides us to congruency. This is the invitation for us to find our own kind of yoga, one that speaks the language of our own essential body dialect, written in its fascial form. That form is inclusive of the muscles and wraps the bones, profoundly invested with fascia and embedded in its multidimensional matrix.

Proprioception is the sense that tells us where we are in space at any given moment, feeling the cup we lift to drink from and the amount of energy it takes to place it accurately and sip; making tiny subtle renegotiations as the volume goes down and we put it back on a surface. (As we will see, it also plays a part in our inner sense of how much we have drunk, its temperature and materials.) Proprioception is at work when we move our fingers over the keyboard we tap to write an email or the strings we pluck to play a musical instrument. Fascia is referred to as our organ of organisation and its proprioceptive qualities are subtle and extensive. In yoga it is essentially the sensing of every part of us, in any given pose, relative to every other part and the mat. It speaks the instinctive language of movement because the body literally senses where it is and what it does all the time, regardless of our ability to analyse it intellectually.

Current research challenges our traditional general notions of anatomy, physiology and biomechanics and shakes the foundations of many classical principles. At the same time, it offers a new context that unifies not only the different parts of the body but also the being that resides within it. This is an exciting time to be a yoga teacher, since union is such a founding, ancient aspect of yogic wisdom and so fundamental to the contemporary art of yoga in all its variety.

The Art of Contemporary Yoga

The external spaces in which we live, and around which we move, form and inform us in unique and

reciprocal relationships. We form and inform our internal world in a similar way, searching for congruency and appropriate expression in harmony within and without. We grow, change shape and organise ourselves on many levels all the time, both within our own development and in the process of growing and moving through our lives. We change that experience from moment to moment and it changes us, in a relentless and intimate relationship. We weave the story of our lives like a web, a three-dimensional matrix, from which we emerge (and into which we retreat) as is appropriate at the time. Always various and variously adapting, we form and function, contained by the outside and containing the inside as a work in continual progress. Our fascial matrix is the changing, growing, three-dimensional context of our form. It responds to the most minute changes, even micro-movements, to our every gesture.

Yoga takes practice beyond the techniques and postures to the being participating in them. It includes the many different ways of moving ourselves, organising our organs (of movement, of nourishment, of knowledge or compassion) within the organism we consciously consider ourselves to be, whatever and whomever that is. It is as much about awareness of that as it is about who is being aware and how they foster that awareness. Congruency is less about a journey towards perfection, whatever that is to you. It might be more about the ability to simultaneously adapt those aspects of ourselves to our outer surroundings and to our inner world, appropriately.

The brand of yoga, the way a pose is performed, the anatomy, physiology and philosophical origins of the posture or meditation, is not the most important thing. You are. Each one of us is seeking our own expression of balance and congruency, a refinement of our proprioceptive awareness and experience. Yoga does not bring you to a particular state so much as it accumulates an inner knowledge of the states you are capable of being in. It can expand the facility to explore your range of potentials and the possibilities you consider yourself to embody. How we connect these many aspects is fascinating and the discovery that we do so through this sensitive connecting fabric of our form enhances the founding principles of yoga and expands our inner-sensing.

> Our yoga practice changes as we do, ebbing and flowing with our lives, as an intimate part of us that simply keeps us awake and aware. It offers us the opportunity to know and develop ourselves, once we find the right type of yoga for our own particular form. It becomes personal: a unique practice that we can mould and develop to deepen our sense of being, through postures and sequences, movements and meditations. It can be a beautiful opportunity to realise our potentials at any age and at any stage in life. It changes with us. We can explore and grow together, in every sense.

Yoga does not respond well to being fragmented, and neither do we. Nor is a static state of fragmentation like life. Essentially, even if our journey is one of distinguishing the parts, it only makes sense in the context of a process of becoming whole. Can we unite, or reunite our sense of who and how we are, at any point in time?

Once we identify the “cogs” we seek to literally and symbolically *re-cog-nise* ourselves. There are many ways of doing this, and yoga is but one of them. Upon exploration, we discover yoga can be a very rewarding pathway along which to seek that congruency. The treasure of comfortable motion, at whatever level we can embody, is well worth the expedition to find it. This is the journey from the vitality of movement itself to its fullest expression into stillness and presence. We can even carve a path of self-esteem once we explore becoming conscious of being, beyond “adept at doing” yoga. It is a beautiful means to an endless possibility.

Learning Anatomy and Physiology

Yoga was never divided up in the way that anatomy and physiology have been. Not only was the yogic body treated as a breathing, moving whole, but the mind, body and spirit did not undergo the intellectual, political and religious segregation practised in Western medical and biomechanical academies. In Chapter 2 we will discuss how this came about. However, we can note here that this legacy sits awkwardly with a practice as naturally integrated and intuitively tuned as yoga was originally designed to be. The growing understanding of the fascial matrix as the foundation of our movement apparatus makes much more sense of the foundations of yoga and what actually happens in a yoga class, whatever style you practise.

> The sense called proprioception is not mysterious. It consists of recognising the very real and natural process of refining our movements that we take for granted as we manage gravity on earth, instinctively, by moving around and doing the things we naturally do every day. We refine it by, for example, practising yoga and becoming conscious of our gestures and motion and internal motility. Most movement teachers and performers also develop a keen kinaesthetic sense, within their favoured modalities.

We arrive whole and complete on our yoga mats, with all our intellectual and instinctive, intuitive and emotional, physical and anatomical aspects intimately interwoven. After all, we are full-bodied animations of our own spirit, however our individual bodies actually express themselves and however we choose to describe them. The recent discovery that the fascia, the very fabric of our form, is instrumental in holding us all together (literally and symbolically) with an intelligence of its own is impacting many fields of study. The growing field of fascia research is going some way to reuniting all the above aspects of ourselves, in more ways than anatomical and physiological. New distinctions are now arising, for example, between proprioception and its close cousin "interoception" (sensitivity stimuli arising within the body). They relate the overlapping fields of neurosciences, psychology and self-development.

Proprioception includes our ability to anticipate; for example, if we are walking up or down a flight of stairs we sense immediately if the last stair is slightly higher or lower than the others. We will experience this as a "jolt" or even a shock, depending on the degree of difference and what influenced our sense of anticipation and our ability to adjust quickly enough. This subtle function is one we use a lot, without necessarily being aware of it. Proprioception is fundamentally, if not knowingly, relied upon.

Interoception includes the internal awareness or "gut knowing" we often refer to as our "instinctive" sense. Putting it very simply, the sensory nature of the fascial matrix and the particular structure of our formation actively keep us in touch with that feeling of "knowing" or "gut reaction". New research about the sensory receptors (mechanoreceptors) of the fascial tissues in the gut are influencing the terms under which this quality of awareness is understood.[7]

Yoga at its best naturally works on and refines instinct and intuition, seeking to enhance our structure and function through awareness and attention and the various different practices yoga can include. It is confirmed by this new way of seeing our anatomical parts and physiological systems. The study of fascia and form in functional movement legitimately unites us, returning us to wholeness, and *makes sense* of many different aspects of our practice. We will explore these theoretically in Part 1 and practically in Part 2.

We begin whole, we end whole, and at all stages between we remain whole. The question is how do we animate *well*? How do we anticipate, navigate and negotiate suitable change? Can vitality be restored and, if so, what is the optimum way to do that? Once recognised, how do we sustain it?

As the fascia is revealed as the basic tissue of relationship in the body, joining everything to everything else in one continuous tensional network, it is redefining our understanding of how one part experiences

sensation relative to another. It is offering new explanations of how forces are transmitted throughout our structure, modified and balanced by our innate kinaesthetic intelligence. The evolving understanding of fascia invites us to see and assess movement in whole gestures and consider the *relationships* of the parts to each other as paramount.

In contemporary yoga, knowledge of the fascia changes how we apply anatomical understanding in a relevant way to our actual experience of the postures. Soft tissue plays a profound role in our ability to adapt and sustain useful adaptations. At the same time we can release compensations that are less than optimal. While human beings share many aspects in common, the fascia of each one of us behaves uniquely, depending upon how we use it, as we will see in later chapters.

More than Thinking

You can read and write about yoga, philosophy and anatomy until you are weary. However, without participation and cumulative experience you will not *incorporate* its incredible value into your tissues. It comes alive first and foremost in our *felt* sense, and not our technical explanations. Our cumulative experience changes our tissues and we will learn how the fascial fabric of our form bears testimony to its own history and can even recall it.

One of the difficulties of teaching yoga through the template of classic Westernised anatomy and physiology is that yoga is essentially about continuity and connectedness. It is about what the parts can *multiply up* to, as unified, rather than what they *divide down* into, as fragmented. As much as we love to identify the fragments, identification must inspire or enhance our experience rather than reduce it to functional data or anatomical concepts. Body factions or theories, be they generic or genetic, are not what we experience.

The Essence of Yoga

Sanskrit is an ancient language and unlike modern languages, for which we have word-for-word translations between languages, it embraces a more symbolic meaning. The word “yoga” is better understood as a journey of *unifying* and connecting, a *process* rather than an event or state. Rather than representing unity as such, it animates the action: the verb “to unify” as a work in progress.

> Achieving all this takes time and practice for the body, time and practice for the mind, and a cumulative process of growing our awareness, appropriately, attentively and consciously for the being. It is all a part of the parts of us, just as much as any techniques on a mat. They are the means to a never-ending exploration rather than a sequence of positions in a shape-shifting competition. We study the shapes to become adept and versatile shapeshifters and expand our experience of ourselves. We do not just learn the asanas because King Pigeon (Eka Pada Rajakapotasana), for example, holds the secret to helping sciatica by stretching or strengthening the piriformis muscle.

We are largely shaped in variations of fascia, a soft, sensory, subtle and self-aware architecture, and we will talk about dose and degree as key features of how we contain, maintain and sustain it optimally. Whichever end of the scale you choose to teach yoga from, be it therapeutic and restorative or dynamic and powerful, bodies respond to demand and balance, congruent with their individual design and lifestyle. Our proprioceptive sense responds to appropriate training. This includes how often you do yoga and when and how you vary your practice, and it changes with you as you mature and develop (see Part

2). We each have to find our own way to manage our movements, “from speed to stillness and beyond”, appropriately.

Yoga is far more than an alternative movement practice. It does not conform naturally to a list of causes and conditions, to be met by a reciprocal counter-list of antidotes and asanas. Like any other movement protocol or random activity, it can equally harm or heal if it is not understood in the context of the body working with it. As teachers, part of our integrity is to identify different body types and their suitability for a given style of practice. In Part 2 we will consider the different fascia types that correspond to a person’s particular build and movement preferences. One size **never** fits all, and in the context of the fascia, we have a means to honour that, given the many and various styles of yoga and people who can benefit from it.

The Neutral Aspect

In yoga, one of the founding principles is polarity. It is symbolised by the feminine and masculine, Ida and Pingala. They are expressed on every scale as coexisting or co-creative forces. We will study further how our structure relies profoundly on these principles.

For every active pose we invite a counter-pose. To assimilate the active asanas, meditation is the natural counterbalance. It represents vital movement balanced by living stillness. This polarity is innate to yoga, as it is to balance and all the laws of motion. Ida and Pingala, the energetic channels of the spine, represent the moon (the feminine principle) and the sun (the masculine principle). They are also the symbolic references for our awareness and attention, respectively. They represent the archetypal quality of opposites.

We only ever know a thing by its opposite force, so polarity itself is the essence of our experience. Yoga practice can provide a context of quietness to distinguish sound and the stillness from which to recognise movement. We have to be willing to be *unable* to do something in order to accumulate and recognise our ability to do it. It has to begin as apparently fragmented in order to *become whole*.

This is one of the key purposes of meditation and the cumulative practices of self-awareness. It is quite distinct from a self-conscious preoccupation with how one feels or looks. It is the inclusion of our *sense* of self, beyond mind. One resides in being, the other prefers identity. Both are required. Neither can do it alone, any more than we can. Indeed, no two aspects can do it without a third, because neither can see its self. Duality is not where we stop; it is a portal through which we can travel to the place where the opposites can coexist and reside together. By developing the ability to observe ourselves, we create that essential third aspect of the witness: the neutral observer.

As soon as we are able to observe polarity, we enter the witness state that sees both opposites, or dualities, at the same time. Paradox makes perfect sense here. This is a shift from two-dimensional thinking to three-dimensional being. It is an essential one because the body works in three aspects at least, not just two. We do not arrive flat packed but take up space. Ida and Pingala are not the whole story but together give rise to a third domain, the spontaneous possibility of *Shushumna*. This third aspect is neutral, the place in which Ida and Pingala unite and coexist in natural balance, in the same way that the fascia unites the muscles and bones of the musculoskeletal system, giving rise to a whole system *as a combination*. The fascia is neither muscle nor bone; it is distinct from them. However, it is also their context, the common denominator of their combined wholeness as a system.

Into Three Dimensions

As noted above, although we occupy space in three dimensions, our culture often resides in a domain of duality, preferring a more two-dimensional thinking. In anatomy and physiology we talk about specific oppositions and about “equal and opposite forces” (see Newton, Ch. 2) that are activated in nature. Muscles are described in terms of antagonistic pairs. We think of muscles and bones as the protagonists of the locomotor system and the breath is often described in terms of the inhale and the exhale (see Ch. 15).

Medical textbooks are often illustrated with two-dimensional iconographic images in order to express things in understandable ways (see Ch. 3). This is not wrong; however, in the light of fascial research it is insufficient. We might also expand our understanding to include and recognise the wholeness we experience. Visually, this is very complex; intellectually, it is easier to draw only one conclusion at a time.

In a paradox, two opposing ideas can coexist at the same time. This field is inclusive of both polarities, both opposite forces. However, it also provides a kind of “platform” yielding a combination that is simultaneously “both” and “neither”. We are calling this the *neutral field* or the *witness state*. This becomes very important because, unless we upgrade the conversation to include this language of paradox, we will not fully understand the impact of fascia on form or function. It will elude us if we stay within the old language of two-dimensional thinking because this is a whole new paradigm. It *is* the third dimension of the locomotor system.

Neutral is not a default condition, resulting from the failure to make a decision, but rather an actively generated state which expands the point of view to include all possibilities. These are challenging notions because they go beyond the mind, to the being. The mind loves the pendulum-swinging metronome, oscillating between right and wrong, up and down, forward and back. This is where we find our rhythm, and such notions do not stop being innately relevant in this view but are included as an underlying pattern in the larger paradigm, where that rhythm is expressed.

Beyond Polarity

Consider a circle. A series of overlapping circles can make a beautiful pattern (Fig. 1.2). (We will see the significance of this in Part 3.) The moment you see that series of circles represented in three dimensions as a series of spheres, it consumes the pattern the circles made (Fig. 1.3). There are fewer lines in the literal sense, but, symbolically, there is more volume represented.

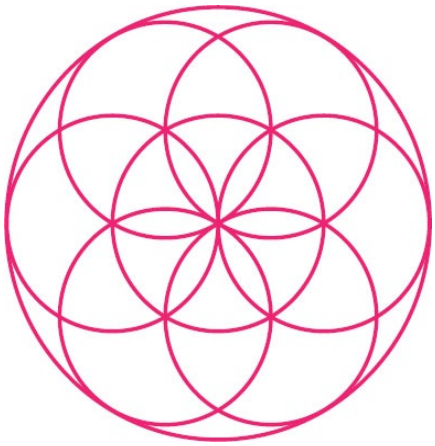

Figure 1.2

This is a three-dimensional diagram of the same eight spheres seen in Fig. 1.2. Image reproduced with kind permission from Martin Gordon.

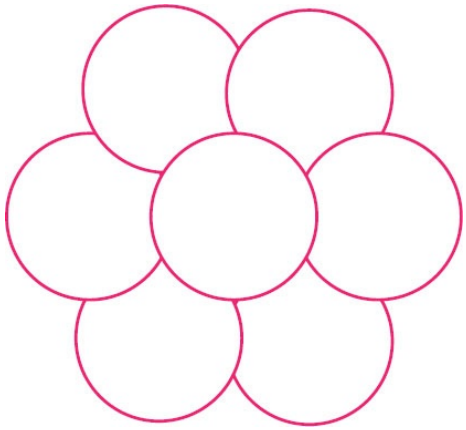

Figure 1.3
This series of overlapping circles is a two-dimensional diagram of eight spheres; one sits behind the centre circle. Image reproduced with kind permission from Martin Gordon.

Yet the circular pattern remains within the spheres, albeit consumed or hidden within them. What has changed is your point of view and the depth of field. What has been transformed is your kinaesthetic ability to interact with the object. The kinaesthetic sense, or movement, occupies a domain that not only lives in three dimensions but also operates at a rate many thousands[8] of times faster than thinking. (See Margin note.)

The three-dimensional perspective, which resides in neutral, includes the circles that are in the spheres. This perspective becomes essential to understanding fascia and how it integrates our fully functional movement. It gives rise to our embodiment of those rhythmical sums of our parts. We make the shapes in yoga in order to enquire how we move and shape space in all our aspects and wholeness. We are the sum of the up and the down, the lateral and medial, the inner and outer. We are the in-between interface, the membrane responding through forms, the domain in which both can occur as polarities and find themselves united.

The Renaissance

The representation of human beings in three dimensions, rather than two, was part of a huge shift in culture, affecting every area of the Western world in the Renaissance. It was shown in art and in our understanding of our planet as we sailed to new lands. This period marked a turning point in the history of European thought, when science and medicine became studies in their own right. The whole period between 1400 and 1800 was a time of immense changes in every field of endeavour in the Western hemisphere. It produced many of the philosophers and scientists upon whose genius our current beliefs rest. We will consider them in Chapter 2, to provide a context for the changes we are seeing in our current age. Indeed, some suggest we are in a new period of Renaissance or rebirth, entering the next dimension of seeing.

If you try to instruct someone new to yoga, or they use a book, with only verbal or written cues and no recourse to demonstration, you will bump into the divide between intellect and instinct and their respective speeds. Participation and practice bring the moves into the instinctive realm so that eventually, we do not have to think about them.

Part 1 examines some of the impacts of past and present changes in thinking on anatomy, physiology and biomechanics, considering how essential it is to understand the triune nature of our wholeness on every level. Nowhere does this become clearer than in understanding the structural principles of biotensegrity

(Ch. 4). Triangulation is presented as a basis of our architecture and its forming. The chapter on embryology (Ch. 5) presents the essence of it all, if we can understand neutral as a third state or place from which to view polarity, evolving beyond two-dimensional thinking.

What we cannot forget in all this is that the practice of yoga originated in the Eastern hemisphere. As such, bringing it to the West is an invitation to expand our thinking to include the far-reaching nature of its potential. If we do not, we risk reducing and diminishing it. The range of studies and the pioneers developing the field of fascia research[9] have made that reductionism unnecessary.

The tensional network of the human form unites anatomy and physiology. It makes sense of the biomechanics and clearly forms the sensory basis of our instincts to move. It transforms our understanding of yoga, while yoga itself can actively transform the fascial matrix. This includes the muscles and bones. Like the spheres absorbing the circles, the fascia includes the organs of movement, unifying them with the whole of the body.

Yoga is not restricted to postures or authentically limited to making shapes using the bony framework of the axial and appendicular skeleton. Our being moves us in every sense and on every level, in our own ways. It becomes clear that yoga and fascia sit congruently together, making sense of each other and of our personal, unique organisation within the space–time continuum.

Yoga is really about sentient beings, but unless we can step into neutral and see how we are being, detached from the illusion of what we make that mean, we cannot easily realise our own potency to co-create our lives and recognise our full grace and potential. That possibility resides in the difficulty and sweetness, the complexity and simplicity of movement and stillness, as they are. We can observe both at the same time. Uniting the multiple aspects of ourselves and witnessing that journey is the invitation to the field of grace that Rumi refers to in the quotation at the head of this chapter. It is the field "out beyond ideas of right doings and wrong doings". As a fellow yoga teacher, I would love to meet you there.

Notes

1. Jelaluddin Rumi, *The Essential Rumi*, translated by Coleman Barks with John Moyne, A.J. Arberry and Reynold Nicholson, HarperCollins, San Francisco, 1995.
2. The number of papers on fascia indexed in Ovid, the MEDLINE and Scopus databases has grown from 200 per year in the 1970s and 1980s to almost 1000 in 2010 (Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012).
3. For an excellent overview see Ch. 1, "The World According to Fascia", in Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
4. Stephen Levin, www.biotensegrity.com.
5. Introduction to Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012.
6. Ibid.
7. Robert Schleip and Heike Jäger, "Interoception: A New Correlate for Intricate Connections Between Fascial Receptors, Emotion and Self Recognition", Ch. 2.3 in Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*. Churchill Livingstone/Elsevier, Edinburgh, 2012.
8. Alexander Filmer-Lorch, *Inside Meditation: In Search of the Unchanging Nature Within*. Matador, Kibworth Beauchamp, 2012.
9. International Fascia Research Congresses 2007, 2009, 2012: www.fasciacongress.org and Fascia Research Society: www.fasciaresearchsociety.org.

CHAPTER
2

Ancient Wisdom and New Knowledge

"Seeing how geometry shapes nature, you can understand why ancient artists, architects and craftspeople of many cultures were impressed by its power and its ability to ennoble human creations. The ancients were aware of nature's geometric language and purposefully employed it in their arts, crafts, architecture, philosophy, myth, natural science, religion and structures of society from prehistoric times through the Renaissance. The world today needs scholars and researchers who give the ancients credit for their intelligence and understanding, to view their art and entire cultures in the light of its mathematical symbolism."[1]

Michael S. Schneider

There is a rich story behind the evolution of anatomy. Early anatomists worked in a way that tended to reduce our soft architectural individuality to the lowest common denominators. The discovery of how important the fascial matrix is in reuniting those same parts and recognising the significance of their natural architecture has come at a time in our culture when we understand networks. While the Internet enables communication and education around the world, the "internal-net" is being recognised as global in terms of the body's world. It lifts the game of anatomy from the page and places it on the mat, where yoga plays it.

How the fabric of the fascial web is structured *as the basis* of our physical three-dimensional architecture will be considered in the next chapter and throughout Part 1. What follows in this chapter is some of the cultural background, showing how the wholeness of human anatomy came to be fragmented into parts in the first place. This chapter begins to answer the question we asked in Chapter 1 as to how the fascia was generally overlooked for so many centuries.

Early Western Medicine

Hippocrates (approx. 460–377 BC) is often credited with being the founding father of Western medicine and with making medical and anatomical studies a distinct profession. Human dissection was strictly forbidden under Greek law so medical practice was developed by carefully taking notes concerning the patient's living experience. This built up a body of knowledge gained from due consideration of ailments and a logical study of the stages an illness or condition and a patient went through.

To some extent the system of humours shared similarities with the Ayurvedic principles that are still practised in Eastern medicine. However, such typing was eventually almost entirely abandoned in the West in the late nineteenth century with the discovery of the cell as the primary unit of life (see Virchow below) as a founding context in the field of medicine.

The Hippocratic School united both the Asclepian principles of intervention (the doctor) and the Hygeian notion of facilitation (the healer; meaning “to make whole”), whereby the patient made some contribution to their own healing process. The system of the so-called “humours” was developed based on classifying each individual into types according to the way their body held its fluids. Balance was the key to managing the person’s health according to their type and various other conditions such as temperament and a suitable environment in which to heal.

In ancient times, the study of the human body was not restricted or confined to a particular science. The study of art and architecture also required an extensive knowledge of nature, form, movement and structure in all living and crafted things. The ideas of philosophers (as the founding fathers were known) and the extent of their knowledge was wide by contemporary standards but perhaps less deep in any single area of specialisation. In earlier times the nature of a philosopher’s religious faith was closely tied into the fabric of his life. Notably, the reproduction of text or image was made by hand, a process which was very expensive. Artists and craftsmen were patronised by the wealthy or apprenticed to a master, so they often had to follow the faith and social or cultural rules of their patron to thrive. Thus the sanction of the church, the emperor or the sovereign had great influence over how knowledge progressed.

Vitruvius

One philosopher who enjoyed the favour of the first Roman emperor, Augustus, was **Vitruvius (born approx. 80 BC)**. The date of his death is unknown. An architect who served in the Roman army, Vitruvius was the first to provide written volumes on architecture. His work included a broad scope, such as the architecture of instruments for making music, the study of human form in its proportions as well as more classical aspects associated with the architecture of constructing buildings. His detailed study of nature as the source of form included how proportion mattered in balancing physical forces and aesthetic forms with sensory perception. In perceiving and presenting beauty in structure and function, the architect studied and portrayed nature and its forces, which were considered essential to any architectural undertaking. Every design in nature, according to Vitruvius, included the three principles an architect must follow in anything he created:

Firmitas, utilitas, venustas

Firmitas, utilitas, venustas (It should be solid [structurally sound], useful [useable, suitable for its specific purpose] and beautiful [aesthetically pleasing])

Divine Proportion gave rise to the harmony of nature and therefore dictated the ideal proportions of a building, particularly one designed to honour the divine, such as a temple or church. The rules of form were applied to far more than buildings, however. Whether for aesthetic harmony to the eye or ear, or the experience of a shape or form, these laws were considered necessary to assure “firmitas, utilitas, venustas” in everything, from the design of an instrument, or a tool, to a piece of furniture. Vitruvius took from Plato and Pythagoras the principles of what was, and is, referred to as Sacred Geometry, and the proportions and ratios of the Platonic Solids, the essence of the shapes of matter in living dimension.

These are the regular polyhedrons inherent to all crystals making up forms in nature, and we will consider their importance to fascial formation in later chapters.

Yoga, at this time was virtually unknown in the West. Between classical antiquity and the Renaissance, however, bodies came to be considered in very different ways. From the aesthetic sensibilities and sensitivities of the arts to the anaesthetic objectivity of medicine and anatomy, all such studies in the West were authorised by the Christian church, since religion was considered the supreme guardian of the human spirit and its highest interests.

The Golden Ratio was found everywhere in nature, so to use it in the broad spectrum of design in ancient architecture was actually to recognise the essence of natural (and therefore sacred) form. The architect did not seek to dominate or authorise this sacred form but rather to capture or recreate its essence and beauty. Man was considered to be the ultimate expression of Divine Proportion, the embodiment of nature's purest geometries. Vitruvius set an extraordinary challenge, whose solution remains a powerful symbol today:

"To any artist or architect to draw the human body with its arms outstretched such that both feet and hands could simultaneously touch the perimeter of the circle and the square" (of the same area).[2]

This conundrum of Divine Proportion in relation to the human body was not solved until the fifteenth century, when Leonardo da Vinci completed a drawing which answered the challenge visually (see later in this chapter).

The Renaissance

"In this one city [Florence], at this one time, there flowed together so many great minds and talents that the combined streams of inspiration brought about the rebirth of Western civilisation – the Renaissance. … Florence's historic centre is so small … yet, the fortuitous coming together of so many extraordinary personalities and events in this tiny area brought forth a flowering of the arts, sciences and philosophy that still influences our world to this day."[3]

The period of the Renaissance in Europe was an exceptional era of expansion and development in many fields throughout the continent. During the Middle Ages, the church's dominance was reflected in social class structures and in the systems that governed organisations and cultures. Education was not accessible to the masses, but remained a relatively restricted privilege of the nobility and the clergy and those wealthy enough to afford it or lucky enough to find a patron.

Communication other than by word of mouth relied to a great extent on skilled use of pen and ink on expensive parchment. Rare, handmade books were the domain of an educated elite, wealthy enough to travel, read and write. As one of the primary patrons of the arts, the church's development of religious symbolism was one of its main means of disseminating religious ideals. The church also sanctioned the fields of education that developed, for without ecclesiastical approval, any theory or practice could be judged heretical and the theorist would not only no longer be patronised, but might even be punished.

Academic fields in former times were unlike those of today. Many philosophers (a term formerly used for both scientists and artists) had what we would now consider to be multidisciplinary skills. Human dissection, for example, was strictly forbidden under religious law, so early scientific development of anatomy and biomechanics was restricted to the study of animals, and theories were derived from such diverse fields as mathematics and the study of clock mechanisms (horology).

Gutenberg's invention of the printing press in 1440 began an era of mass communication that changed society. His 1455 Bible is revered for its beauty of design and illustration and its iconic status as the first major printed book. The popularity of relatively economically produced printed books over subsequent decades extended education beyond the elite so that information and ideas could be circulated more widely. This gradually gave rise to new waves of scholarly investigation and popular culture was changed by what was to diversify into the arts and the sciences. The ability to print and publish their theories allowed the founding philosophers, writers, artists, musicians and scholars in a wide variety of different fields to *communicate* their concepts and interpretations. Their ability to explore and develop their ideas, however, was intimately related to whether they were able to gain sanction or patronage from the church or from local noblemen. For centuries to come, the church's influence over all aspects of academic and social development was profound.

While the sixteenth century was a very significant time for all aspects of European culture, this was particularly true for the birth of what we now call science. From this period, change was rapid and many of the great philosophers were to become the so-called fathers of various fields of modern science and medicine.

Polarity

The volume and depth of information being discovered with new instrumentation, when telescopes and then microscopes brought the worlds of both heavenly and living bodies into new perspectives, generated exponential growth in opposite directions. One field grew on the scale of the cosmos and the other on the scale of the universe inside a cell. Such polarities naturally stretched the space between them and gave rise to fast and vast growth in every area of Western culture.

A great divide began to arise between man and nature, his own nature, due in part, ironically, to the way in which the study of human anatomy eventually came to be sanctioned by the church (see Descartes, later in this chapter). Soft tissue was removed from the physical body when human dissection was eventually permitted. Since it was not recognised as playing any kind of significant role in physical, mental or emotional realms, it was relegated to a kind of unclassified hinterland where it remained for centuries to come. In short, it was overlooked.

While artists such as Leonardo and Michelangelo changed the aesthetic aspect of how human form was presented, Descartes and Borelli theorised over the anaesthetic domain of "mechanical function" and formal anatomical study. The kinaesthetic aspects of experience were somewhat lost in translation.

We will next consider some of the key pioneers (in chronological order) from earlier centuries in order to show the significance of what is happening in this, the third millennium. A groundswell of change is shaping our very different worlds. The huge impact of printing in the fifteenth century is echoed by that of personal computing in the twenty-first. Both inventions have transformed the rate and range of the dissemination of information, the former at walking pace and the latter at the speed of light. It is our task to somehow unite the ancient wisdom with contemporary knowledge, and incorporate the details of all those parts into a whole body of distinction and understanding.

The Cutting Edge

Galen (AD 129 – approx. 217) was a prominent physician and philosopher at the court of the Roman emperors. His reputation was gained from his extensive anatomical studies, although since human

dissection was strictly forbidden under the laws of Rome the subjects of his dissections were often Barbary apes on the grounds that they were similar to humans. Galen's theories followed those of Hippocrates and remained unchallenged until the work of Vesalius in the seventeenth century (see later in this chapter).

It was during the period of the Renaissance that the long established principles of antiquity began to evolve more rapidly into new areas of advanced study, and creative and scientific development was opened up.

"The Renaissance was the rebirth of man out of the dark years of medieval superstitions and belief and a return to the light of human reason. Italy and particularly Florence were at the heart of this reawakening of the human spirit. What more promising time or place could have existed as Leonardo's milieu?"[4]

Leonardo da Vinci (1452–1519) is considered to be one of the finest examples of the archetypal Renaissance Man. It was Leonardo who solved the circle and the square riddle posed by Vitruvius, by placing their centres at different points on the human form (Fig. 2.1). Every other draughtsman who had attempted to solve this problem had assumed the centre point of the circle and the square were set at the same place. Leonardo's Vitruvian Man sets the centre of the square on the pubic bone and the centre of the circle at the navel. This drawing has profound significance in terms of Sacred Geometry.

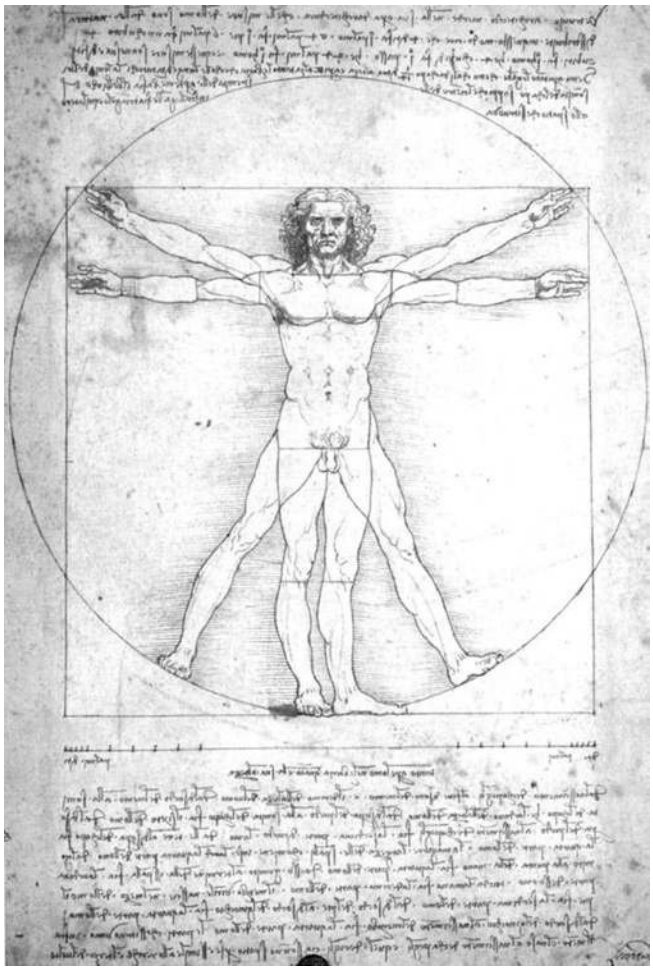

Figure 2.1
Leonardo da Vinci's Vitruvian Man. Leonardo's knowledge went beyond the ordinary and his ability to both literally and symbolically think outside the box demonstrated his unique mind and the breadth of his insight.

The hallmark of Renaissance humanism was its complete departure from the medieval culture of iconic

symbolism that preceded it. The Renaissance artists sought to achieve a vivid sense of animation in portraying their living subjects. Leonardo was a leading figure in the transformation of the artist as a craftsman to the study of art as a science and the elevation of aesthetic principles.

"artists wanted to learn all they could about the inner structure of the human body in order to come up to the level of expertise of the ancient Greco-Roman artists in representing the human form. The Church had forbidden any such dissections, since it considered the human body a divine mystery. In addition, it was still leery of perfect representations of human and mythological figures, which it thought might lead to a sort of spiritual recidivism, a return to pagan idolatry. This is the reason that medieval portrayals of the human figure seem so flat and unnatural compared to those found in Classical and Renaissance artwork."[5]

According to his own notes, Leonardo did not want to draw muscles as "bulging shapes"[6] without understanding how the "tendinous function" caused them to actually behave in physical movement. As well as using cadavers he made extensive studies of living bodies in motion. This was to explore how the whole body in "action" expressed movement *naturally* before it was transferred onto canvas or fresco. Structure and function were intimately related, and a profound understanding of fundamental principles of geometry and mathematics was translated into his engineering and architectural designs, as well as his drawings, paintings and sculptures.

Leonardo's studies also included Sacred Geometry and through his deep understanding of nature he was able to capture the essence of his subjects as well as their form. His sense of the three-dimensional space and light around and within his subjects is exceptional even by modern standards, with the use of computerised animation. For Leonardo, the body had a vital architecture. It was not just a shape, nor did it function mechanically. He understood that structure and function were profoundly related. His paintings also evoke an emotional response and the sense that the Mona Lisa is following you around the room is palpable. It went beyond the aesthetic to include the kinaesthetic, evoking the felt sense from the observer. This was an essential aspect of Renaissance art: to capture the charisma ("charism" meaning soul-essence) of the subject(s) permanently.

The foundation of Leonardo's skills, however, was in mathematical deduction and geometry. The complex and mathematically accurate studies by Leonardo of the five Platonic Solids (Figs 2.2 and 2.3) relate directly to the study of biotensegrity (see Chapter 4) and the most contemporary research into human motion.

The subject of Leonardo's mastery, whether a body or a building, was considered from the point of view of its aesthetic, its function and its form. Its whole architecture and purpose were integrated and the fundamental origins and ultimate "utilitas" of the structural shapes were recognised and presented with artistic conscience.

Leonardo developed art as a science, even though he did not observe from a medical point of view. He was creating an artefact that suggested atmosphere and portrayed the vitality of the subject, earnestly studying how movement was captured in a moment of stillness. His work now seems very far removed from that of the developing sciences. Here, dead bodies were the principal source of knowledge, and function was deduced after the fact, after all of the soft connecting tissues had been removed. Leonardo included the "tendinous architecture" in defining movement and redefining his designs in other fields. (He designed machines, instruments, vehicles and buildings as well as being a prolific painter and craftsman.) At this period the absolute division between art and science had not yet become part of accepted dogma.

Figure 2.2

The small marginal image is a visual reference to one of Leonardo da Vinci's geometrical drawings in the book *De divina proportione*. Only two copies of this book exist: one in Biblioteca Ambrosiana in Milan, the other in Bibliothèque de Genève in Geneva. (Various Leonardo da Vinci geometrical images are available online from the Bridgeman Art Library.) In an attempt to draw this complex geometry with computer graphics the other images were produced – however, they are not entirely accurate. Leonardo "saw" beyond the page to create this with only a pencil and the instruments available to him. They present something far more sophisticated than technical draughtsman's skills. Images by Martin Gordon (www.mothcreative.co.uk).

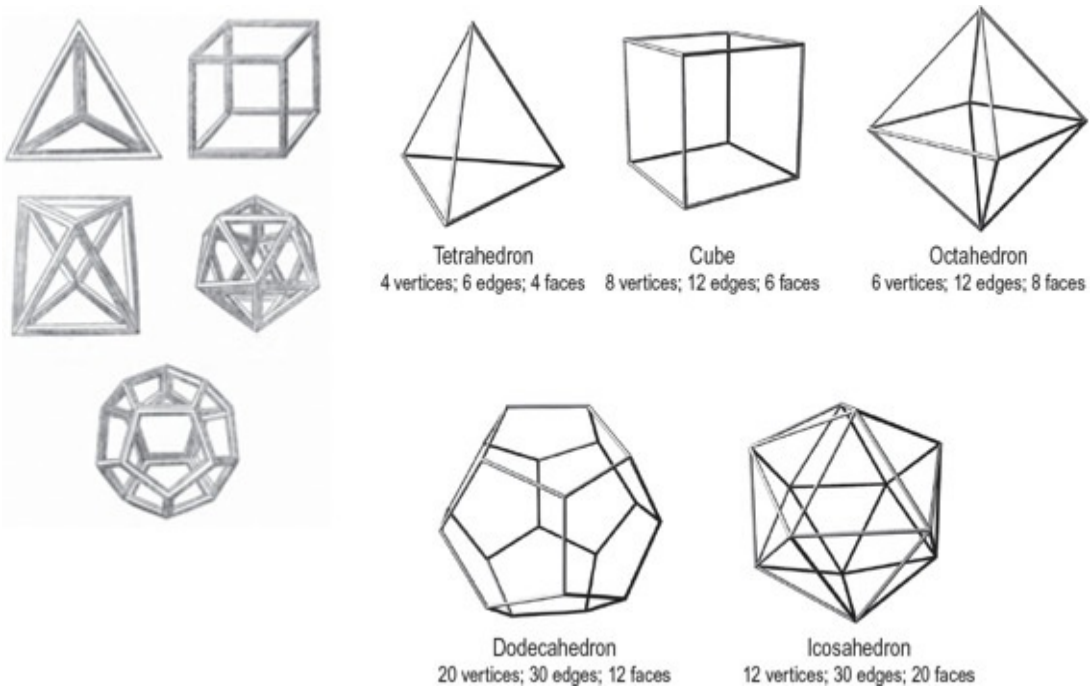

Figure 2.3

The marginal image is a reference for Leonardo's exceptional drawings of the five Platonic Solids, cleverly portrayed in three-dimensional perspective. The main image conveys the same solids using computerised graphics – pointing to the exceptional vision at the heart of Leonardo's profound understanding of all nature's forms, something he sought to translate into fresco, painting, instrument design, machine design and elaborate architectural ventures. Images by Martin Gordon (www.mothcreative.co.uk).

It is notable that, over the ensuing centuries, the realism the Renaissance artists were striving for was gradually replaced in the study of anatomy by ever more iconic renditions of schematic diagrams. This is partly why the connecting tissue continued to be overlooked. *Clean* dissection and clean, diagrammatic or graphic representation of what is dissected have underlined the focus on content over context. This is an important factor in understanding fascia. We have been mesmerised by iconic images of clean red muscles attaching to defined bones, just as our predecessors were seduced by Christian iconographic symbols. On every level, we are now invited to reconsider our perspective to one that is more inclusive of the context.

Andreas Vesalius (1514–1564) was the first to challenge 1500 years of tradition, upheld by Galen, in the field of anatomy. Vesalius acquired rare and special dispensation from a local judge to work with human cadavers. He directly compared human bodies with those of certain non-human primate specimens,

thereby challenging classical anatomy such as it was considered to be at the time. In the Theatrum Anatomicum at the University of Padua, the first anatomical theatre, Vesalius' anatomy demonstrations drew an audience from around Europe, including artists, scholars and members of the medical profession. Despite the fact that he was able to show the *significant* difference between the straight lumbar spine of the ape and the curved human lumbar spine (lordosis), he was highly criticised for his views by many at the time. In a culture dominated by doctrine, "proof by demonstration" did not necessarily counter "tradition by declaration".

Anatomical drawings relied heavily on excellent artists to produce them. After a century of development, refined printing techniques meant that the work done by Vesalius could be more easily publicised. Though acceptance of his work was not universal, it represented an exceptional breakthrough at the time in several ways. First, he challenged the 1500 years of acceptance of Galen's work on apes as the basis of human anatomy. Second, he considered the study of anatomy an essential basis for surgery, which was a revolutionary notion at the time. Third, he publicly presented his findings by demonstration and observation.

These events have to be seen in the context of their time. They were extraordinary challenges to the centuries of belief they sought to evolve. Vesalius redirected the course of anatomical study of the human body from its established tradition and asserted its relevance to medicine. In 1543 he published his groundbreaking work *De Humani Corporis Fabrica*, literally meaning "the material/workings of the human form" or "made from the human body". The book was based largely on human dissection which was done in a particular way. The scalpel was focused upon what it cut *to* rather than what it cut *through*. Nevertheless, anatomy was transformed into a subject that relied upon detailed and careful observation and meticulous dissection, making it as much an art and a skill, as a science. His legacy was available in print and thus contributed to the expansion of the whole field of medicine, surgery and anatomy across Europe. Many universities opened anatomical theatres as a result, to further develop the study of anatomy both as a subject in its own right and as the basis of medical practice. Padua remains, to this day, at the forefront of anatomical authority, maintaining the official archives on human anatomy. Whatever his contemporaries thought about his views, through his style of dissection Vesalius radically changed the point of view regarding human form and the significance of anatomical organisation. His use of the scalpel (according to Tom Myers "at right angles to the body") in cutting up parts, regardless of the layers or continuities in which they reside, became the assumed basis of the study of anatomy.[7]

Galileo (1564–1638) first studied medicine at the University of Pisa but changed to philosophy and mathematics, becoming Professor of Mathematics at the University of Padua in 1592. He is most famous for supporting the Copernican theory that the sun was at the centre of the universe, not the earth, as the prevailing orthodoxy had it. The church forbade such heretical ideas, which Galileo nevertheless put into print. His work is thought to have influenced Descartes and Newton (see later). The key point here is that his focus was via the telescope (in one direction), seeking to view the earth in the context of a universal scale. Importantly, the developing science of astronomy explained the movement of the planets through complex epicycles, to justify their earth-centred (geocentric) motion. Through Galileo's recognition of a sun-centred (heliocentric) universe, the epicycle theories were made redundant. They were transcended. This could act as a metaphor for the impact of current theories of the significance of fascia, which is evolving to transcend many classical anatomical notions and biomechanical concepts (as we will see in Ch 3).[8]

This philosophy is significant in terms of the Age of Reason that ensued in Western culture. In the Eastern world of the yogic sages, the intellectual mind and its powers of reasoning are distinct, although not separate, from the mysteries of the being and the spirit

therein. Regardless of the religious, theoretical or political preferences, Descartes' meditations influenced the emerging cultural notion that wisdom resided in the reasoning mind and scholarly, academic pursuit of science.

Descartes (1596–1650) was primarily a philosopher. He set great store upon breaking things down into their component parts in order to understand how they were assembled and then, according to Dr Candace Pert,[9] "*extrapolat[ing] over-arching theories about the whole*". This included human beings. According to Descartes the mind was demonstrably separate from the body and thinking and being were upheld as synonymous. He is most famous for his phrase "Cogito, ergo sum" (I think therefore I am).

Although he is known as the father of modern medicine and science, Descartes' subjects of study included clocks (horology) and he was a mathematician in geometry and laws of motion. He applied the same intellectual reasoning to human behaviour and movement, considering the body to function completely separately from the mind. Descartes sought sanction directly from the Pope to use human bodies for his dissections, to study anatomy and properly demonstrate his point of view and analysis of function. He argued that human behaviour itself was evidence of the fact that the mind and the body were entirely separate. Thus, when the Pope sanctioned dissection on the grounds that the church retained jurisdiction over the thinking and feeling realm of human experience, it was a confirmation of Descartes' larger philosophy (and possibly an act of guardianship for the soul) to sanctify the science. Body and being thus became considered as separate domains.

Descartes argued that bodily human motion is based on similar workings to those found in a clock mechanism and declared the body to move like any other "automaton" (from Greek automatos, meaning "self-moving" or "self-acting"). Thus his reasoning effectively reduced the movement of the human body to that of a purely automated system of mechanical function; albeit self-motivated. Although the spirit of that "self" belonged to the church, human form came down to the biomechanical sum of its anatomical parts.

It is important to note again at this point that yoga did not develop under the influence of such segregation of the human experience. The study of Ancient Psychology (as it was called) in the mystery schools, was not practised under these particular influences.[11]

This philosophy proposed that the mind was distinct and could be elevated through study, the soul belonged to God, so was clearly under the domain of the church, and the body could be *authentically* broken down into its component parts for scientific analysis. Science could therefore justify furthering intellectual knowledge of anything under examination through the lens of "objective realism". The anatomical parts of the automated system could then be legitimately labelled and assigned their function and all aspects of a human being would thus be understood and correctly assigned to the appropriate authority.

"I desire you to consider, I say, that these functions imitate those of a real man as perfectly as possible and that they follow naturally in this machine entirely from the disposition of the organs no more nor less than do the movements of a clock or other automaton, from the arrangement of its counterweights and wheels."[10]

The Italian physiologist **Giovanni Alfonso Borelli (1608–1679)** was a philosopher, mathematician and astronomer with a special interest in animal biomechanics. The two parts of his major work *De Motu Animalium* ("On the Movement of Animals") were published posthumously but his investigations into the field of movement led to his being called the father of biomechanics. In accordance with ideas of the time, Borelli's analysis of animal movement was based upon linear mechanics and two-dimensional deduction, while his theories were validated mathematically. He stated that "muscles do not exercise vital movement otherwise than by contracting", extrapolating that the body moved forward by shifting its centre of balance

via the joint angles acting as various kinds of levers. This principle is still alive in current research, so it is still considered to be part of the classical model of biomechanical movement of the human gait and structure.

What was also developing rather than a universal understanding, were the different fields of *specialisation* that we encounter today. Disciplines such as physics, chemistry, biology, botany, mathematics, biomechanics, medicine and anatomy were dividing according to religious and social orders, political and philosophical differences. The power of communication of knowledge was increasing and with it the value placed on theoretical reasoning. Standards of learning were developing too, as education became more available to a broader range of people. Fragmentation was occurring at many levels.

Sir Isaac Newton (1642–1727) was, among many other things, an alchemist. He devoted much time to discovering the philosopher's stone, as well as studies in the fields of theology, mathematics, astronomy, optics and numerous other scientific investigations. He is most famous for his formulation of the laws of gravity, and work on the light spectrum and laws of motion and speed that were to become the basis of modern physics. He understood the principles of force and counter-force. Now considered as one of the most influential scholars in the history of science, in his day, Newton was revered in some academic circles but ridiculed in others as the "great geometer". He proposed the powerful distinction that "to every known action in the universe there is an equal and opposite reaction".

Newton sought to understand man in the context of nature as a whole, formulating the common physical laws of motion that govern individual and celestial bodies. He did not *invent* gravity so much as distinguish it. The century that saw the invention of both telescope and microscope opened the cultural perspective to include a kind of "zoom lens". It distinguished scale from the telescope ("zoomed out") to the microscope ("zoomed in") as an asset or common denominator to all nature and forms. This context of scale is very important in understanding the body from a point of view of the soft tissues in current research. At this period in history it did not prevail in quite such inclusive, or universal terms.

Bernard Siegfried Albinus (1697–1770) was a lecturer on anatomy and surgery and one of the most famous teachers of anatomy in Europe, as was his father. He was appointed professor in 1745 and worked with draughtsman and illustrator Jan Wandelaar to produce exquisite anatomical drawings (Fig. 2.4).[12] The printing press was now 300 years old and considerably more sophisticated, and so the speed of change and availability of information was expanding rapidly. Nevertheless, the reproduction of information retained an aesthetic value. In order to be true to the human form, Albinus and Wandelaar would hang webbing with a grid marked upon it behind the suspended cadavers to give an accurate representation of scale and perspective. The principles of Renaissance humanism were retained, in that the images kept a sense of their original wholeness in the living body, separated out for medical purposes but nonetheless displaying a context for their original form. This aesthetic upheld the continuity of structure. Albinus' famous work *Tabulae Sceleti et Musculorum Corporis Humani (Plates [illustrations] of the Skeleton and Muscles of the Human Body)* was published in 1747 but garnered much criticism of the "frivolous" backgrounds to the drawings. It seems that by the later eighteenth century aesthetics were considered to be out of place in the serious academic study of anatomy and medicine. Other branches of science were also detaching body content from the context of the whole and the gap between human experience and human fact and function was widening.

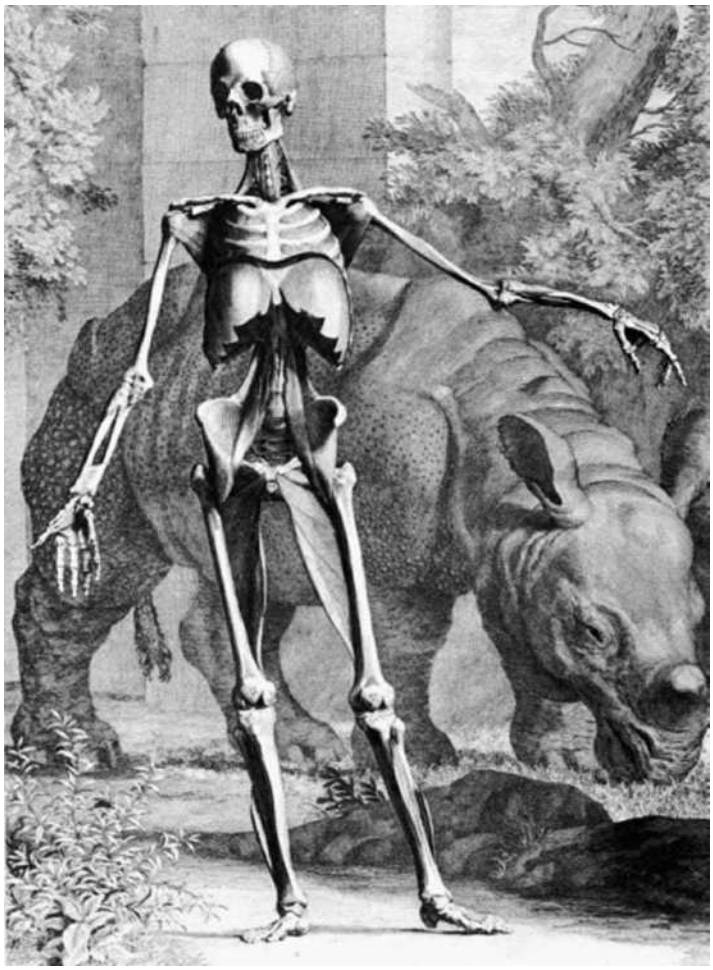

Figure 2.4
Albinus on Anatomy includes beautiful drawings of the bones and musculature. The original work shows wholebody presentations of the musculoskeletal anatomy in layers and includes many exquisite drawings of the layers and their relationships, such as this one of the diaphragm and its connectivity.

With the increase in information availability and the cultural changes accompanying the Industrial Revolution there was a rapid expansion of education. Increasing specialisation brought about a separation of the arts and the sciences. The study of anatomy began to be respected for its own sake and the hallmark of excellence in the field was to create “clean dissection”, with images of the detail completely separated from their place in the context of the whole body. Everything other than the key elements (bone, muscle, vessel, organ, gland or tendon and ligament), such as the layers of adipose tissue (fat) or scruffy bits of “packaging material” (fascia and certain connective tissues), was considered inert and largely irrelevant to the study. It was removed and discarded apart from certain discrete elements. In the anatomical laboratory the fascia was largely consigned to the cadaveric bins. Fascia was, and still is, literally thrown away.

This was the general trend of anatomical study, in the growing fields of medical and surgical practice. However, there were exceptions.

John D. Godman (1794–1830) was an anatomist and naturalist who died very young and was known, if at all, for his outstanding anatomical drawings and studies of the natural world. He came from a less than traditional medical background but his passion and enthusiasm for true anatomy were themes in his drawings, paintings and writings at the time. In his book *Anatomical Investigations comprising descriptions of various Fasciae of the Human Body* (1824)[13] he espoused a principle of honest observation of all that was in front of the student in order that they could fully appreciate the connected nature of all the anatomical parts they were asked to understand. He insisted they ignored preconceived

notions of named systems and looked at the parts in their context of this continuous tissue, the fascia. He went on to detail the class observations of this tissue as a connected whole throughout the torso.

"The following investigations were begun without reference to any system, and without the slightest wish to support any preconceived opinions. The conclusions drawn were unavoidable, even at first inspection, and their correctness was more firmly established by every subsequent examination."[14]

It was almost 200 years ago that John Godman wrote presciently, at the end of his introduction:

"The novelty of these descriptions will, perhaps, be the greatest impediments to their general acceptation, for it has been very correctly remarked by an illustrious anatomist, Geoffroy Saint Hilaire, that there are many persons who become furious at the mere annunciation of new ideas – like him, however we shall wait patiently, convinced that time fixes everything in its place."[15]

The cell came to be the centre of many branches of scientific enquiry and generally considered as the unit of life. The parts being examined were getting ever smaller and the quantity of information was expanding exponentially. This, in itself, raised difficulties of scale and focus. There were ever more powerful telescopes to see the farthest reaches of the universe and ever more powerful microscopes to see our smallest universe, inside an individual cell. What happened to the context in which, or from which, both arise?

Rudolf Virchow (1821–1902), considered to be the father of modern pathology, developed microscopy further and stated that the cell was the basic unit of the body that had to be studied to understand disease (Fig. 2.5). This was a significant turning point as the focus in medicine narrowed even more, concentrating on the smaller components.

Science, medicine and anatomy were about discovering what is "true" and objectively, measurably accurate. However, they diverted attention from a perspective that was inclusive of wholeness, or whole body function and structure as a united and complete being-in-action. **Andrew Taylor Still (1828–1917)** was a physician and surgeon who became the founding father of osteopathy. Interestingly, Still referred to the body as a machine but offered the idea that it was designed to heal itself, by a force greater than itself. He wrote of the inclusive aspect of the soul, rather than segregating it.

"This life is surely too short to solve the uses of the fascia in animal forms. It penetrates even its own finest fibers to supply and assist its gliding elasticity. Just a thought of the completeness and universality in all parts, even though you turn the visions of your mind to follow the infinitely fine nerves. There you see the fascia, and in your wonder and surprise, you exclaim, 'Omnipresent in man and all other living beings of the land and sea …Other great questions come to haunt the mind with joy and admiration, and we can see all the beauties of life on exhibition by that great power with which the fascia is endowed. The soul of man with all the streams of pure living water seems to dwell in the fascia of his body."[16]

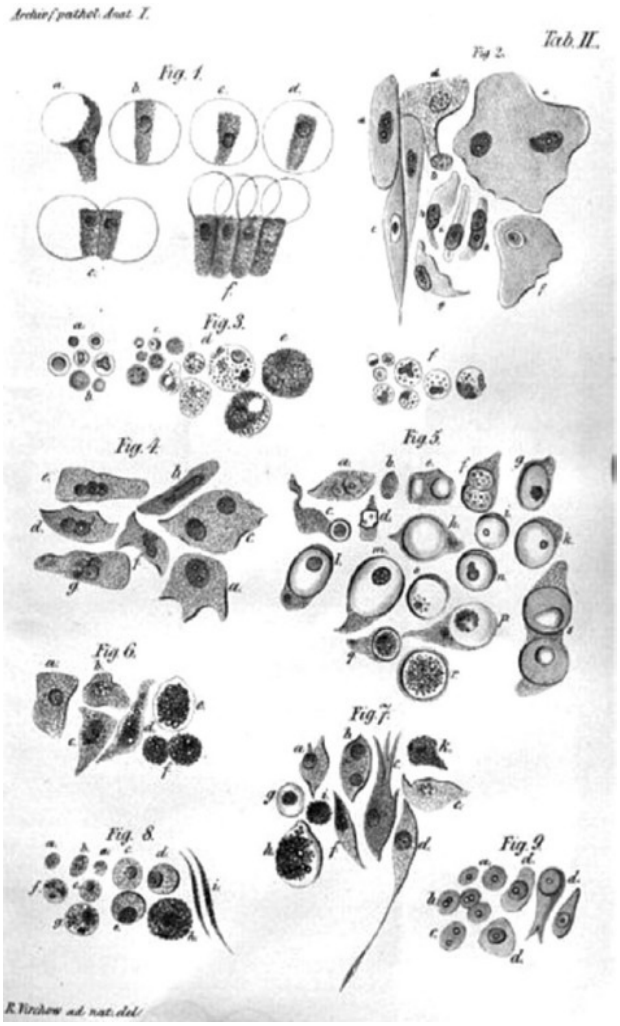

Figure 2.5
Image of Virchow's cell biology.

It could be said that Still conceived the genesis of the science of body architecture. His work had the authority to give birth to a new school of medical thought. His writings on the fascia, now over 100 years old, showed a deep sense of awareness of this fabric of the human form and its profound relationship to the being. The most recent research can be seen to validate much of what he, and John Godman before him, asserted, researched practically and found considerable evidence for through their work and experiences.

Writing from a view that harks back to Hippocrates in its values of working with the human experience as well as the condition being presented at the time, Still suggested the innate human capacity for healing.

"The Fascia: I know of no part of the body that equals the fascia as a hunting ground. I believe that more rich golden thought will appear to the mind's eye as the study of the fascia is pursued than any division of the body. Still one part is just as great and useful as any other in its place. No part can be dispensed with. But the fascia is the ground in which all causes of death do the destruction of life. Every view we take, a wonder appears …I dislike to write, and only do so, when I think my productions will go into the hands of kindhearted geniuses who read, not to find a book of quotations, but to go with the soul of the subject that is being explored for its merits, – weigh all truths and help bring its uses front for the good of man."[17]

We have outlined some of the highlights of the rich story behind the evolution of anatomy in the West. Now, after a long divorce between the pieces of the person and the persona, fascia research is materially changing the view and the language of the body, written in its own kinaesthetic dialect. The soft

architecture of our unique movement signature is an exciting field to explore, restoring the wholeness that yoga invites us to perceive and express.

If fascia does anything, it offers us the opportunity to evolve our perspective to *include and transcend* all that precedes it. We cannot just throw out the muscles and bones or beautiful dissections of many an anatomical book. We can, however, regard them in their unifying context. They only exist in the presence of their intimate witness, the collagen matrix without which they have neither structure nor function. The science of body architecture emerges as a triumvirate in many ways, calling upon a new perspective from which to represent all that we thought we knew, from the microscopic to the telescopic level; a scale free model that makes sense of the wholeness which includes all of our parts. At the same time, paradoxically, it distinguishes them. The next chapter examines this paradigm shift that echoes the Renaissance principles of a new perspective.

Notes

1. Michael S. Schneider, *A Beginner's Guide to Constructing the Universe: The Mathematical Archetypes of Nature, Art, and Science*, HarperCollins, New York, 1994.
2. There is speculation that Leonardo had help from a dear friend, a young architect well versed in Vitruvian principles named Giacoma Andrea (Toby Lester, "The Other Vitruvian Man", Smithsonianmag.com February 2012).
3. Benjamin Blech and Roy Doliner, *The Sistine Secrets*, HarperCollins, New York, 2008.
4. Silvio A. Bedini, "The Unknown Leonardo".
5. Benjamin Blech and Roy Doliner, *The Sistine Secrets*, HarperCollins, New York, 2008.
6. Translated from Leonardo's notes. In: *The Unknown Leonardo*.
7. Ch. 1 in Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
8. In *Cells, Gels and the Engines of Life*, Gerald Pollack uses a similar metaphor for the changes currently being demonstrated in cellular biology and the structure of water (Gerald H. Pollack, *Cells, Gels and the Engines of Life*, Ebner and Sons, Seattle, 2001).
9. Candace Pert, *Molecules of Emotion: The Science Behind Mind-Body Medicine*, foreword by Deepak Chopra, Scribner, New York, 1997.
10. René Descartes [published in French in 1664], *Treatise of Man*, Harvard University Press, Cambridge, MA, 1972.
11. Alexander Filmer-Lorch, *Inside Meditation: In Search of the Unchanging Nature Within*. Matador, Kibworth Beauchamp, 2012.
12. Robert Beverly Hale and Terence Coyle, *Albinus on Anatomy*, Dover Books, New York, 1988.
13. *Anatomical Investigations, comprising descriptions of various Fasciae of the Human Body* (http://www.biodiversitylibrary.org/item/89909#page/7/mode/1up), originally published in 1824 in Philadelphia by Carey and Lea. Digitized by the Internet Archive in 2010 with funding from Boston Library Consortium Member Library.
14. Ibid.
15. Ibid.
16. Ch. 10, "The Fascia", in Andrew T. Still, *Philosophy of Osteopathy*, A.T.Still, Kirksville, 1899.
17. Andrew T. Still, *Philosophy of Osteopathy*, A.T.Still, Kirksville, 1899.

CHAPTER
3

The Science of Body Architecture

"We shape our dwellings and afterwards our dwellings shape us."[1]
Winston Churchill

The 24/7 Tissue

If indeed the musculoskeletal system cannot exist without the fascial matrix, is it perhaps necessary to redefine it? A definition suggesting that the musculoskeletal apparatus is made up of only muscles and bones might be an inadequate, if not misleading notion. It is rather like saying that Monday to Friday are the days of the week and stopping there. They are indeed, but what joins the weeks together?

The muscles and the bones have always been considered to be the "working team" in the musculoskeletal system, with the nerves, blood vessels and so on present to direct and feed them. Fascial tissue was, as we have seen, largely disregarded; removed in order to reveal the apparently more important muscles and bones.

There is now a new level of understanding of the tissues of the "internal net". These tissues work 24 hours a day to determine where we are in space, even as we sleep. No muscle or bone anywhere in the body ever works without them. Nor are they merely connecting tissues, like a sort of fibrous scaffolding. Rather they are active, sensory fibres, including "antennae" in deep organisational relationship with the neural network, hydrated and vascularised by the circulatory matrices. We will go on to consider these aspects in detail throughout Part 1. What is important to note here is that everything we thought was true shifts context in a new paradigm and it takes a while to re-orientate our knowledge. We therefore have to find new coordinates.

See for Yourself

Muscles and bones appear to most of us to make up the musculoskeletal system because that is what we have seen illustrated in the vast majority of books about how we are built and what we use to move. We can readily see their shapes when we look at ourselves or each other. We can see the joints, the angles they make at the elbow or knee, for example, and make out the muscles under the skin by their shapes when they are contracted. Mainstream medical school training refers to the "musculoskeletal system", and mostly muscles and bones are named as the main movers and shakers of living mammalian movement apparatus. The so-called auxiliary connective tissue structures (such as tendons for example) are often considered to be part of the muscles. The key point is that the focus tends to be on a mainly twofold system of muscle to bone.

It is little wonder the fascia is being called the “Cinderella tissue” of the locomotor system and orthopaedic medicine: “After several decades of severe neglect, this ubiquitous tissue has transformed from the ‘Cinderella of orthopaedic science’ into an almost super star position within medical research.”[2] Like Cinderella, she has been ignored, left to her own devices, but nonetheless relied upon. In the body, the musculoskeletal system literally does not exist without the fascia.

Your fascia is the neutral servant of all that you embody, containing every detail of you. It responds with exquisite sensitivity to your ways, your woes and your wisdom, as they are at any given time. How you express yourself physically, *every moment and movement of the day*, is recorded and recognised by the fascial network, if not animated by it. Or perhaps it is the medium in which we express our animation. At its best, it is how we restore ourselves to balance, and it plays the sovereign role in defining what shape we are in.

It is not that we do not have muscles and bones, or that they do not take up the larger spaces of the movement (locomotor) system. It is that they do not have *any* ability to connect to each other without the tissues that hold them together and apart, to create and fill those spaces *on every scale*. Not one single microscopic fibril of muscle escapes the fascial web that weaves us together. It is how we grow from the dot-sized being we are at conception and, without question, how we live happily ever after. Without it we do not move or function, and we certainly do not retain our form.

Grace and Patience

It has taken well over a century for Andrew Taylor Still’s ideas on fascial structure and function to be researched enough to be treated with the seriousness they merit (Ch. 2). Fascia is not easy to see or imagine when you glance at a body; it is not evident until you learn to read shadows and dimensions and understand a matrix or multidimensional network. Every single muscle fibril, group of fibrils forming fibres, group of fibres forming bundles, group of fibre bundles forming the muscle belly and *continuously extending* beyond the muscle belly to form the tendinous part of the muscle is fascia. Fascia is what holds a group of muscles together, what attaches them through cross-links, as a group or individually, to another group, or to the wrapping around the bone (periosteum). It is fascia that wraps every bone and forms that periosteum and the joint capsule and plays its part in the so-called ligamentous bed between the bones. Even more emphatically, the embryo shows us that the “primary space in the body is fascia”.[3] It is the matrix in which all the other organs are embedded (Ch. 5).

Fascia forms the connective tissue wrapping around the organs (visceral fascia), between the layers of tissues that form us. We call the wrapping of the blood vessels “tunicae” and the casing around the nerves “dura”. Both are part of the fascial matrix expressed in different, but nevertheless interconnecting forms (neurovascular tracts). Fascia attaches our skin to us, containing the subcutaneous layer underneath it and the adipose (fat) layers between, forming a body-wide web that has as many roles as it has characteristics to perform them. It is the essence of our variability and variety and it takes various forms according to the requirement of a given territory in the body. From heart to hamstrings, from cell chamber to body chamber, it is organising and forming our inside-out and outside-in architecture, including what is in-between. It communicates, signals and organises us in a fluid medium, continuously, in continuity and in concert.

Muscles and bones get to be in the limelight because “the Cinderella tissue” has the good grace and patience to watch out for them and keep them together. Research now abounds to demonstrate this (see Ch. 1) and it invariably “makes sense” for people’s instinctive understanding of their own living experience.

Read the Shadows

When you drum your fingers on the table, or type at your keyboard, the shadows you see on the back of your hand as you make the movements are where the tethers and layers of fascia permit or inhibit glide. Turn your hand over and you will see much less apparent movement within the tissues. They have a different characteristic. The fascia tethers the palm more because you use it differently. When you see muscles defined, it is the borders where the fascial layers meet that you are seeing in the hollows and grooves of the skin. It is what gives us our shape and our form. You have just touched upon your inner architecture, experienced its sensory feedback mechanism, demonstrated to yourself the responsive subtleties of movement your body does all the time and seen that it restored itself immediately. You might now be more conscious of the hand that felt you, or the hand you felt, but they have gone back to their original shape as rapidly as you let go.

If you gently hold your hand, so that your left fingers are across the back of your right hand … and wiggle your right fingers, you will feel the gliding and rippling of tendons, muscles and bones sliding under the skin (Fig. 3.1). Pretend you are drumming the table with your right hand but in mid air. If you squeeze a little harder with your left hand you will find they still glide, if slightly less easily, but you can feel other structures underneath which are deeper tissue arrangements. There are several things going on at once here:

- You can feel the tissues sliding in the back of the hand inside the fluid and gel-like matrix of and between the fascial layers.
- You can feel a different quality of sliding in the palm of the hand. Notice it is stiffer and thicker.
- If you slow down or speed up the movements of your fingers (right hand) ever so slightly you can modify the speed readily and change the sense of the movements by timing them differently, at will, in an instant.
- The fingers of your left hand are sensing every one of these subtle differences.

Figure 3.1

Try it. *Feel the glide*. Notice that everywhere in your body, the skin slides over the structures underneath it and then restores itself to where it was before. Note that you can feel one quality of sliding at your ear lobes (it will be different for every individual) – how the back and front of each one slide over each other (or not) – and another quality entirely between your scalp and your skull bones or over the back of your elbow.

All that sliding is the superficial fascia, which is effectively the back of the skin, moving over the deep fascia, which is over the muscles enclosing the bones. Between them is a layer of what is called “loose connective tissue”, sometimes referred to as the “shearing zone”. This layer of loose connective tissue arises between various structures of the body and plays a key role in mechanoreception (Ch. 9). It forms

part of the matrix that, notwithstanding its precise location in the body or particular characteristics, is *everywhere* (Fig. 3.2). (Please note that all fasciae are connective tissues, but not all connective tissues are fasciae. The terms are not synonymous.)

It is also possible to work out the layers[4] or the units within the fascia, or the sections it defines and the details of its organisation, and think of them invariably as separate fascial parts. This would be to retain a reductionist viewpoint – the units you break the body down into simply shift from chunks to sheaths. It substitutes reductionist bits and pieces for reductionist lines and layers. This does not always recognise them as unified, which is how they work. It is also how we work *with* them in a yoga class. They may be distinct but they work together as a unified whole and they can change in response to use, so care must be taken to appreciate the new *context* and not just appreciate new ways of seeing the *content*.

Fascia wraps organs, forms the wrappings of vessels and tubes, and ensures that they are all connected to each other in the right places. It also wraps the whole body, creating the layer between our skin and body walls. These areas or layers all have different characteristics but essentially, the governing principle is that this matrix is subanatomical, anatomical and transanatomical; that is, it is at its finest within each cell. It holds the cell communities in its matrix, expressing how the organism has ordered itself into organs and structures. It is all organised in fasciae of one sort or another; the organism itself is a fascial, organising matrix. We are formed out of variations on its theme and each part is part of the continuous wrapping around all the parts. It starts that way in the embryo and that continuity does not change as life goes on. We simply and complexly grow and specialise and adapt in all our glorious variety. Welcome to the world of the “in-between”.

Figure 3.2

The internal net and tensional network is hard to see, or even to imagine in the context of its wholeness and ubiquity. This image was created to give the sense, albeit externally, of the moving layers responding as a whole soft, tensional architecture or internal fabric throughout the form, whatever shapes it is engaged in making. Image reproduced with kind permission from David Woolley (www.limitlesspictures.com). Model: Samira Schmidli

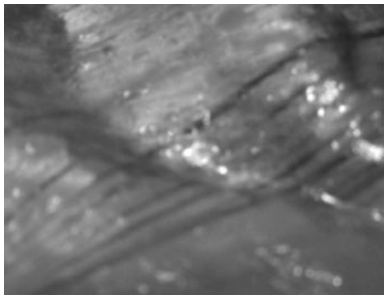

Figure 3.3
The fascia is found between every muscle fibre and around and between muscles. This image shows a small section of the tissue layer underneath the rectus abdominis myofascia (at the linea alba).

Understanding fascia does not replace our understanding of muscle or bone but reconfigures our point of view of how they work together and apart, in other words, how they are *related and organised*. This is the tissue of relationships and relatedness and we have to be cautious when we study it. It is very tempting to get excited about fascia at the expense of the muscle–bone working team. The *whole* team works together in a triumvirate, rather than as a duo or in isolation.

The point is that the tensional network of the fascia is ubiquitous and relentlessly faithful to its wholeness, its continuity and its sensitivity (Fig. 3.3). It also changes and metabolises in a continuum, throughout our lives, renewing and restoring itself and our vitality to a greater or lesser extent. That is why it is so congruent with yoga practice and makes sense, by context, of all the tiny variations and gross movements we can make on a mat. It also wraps us, from core to sleeve, in our own sensitivity and sensory awareness (Ch. 9).

The fascia blends the physical with the instinctive and emotional aspects of us in motion, stillness and presence. It provides the medium of, at the very least, our physical expression as *form*.

A New Word

"Biomotional" is a new word that might be easy to grasp on paper but is not easy to "get", since we have been brought up on, and reasonably nourished by, a diet of biomechanical function in separate muscles and individual bones, and the idea that the joints connect them. Quite why the study of motion is called biomechanics and human bodies are treated as if they are designed as machines first and human beings second is not fully answered by our scientific history. In reality, we are not machines; we do not move mechanically and we do not have mechanistic joints. Robots have those and we have not yet managed to design a robot that moves as fluidly or as intelligently as human beings can.[5] We have underestimated the complexity and genius of the human form, for it does not only behave in a biomechanical way, but also in what we might call a "biomotional" way.

There is, technically, no such word as "biomotional". However, the term "biomechanical" somehow implies automation, and the human form, given the fascial matrix, does not really resemble a robotic lever-armed system. Biomechanical is a term that refers to movement methods of the locomotor system; but we are entirely made of various soft tissues, including relatively compressed, hardened soft tissue, i.e., bone and cartilage, and relatively stretched or folded and softened soft tissue, i.e., muscles, membranes and vessels, enclosing gel-like substances and fluid flows (colloids and emulsions). These may have various properties but do not appear to exhibit purely mechanical characteristics such as a machine might have. In essence they are liquid crystals, tensional fabrics and continuously soft tetherings of various types, not nuts and bolts. All of this is a tensional network. Fascia can be like gossamer webbing remaining entirely connected from one end of us to the other, in 360 degrees of space-occupying/containing wholeness. It binds together to form very strong areas of densification and is also loosely woven to form very soft areas. Metabolic movement is constant; a sign of life. It includes the containment of solids, liquid crystals, fluids and gases of the body in motion and interrelated, sentient communication and exchange. We are essentially emotional beings with 60% or more fluid within our tissues. Machines have parts while mammals have

continuities. No part can be removed from a living body without affecting the rest because it is continuously in an unbroken matrix. Thus the word "biomotional" is offered here to enhance the sense of soft tissue organisation that we will explore in later chapters. It does not replace the term biomechanical; however, it seeks to expand our sense of movement in the yoga classroom.

"And that machine thinking comes from the notion that the body is built up from parts. That is the machine-view. That is not true: the embryo shows us loud and clear: First the whole then the parts. First the matrix, next the elements, first the body, then the organs!!!!!!!!!
A machine is built up from parts. That the system might work LIKE a machine does not prove it IS a machine. That you can replace a joint by a hinge does not prove it is a hinge. It works like a hinge and that is a big essential difference!!!"[6]

Understanding fascia and its fluid medium, the containment of the cells and the extracellular matrix in which they reside, is why robotics is about mechanics and we are about individual grace and guts. Whether in light or clumsy gestures, coordinated or awkward moves, we express our fascial make-up as uniquely as we are shaped. We are not cloned. We do not conform to a rigid plan. Ours is a fluid, self-motivated, sensory kind of geometry, full of choice and personal interpretation that began with our embryonic genesis.

We are conscious archetypal beings, developing continuously from our embryonic origins to the best of our abilities at the time, under the circumstances in which we find ourselves. The tissue can and does, with the appropriate dose and degree, respond to new loading patterns, if we understand how they accumulate. The body represents, essentially, time in motion, which we will consider in later chapters.

Fascia Research

The story of fascia is taking some time to filter through some layers of our culture, although many areas of medicine, movement and manual therapy are in the process of recognising the work of fascia research pioneers and changing their approach. They, in turn, are influencing fascia research. As it was for Vesalius, new ideas are not always being greeted with enthusiasm. Evidence by demonstration disturbs truth by declaration, especially if institutions have built themselves upon the "truth" of what they thought they knew. We have our very own twenty-first-century Vesalius, or at least a suitable counterbalance, to challenge the preceding history and change completely the way the scalpel is used to define the tissues. Jaap van der Wal's pioneering work has become a powerful resource for the other explorers in this rapidly growing field. What he found is also palpable and demonstrable now that we have the refined technology with which to "see" it and even measure it.

A Modern Vesalius?

In the late 1980s, for his doctoral research, Jaap van der Wal, MD PhD, Associate Professor of Anatomy and Embryology (now retired), carried out a tissue-sparing dissection of the human elbow. In other words, he did the opposite of the required clean dissection. Instead of removing the scruffy, fibrous "stuff" in the way of the muscles and bones around the joint capsule of the elbow, he spared the tissue and meticulously removed the muscles, in order to see what the 'fibrous scaffolding' looked like on its own. He revealed something extraordinary, namely, that the fibrous material formed a complete and continuous whole architecture. There was nowhere that it stopped, changed angle abruptly or failed to enclose the

whole elbow organisation. There were different densifications of the tissues. However there was no part of the joint that was not under continuous tension, or omitted from the ensheathing, encapsulating integrity of the whole architecture of the joint and the arm. He suggests that a different view might be that the arm is continuous and the elbow represents a "disjoint" in that continuity, thus permitting motion.

> Jaap van der Wal was Associate Anatomy Professor at the University of Maastricht in the Netherlands. The new method of dissection he used in his research project was developed by one of his colleagues, H. van Mameren, in the 1970s. Jaap van der Wal came to work in the laboratory of Professor Drukker (then Chairman), where van Mameren did his studies, and under his supervision van der Wal started to follow the same procedure and researched the importance of this connective tissue or fascia architecture in the process of proprioception. It came about that this "continuity thinking", in architectural terms, fitted the way our proprioception and body sensing is organised. It made sense of our movement sense, so to speak. "It was not the anatomy of bones and muscles that was instrumental for proprioception, but the architecture of continuity."[7]

This discovery shone a totally different light upon anatomical study itself and it did (and still does) stimulate whole new issues of how we move. What van der Wal and his colleagues did was a complete reversal of standard procedure. In a sense, he dissected the "negative space" – in simple terms, he did not cut out the "stuff" to get to the "thing", rather, he removed the "thing" to see the "stuff". This constituted a shock to the traditional view not wholly dissimilar to that caused by Vesalius when he queried Galen's hitherto unquestioned dissections of Barbary apes. Once again, centuries of assumptions had been hugely challenged by a new context of curiosity.

Van der Wal's findings were not embraced immediately, any more than Vesalius' work was. (As a result van der Wal turned his attention at the time towards embryology.) In truth, van der Wal's earlier work has not yet filtered into the anatomy textbooks, although that is changing now, in this new millennium. After several decades the message is gradually being acknowledged through manual and movement practitioners and researchers working in fascia, rather than as a universally accepted basis for medical anatomy. The implications of this work, sparing the soft tissue instead of slicing it, were huge at the time and their impact is still authorising change in the hallowed halls of anatomy education. Van der Wal described what he revealed as "the transanatomical architecture [of the human elbow] and its proprioceptive substrate".[8] Transanatomical in this sense means something beyond the (traditional) anatomical distinctions, inclusive of all of them.

Transanatomical Architecture

The implications of this continuity of tissue were that the separately named muscle-to-tendon, bony periosteum, ligament and joint capsule together formed one continuous architecture. It was thickened, vascularised, innervated and invested with different qualities at different points of connection and *disconnection*. Nevertheless, the tissue in, around and beyond the joint was uninterrupted, containing and continuing the different facilities for movement afforded by muscle–tendon–bone–ligament and joint space. On examination, it was also found to be sensory in nature with a density of sensors (mechanoreceptors) around the joint and between the fabric layers. This suggested that the perception of gliding motion within the tissue matrix is relevant and it raised a host of questions.

Van der Wal's work pointed to the idea that the naming of certain ligaments, and the particular way in which they are cut out from their neighbouring (whole) myotendinous joint architecture and bone, makes them more of an artefact than a distinct fact. Apart from very few "true ligaments" such as the cruciates, which exclusively join bone to bone, most others are part of a larger architecture including elements that

are named separately, but do not exist separately in the body. It implies that the anatomist is using his knife to *design* and name a part of the body (assigning it the role of a ligament, for example, by the act of cutting it) rather than using that knife to *reveal* the architecture exactly as it is in life, which is whole and combined. This is a very interesting revelation in a field that threw out aesthetics several centuries ago in an earnest pursuit of the facts behind anatomy. It is not actually saying there is no ligamentous attachment. It is including the ligamentous attachment as part of a particular continuity: an entire architecture that does not separate the ligamentous attachment, which remains inherent to the integrity of the whole structure. It is a contextual change which impacts *how we view* the content.

Accusing an anatomist (or several generations of them) of designing anatomy instead of revealing it rocked a very big boat. If every animal on the planet is a fascial matrix, not a mechanical construction, then Borelli's *De Motu Animalium* (Ch. 2) would need to be rewritten in fascial webs and tensional matrices, a notion that would have its author turning in his grave. The fact remains that Dr van der Wal was revealing the body as it is, inclusive of all that is in the anatomy books but in full-bodied three-dimensional architecture with its substrate intact. He showed it how it is before it is cut, with the "white stuff" in place.

Actually, this is Progress with a capital "P". Of course it is invaluable for surgeons and anatomists to be able to name tiny sections of our anatomy and place them on the map of the body. However, it transforms our application of living anatomy and physiology in motion to know that the territory is all one piece. Whatever names you give the anatomical and subanatomical details, the transanatomical architecture is unified *at the same time*. We are a unity walking around with named parts, not distinct parts longing for unity.

Dr van der Wal suggests that, with the exception of very few (approximately six) specific "true ligaments" in the body that only connect bone to bone, our joints actually form continuous "dynamic ligaments", where muscle and connective structures do not only function in parallel with each other but where muscle and connective tissue are also organized *in series*. This echoes the early nineteenth century work of John Godman, who invited his students to observe a subject of study without engaging preconceived ideas of systems. Their point of view was the key (Ch. 2).

More than a century and a half later, Van der Wal coined the term "dynament" as an inclusive name that better represents the muscle–tendon–bone–ligament *relationship* from a functional point of view. He derived this concept from the embryo, in which one could also state that muscle tissue is a dynamic specialisation (Ch. 5): "*a 'synovial joint' is a contradiction in terms. It is not a joint. It is a disjoint. Here connective tissue (cartilage) enables space and therefore motion*" (Jaap van der Wal).[9]

He went on to point out that the nature of the tissue itself made it far more than a connector. It formed "*a proprioceptive substrate*", a kind of "intelligent lining" around the joint that can feel itself. It knows where it is in space via the tensional network. With a distribution of mechanoreceptors in the tissue (they might be said to act something like antennae), it makes the fabric of our sensory organism and the organising matrix the same (Ch. 9). It shifts our perspective to recognising the exquisite detail of the proprioceptive sense.

The proprioceptive substrate means that the actual tissue we are discussing is sensitive to where the joint is, what angle it is moving through relative to our position and what organisation or particular movement it might be "activating" in space. That is, the cellular make-up (histology) of that tissue is highly innervated, under tension. This points to particular sensitivity in monitoring movement and organisation. So the body uses its own building material to check out where it is all the time in relationship to everything else. It also suggests it responds to that information from within the tissues: "*the branch offices of the brain*".[10]

Figure 3.4

These poses all require tensional integrity of the system at all angles through the elbow throughout the posture, whether during preparation, execution, completion or release. Whichever yogic style, tissue integrity is required through the organisation of the muscles and the bones at the joints throughout the body. Images with kind permission of Katie Courts.

This makes sense of the yoga postures and our ability to do them and make tiny adjustments in order to sustain a pose. The postures explore range, balance and coordination at multiple angles and directions, from detailed, subtle changes to gross ones. A demonstrable theory that sees this detail as part of one whole organisation makes obvious sense. One suggesting versatility, adaptability and flexibility with the integrity of the joints in tensional balance at all angles is akin to the practice of yoga itself (Fig. 3.4). This does not mean there is no need to learn your anatomy. It does mean that you should recognise it as a (topographical) map within a continuous territory that senses itself in space and in response to gravity, continuously: "*read in your anatomy the neglected story between the lines; that is the continuity*".[11]

Living Architecture

Van der Wal's work was not publicly presented until the Second International Fascia Research Congress in Amsterdam two decades later (in 2009). It has been part of a momentous change in focus over the last ten years. During this time, a hand surgeon in France, Dr Jean-Claude Guimberteau, has made further progress, confirming the continuity of the tissue, this time by making it possible to view it within the living body.

Using the endoscopic tools of the most advanced science to unravel the deeper questions of a tendon's ability to slide, Dr Guimberteau and his team of surgeons and researchers produced a *revelatory* movie called *Strolling under the Skin*, which was followed by *Muscle Attitudes* and then *Interior Architectures*.[12]

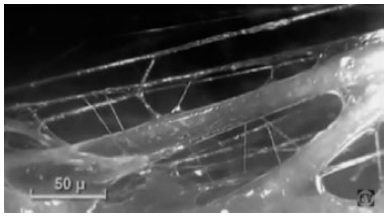

Figure 3.5

This image shows the our transanatomical architecture, found under the skin throughout the body. It is taken from *Strolling Under the Skin* a DVD by Dr Jean-Claude Guimberteau, http://www.guimberteau-jc-md.com/en/

Guimberteau has transformed our view of the fascial matrix through his exceptional work in hand surgery and most particularly tendon transplants.[13] He discovered internal mobility and characteristics at the different levels of tissues under the skin that challenged many of the theoretical notions about movement of tendons and their ability to slide. With the use of the endoscopic camera during surgery, he was able to view living tissues. His films of what happens under the skin, throughout the muscle and in and around joints show the fibrous webbing of the fascial matrix everywhere (Fig. 3.5). This permits movement between structures, so that tendons in the hand can move independently of blood vessels, for example, just as you felt them move in your own hand in the earlier exercise. They always return to their original position via the fabric and the architectural design of the fascia. His work has changed the view of sliding structures in the body and recognises a deep shift in understanding internal motion and motility (i.e., internal movement of the organs, what we might call biomotion).

The three principles of movement and restoration (Ch. 8) are based on how formation, deformation and reformation are happening constantly in what appears as fractal chaos under the skin. The connections of the soft tissues directly beneath the surface (that you felt sliding under your hand) softly break and reform in a diaphanous dance of the fluid fibrillar matrix. The apparent chaos contains an order of its own, throughout the living system. Here we find, as ever, perfect paradox. In a way, we discover the Vitruvian principles of architecture: “Firmitas, utilitas, venustas”, that is, formation and deformation to usefully perform and then reform to the original integrity, once the task or movement is complete. It is fit for purpose – your purpose at the time – and it is very beautiful.

Form, Deform, Reform

This subject is of huge interest to a yoga practitioner, particularly when we look in Part 2 at how important it is to execute pose and counterpose within a session. At the simplest level of observation, if we move from a Downward Dog (Urdhva Mukha Svanasana) (flexion) through Forward Lunge into Half Moon (Ardha Chandrasana) (extension), we rely upon the body’s ability *as a whole structure* to slide internally, at all the joints, in order to carry out the poses with grace and poise (Figs 3.6–3.8). There need not be anything disjointed or fragmented about the effort *or the transition* once we have practised and mastered the sequence. Many meters of tubing, vessels and internal structures have to glide fluently with the movements and change with our intention to carry out the asana sequence. We also have to organise these movements, and the balance between tension and compression, through *containment*. It is at once beautifully simple and innately complex; in Vitruvian terms that would be a divine paradox.

We know the body can and will do this “deform–reform” or “disorganise and reorganise”, always returning to a state of equilibrium, if it can, to the neutral field. This aspect of internal sliding is happily taken for granted. It is when tissue does not slide that we notice it. “Sticky” tissue (a kinaesthetic term) can have micro-tears, dehydration, inflammation or adhesion, and it is when we cannot do something easily that it becomes an issue. We do not generally expect our students standing in Eagle Pose (Garudasana) to get locked in that position to one side and not be able to do the other side because the body cannot translate the movements. We take it for granted that to the extent we can do a pose, we can undo it (Fig. 3.9).

Figure 3.6
From Downward Dog (Urdhva Mukha Svanasana) to transition into a Forward Lunge as part of a flow of movements, the whole body adapts to accomplish the sequence.

Figure 3.7
Forward Lunge (flexion) into Half Moon (Ardha Chandrasana) (extension).

Figure 3.8
From a Forward Lunge posture, it is an effortless glide into Half Moon Pose (Ardha Chandrasana) once we have mastered the transition.

Figure 3.9

Even in the yoga forms that require a posture to be held for long minutes we know the extent to which we can do it and are able to undo it. There is a system taking care of that ability and it is not the muscles alone. They are just part of an orchestra of architecturally organised tissues. What holds them together and to each other, what holds them apart and relates them to everything else makes a huge difference to their

ability to make such changes and reverse a pose. Transition is fundamental and it is about the instinctive function of the whole structure and the structure of the organising architecture. The tissues are not separate on a mat. The need for them to glide over each other and remain contained overall is primary.

This approach changes the foundations of study of the so-called musculoskeletal system and the physiology of muscle, of sensory communication of force transmission and of movement management. We will consider the sensory communication and the biomechanics in more detail later. For now, let us explore the musculoskeletal aspect in a little more detail.

Classical Anatomy View

Figure 3.10

A classic classroom skeleton, artfully used here by Justin to playfully demonstrate the Anatomy Trains® Lateral Line to his peers at the Art of Contemporary Yoga teacher training. He was demonstrating continuity of tissue vs. an apparently disconnected (but invisibly wired) model.

The classic basic skeleton used in schools is a traditional teaching tool in many yoga classrooms and certainly in the study of anatomy and physiology (Fig. 3.10). It is designed to demonstrate the approximately 206 bones of the adult human body, the bony landmarks on the living body, and how the spine is organised. It is also there for you to learn the attachment sites of muscles. In short, it provides the basics of the axial (excluding girdles and limbs) and appendicular (girdles and limbs) skeleton.

Looking at this particular configuration of the bones, we have no need to consider the connecting wires without which we would be looking at a pile of rods and knuckles on the table. What is holding the whole thing up, or together, or suspended? (That is apart from wires and a pole where the spinal cord should be in most classroom models!)

We must not think about that too literally because of course we “know” that what is missing from this model is the muscles. We have stripped the skeleton so that we can learn where the muscles attach to the bones and work out how they move them. We assume that movement would be available if the muscles were holding the limb-bones together and able to do their antagonistic “pair dance” which would then set those bones in motion at these various joints. That is, of course, according to the actions traditionally assigned to those muscle components of the locomotor system via the nervous system. (Jaap van der Wal taught his students about a “posturing and *locomoting* system” rather than talking about locomotion or the locomotor system as such. It is a distinction that makes sense in yoga.)

Traditionally then, once we learn the bones, we can go on to work out the origin and insertion points (proximal and distal attachments) of the approximately 600 muscles attached to them. We then learn their individual actions, according to the charts. Then we have to group them into suites, such as the rotator cuff muscles or the quadriceps, as we seek to link the anatomy-of-the-parts into an organised system of functions.

Figure 3.11
This is a common style of schematic, showing clean red muscles (the biceps and triceps brachii in this example) attached to clearly defined bones, touching each other at specific points. The whiter bits indicate the tendons. This is an artefact of dissection.

Figure 3.11 shows one such typical presentation of the muscles. Muscles are often shown as working in antagonistic pairs, as here in the upper arm, demonstrating the relationship between the triceps and biceps brachii muscles. They are presented as lovely clean red features, with clear separated tendons attaching to the bones. This is typical of the vast majority of anatomy teaching manuals. Muscles contract, therefore, when the biceps contract they stretch the triceps, and vice versa. This explains a lever, which is a two-bar open chain mechanical device. (This actually means it explains how it might move if someone else was moving it.) All this is displayed in tables, showing how each muscle functions according to its specific connections to the bony framework, via the actions assigned to it from the nervous system. So, in summary, from the schematics, we would learn something like the information shown in Figures 3.12 and 3.13.

Latin	*musculus triceps brachii*
Gray's	(Subject reference)
Origin	**Long head**: infraglenoid tubercle of scapula **Lateral head**: above the radial sulcus **Medial head**: below the radial sulcus
Insertion	Olecranon process of ulna
Artery	Deep brachial artery (Profunda brachii)
Nerve	Radial nerve and axillary nerve (long head)
Actions	Extends forearm. Long head extends shoulder
Antagonist	Biceps brachii muscle

Figure 3.12
A table adapted from typical example in Wikipedia.

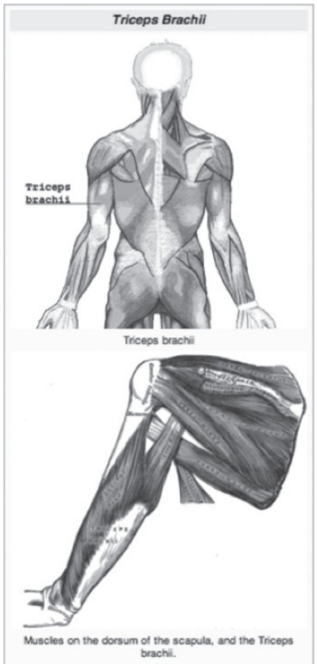

Figure 3.13
Again, this is typical of what you would expect to find in traditional sources of information about the muscles. This image is from *Grays Anatomy* via Wikipedia.

In some resources a cross-section of a real cadaver is included to endorse the positioning of these muscles within the arm. As soon as you see the image of a cross-section such as the one shown in Figure 3.14, it begs one serious question for the schematic representation, namely, which bit in this cross-section is not attached?

Continuous Anatomy

Nothing in the living body is like Fig. 3.11, ever. Moreover, the "white stuff" actually runs through the entire muscle on every scale and wraps the bones in a continuum of tissue. We use our musculoskeletal system in life as it exists before dissection, not as shown in schematics. We "know" this, but how do we interpret the difference if all we are taught suggests the muscles are clear, separate units?

From skin to bone marrow in Figure 3.14 appears to be continuous and cross-section after cross-section is the same, however finely they are sliced. In a human dissection programme[14] it takes literally hours to dissect a single muscle. You might be forgiven for thinking (from the schematics) that you would be able to just “unhook” a muscle at its origin and insertion points and lift it away from the skeleton. However, the first thing that would strike you in the anatomy laboratory is that these points and separations are not obvious or separate from their surroundings in the body. They have to be taken out of that original context, the one in which they reside. Origins and insertions, if you leave the soft tissue respectfully where it belongs, look more like continuous attachments, with densifications. The densifications form more continuous attachments and so it goes on. Nothing is entirely separate or separable from the whole. That is just as it appears in any cross-section of the limb. As ever, it depends how you look and what you are looking for.

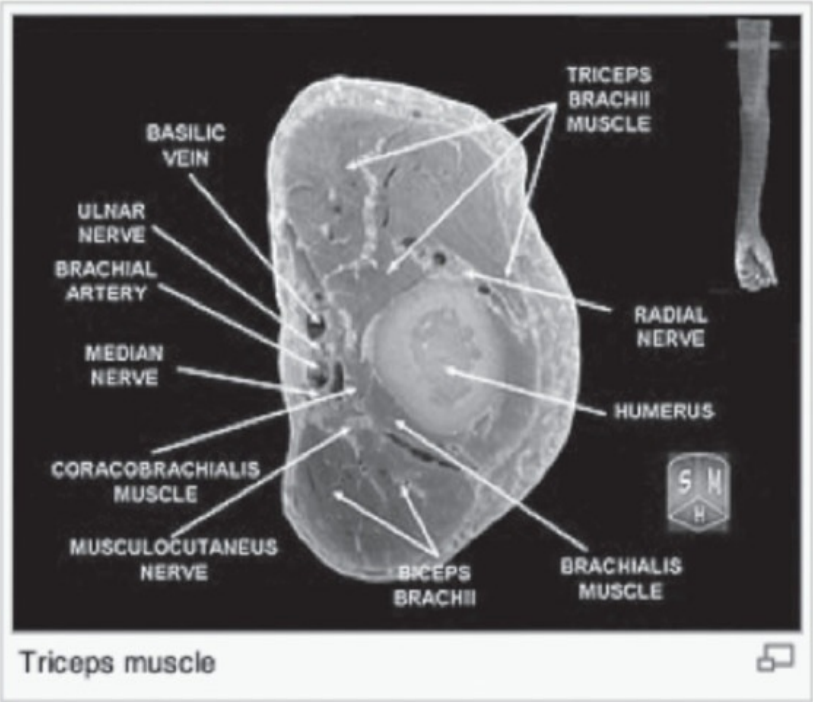

Figure 3.14
Cross-section of the upper arm showing triceps muscle. This is what you would expect to find in traditional sources of information; this image is from Wikipedia.

The Paradigm Shift

"The simple questions discussed in musculoskeletal textbooks 'which muscles' are participating in a particular movement thus becomes almost obsolete. Muscles are not functional units, no matter how common this misconception may be. Rather, most muscular movements are generated by many individual motor units, which are distributed over some portions of one muscle, plus other portions of other muscles. The tensional forces of these motor units are then transmitted to a complex network of fascial sheets, bags and strings that convert them into the final body movement."[15]

> Recent research, as a whole, moves us very far from seeing the body as a series of stacked bony blocks with two hanging appendages (arms) and two supporting appendages (legs), balancing the axial stack (spine, torso and head) in a compression structure. That foundational shift then influences how we see muscles as the contractors, working in pairs or groups, to lift and change the angles of those stacked bones. This in turn changes how we interpret biomechanical movement and challenges the lever system and the pendulum explanation (upright inverted or otherwise) that is often used as a metaphor to explain the walking gait of the bipedal human.

What is being revealed, at the most fundamental level, is that the connecting wires we pretend are not there in the classroom skeleton are the *only* reason that the bones stand up. It becomes a crucial omission in the light of this complete change of context. Furthermore, the muscles are not connected to the bones other than via this fascial interface. It contains them, integrates and interconnects them all, as well as distinguishing them from each other.

This challenges our attachment to many classical concepts of anatomy, physiology and biomechanics and urges us to evolve them. If those concepts rely upon the idea that individual muscles have assigned actions, the discovery that they do not work that way re-organises notions upon which many long accepted movement theories are based.

Figure 3.15
Cross-section of an orange.

To give you a simple way to see this anatomical continuity, Figure 3.15 shows how an orange looks in cross-section. Figure 3.16 is how it looks along the lengths of the segments. The hydration of the fruit has a lot to do with how its "soft tissue" behaves, how plump it is and how tightly interwoven the segments are. If you can separate them carefully you will see each one is surrounded, contained in its own bag-within-a-bag, from one end to the other. Nowhere in any cross-section are they separate.

Within each segment are the juice droplets. They too reside in a chamber of very much finer connecting tissues than that of the segment, which is finer than that of the pith, between the skin and the body of the whole fruit. Chambers, within chambers, within chambers is a forming principle in nature that we see recapitulated everywhere, including our own biology (Ch. 5).

Figure 3.17 shows how this works as a model for soft tissue formation.

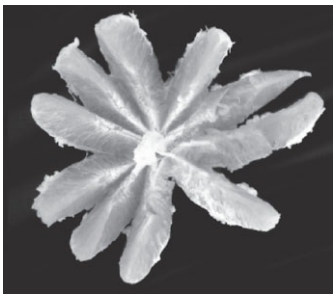

Figure 3.16
This is the three-dimensional view of an orange cross-section; bearing little or no resemblance to the two-dimensional version. Notably each segment has its own layers, thus making the lines between the segments in the cross-section (Fig. 3.15) very fine *double* layers. Note each droplet of juice also has its own finer "bag" of thin connective tissue material.

What is even more striking in a human dissection laboratory is that besides everything being connected longitudinally, no two cadavers are quite the same. As noted (Ch. 4), biological systems honour the laws of biological self-assembly.[16] In the case of oranges, while the majority have the same overall format, you are unlikely to find an orange grove full of identical fruit. When you open them you may sometimes find there are extra little segments where their soft tissue divided them slightly differently to a sibling on the same tree. They may all be in the same family but (thank heaven) they are all slightly different.

We humans are not machines. We do not do straight lines, flat surfaces or exact symmetry anywhere in the body and no two of us are exactly the same. We might be very similar, but that is as near identical as we get. Take a long look in the mirror, then look at everyone else. It goes without saying that every Dog Pose, performed in the yoga classroom, is unique.

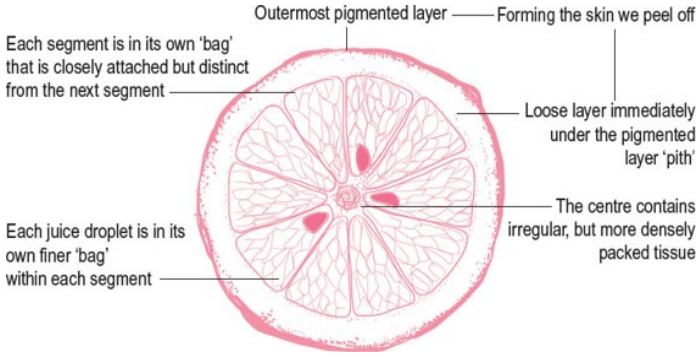

Figure 3.17

The form of the soft tissue in the orange provides a metaphor for the containment of fluids, in fascia of different densities and regularity, as a continuous architecture. Just as the segments are all attached along their lengths, so too are muscles. As the juice droplets are all closely packed in their particular organisation with the segments, so too are muscle fibres within the muscles.

New Views

Like the orange, you too are different. Tubes, pockets and pouches form in similar but by no means identical patterns and muscles show considerable variation. Our faces do not appear the same on the outside and nor do our cavities, organs and vessels on the inside. Genetic modification may be useful for food companies to ensure they can package standard bags of oranges that all look the same and can be measured by machines. However, notwithstanding the fact that you can taste the difference, it lulls us into a false sense of identikit.

Human beings discovered and designed the laws of science; we were not designed by science. We are not the product of some evolutionary historical genetic modification programme. We have far too many dreams and aspirations of our own to be in anything less than a co-creative dance with life itself. This is common sense, and finding out that the connective tissue of the human form is common to everyone, everywhere in every body (invariably expressed uniquely) is a paradox that is transforming science.

The discovery that the fascia is among the largest sensory organs of the body[17] (Ch. 9) makes it literally and symbolically our common sensory organ. We did not invent this important connective tissue; we overlooked it. We woke up to seeing it. The hard part is restructuring what we make it mean (given what we *have* made it mean historically) in terms of how each one of us moves as a whole being.

This change in viewpoint is reminiscent of the change in perspective that came about with the artistic movement known as Cubism. The Renaissance had moved the visual perspective of an artist from two to three dimensions, including a natural environment in perspective. The Cubists, however, painted the spaces between and around things: that which gave them their three-dimensional definition or boundaries. They represented form, shapes and movements by what they were *not*. Shapes were essentially revealed by negative space, or the surrounding environment. This will become important in Part 2 because we actually rely on just that when we assess form in a classroom. In fact, it is a useful way to "realise" the fascial matrix invested through muscle.

"Peri" means outer, "os" means bone, "myo" is muscle, so periosteum is the tissue around the bone and perimysium is the tissue around the muscle. "Epi" means on or around, so epimysium is what you can see around the muscle fibres and bundles, within the perimysium. "Endo" means inner, and the endomysium, which is not visible to the human eye, is right inside the muscle fibrils as the gossamer webbing within the gossamer webbing. It forms an inner matrix, but not separate from any other layer.

If we look at Figures 3.18 and 3.19 we can see that if we take the structure of a muscle and switch how it is drawn, we get the "negative spaces". What you see defined in black in Figure 3.19 are the different

layers of the fascia: the perimysium, epimysium and endomysium, depending on which layer you are referring to. The point is that they are all connected, all the time. It is a continuous web throughout the muscle (literally everywhere), like the orange segment. It is a model that works throughout nature, making sense of movement, as we will go on to explore.

Endomysium (Fig. 3.20) looks like a loofah brush, although be careful if you use that particular analogy because a loofah is dry and stiff, whereas healthy living human connective tissue resides in and contains a vital fluid medium (Ch. 10) and is held under tension (Ch. 4).

"as to the periosteum, the situation is even more clear; Bones are not 'passively' enveloped by a periosteum. The periosteum is the skeletal element itself that deposited the hard osseous tissue and serves the insertion of muscle and connective tissue. It mediates."[18]

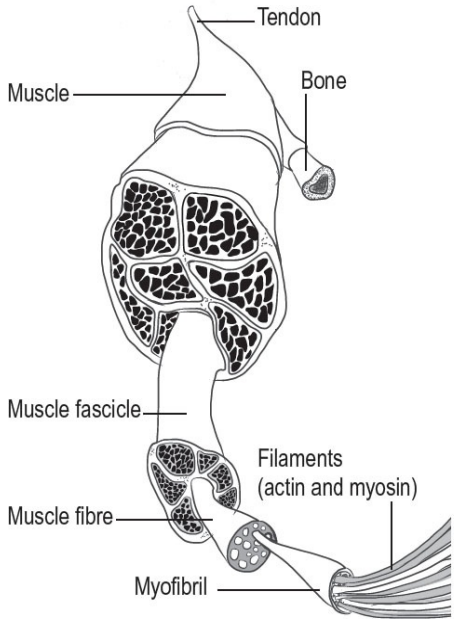

Figure 3.18
This is how a muscle is usually shown in an exploded diagram schematic on the physiology of muscles.

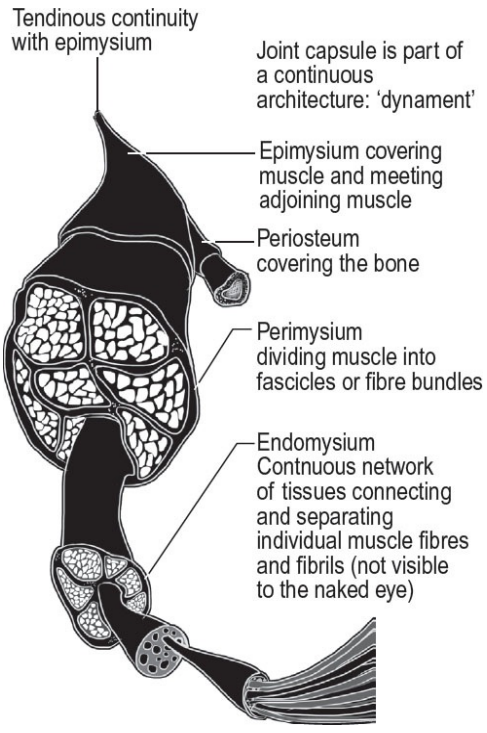

Figure 3.19

The same drawing as shown in Figure 3.18 has been used to highlight the fascia of the inner (endomysium), intermediate (epipysium) and outer (perimysium) fascial sheaths.

New View – Same Architecture

The difficult thing to grasp is that, in a way, nothing has actually changed, only the point of view from which we are looking at and analysing the body and the context of how it is presented and learned. We can call this new way of seeing the science of body architecture, to distinguish it from the old way of seeing. It is revealing what was always there, off the plan or side elevation on the drawing board, and showing it full blown into three-dimensional animated life.

Of course, the new science of body architecture is not restricted to muscles and bones but includes the tissue network surrounding and containing the spaces of the body. This is the "extracellular matrix". Everything in the body resides in it. It is the "stuff" that the vessels, organs, glands, bones and muscles are dissected out of. It is our internal context in which the cells move and manage, the environment within which the internal net sustains and contains itself (see Ch. 10 for more detail).

There is at the present time much discussion about what fascia is where and the different types of fasciae and their relative roles and collagen types. However, the question of detailed terminology remains a subject of debate around how exactly all these types are differentiated into named parts of the entire fascial matrix or tensional network. The fascia itself presents a profound difficulty when it comes to naming its parts since it is essentially ubiquitous and continuous. That is the point. Moreover, to some extent we express it uniquely according to use, so, although we have a general pattern within the species, we are working with asymmetries and biologic similarities rather than rigid geometries or machines. In other words, you do it your way and I do it mine. We can share the idea, we can even recreate the process and make new patterns and synchronise and mimic each other, but we are never identical. You already know that in a class we may all do the same pose but no two will be identical. The science begins to confirm why that might be so.

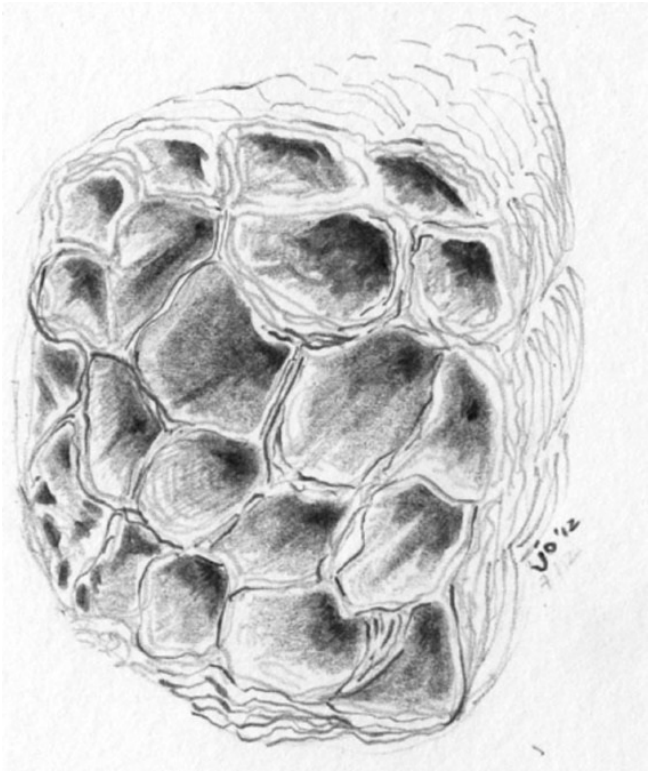

Figure 3.20

This drawing is taken from a photograph of an electromyographic image of the endomysium once the myofibrils have been removed. The endomysium is the deepest layer and cannot be seen with the naked eye. The image shows the long hollow spaces where the myofibrils were and reveals the continuity of the architecture in which they reside. It has a slightly randomly shaped honeycomb structure and clearly acts as a part of the communication and coordination faculty of what is commonly called the "musculoskeletal system". In the living body it is completely continuous with the epimysium, perimysium, loose connective tissue and skin.

What this comes down to in general terms for our teaching is that we cannot usefully separate structure from function because they are not separate. You move and create form as you form shapes by moving. We need to keep an overall sense of the whole as movement teachers, and as yoga teachers we sit at a huge advantage. We are trained in shapes, sensory awareness and kinaesthetic attention.

Much of this information was presented at the first International Fascia Research Congress, in 2007, resulting from the work of pioneers since Andrew Taylor Still and including many curious and committed scientists, clinicians, surgeons, anatomists and bodywork professionals in all fields who constitute our modern day philosophers, with a portfolio of ideas between them. Together, in a collaborative network of communication and scientific research, artistically presented, the Fascia Congress is moving towards its fourth worldwide exhibition at the time of writing. This will take place in 2015. Further information and details of the network of dedicated individuals in every field that come together, from all over the globe, to bring this work to the rest of the world can be found at www.fasciaresearch.com and www.fasciaresearchsociety.org. They are too numerous to reference individually and no doubt some will challenge specific details here. However, if this does no more than shed light on the *need* to reconsider anatomy, biomechanics and physiology, and endorse the whole body that yoga is devoted to, it will have ignited curiosity and, therefore, been worthwhile.

When it comes to reading shapes and postures, we need to be able to stand back. We learn to read shadows at the speed of movement and get a sense of how each participant in our classes uses their *whole body*. This is the basis of Part 2, but first we have to consider the whole and how it moves.

We can learn to see from a different point of view that does not involve mentally dissecting someone in motion, or reducing their movements to a system of levers or single/paired muscle functions. There are three reasons for this:

- You do not have time in a movement classroom.
- That is not how we move.
- What you move and *what you don't move*, in order to make "a move" are of equal significance in terms of co-ordination and balance.

Everyone you teach already has organised body architecture. They come to you to assist in refining and optimising how they move it, in the context of the particular style of yoga you teach. Once the overall architectural principles are understood, common to every cell, muscle, organ and the whole organism, the pieces begin to fall into place, literally and metaphorically held together by our tissues.

We have to go back to the beginning to ask the embryo (your embryonic origins) how it formed (how you formed your self). Then, in the light of fascia research, we begin to see how the whole formation remained whole throughout life. This allows us to understand our architecture as a self-contained, self-organising system of something called biotensegrity. We will give this some chapters of its own because it upgrades our understanding of the soft vehicle we live in, to a three-dimensional integrated whole that actually moves independently of gravity and in very intelligent ways.

Yoga could be said to already understand many of these "new" aspects of the science instinctively, by incorporating them into its ancient and holistic practices, much like many of the martial arts. We have to go a little deeper, however, to confirm why the kinaesthetic intelligence we explore on the mat is so multifaceted. This is vital, otherwise we risk segregating and fracturing yoga with reductionist principles, and there is no need to do that.

Yoga is a beautiful medium in which to demonstrate this work because it works this way in practice, demonstrably.

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3. Jaap van der Wal, personal communication, July 2013.
4. "Fascia is formed by undulated collagen fibres and elastic fibres arranged in distinct layers, and within each layer the fibres are aligned in a different direction", Luigi Stecco, Facial Manipulation® (http://www.fascialmanipulation.com/en/about-fascial-manipulation.aspx?lang=en).
5. The relatively new field of Soft Robotics is using the principles of Biotensegrity (Ch. 4) to create a new generation of robots. Vytas SunSpiral (Thomas Willeke to 2005) is a computer scientist and roboticist at NASA who has shared many fruitful discussions and collaborations over the years with Tom Flemons. His website is http://www.magicalrobot.org/BeingHuman/.
6. Jaap van der Wal, personal communication, July 2013.
7. Jaap van der Wal, "The Architecture of the Collagenous Connective Tissue in the Musculoskeletal System – An often overlooked Functional Parameter as to Proprioception in the Locomotor System". This article is published as supplement to a lecture at the Second International Fascia Research Congress, Amsterdam, 27–30 October 2009, with the title "The Architecture of Connective Tissue as a Functional Substrate for Proprioception in the Locomotor System". (Jaap van der Wal MD PhD, University of Maastricht, Faculty of Health, Medicine and Life Sciences, Department of Anatomy and Embryology, P.O. Box 616, 6200 MD Maastricht, Netherlands.) It includes a revised version of part of Van der Wal's doctoral thesis, submitted to the University of Maastricht in 1988, entitled "The Organization of the Substrate of Proprioception in the Elbow Region of the Rat".
8. Jaap van der Wal, private communication, July 2013.
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13. Ibid.
14. The author would like to express profound and reverent gratitude to all donors.
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16. Donald Ingber, "The Architecture of Life", Scientific American, Feature Article, January 1998.
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CHAPTER
4

Biotensegrity Structures

"That nature applies common assembly rules is implied by the recurrence, at scales from the molecular to the macroscopic, of certain patterns, such as spirals, pentagons and triangulated forms. These patterns appear in structures ranging from highly regular crystals to relatively irregular proteins and in organisms as diverse as viruses, plankton and humans."[1]

Donald Ingber

A biotensegrity structure is triangulated (see later). It occupies and encloses space in particular ways. There are three aspects of innate force transmission acting in three dimensions on the whole structure. It is not just triangulated geometrically. It occupies three dimensions and it integrates multiple means of force management simultaneously. For example, on the scale of the "musculoskeletal system", the bony part can be tensioned to some extent, *and* the bony part can withstand compression to a much greater extent, *and* the fabric part is the main tensioning and, importantly, *tensioned* aspect. *However, it does not respond well to compression; the tensional part tends to fold under compression forces.* There are different qualities to all the different fascial membranes but in concert they can orchestrate multidirectional movement and appropriate response to a variety of dynamic stresses, by the principles of this model. They allow the continuous signalling of forces to be transmitted throughout the structure. Thus our soft parts can fold and then unfold, to restore their shape appropriately. The bones, being stiffened, act like spacers. They withstand compression of the tensioned layers around them. At the same time, they push or stretch those layers of the body suit *into* tension. Meanwhile, the whole myofascial aspect pulls the bones together into compression but (here is the part that is hard to grasp) they are organised regionally in the body in concert with the dynaments (dynamic-ligaments[4]) such that they also pull the bones apart from each other at the same time. This is clearer from the global pattern of muscles and bones in their connective tissue substrate. It is hidden when they are removed from their living context. It supports van der Wal's findings (Ch. 3) that a joint is under tension at all angles.

The word "biotensegrity" is a shortening of "biological tensile integrity". It refers to a type of tensional, three-dimensional structure that is formed under tension and compression. The "bio" part means "living" and the suggestion is that it provides a compelling metaphor for how we are formed and move around as a living architecture. It is a challenging idea.

A spider's web, for example, is a tensional structure and can be said to have "tensile integrity". However, it is not a tensegrity structure as such, because it requires an external frame. "Tensegrities are different – their forms are self-stabilized, independent of gravity and need no external support" (Tom Flemons[2]). Our ability to walk around and do yoga on one leg or balance on our heads is, in part, explained by these architectural principles. We carry our frame around with us, but it lives on the inside. Our tissues are tensioned around that frame (as they tension the frame in a reciprocal way) such that we qualify as tensegrity structures.

What does that mean?

"Biotensegrity" is the term coined by Dr Stephen Levin to describe biologic structures such as we are. What it means is that our forms are self-stabilising, they are independent of gravity and we need no

external support. We use the ground, but when we jump or dive or tilt, for example, we do not deflate, or collapse, or fall over or apart as a house would if there was, for even a single moment, no ground underneath it. Our form, unlike a house, is not a purely compression structure. We are quintessentially made of soft tissues, some relatively harder than others, some fluid and some soft, but all joined together, contained and organised by an essentially *tensional* network. Many traditional biomechanical models suggest we are constructed under linear rules that apply to compression structures. Biotensegrity offers a global model that possibly explains how we naturally organise all the elements of our moving "body architecture", in all its roundness, volume and detail, as a whole animated body contained in (and containing) an intricate fascial matrix. Significantly, it is the *relationship between* tension and compression that is so crucial to understand. It is worth exploring.

Biotensegrity: Tension and Compression Together

In a biotensegrity structure there is a *continuous* tension network in which *discontinuous* compression elements are suspended. The compression struts do not touch each other. This is the first challenge to notions derived from general anatomy books. Our bones do not touch each other and, according to Levin, the cartilage lining our joints in *the living body* is not tough and strong, such as we might imagine from the knuckle on a chicken bone (by the time we see it to get that impression, that knuckle is dead or cooked, which makes it hard). The cartilage in the living form is more like the texture of a boiled egg-white. In a healthy body it is hydrated and intimately organised in the joint it is part of. It is not fundamentally designed to withstand direct compression forces as the cement between the bricks in the walls of a house does.

Unlike the drawings in many books, where the bones appear to overlap, in healthy organisation our bones act something like spacers in the network of our tensional body suit. Their action is not simply explained by levers as if they were overlapped or hinged like a mechanical joint as they can appear in many representations. If you think about it, it is rare that we actually move our limbs or joints in one plane as if they were levers. Indeed, on the yoga mat, we do things that would permanently twist or break a form designed by the linear logic that some of the mechanical theories we are more familiar with might suggest.

Our dynamic arrangement is a tensional organisation in which the joints are perhaps more aptly described as "floating fulcrums".[3] The intricate geometry of the whole form is organised so that the tensional and compressional forces press and pull each other *simultaneously* all the time. This intimate relationship means the compression part contributes to and elaborates the tensional aspect, which reciprocally compresses the compression part. They work in complementary (if apparently opposing) forces. Their combination is the key to understanding biotensegrity.

In its entirety and continuity, such an architectural design is resilient, and it can rapidly transmit and distribute forces to all parts of the structure. It is a relatively economical and lightweight design of a structured volume-in-space that can independently move and withstand dynamic stress while balancing multiple forces. It is an elegant model that makes a great deal of sense, despite the complexities of its finer detail.

Living Architecture

Once the overall principles are understood, biotensegrity can be readily seen as a means by which many living things successfully manage their architectural ability to defy gravity, that is, moment by moment,

from the inside out and the outside in, through multiple angles in space and in real time.

All living things, from flowers to vertebrates, share this fundamental ability to oppose the gravitational forces pulling them towards the centre of the earth. This is achieved throughout our volume in space. It is not just as opposite ends of a "push-me-pull-me" or "a pressing down and pushing up" line. It is the whole of our structure, the "all of us" that we explore in yoga on the mat. How, in the techniques of the postures, can we hold positions at all sorts of angles and still restore our shape? How do we do that so rapidly throughout a practice?

The general logic behind biotensegrity is appealing, if we let go of the concept of individual muscle units moving local joints in isolation (Ch. 9).

Despite its appeal and elegance, by comparison with many traditional, long-held concepts of levers and fulcrums, biotensegrity is an emerging theory. It is an inspiring perspective on how we do yoga. It is also being adopted in the relatively new field of soft robots[6] and research is gradually developing in prosthetics as interest and understanding grow. Until there has been further research, however, in strict scientific terms, biotensegrity is something of an extended metaphor in this context.

We will go on to see that biotensegrity offers some compelling explanations in answer to that and many other questions. It applies to the wholeness of our cells and organs. It scales up to include how we contain the organisms that are our bodies, as we move them around in their entirety. It challenges the premises upon which many classical biomechanical theories are based.

"*Levers and fulcrums describe idealised Platonic conditions that exist in fixed structures.*"[5] We are not fixed structures; rather we are nonlinear biologic structures that move around and manage dynamic forces constantly and with relative ease. We are self-motivated, without necessarily thinking about it.

Theories of simple levers are clearly not sufficient to account for all that we can learn to do and make possible in a yoga practice. Nor are they easily expanded into symbolic aspects beyond the classroom, where tension–compression recapitulates the positive–negative, attract–repel forces we come across on every level of our awareness.

What Tom Flemons terms "a comprehensive theory" has yet to show in precise detail exactly how biotensegrity translates the forces through the joints. It is compelling nonetheless, with clear evidence on a micro scale, as we will see. Flemons offers elegant explanations for such a theory[7] and adds:
"it is clearly a more comprehensive account of how living structure operates on all micro-scales but to describe macro structural anatomy in biotensegrity terms requires a leap in analysis that hasn't been achieved yet. … The most we can say about the joints in our body is that they are floating fulcrums which forces percolate through. If muscles and tendons are acting like levers, they are not simple levers [see Ch. 7] *because the fascial net which wraps everything transmits forces across the joints as well."*[8]

Such polarities are symbolised everywhere in yoga by the more metaphysical aspects of the practice (see Part 3). Philosophically, levers represent linear and intellectual thinking. Yoga includes and moves beyond the restrictions that kind of thinking can impose. (We *can* move as if we had levered joints, but we rarely do; it is hardly natural.) What is so welcome is an evolving perspective such as biotensegrity, that accounts for body, mind and being in a united, congruent whole, beyond the sum of the parts. If the fascial matrix provides the weave of our fabric, the biotensegrity might describe the form as volume that allows it to move around, all joined together and appropriately organised. According to Kenneth Snelson, weaving is the "mother of tensegrity". Tensegrity provides the opportunity for a (woven) fabric (area) to contain and occupy space (as a volume), given the *spacers* – the floating compression members. This, in

the vertebrate body, is represented by the bones of the skeleton and the particular ways in which they hold the soft tissues apart, while being held together by them.

The essence of the research into the fascial matrix is that it is changing the nature of enquiry into how we move. This is permitting a new light of curiosity to shine on many historically accepted theories. Let us look into biotensegrity to see how it presents such a powerful metaphor in yoga.

How Biotensegrity Came About

People often refer to Newton as if he invented gravity. If this were so then Kenneth Snelson (see Margin note, below) would be responsible for creating an art form called "floating compression", the genesis of this concept of tensional integrity, or tensegrity. In truth, as Caroline Myss points out,[9] the force of gravity existed long before any theories emerged. Newton's genius was to animate and apply the idea, recognising it as a natural law. Just as apples have been falling out of trees for many centuries, tensional integrity, as a principle of living architecture, has been the basis of all things growing and moving in the earth's gravitational field since long before the dinosaurs. We simply did not recognise it.

Yoga seeks to bring intellectual knowledge into being, realising it as a physical wisdom translated into the body's own experience. A beautiful sequence of Vinyasa Flow Yoga, for example, does not benefit from reductionist theory. Biotensegrity, however, offers a kinaesthetic appreciation of form that makes absolute sense of every twist, turn and breath of a flowing sequence or a slow series of held poses and the balancing act they incorporate. It makes sense of what actually happens in class. Biotensegrity seems to be so much more than a model. It offers a context that illuminates a much fuller realisation of form and functional movement on every scale and throughout nature.

Levin discusses the principle of biotensegrity in terms of spinal mechanics and shoulder movement in specific detail (see notes).

What Newton did was to *animate* the distinction of gravity as a governing physical law. This allowed him to apply its logic universally. He was able to ignite the discovery of this existing principle of forces, to make it mean something in many fields of endeavour and generate its power as a law of nature on every scale. In his day, Newton had to prove the merit of his discovery mathematically and by careful philosophical logic. The pull of gravity is a law we now take for granted. Of course it goes beyond the apple; it also includes how the rest of the tree grows *upward* and, crucially, maintains its volume *in spite of* gravitational forces acting along all its branches and its extremities in space. Tensegrity is the principle the tree uses to solve that problem. We are in exciting times as we learn to reveal its apparently universal application.

An Art Form

Kenneth Snelson (born in 1927) is an artist, sculptor and geometer. His profound understanding of how nature shapes form in space can be seen applied to many aspects of science and art. He writes: "My art is concerned with nature in its primary aspect, the patterns of physical forces in three dimensional space."[12] Snelson was a student of Buckminster Fuller and it was from Snelson's floating compression sculptures that Fuller coined the term tensegrity, from "tensional" and "integrity". Snelson's work and articles can be viewed through his website.[13] His article "Weaving, Mother of Tensegrity" brings us closer to the idea of the fascial matrix bridging the micro and the macro scales of our form in its local weave and its global structural integrity.

Kenneth Snelson (see Margin note) animated this principle of structure that works independently of

gravitational downward force and constantly responds to it in intimate relationship. Through his understanding and development of compression members “floating” in a sea of continuous tension, he identified a companion law of nature. Tensegrity takes the application of gravity working on living creatures into three-dimensional life (Figs 4.1 and 4.2). For Snelson it was an art form, and in the 1980s tensegrity was not generally considered in terms of human biomechanics.

Figure 4.1

This beautiful image from Albinus, drawn by Jan Vandelaar, shows the human skeleton. This is the classical model. However, it cannot stand up like this without the connective tissues that are missing from the drawing.

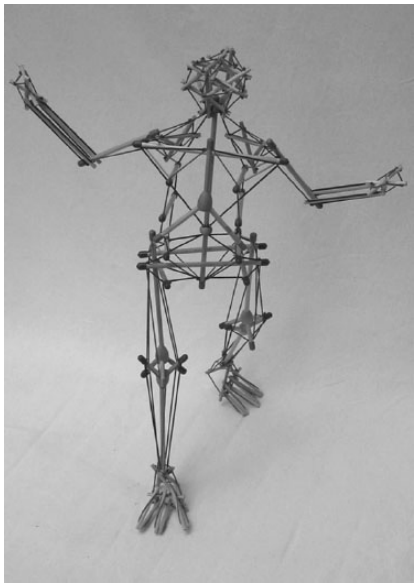


Figure 4.2

This model of the human form as a biotensegrity architecture, by Tom Flemons (reproduced with his kind permission) does stand up on its own.

Figure 4.3
Dr Stephen Levin standing under Snelson's Needle Tower in Washington DC.

Fig. 4.3 shows Snelson's famous Needle Tower. The bars (compression members) are held in place by continuous wires (tensional members) that are not made of elastic material. However, the net result of this architectural form is that it contains space using the minimum of materials, with high elastic storage capacity (see Ch. 8). It is relatively light and completely free to respond to forces acting upon it with a remarkable resilience and ability to restore its shape (integrity of form). If the wind blows the Needle Tower in one direction it responds architecturally as a whole and then returns to its centred position. It is naturally responsive to any change in force. Importantly, however, it resists deformation and is easily moved as a whole, despite its scale. (This huge form can be lifted and moved with relatively little effort given its overall size. This is part of the economy of material and scale that makes it so appealing in nature.) Forces can also move *through* it.

The mathematical implications of this geometry are to be found everywhere in the natural world and the human form seems to be no exception. It certainly invites us to consider it, particularly given what we can do in the yoga class. The Needle Tower is an example of how the third neutral force (see Ch. 1) plays an essential role, as the uniting of two opposites, or paired structures. These two forces (tension and compression) combine in one whole architecture and form a third force, or unity, to create form. They cause each other to be. This is the form we live in or are contained in, as a volume in space. This is not just up and down force, but omnidirectional: side to side, corner to corner, inner to outer, outer to inner.

Think of a tree, solving the business of growing (upward and outward), taking up space and moving with the wind, without breaking. It uses tensegrity as the basis of its architecture. The structure and fabric itself (of the tensional and compressional elements) become the force transmission network. It is profoundly economical.

Snelson's artistic creation of a tensional network simultaneously holds the compression "struts" together and keeps them apart, while it is held open by them. It is constructed on the principle of triangulation, which in this design forms a cross-section of the star tetrahedron when viewed from one particular direction. The geometry of this, in plan view, is clearly visible from underneath the structure (Fig. 4.4).

"Chirality" is the term given to the spiralling nature of the structure in volume. The chirality is the direction of its spiral, achieved on all scales. (Chirality in trees refers to the direction of the twist of each growth ring. Each layer has counter-chiralling properties so the tree can grow upright. Research suggests they respond to their environment; see Ch. 7.) The model in Figures 4.5 and 4.6 is about a meter long and exhibits the same structural properties as Snelson's tower.[10]

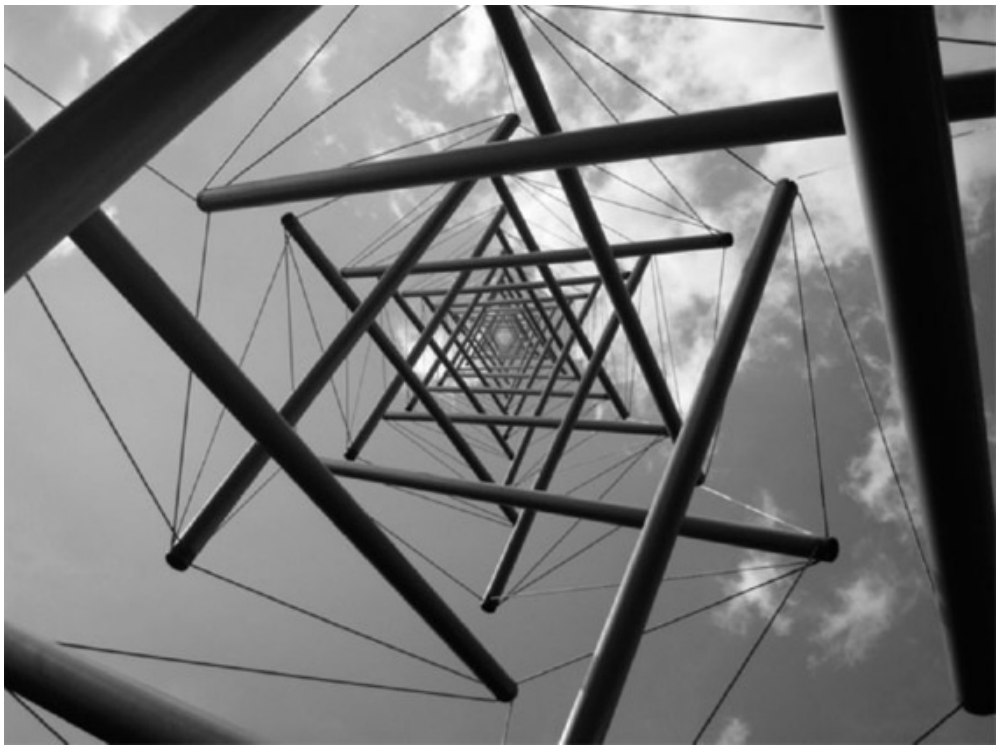


Figure 4.4

The view from underneath the Needle Tower; note the geometric pattern of a star tetrahedron in cross-section.

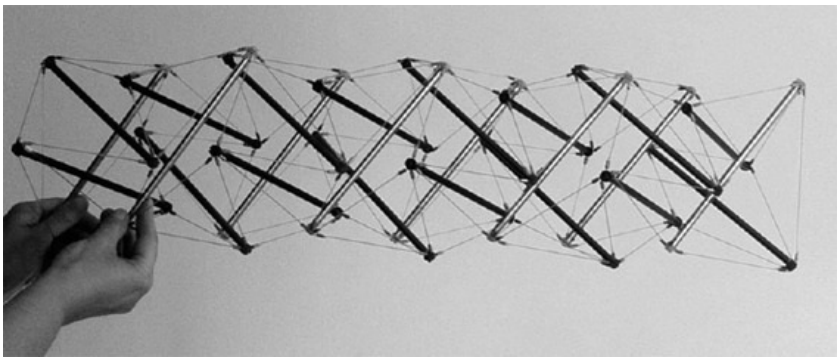


Figure 4.5

A biotensegrity mast. It begins as continuous strings, which are not elastic, joined together, without tension, at specific points, into which the metal tubes are inserted. As the whole mast tightens, the spacers take up their roles. It assumes this shape which, when dropped on its end, bounces several inches off the ground and maintains its tensional integrity and innate elasticity. Reproduced in kind acknowledgement of Bruce Hamilton, designer of this mast.

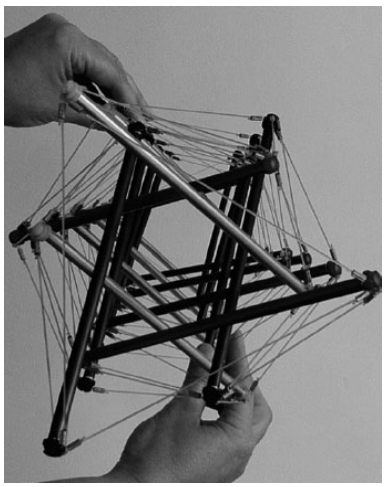


Figure 4.6

As in Snelson's Needle Tower, the end elevation of the mast appears in cross-section, at any point, as a plan view of the star tetrahedron (Ch.

2 and 21).

The architect Buckminster Fuller recognised the innate structural principle in Snelson's work and applied it to architecture. About five years later, Fuller coined the term "tensegrity" from "tension integrity" and designed the geodesic dome based upon its architectural economy and resilient form. This is fundamentally based upon the principles of architecture and the Sacred Geometry of the Renaissance that we examined in Leonardo da Vinci's work (see Ch. 2 and Fig. 4.7). It is now being recognised as a possible explanation of our internal organisation on every scale. The layers of tubing in a blood vessel, for example, are considered to have counter-chiral weave, which gives them elasticity and resilience as well as structural integrity.[11] We will consider the context of whole body movements here, but the appeal is that biotensegrity applies on every scale of our form.

In the early 1980s, Tom Flemons, another artist and inventor, was working in a different way in Canada. He revealed the same fundamental principles. Flemons also refers to himself as a geometer and his own applications of tensegrity were focused on their relevance to human form and representing functional anatomy. Stephen Levin, an orthopaedic surgeon, followed a line of enquiry along the same theme. Levin's questions arose from his own surgical practice. He sought answers in his local Natural History Museum, located not far from Snelson's Needle Tower.

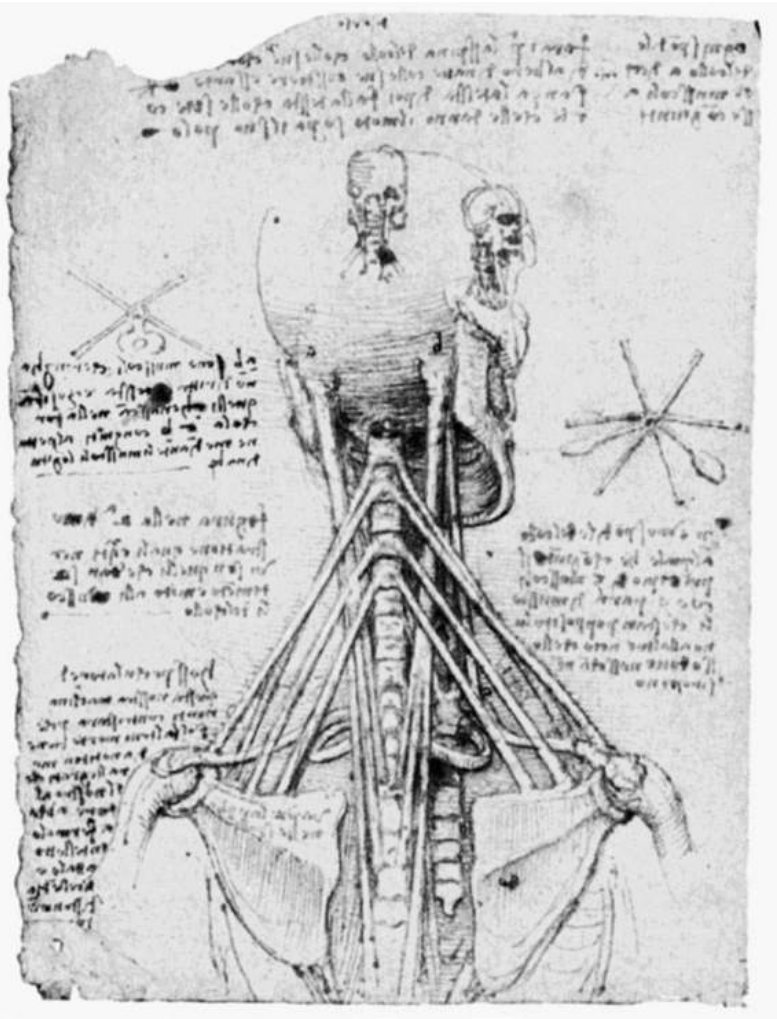


Figure 4.7
Leonardo da Vinci saw architecture when he studied human form. The weave of the myofascial matrix, taken globally, expands the possibilities of how we define form.

Having written expansively about this subject since the early 1980s, Levin began to work with Tom Flemons in the late 1990s, and their respective approaches are gradually revealing the depths and

application of tensegrity principles in the broadest sense, applied to human structure and motion. Their work is transforming our understanding of biomechanics and balance and certainly inviting new questions about more traditional ideas. Examples of Flemons's work are shown in Figs 4.8 and 4.9.

Micro to Macro Scale

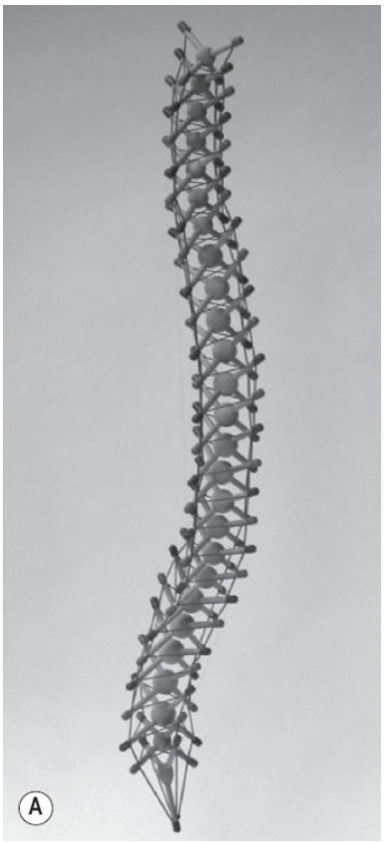
Figure 4.8
This is a new model, rendered by Tom Flemons, of the pelvis and spine; reproduced with his kind permission.

One aspect to highlight is that tensegrity is found to be the basis of living architecture on many different scales. The cell used to be considered as a bag of water, held up by hydraulic pressure. It is now understood that it contains tension and compression elements and actually conforms to biotensegral architecture in its fullness of form and motility. (New research suggests it is a special kind of water structure too.)[14] Professor Donald E. Ingber,[15] a cell biologist and bioengineer, has studied and researched tensegrity principles on the molecular level while Dr Levin has sought to show how biotensegrity applies to the whole body – macro-movement.

"Despite centuries of study, researchers still know relatively little about the forces that guide atoms to self assemble into molecules. They know even less about how groups of molecules join together to create living cells and tissues. Over the past two decades, however, I have discovered and explored an intriguing and seemingly fundamental aspect of self-assembly. An astoundingly wide variety of natural systems, including carbon atoms, water molecules, proteins, viruses, cells, tissues and even humans and other living creatures, are constructed using a common form of architecture known as tensegrity. The term refers to a system that stabilises itself mechanically because of the way in which tensional and compressive forces are distributed and balanced within the structure."[16]

Thus the principle called "tensegrity", now more developed and referred to by Levin as "biotensegrity", became animated through different areas of study as diverse as art, engineering, surgery and molecular biology. Uniting them all is the nature of living architecture. Biotensegrity can be applied to a multiplicity of living structures and the research of the last few decades has evolved alongside research on the fascial matrix. These begin to explain each other at various levels of our form and invite us to new interpretations of what actually happens in what we call "functional movement". If fascia is the

fabric, the weave, and biotensegrity is the basis of how it works in our structural architecture, how exactly do we move?



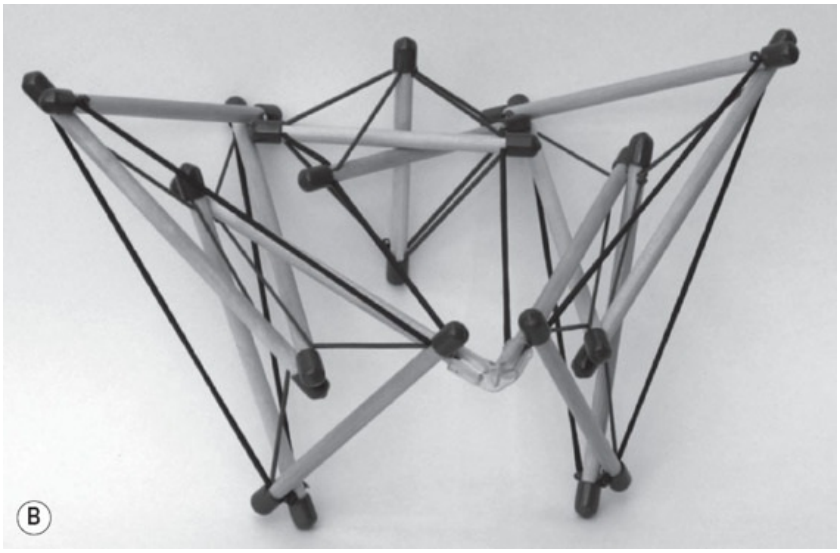


Figure 4.9
A three-dimensional model of a "tensegrity spine" (A), and a "tensegrity pelvis" (B), created by Tom Flemons and reproduced with his kind permission.

From the website of Tom Flemons *"Based on the west coast of Canada, Tom Flemons is an artist and inventor who founded the company Intension Designs Ltd. He has employed tensegrity principles for 30 years, designing portable structures, freestanding fences, children's toys (Skwish), furniture, mobiles and sculptures.*

He first noticed the formal resemblance between tensegrity masts and vertebral 'columns' in 1985, and built several models of a tensegral spine which he sold to doctors and chiropractors. A search of the medical literature on biomechanics revealed no one was exploring the similarity of spines and tensegrity masts. However, an orthopedic surgeon Dr. Stephen Levin was writing about the connection and eventually he and Tom Flemons met and began to work together in the 90s.

For over ten years, in collaboration with Dr. Levin, Flemons has built many bio-tensegrity analogs of vertebrate anatomy and it has proved quite possible to model the body using tensegrity. Each iteration approaches a better accuracy and

resolution of anatomy and, in turn, sparks insight into an explanation of biomechanics that does not require levers and fulcrums. These models offer researchers, therapists and health care professionals a 'hands-on' experience of the tensegral human body."

Ingber's work shows these principles on a molecular level. Guimberteau and others (see Ch. 3) reference Levin's (and others; see notes) work at the macro level of human movement. The specific explanations are not yet widely agreed, as it is possible that several kinds of geometries are involved at the same time to manage the intricate range of movements we can do. For example, we might move gracefully through a Sun Salutation (Suraya Namaskar) but we do not only "do Dog Pose" then "do Plank Pose", and so on. We experience the movements through subtle transitions at various amplitudes and progressions, while breathing and sensing the ground through feet and fingers, in subtle and strong, steady and sweet rhythms. The fascial matrix works in tubes within tubes and various layered organisations throughout our form. It makes sense that just as there is more than one way to do the postures, there may be more than one way to transmit the forces within and through the joints, indeed the whole architecture. We will go on to explore this in the following chapters. At this stage, it is worth understanding biotensegrity even as a metaphor, for the sense it makes of what we actually do on the yoga mat.

Biotensegrity and Yoga

The implications of understanding tensional forces in this context are exceptionally valuable for yoga teaching. This is largely because it is relatively easy to see tension–compression balance globally in the body once you know what you are looking at. It also identifies the balance between stiffness and elasticity (Ch. 8) and this can provide a direct path to organisation that works at the speed of a movement class. Eventually we can develop our own (internal) sense of tensional balance. In a context of curiosity, finding our way into the poses, this seems to be a fruitful pathway en route to conscious movement and structural integrity (Part 2).

We are aligning with a different theory of movement that accounts for all of our range and makes sense of what we readily do in a yoga classroom, regardless of angle, position or speed. Trees, flowers, mammals, birds, insects, fish, all fauna and flora do this. They fold and unfold and move their volume as a contained but constantly changing morphology in perfect balance with the gravitational field around them. (We will see this in Ch. 5, as a forming principle in embryology.) It is a system of coordinated resistance and surrender, stability and mobility, so fundamental to yoga practice. It invites us to re-evaluate a new context for some of the Sanskrit terms with which yoga is described. They can appear less literal and more naturally symbolic of our full, dynamic architecture (see Part 3).

Once you develop a clear sense of how a biotensegrity structure is defined and expressed, it simplifies what you are looking for and amplifies the difference a small adjustment can make (Ch. 14). What can be developed as a skill is the recognition of how the parts of us can be integrated and united by these principles, then translated usefully into movement management and precision. Here, we will attempt to define the logic, and in Part 2 we will apply it to a number of postures and reveal its relative simplicity in practice. This does not mean biotensegrity is the answer to everything, but research that *comes from* movement is intriguing. It makes sense of us as self-motivated and self-stabilising creatures. It is quite different to taking theories and trying to make the movements fit them. All research relies, to some extent, on the way the question is posed. Biotensegrity as the explanation for our volume, woven together by the fascial matrix of our forms, raises questions for new kinds of research. We will find out in Part 3 how eloquently they are reiterated in some of the ancient wisdom behind yoga.

The Gravity Line

Yoga teachers often talk about the body responding to gravity, at least in the exploration of the physical yoga techniques and postures. We "find the gravity line" and a sense of being centred in the standing postures in particular. The phrase refers to the idea of imagining a plumb line passing through the exact centre of the body, from the crown to a space between the feet, or the sitting bones if you are seated. This cue allows the body to sense itself sitting or standing "tall and straight", aligned in gravity.

There is, however, a fundamental problem with this visual idea, which is that gravity does not work in lines any more than people do. It is not simply a linear force and the idea that it is keeps certain awkward biomechanical arguments alive. These arguments are based on intellectual, linear and two-dimensional principles. Gravity is a radial force. We might imagine the opposite direction of a radiant light beaming out *from* the centre of the earth; gravity draws everything *towards* the centre of the earth. The ground interrupts us. It also gives us something to resist, in order to stand up or make adjustments. (We rely on it so completely that we can take it for granted.) As Leonid Blyum points out; you can't adjust someone doing yoga in outer space, there is nothing to resist.[17]

Thus we can all live on a globe and not fall or float off. How are we built, at the simplest level of understanding, so that we constantly resist this force in such a balanced way, throughout our form, that we do not get flattened and compressed by its pull, or released completely by relative weightlessness?

The simplest answer to this question is "this way", however "this" is. How we move the way we can is through a constant balancing of multiple forces. It is what we do. With such a radial force operating upon this contained architecture, the body is originally and ideally designed to respond morphologically to tension and compression forces throughout its network. We live in constant counterbalance: the ground reaction force (Ch. 7) in response to gravity in multidirectional expressions.

Tension and compression are paired elements of our force transmission system, i.e. a network through which those forces are transmitted and, we might say, *translated* into movements congruent with our intentions. Yoga is about unifying forces; multiplying up to the whole, rather than dividing down to the parts. Together, tension and compression facilitate a "third force". That third force is the balance, at any moment in time, of tension–compression combined. It is what we already do.

"Tensegrity systems (when talking of robotic platform design for example) have multiple paths to failure. Tensegrity meshes redirect forces such that redundancy is built in [in the sense that, for example,] an injury to a leg or an arm can be accommodated by redirecting the forces along slightly different pathways that don't engage the injured part directly."[18]

The difficulty in describing this lies in the limitations of theory versus experience. The first is restricted to words on a page while the second occurs in three-dimensional form. What is immediate and obvious in experience can be hidden from a two-dimensional format presented on paper. In architecture, for example, you take a leap from looking at the plan view or side elevation on the drawing board to experiencing the actual building. When you physically experience occupying the space that the drawing is designed *to represent*, it is almost beyond imagination. Even virtual, three-dimensional images cannot recapitulate *your sense in space* of relative relationships between the parts. We have to make that leap to explode out of the linear theories of levers and *feel* how tensegrity principles might be innate to our structure. From a diagram (meaning two [dimensional]) to a hologram (meaning whole) requires a sensory leap of awareness and attention. As soon as you hold a tensegrity structure this makes immediate sense; its volume and resilience resonate with your own *through the experience of holding it*.

Structure of the Spine

Let us look at the spine, for example. We think of the spine as a column because it is often described as a "spinal column", with separate vertebrae and segments. The notion is that it stands up, stacked vertebra by vertebra upon the pelvis, balanced in the gravity line at its truest alignment (Fig. 4.10).

In fact, no bones in the living body are stacked. In a healthy body the bones do not touch each other.[19] Furthermore, by the most elementary rules of architecture, the spine is not a column. It does not form anything remotely like a column and if it did we would not be able to do the vast majority of yoga postures that we routinely enjoy. Child Pose would break us into little pieces, and how would anyone get up from Corpse (Shivasana) or survive any inversions given the journey to get to them? Half Moon (Ardha Chandrasana) would be impossible (the wrist bones would fall off, at least). Clearly it is not a column (see Fig. 4.10). So where do we go on a quest for new explanations?

A column is a compression structure like a house, relying on the ground and on the forces and design that hold (and maintain) it at right angles (Fig. 4.11). Unlike houses, which do not stay upright if the ground underneath them subsides, a human being can do remarkable things on a yoga mat (or ski slope, etc.) without breaking or deforming permanently. We can happily tilt or modify our structure to accommodate a change of terrain. There *must* be a different architectural principle working here.

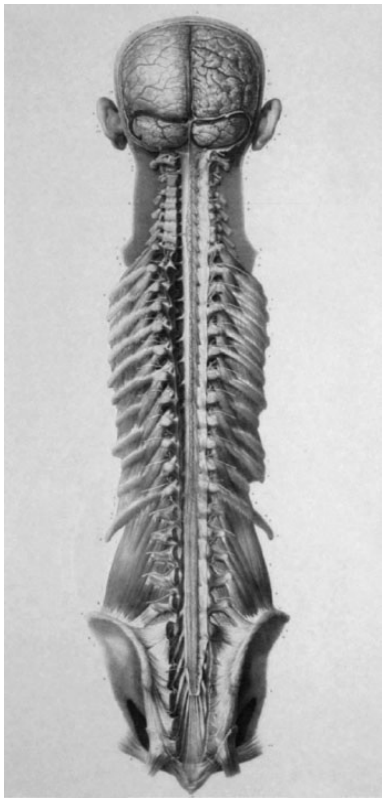


Figure 4.10
The classical notion that the spine is a vertebral column is reiterated here

A tree trunk appears superficially to be more like a column, but it does not fit the description either. It sways fairly substantially in response to reasonable extremes of natural forces. It does not topple over or break, despite the span of its crown or upper branches – it can often grow tilted. A tree is, of course, a relatively stable tensegrity structure but it is not a column either, or not until it is dead and turned into one.

The overall form of the human spine is an "S". It ideally has to be S-shaped, in order to be able to manage the range of positions, loads and movements human beings can do. It is designed to manage all the different internal and external changes while remaining spring-loaded, as a whole. When the human spine

is not in an S-shape, the person living around it is often impaired in their range and quality of motion (see Ch. 7). (Monkeys, for example, have relatively straight lumbar spines, and they move very differently from us over the ground and through the trees. They use their arms to swing through, or swing from, in very different patterns to humans.) In the yoga classroom, people can do curious things that simply do not support the spine being considered as a column (Fig. 4.12).

We do not so much move around the gravity line. We occupy the contained space that works constantly to oppose its radial force on every aspect of us. In Figure 4.12 Katie is easily keeping the majority of her body weight stretched out parallel to the ground, organised around her standing foot. The bones of her spine, upper leg and arms, including all those little wrist bones and finger bones, are not stacked anywhere. In this position, they would collapse if that were the case. They are all tightly held in place by the tensional network that is drawing them together. The muscles in Katie's left foot are not strong enough to support this position either. This, like any other, is a whole body posture.

Figure 4.11
A column is a compressive structure, as seen here, at the White House at Beaumont Estate, Windsor, UK.

The same bones are effectively holding that tensional network open to occupy the space Katie takes up and surround the space within her body cavities. This tensional network is pressing the bones together and, at the same time, it is also holding the bones apart, because of the way it is organised around them. Three forces are acting together to respond constantly to Katie's responses (tension, compression and the combination of the two forces: tension–compression). Without the tension element provided by the connective tissues, the bones would fall apart. Without the compression element, there would be no tensioning. Together they combine to form a variety of patterns and organisations. This united polarity, or paired organisation, allows us to make extraordinary shapes on the mat, as a whole body.

The Three Laws of Biotensegrity[20]

First Law. A *tensegrity structure is a continuously connected, tensioned network supporting discontinuous compression struts.*

This biotensegral continuity explains how forces are transmitted through the entire system. In Figure 4.12 there is no part of Katie's body that is *not* participating in the pose. The clear balance she is able to find is not just revealed by the fact that she is not toppling off her standing leg; it is in the *balance of*

multiple forces that she is simultaneously managing in all directions, as one united whole. As Katie breathes, the pose subtly changes. In spite of this, the tensional network of her body re-establishes its balance again, organising and reorganising out from and in to her centre, continuously connected. Her muscles, bones and connective tissues are maintaining a versatile and continuous management, within a tensional network that houses compression elements in ways that levers do not adequately describe. Her muscle tonus is even throughout but no one muscle is responsible for this unified balance and global organisation.

Figure 4.12
If the spine were a column, this pose would not be possible. Reproduced with kind permission from Katie Courts

Second Law. A *biotensegrity structure is an essentially self-supporting structure that is pre-stressed under tension, which means it can maintain its shape independently of gravity.*

Katie's body is containing and managing the internal changes of breathing. At the same time it is organising the external balance between gravity (drawing her toward the centre of the earth) and ground reaction force (her body instinctively resists, away from it). Thus her ability to "draw in" to her sense of her centre and at the same time reach and expand out of it, "against gravity", makes this posture look easy. It is essentially self-supporting and abides clearly by the second law of biotensegrity.

Third Law. A *biotensegrity system is a self-contained, non-redundant whole system. All components are dynamically linked so that a force exerted on any part of the system (i.e. a change) is reflected throughout the structure: "forces are translated instantly everywhere".*[21]

In Figure 4.13 Katie's arm position has been modified and forces are immediately redistributed through her whole system, to reestablish balance and tensional integrity. Her tensegrity is able to hold her in stillness, where she chooses, in order to express the pose (asana). In real life, Katie gracefully changed the arm position with barely a perceptible shift in the rest of the body. The new pose was organised around the breath with apparent effortlessness. This is the economy of movement and grace we see in animals. It optimises the non-redundant aspect of our living architecture.

The way the body organises the tissues of the spine (in terms of biotensegrity structure) is carefully described in Tom Flemons's article "The Bones of Tensegrity".[22] It is an emerging proposition, so there are different questions arising from various researchers. Flemons raises the question:

Levin refers to "non-redundancy", meaning there are no external parts required; everything in our system manages multiple forces and

we do not have any superfluous parts. Flemons uses the same word to mean if any part is injured, the system can redirect forces as a whole and has “built in redundancy”. Both statements are accurate.

“How does the fascia assist in distributing the loads? The thoracolumbar fascia wraps the vertebral bodies in diagonal and lateral strands like a woven sleeve with multiple attachments to the vertebrae. Pre-stress maintains the integrity of the spine and slight contractions laterally or even diagonally can extend it, ameliorating compressive loading, separating the vertebrae and sparing the discs.”[23]

Figure 4.13
We can readily see that this change in the posture that Katie is executing expresses the fact that “all components are dynamically linked”. Reproduced with kind permission from Katie Courts.

Whatever the questions and discussions about the laws of biotensegrity, you cannot fully “get” a practical sense of why it is posing such an attractive explanation unless you handle a biotensegrity structure yourself. The actual architecture is so balanced and tuned that it innately resists any force applied by counteracting it and transmitting it throughout the object. What this means is that when we do a twist, for example, the “body” touches a point of resistance and stops; it tightens or resists deformation (see Ch. 8 on elasticity). This is an important feature of our sensory feedback system, preventing us from tearing or damaging our bodies.

A biotensegrity system is also extremely economical because the same architecture of force transmission manages the compression and the tension at the same time, at all times. In addition, if one area is not functioning ideally, it can find alternative pathways. This also makes sense of what happens in our classrooms. We know that different people do things different ways, depending upon their body type and state of mobility and health.

“After all, both organic and inorganic matter are made of the same building blocks; atoms of carbon, hydrogen, oxygen, nitrogen and phosphorus. The only difference is how the atoms are arranged in

three-dimensional space."[24]

Biotensegrity Everywhere

In the example of the orange in Chapter 3, we saw the architecture of the tissues that held the juice droplets together and apart. This is tensegrity architecture, creating a tensional membrane network throughout an organism. It contains the structural growth and expansion and containment of fluids from within. At the same time, it pushes and holds them apart so they do not collapse, compress too much, or leak. It is a finely tuned balance between tension and compression.

The word "hierarchy" can be slightly misleading in this context. It does not imply a higher quality but rather a different level in the order, repeated on every scale. A more neutral word is one coined by Ken Wilbur. He describes a "holarchy", referring to something that is a whole and complete unit within a whole and complete unit. A well-known example of this would be a set of Russian dolls. Tensegrity structure invites the possibility of a universal principle (of three-dimensional architecture) from cell to being. Its founding geometry goes beyond literal form to the symbolic aspects of yoga, to the metaphysical (Part 3). Each level of the holarchy works on the same fundamental basis, uniting to create something quite unique, in and of itself, something greater than the sum of the parts.

"This phenomenon, in which components join together to form larger, stable structures having new properties that could not have been predicted from the characteristics of the individual parts, is known as self-assembly. It is observed at many scales in nature. In the human body, for example, large molecules self-assemble into cellular components known as organelles, which self-assemble into cells, which self-assemble into tissues, which self-assemble into organs. The result is a body organised hierarchically as tiers of systems within systems. Thus, if we are to understand fully the way living creatures form and function we need to uncover these basic principles that guide biological organisation."[25]

Internal spaces that remain open owing to a structural system that operates at every level by the same principle is a compelling argument for what we explore through practice. This principle of architecture includes the spaces in which the parts reside. It is a global system for a universal structure that can be found in cells and viruses on the micro level, as well as the gross body as a moving macro-organism. In one way, it is beautifully simple. At the same time, it remains exquisitely complex. Therein lies the paradox of working with fascia.

Biotensegrity in Motion

Our entire experience of yoga includes this possibility of biotensegrity. Our internal structures are enclosed, moving and changing with every breath, on every scale.

Our form is the combined or unified presentation of the holarchy in motion, changing from moment to moment. The outer kinesphere and the inner kinesphere (I prefer to call them the kinesphere and the innersphere) form the interface between internal and external forces and *the network transmits those forces*, constantly seeking balance. This architecture allows forces to be transmitted throughout the structure, managed appropriately via our proprioceptive sense.

Dr Levin coined the term "mesokinetic organ" to describe the moving living structure as a whole. That includes the musculoskeletal system and all the tissues, vessels and supporting spaces it works around and within: the colloids and emulsions in the "soup" we contain (the extracellular matrix and all the forms contained within it). The term refers to and includes the chemistry of the structure

and its functional motion, as well as its architectural components.[26] He defines something that makes sense of our yogic experience. It seeks to unify many aspects, just as we do.

"Tensegrity icosahedrons are used to model biologic organisms from viruses to vertebrates, their cells, systems and subsystems. There are only tension and compression elements in tensegrity systems. There are no shears, bending moments or levers, just simple tension and compression, in a self organising, hierarchical, load distributing, low energy consuming structure."[27]

Wholeness

It is difficult to think in whole terms when we are used to seeing joints locally, referencing only the specific muscles that cross them. In yoga, even if we are emphasising a pose for one part of the body, we are counterbalancing that part with the rest. Biotensegrity invites us to think globally, although we can express movement locally.

When you press on a floating compression (tensegrity) structure, it presses back at you. When you twist a tensegrity mast, it counter-twists in your hands. The architecture itself responds by bringing balance to the force applied, even if the structure is *inert*. That is what our sensory bodies do, instinctively, on yoga mats. Whether they are exploring yoga techniques, or sitting in meditation, breathing in (expanding the whole structure) or breathing out (squeezing the whole structure), the principle applies literally, symbolically and universally. We go down to go up, rotate and counter-rotate; we go out to go in, and vice versa.

The various styles of poses do not just rely on muscular forces to place them; we spring and bound, soften and release into them at different points in our practice. Our bodies travel through space and maintain their integrity. We use our tensional network, which is very efficient energetically. We can organise in a refined and relaxed manner facilitating all kinds of movements at will, from the fluid to the robotic. Relative to our own capacity, we develop range and choice. We can choose how to train this sensitive, responsive material that is the form of our soft body architecture. It allows for an exploration into different types of yoga (or any other movement protocol from martial arts to mime).

Biotensegrity makes sense of whole myofascial slings, from head to foot. (We will consider "Anatomy Trains"[28] in this context in Part 2.) It is more difficult to translate into local muscle units. As we discover that muscles do not function in units (Ch. 9), we can see how fascial architecture raises new questions about how we move locally and globally. It suggests that even micro-movements are appropriate whole-body responses to subtle forces. Biotensegrity can explain how the different amplitudes of all kinds of forces can be universally transmitted and managed throughout our structure.

Trees can only grow up to the extent that their roots counterbalance the down-ness, but their span and height can defy linear logic. They rely upon biotensegrity architecture, just as we might. We search and record in every direction our tissue's ability to find balance, regardless of which lever, fulcrum or swinging joint it chooses to use in a pose (just watch gymnastics). Something holds that shape together and simultaneously maintains the inner spaces with integrity. This is tensional integrity, and nothing else answers how we move, at the speed we move, and makes continuous sense of our ability to be still or to use momentum, as a matter of personal choice, as a whole.

It is one thing to analyse the variety of postures in the classroom from the point of view of particular antagonistic muscle pairs, levers and fulcrums, but quite another to make sense of them in action. Given that every pose is designed to affect our whole body, local analysis can fail the test of universal application. We are essentially nonlinear biologic systems, not only from the point of view of where our

limbs are in relation to our torso. It also applies to our physiology, for example how the breath actually moves us and how we move the breath, throughout the changing duration of a pose. It includes the visceral organs and the gliding layers of our whole tissue matrix; the transitions to and from the pose. The body and limbs, breath and thoughts, feelings and containment occur at once. We experience our spines and our senses before, during and after any one whole asana, at that moment in time.

When we stand on the yoga mat, we become very interested in gravity and finding balance on one leg, two legs, hands, elbows, shoulders, head, in multiple directions and angles. If we did that as a stacked system of blocks with a spinal column up the middle of it (also stacked smaller blocks), then certain poses would make very little sense. We can see that in Figure 4.14 no part of Katie's body is failing to participate in or be affected by this whole pose.

As we explore the yoga poses, slowly and therapeutically or fast and athletically, we do so at one with our instinctive style and form. These are whole-body expressions and the more refined (and appropriately tensioned) they become, the more we can be in command of our poise and balance. We begin to find congruency between structure, function and self-expression of our own unique form.

Biotensegrity is gaining traction in the field of biomechanics as an explanation of global organic organisation. However, it is an emerging field and not yet fully understood in terms of the organisation of joints and articulations. Pioneers in the field such as Levin, Flemons, Snelson, Daniele-Claude Martin, Graham Scarr and Vytas[29] (computer science and robotics) are providing inspiring new questions that resonate with yoga practice and many forms of movement, ancient and contemporary. They offer fascinating ways to explain what we actually do in all the variety we seem able do it.

When we achieve the beauty of poise and grace in the postures, we become so "full" of the sense of balance within and without that we take it into our lives. It becomes relevant, like a hallmark, in everything we do. It becomes an instinctive way of moving and of being. In the next chapter we explore whether anatomy does, or ever did, really occur in the body as separate isolated parts.

Figure 4.14

Katie's spine is balancing and managing force and counter-force (Ch. 6) from multiple angles that challenge any idea that it is a stacked compression column. Reproduced with kind permission from Katie Courts.

Notes

1. Donald Ingber, "The Architecture of Life", Scientific American, Feature Article, January 1998.
2. Tom Flemons, www.intensiondesigns.com.
3. Tom Flemons, private correspondence, 2013.
4. Jaap van der Wal – see Ch. 3.
5. Tom Flemons, private correspondence.
6. Vytas SunSpiral's website is at http://www.magicalrobot.org/BeingHuman/.

7. Tom Flemons “The Bones of Tensegrity”, ©T. Flemons 2012, www.intensiondesigns.com/bones_of_tensegrity.html.
8. Tom Flemons, private correspondence.
9. Caroline Myss, *Defy Gravity: Healing Beyond the Bounds of Reason*, Hay House, Carlsbad, California, 2009.
10. Bruce Hamilton’s designs can be seen at www.tensiondesigns.com.
11. Graham Scarr, www.tensegrityinbiology.co.uk/, article: “Geodesic”. See also: “Biotensegrity: The Structural Basis of Life”, Handspring Publishing Ltd., Pencaitland, 2014.
12. Kenneth Snelson, http://kennethsnelson.net/.
13. Ibid.
14. Gerald H. Pollack, *The Fourth Phase of Water: Beyond Solid, Liquid, and Vapor*, Ebner and Sons, Seattle, WA, 2013.
15. http://www.seas.harvard.edu/directory/ingber
16. Donald Ingber, “The Architecture of Life”, Scientific American, Feature Article, January 1998.
17. Leonid Blyum (http://blyum.com/).
18. Tom Flemons, private correspondence, 2013.
19. Stephen Levin, private correspondence, 2013.
20. Stephen Levin, www.biotensegrity.com.
21. Leonard Dubovoy; see www.biotensegrity.com.
22. Tom Flemons “The Bones of Tensegrity”, ©T. Flemons 2012, www.intensiondesigns.com/bones_of_tensegrity.html.
23. Ibid.
24. Donald Ingber, “The Architecture of Life”, Scientific American, Feature Article, January 1998.
25. Ibid.
26. Stephen Levin, www.biotensegrity.com: “The Tensegrity-Truss as a Model for Spine Mechanics: Biotensegrity”.
27. Stephen Levin, www.biotensegrity.com: “Tensegrity: The New Biomechanics”.
28. Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists,* 2nd edition, Churchill Livingstone, Edinburgh, 2009.
29. Vytas SunSpiral website is at http://www.magicalrobot.org/BeingHuman/.

CHAPTER
5

The Remarkable Human Blueprint

"The body has its own way of fighting illness, readjusting itself to harmony. We all want to survive and be well and will find infinite ways to serve our needs. There are no obstacles to this tremendous urge to live. The body will always strive to overcome the difficulties impeding its existence. To live is one of the greatest miracles."[1]

Vanda Scaravelli

Yoga is about the process of unifying form and the union of all our aspects. This includes the mind, the being and the form of the body through which we express ourselves. Embryology is about the process of forming from original unity as much as it is about the formation of all aspects of us. The two are intimately related. Perhaps all we ever needed to know about yoga but were too afraid to ask is there, in the embryo.

It is interesting to consider that we all began as embryos. Like the acorn that somehow "knows" how to become an oak tree, we know what is required to become all that the remarkable human blueprint promises. The embryo essentially self-assembles, motivated by the miraculous ability to animate the codes and patterns it inherits. Embryology is the study of how we achieve this. In a medical context, this is described as the progressive stages of developmental growth. In the advanced practices of yoga it becomes a metaphor for the symbolic growth of our emerging consciousness. The fundamental question remains: how exactly does the embryo differentiate?

Whichever lens we look through to explore our origins, embryology is the story of an evolving work in progress. It is very complex; however, it describes only one particular time frame in our development, which is a progression of changes that continues throughout our lives. Each of us goes physically from conceptus to embryo, from fetus to neonate, then from newborn to baby, toddler and child. We all undertake a journey to whichever point we reach, through adolescence to arrive at adulthood, and eventually elderhood. We continue to express this in a body that presents "time" by the stage to which it has developed, in a unique way.

Embryogenesis
The word "embryo" comes from the Greek meaning "young one", and came to mean "fruit of the womb" (literally "that which grows", from *en* "in" + *bryein* "to swell, be full"). "Genesis" means beginning. At the earliest stage, one name for the fertilised egg is the "conceptus", from the Latin "a collecting, gathering, conceiving"; the term can also be used at the metaphysical level to describe the conception of a new idea.

Yoga is interested in developing our awareness of that process and becoming ever more present to it. The yogic Yantra speaks of a "sacred journey", which might describe the developmental weeks of

embryonic forming or the developmental years of a whole life. They are seen in these terms as a microcosm of the macrocosm. The question of scale differentiates them. At this early stage of embryogenesis, yoga views the energetic body as part of the forming process. Medical textbooks, in contrast, identify process in terms confined to physical developments and the genetic codes that authorise them.

Research into the role of the connective tissue offers some interesting invitations that seem to bring these ideas together, at least a little. Given its unifying nature, the fascia is, perhaps unsurprisingly, evoking a new curiosity around our original formation.

Sensing into Form

When we practise the yoga poses, by exploring the shapes of new forms we develop our physical bodies as well as our mind and being. We practise to become more articulate, developing our inner sense as we perform the poses while, with our outer sense, we listen to where we are in space, seeking congruency between them, in all the variety of shapes, directions and ways in which we can balance and respond to and from the ground. We move in the gravitational field and although we are no longer wrapped in the fluid chambers of our original forming (morphogenesis), we might say we are wrapped in gravity, or at least "ground reaction force" (see Ch. 8).

Much like the forming embryo, we interact with biodynamic forces, rates of change and relationships between the forms. We experiment with the forces in which we are growing and moving, as a whole body, all the time: from the outside in, the inside out, side to side, rotation to counter-rotation, and so on. On the mat, we consciously explore the ways the forms and forces affect us as we effectively change them, by moving. That might be very similar to what the embryo does. The earliest cells grow and organise the forms by moving and changing biodynamic forces and genetic patterns; they consequently change each other. Yoga could be said to do the same, since we all express its forms and practices uniquely.

"If you think the adaptability and range of possibilities and complicated interactions in the body of an adult is a beautiful achievement, you can multiply that by a million in the embryo. It appears as a kind of chaos, if you can say that of something that contains and emerges into such exquisite and various order."[2]

Chemistry or Geometry?

Yoga's most ancient history is richly woven with symbolic geometry (see Ch. 21). It is no coincidence that the earliest pre-embryonic forms can be shown geometrically to present many aspects of Sacred Geometry (Chs 2 and 21) and the principles of Divine Proportion. More contemporary studies of geodesic geometry[4] are also providing new lenses through which to view embryological forming. The symbolism is rich and rewarding on every level and, depending on what we are looking for, embryology resonates with many people in different ways.

The scientific and medical books on embryology tend to take a point of view based mostly around genetics. However, that view is changing. Advanced technology in instrumentation and the new questions arising from research in connective tissue biology are affecting every field of knowledge; the study of the embryonic process seems to include them all. From maths, physics and chemistry to biology and music we can find rhythmical patterns and correlates in the embryonic forming process. Authors such as Richard Grossinger, in a work rich in metaphor,[3] take a phenomenological approach, comparing the embryo to the

galaxy, the difference being one of scale. Anatomist Jaap van der Wal (Ch. 3) presents the embryo as a sentient being, highlighting the primary role of the fascial matrix and the subtle exchanges that take place as it develops. Proprioception is presented as our original sense of form and van der Wal describes human beings as multisensory and aware, unified from the beginning. The suggestion is that we learn from the embryo, as distinct from thinking we might explain entirely how it functions from the anatomy of the parts. Biotensegrity stretches the point of view further, unifying the science and the symbolism in the geometry that is fundamental to both.

The Scientific Questions

This point of view suggests the continuity seen in Jean-Claude Guimberteau's films of the living (adult) matrix (see Ch. 3). Guimberteau places great emphasis on the way the connective tissue matrix is organised and omnipresent. It has multiple functions, as is suggested here. The paradigm shift from thinking in terms of muscle and bone units to thinking in terms of continuity of form throughout the tissues is highlighted by such research questions as these.

The potential role of the fascia in our bodies is gaining in significance in many fields. Embryological research carried out by Evans (a developmental tissue biologist and anatomist) and colleagues in 2006 refers to the fascia as "the forgotten player".[5] It suggests that connective tissue may be more primary than muscle tissue, essential for the creation of the "musculoskeletal unit". As we learn that the fascial matrix cannot be logically excluded from understanding the musculoskeletal system or any of our movements, new ways of examining embryogenesis are emerging.

"Connective tissue: the forgotten player? *… Skeletal muscle is invested and anchored to a number of specialised connective tissue layers organised as the endo-, peri- and epi-mysium* [see Ch. 3]. *These layers not only act as a conduit for blood vessels and nerves but because they become continuous with the connective tissues of the tendons and other muscle attachments, they are essential in transmitting the motive force of the muscle to the attached structure (e.g. bone) as appropriate."*[6]

The Embryonic Period

At the earliest stage of our development, the embryo is whole and complete, so let us start from the beginning.

How the embryo essentially forms itself is a complex and exquisitely detailed series of events that take place over a period of just five weeks (from approximately week 3 to week 8 after fertilisation). In that short space of time, a tiny ball of water just visible to the naked eye becomes a recognisable, if barely, developing baby human, about the size of an acorn. It still has a long way to go to become a newborn; however, the plan (the whole *anlage*, or rudimentary basis of a particular organ or part) is in place. It has a heart and primitive, but nevertheless distinct and functioning organs: head, spine, body wall and limbs; pulsing lungs, fingers, toes, eyes, ears and nose. They are all ready to grow and develop into the precise features we embody and enjoy exploring on the yoga mat.

The Journey

The embryonic journey is mostly described in books as a number of events, one following after the other in sequence, whereas in fact many of the events happen at the same time, in one co-creative process of

development. Each one relies on the other. It is not like building a robot or making a soft toy. Nothing in the embryo is bolted on or added afterwards.

The heart descends according to the (reverse) order of the chakras in yoga, from the seventh to the fourth chakra. The third descends from the fourth and as the spine grows down towards the tail, the second and first arise later in the sequence, during the forming process. From this point of view our subtle body is formed originally in our physical form, from the crown towards the tail.

We could say it is more like folding an exquisitely elaborate origami sculpture, in that the innate geometry of form *has a sequence* but the whole arises from the folds and interrelating layers of the original piece of paper. They all come together at the end, they all rely upon each other, and if one fold is inaccurately pleated, it affects the whole finished form.

Every fold, every enfoldment, every pattern and pulsing rhythm of the embryonic progression happens inside chambers within chambers in this three-dimensional, fluid, biodynamic origami. The folds form tubes and bags; these are volumes rather than flat paper pleats. The layers and spaces are formed such that the folding consequences bring us and all our organs into the shape of a human being. Each layer takes those sacs with it as it itself folds, and, in less than two months from conception, the emergent creature incorporates all of them. It then grows and expands into the fluid sacs *from which it formed*. We discover that the layers and the spaces all come from the same original "piece of paper", that is, the single, tiny ball of fluid enclosed in a membrane that is the fertilised egg (and its adjacent and surrounding chambers).

The Embryonic Parts are Whole

In the embryo, each tiny layer and space has been given a name (which is considerably longer in the writing than the length of the formed embryo), in order that the sequence of metamorphosis can be followed. In textbooks the embryological sequence is usually presented visually as a series of graphic icons, cut out of the spherical sacs in and around which the actual embryo folds itself.

The word "yoga" means unifying. The single chamber of our origin holds our entire remarkable human blueprint in potential *as one unified form*. It divides into chambers within chambers, part of this original cell residing in the nucleus of every other cell. Every part of us arises from the one part of us, from which we emerge. It is somewhat like an Escher painting or a Rumi poem. The embryo is the architect of the architecture that forms the embryo. Reasoning comes a long time after.

Depending upon which text you are reading, development can be a literal and prosaic description of stages or a poetic story of transformation. Either way, many people (even those who have studied the basics of embryology as part of a medical degree) can learn the facts without necessarily realising that in three dimensions, the embryo forms from the actual layers of two tiny water bags meeting, both inside another surrounding one (Fig. 5.1).

The embryo takes these sacs with it during every fold of the journey to formation. It only sheds them at birth, having structuralised its own outermost layer (skin) inside what becomes the surrounding amniotic sac. This is almost impossible to represent as three-dimensional form in two-dimensional media. The essence of that continuity (and its sentience) is exactly why fascia is raising so many questions and inviting different perspectives to account for our anatomy, physiology and biomechanics, at all stages of our development. Fascia seems to play an essential role in every aspect of our formation; perhaps that is how it earns the title "organ of organisation" as it clearly organises and seems to unify the embryological forming processes.

Heart-felt Beginnings

In Figure 5.1 we see that the inner chambers touch each other, forming the upper and lower sentient layers that will become the embryo; the future heart starts “above the crown” before the growing brain folds over it. We will also learn that the fluid of these chambers (the “embryonic soup”) is the basis of all the building materials[7] and connective tissues from which we form ourselves. The rhythmical beat of the heart begins very early in the process, pumping blood to the rapidly growing brain, as we will see in a little more detail below.

Spacialisation

> Interesting research at Tufts University,[8] in 2011, involved filming the development of a frog embryo using a method that could capture light. The clip shows that what is called “bioelectric signalling” made a holographic light-print in the embryonic tissues. The clip clearly shows a midline and the sensory features of the head, in a moment of illumination. The researchers discovered that if this light-print was interrupted, the tadpole developed abnormally (two heads or two tails, for example). This indicates that the signals interrelate with membrane voltage and pH levels, influencing the forming process of the embryo. Their research suggests this illumination might precede the genetics. Clearly, many questions remain unanswered.

The entire embryonic process is one of specialisation and spacialisation, in that the embryo must form the cavities, the tubes and the layers which fold and enfold the organic origami pattern. They all remain connected and continuous, although distinct and differentiated.

Some geneticists believe this differentiation into form is attributed to a genetic coding programme, the chemistry of the DNA. Other researchers (epigeneticists) believe that the movements of forces in the forming and growing process create the tension and compression or dynamic fields that participate in shaping the embryo into form. They argue that it is the “movement fields” (kinetic morphology) that initiate which genetic coding patterns get switched on. In other words, what can DNA do without the appropriate cell in which to express itself? Which comes first?

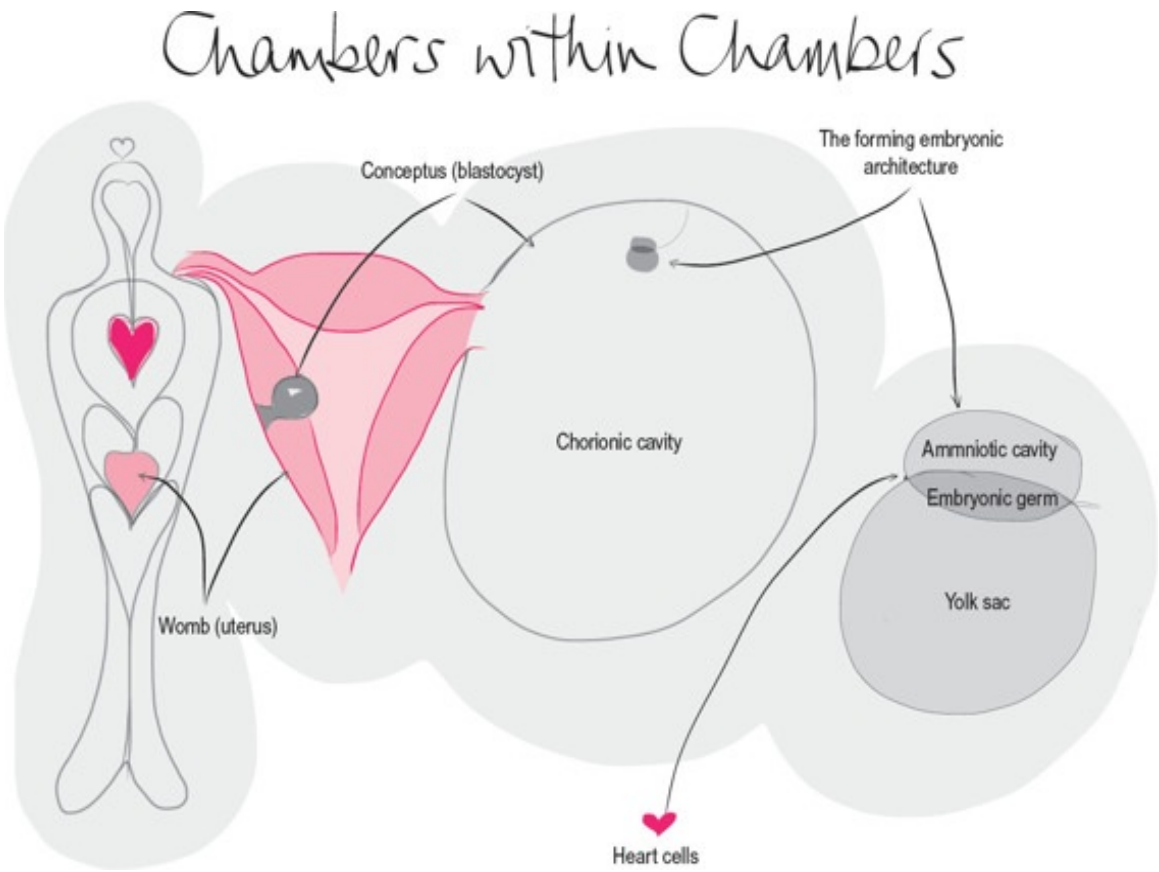


Figure 5.1

The embryo forms at the meeting place of the upper (future amniotic) sac and the lower (yolk) sac. The heart begins just beyond where they join, above what will become the crown. It is not a seed or a germ between the sacs. It is the sacs.

Perhaps we could view the genetic codes as “pattern potentials”. Since movement is a sign of life, then each vital movement can produce a pattern. Like the colours in a kaleidoscope, there is a limited number of individual coloured pieces. However, with reflections and shifts of the structure and motion of the kaleidoscope, infinite variety occurs down the viewfinder. Could we imagine that the colours are the genes and the movement presents them in unique patterns, within the blueprint? Perhaps that is a way of seeing how order arises from many different aspects of the apparent chaos of the embryonic forming. We are all unique presentations of our species, which, paradoxically, makes us all the same.

The Sequence of Events

Table 5.1 highlights the key events in the sequence of embryological forming and provides a basic chronological reference for the rate at which changes take place. What is harder to appreciate is that the forming process occurs in 360 degrees and, in fact, many of the processes happen simultaneously. They do not wait for one event to be followed by another. In many of the drawings and schematics of the forming process, the focus is mainly on the actual embryonic germ changing shape (it has to be) within the chambers from which it forms. What we have to remember is that this is similar to cutting muscles out of their original habitat and placing them separately on the drawing board. Muscles do not function on their own, out of the context of the connecting tissues and fluids they contain and reside in, and nor does the embryo.

Table 5.1

Table of embryonic process showing main features of embryonic development in days

Table 5.1 Table of embryonic process showing main features of embryonic development in days							
Pre-embryonic Period							
Week 1	*Day 1*	*Day 2*	*Day 3*	*Day 4*	*Day 5*	*Day 6–7*	
Fertilisation	Fertilised egg; the single-celled conceptus in fallopian tube enclosed by membrane (Zona Pellucida)	1st division into 2 identical cells after 30 hours). More dividing into smaller cells	A ball of over 100 cells in the Zona Pellucida carried along the fallopian tube	A ball made of cells with an outer layer and an inner cell mass (the blastocyst)	Beginning of implantation. The blastocyst must snuggle in to the uterine lining	The pre-embryonic journey of the fertilised egg, down the fallopian tube, takes about a week. The cells are dividing within the delicate membrane of the Zona Pellucida until they form into the blastocyst (a ball made of cells), losing the membrane and beginning to implant into the lining of the uterus	
Week 2	Day 8	Day 9	Day 10	Day 11-12		Day 13	Day 14
Implantation (the week of twos)	Embedding in uterine lining. This is essential or there is no pregnancy. The outer part of the blastocyst has to establish this direct nourishment to grow	Forming the outer chamber and the cavities that will form the inner chambers	Forming layers and linings of the inner chambers that become the amniotic and primitive yolk sac	Forming connection with the mother through implantation, the blastocyst must send out a tiny root into the uterine lining that will eventually become the placenta. This continues to grow from the structures of the outermost chamber		Chambers within chambers form growing spaces of the amniotic sac that meets the yolk sac, forming inside the outermost chamber	A two layered disc forms where the upper (amniotic) sac meets the lower (yolk) sac. This interface, where they touch, forms the pre-embryonic disc
Week 3	Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21
Orientation Neurulation, Gastrulation: (the week of threes)	Polarity and orientation arise: head end, tail end and laterality. The primitive streak and node predict the Notochordal axis	Early notochord, predicting future spine, axis for formation and support of the entire embryonic forming process	Growth rates pull the upper and lower layers of the pre-embryonic disc apart. Cells pour in to the gap from the upper layer	The upper (ectoderm), the middle (mesoderm) and lower layer (endoderm) form 3-layered embryonic disc and notochord	Central Nervous System is induced where spinal cord will grow	Neural tube formation and the somites begin to form. They are organs of the body wall: 360° forming vertebral organisation and the axial body	The heart starts above the crown of the embryonic disc: so-called at this point for the tri-laminar disc that is formed

Embryonic Period							
Week 4	Day 22	Day 23	Day 17-28		Day 26	Day 27	Day 28
	Neural tube closure begins. Number of somites increasing from head towards tail	Heart pumps the rapidly growing brain, intimately relating the circulatory and neural growth functions	The Folds; Head Fold, Tail Fold and Lateral Fold shape the form and inner cavities of the head and torso. Meanwhile the outer (chorionic) sac grows and the placenta develops		Pharyngeal arches appear and lung buds begin inside the anlage of the thorax	Somites, important transient features of segmentation, grow the embryo. (Number of pairs denotes age)	Neural tube complete. Primitive anlage of ear and eye structures appear
Week 5	Day 29	Day 30	Day 31	Day 32	Day 33	Day 34	Day 35
2nd Month 5 – 8 mm	Arm buds and (about 2 days later) leg buds forming from body. Lung buds forming inside	Developing gut tube from membrane to membrane that will form the mouth and anus at either end	Embryo in flexion as it expands into growing chambers	Umbilical ring forms. Body stalk grows	The heart grows and body begins to form more recognisable proportions	The eyes appear in the cranial formation, initially oriented more laterally.	The lungs develop further as the anlage of the pleural cavity and bronchial apparatus. Thorax form a primitive breathing pattern
Week 6	Day 36	Day 37	Day 38	Day 39	Day 40	Day 41	Day 42
10-14 mm	Umbilicus forms	Face Develops more detail and organisation	Myofascial development (according to the somitic segments) and differentiation	Visceral development and differentiation: e.g. liver filters blood to heart	Ear structures develop for balance and hearing	Differentiation of the heart. Atrial septum formed	Differentiation of the hand digits then the foot. They begin as paddles and transform via four interspacings
Week 7	Day 43	Day 44	Day 45	Day 46	Day 47	Day 48	Day 49
17-22 mm	Limb differentiation and digital rays of the fingers and toes more detail	Development of the face and cranial formation	Detail of the heart more developed	Expansion of placenta, as chorionic cavity grows	External genitalia appear	Facial prominences fused	Hands, fingers, feet and toes present, eye lids forming, upper lip forming
Week 8	Day 50 – 56						
28-30 mm	Limbs lengthen proportionately and fold at knees and elbows. Fingers and toes are free and face becomes more clearly organised and proportioned as recognisably human. Tail disappears and umbilicus forms						
Fetal Period (from 9th week onwards)							

"Life makes shapes. These shapes are part of an organising process that embodies emotions, thoughts and experiences into a structure. This structure, in turn, orders the events of existence. Shapes manifest the process of protoplasmic history finding a personal human shape – conception, embryological development and the structures of childhood, adolescence, and adulthood. Molecules, cells, organisms, clusters and colonies are the beginning shapes of life's movement. Later on, a person's shape will be moulded by the internal and external experiences of birth, growth, differentiation, relationships, mating, reproducing, working, problem solving and death. Throughout this process, shape is imprinted by the challenges and stresses of existence. Human shape is marked by love and disappointment."[9]

The Basic Process

The three fundamental principles of the embryonic period are
- to get the cells in the right positions (the first three weeks)
- to bring the basic human form into being (weeks four to eight)
- and to lay down the rest of the pattern of the remarkable human blueprint once that form has emerged.

Bearing in mind that the wholeness of each stage gives rise to the parts (not the other way around) let us consider each of the eight weeks from conception, including the pre-embryonic period.

Week 1

Fertilisation (the original cell) takes place in the fallopian tube. The fertilised egg travels to the uterus, as it divides into daughter cells (Fig. 5.2).

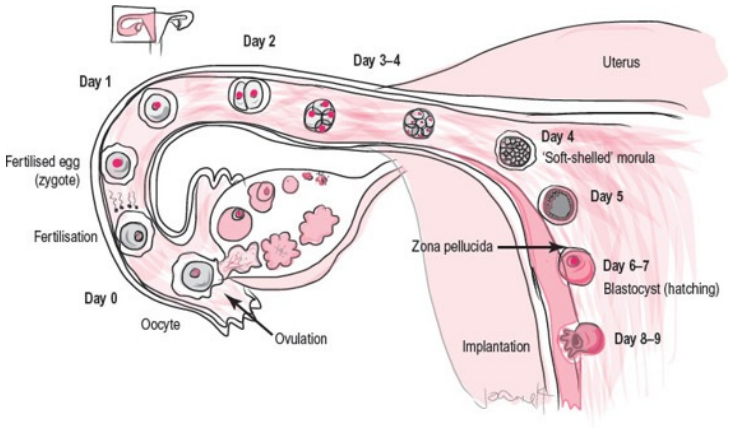


Figure 5.2
The journey of the conceptus (zygote) from fertilisation to implantation (days 1–9 approximately).

Cleavage (from cell to cells). On the way to the uterus (Fig. 5.2), the single-celled chamber (conceptus or zygote) must divide into two identical daughter cells. They will then repeat this division process (cleavage) to form eight daughter cells. Each one is whole and complete in itself, with nucleus and cytoplasm, smaller than the cell it divided from (see Ch. 21).

On the fourth division, to sixteen cells, the conceptus forms a ball of cells and is called a blastocyst. The surrounding membrane (zona pellucida) has not expanded in size but encloses the increasing number of smaller and smaller daughter cells (blastomeres). By the seventh or eighth division there are over 100 of these. The blastocyst is called a morula at this stage, meaning “mulberry” shape, although it is in fact still enclosed by the zona pellucida (Fig. 5.3).

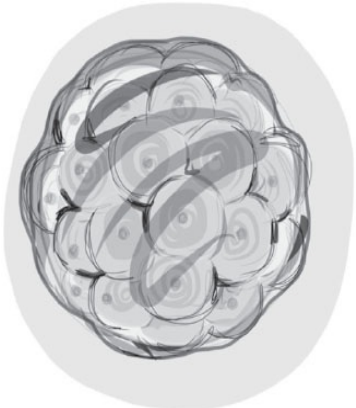


Figure 5.3
The blastocyst, a ball of cells, is still wrapped in its containing membrane (the zona pellucida), a significant aspect of the primitive circulatory processes of fluids between the cells.

From dot to disc:
Anatomist and embryologist Jaap van der Wal (see Ch. 3) celebrates embryology from a more humanist view of being and becoming. He points out that, at the initial stage of fertilisation, the egg (ovum) is (approximately) 90% cytoplasm and 10% nucleus; it is the largest single cell in the human body, visible (just) without a microscope. When sperm reach the outermost layer of nutritive cells of the ovum (called the corona radiata; “encircling radiance”) they first rest there and the egg begins to spin.

The sperm is the smallest cell of the body and is made up of (approximately) 90% nucleus and 10% cytoplasm, in other words, the opposite of the egg. These essentially polarised cells enter what van der Wal describes as a “conversation” or subtle exchange. If they merge, the sperm completes the nucleus of the ovum and the ovum completes the cytoplasm of the sperm, and vice versa. Thus, together, they form one whole and complete original cell, the conceptus, from which all subsequent divisions and subdivisions occur.

Implantation. The ball of cells then changes itself into a ball *formed of cells*, with a distinct outer layer and an inner cell mass around a cavity. It must reach and implant itself in the uterine lining (Fig. 5.4).

Post-implantation. Implantation confirms the pregnancy. Described as the "week of twos", in this second week the biodynamic origami begins, and layers and spaces form into chambers within chambers inside the ball of cells. An upper cavity forms that will be the amniotic sac and the lower cavity will become the yolk sac, inside the surrounding chamber. This simplifies a complex sequence in which the embryo forms its own "living accommodation" within (and from) which to grow.

As mentioned earlier, the fascinating aspect of this that is hard to appreciate from two-dimensional schema is that the embryonic germ itself forms *from the interface* where these two main inner sacs meet. The initial germinating pre-embryo *is the in-between* – the meeting place where these two "soft bubbles" touch. The embryonic disc actually derives its upper and lower layer from where the outer membranes (of the amniotic and yolk sacs) contact each other (Fig. 5.5).

Membranes will form across the joins that will eventually become the mouth and anus at either end of the gut tube, when it has formed. Once the embryo has grown and folded laterally and longitudinally into tubes within tubes to form the body, it will begin to resemble a developing fetus. At this stage before the folding begins it is a two-layered disc. When the embryo folds (week 4), it will take these chambers with it, remaining part of them. It folds around the lower one as it is enfolded by the upper one. Thus it is formed from the continuity of its own architecture.

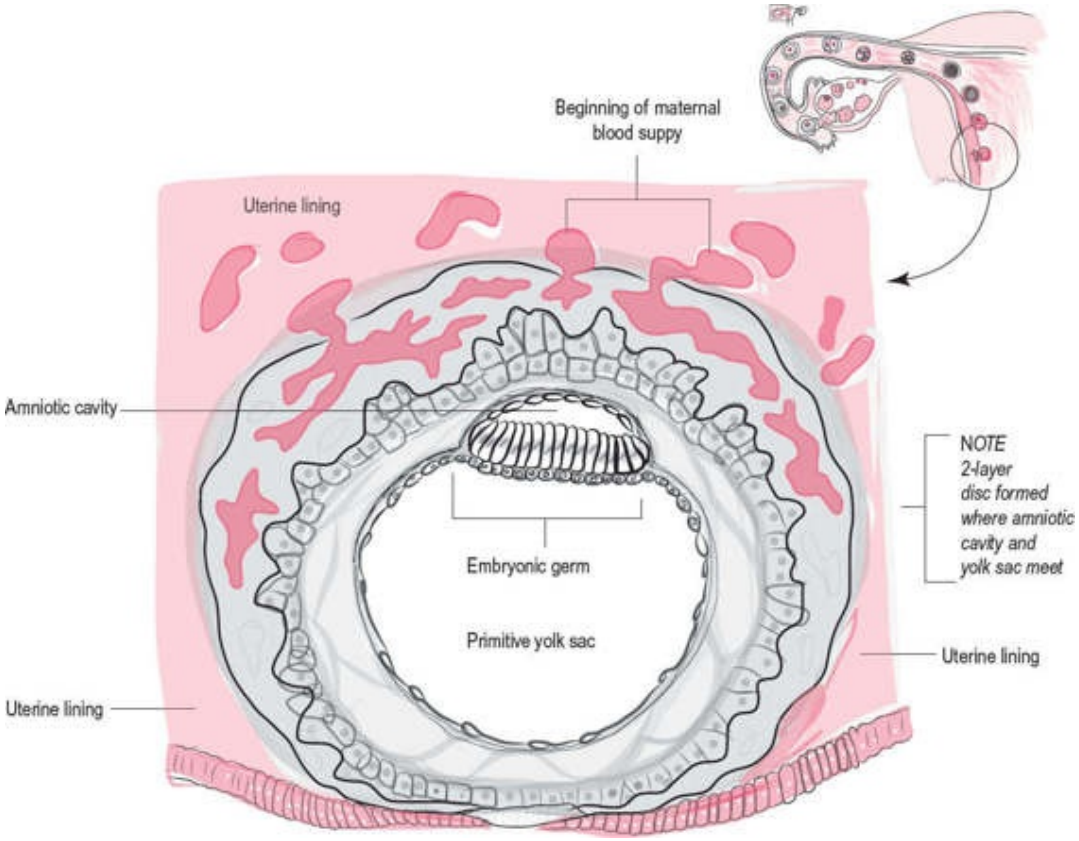


Figure 5.4
In this sketch the tiny outermost chamber implants within which the sacs of the innermost chambers are forming.

Van der Wal describes the process of spinning as "a very subtle mutual process of encounter and exchange of signals and substances, which lasts for several hours".[10] He elevates it from genetic coding reactions to a wondrous process of recreation at the mutual

agreement of the feminine and masculine polarities. A third being, the child, arises when the egg is fertilised and the outer membrane of the egg (zona pellucida; "transparent membrane") shields the conceptus from the outside environment and other sperm.

Before this embryonic folding sequence can happen, the pre-embryonic disc has to go from two layers to three, by creating a middle. (We might say it "spacialises" into three layers.) First, however, it has to gather coordinates from which to orientate, in order to organise.

Week 3

(a) Orientation, (b) gastrulation and (c) neurulation. Three key process happen in this third week. The disc also develops **orientation** with a head end, a tail end and sides (laterality). This predicts an axis, around which the subsequent developmental progress will evolve. The two-layered disc becomes a three-layered (trilaminar) disc of the true embryo. This process is called **gastrulation**. The third process in week three is **neurulation**, which refers to the formation of the brain and spinal cord.

From a biodynamic point of view, this "enclosure" within a containing membrane is an important distinction because it influences the motion of the internal fluids and shape changes between the cells, in the tensional micro-network. It might correlate to a very primitive form of the micro-vacuoles seen in *Interior Architectures*, by Jean-Claude Guimberteau.[11]

The fertilised egg must snuggle into the uterine lining and literally implant itself. Mother and future embryo respond to each other chemically, kinaesthetically and proprioceptively in another subtle exchange. They form specialised circulations to provide nourishment (including nutrients and oxygen) at the rate the embryo will be able to receive it and send out its own circulatory by-products of metabolism (waste and carbon dioxide).

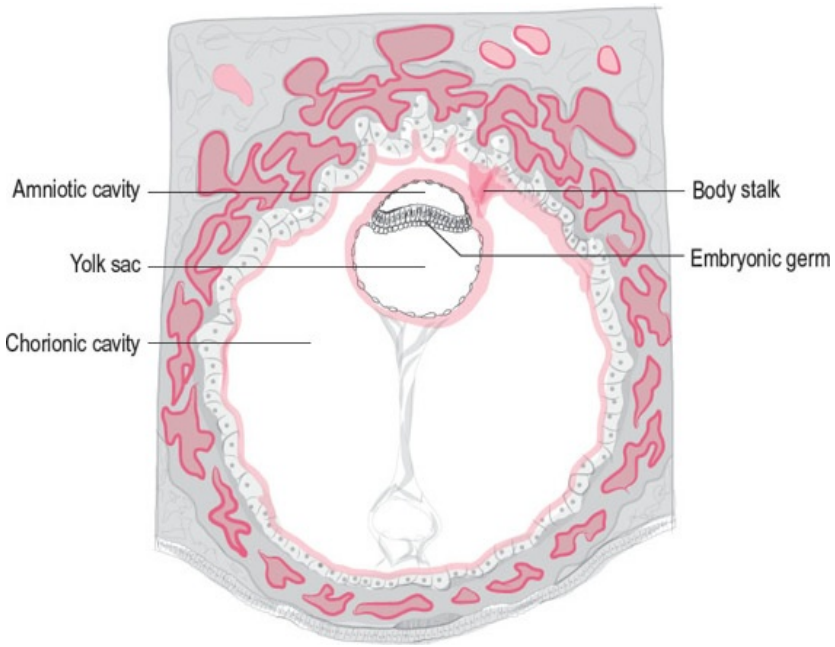


Figure 5.5
Chambers within chambers. The embryo itself is formed where the two main inner sacs meet. It is not a separate seed or a germ between their layers. It is their layers. (Image modified after T.W. Sadler, *Langman's Medical Embryology* (see note 15).)

Let us consider these one at a time:

(a) Orientation. Perhaps we are drawn to the spine in yoga because it is one of our primal features of orientation, present even before the pre-embryonic stage of development is complete. A midline (called the primitive streak) forms in the upper layer of the 2-layered (bi-laminar) disc identifying axes: a left and

a right side, a head and a tail end. (At this time the embryo is about 0.23 mm in length.) We might consider that this original organisation as our "null point" (Fig. 5.6)[12]. It remains our movement reference throughout our lives. It is something we consciously explore in yoga practice and recognise in positions of the chakras along the spine (see Ch. 21).

This delicate structure will eventually form the placenta, the other end of the umbilical cord, which supplies food and oxygen for the duration of the pregnancy. There is total dependency upon the mother for nourishment and oxygen. From a structural point of view, there is also a need for containment, with the biodynamic forces of layered containers and limiting tissues. The womb, the soft tissue of the abdominal wall and the framework of the pelvis will play a containing role for the growing fetus similar (though on a different scale) to the zona pellucida for the blastocyst.

(b) Gastrulation. The upper layer of the tiny germ grows the most rapidly. It is nearest the source of nourishment. The lower layer grows more slowly. It is furthest away. Thus the upper layer and lower layer grow apart from each other and the middle space forms between them:

"as a consequence of rapid differential growth, the ectoblast [upper] glides away from the hypoblast [lower] and an intermediate layer of loose tissue forms between them. Thus from a biomechanical point of view, the tissue in this layer is strained under tension in a circular and radial direction as the conceptus enlarges. As far as the cells of this intermediate layer are concerned they become flatter and this leads to a loss of their intracellular fluid. This fluid collects together in the interstices as intercellular substance. In this way the tissue becomes reticulated or honeycombed. The ***network*** *is the middle blastocyst layer."*[13]

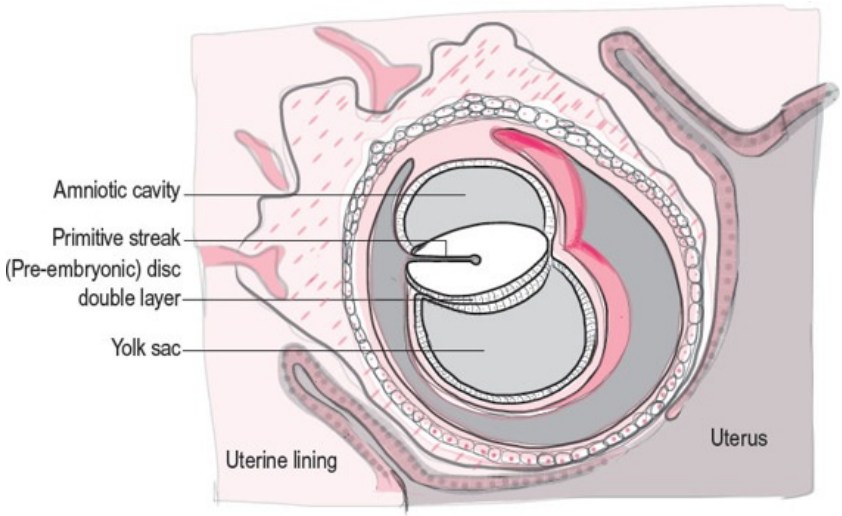
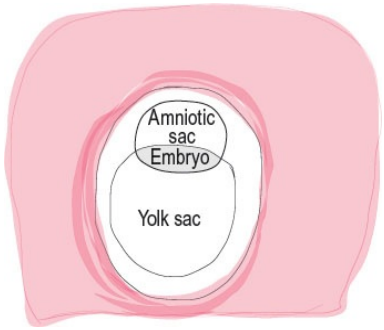


Figure 5.6

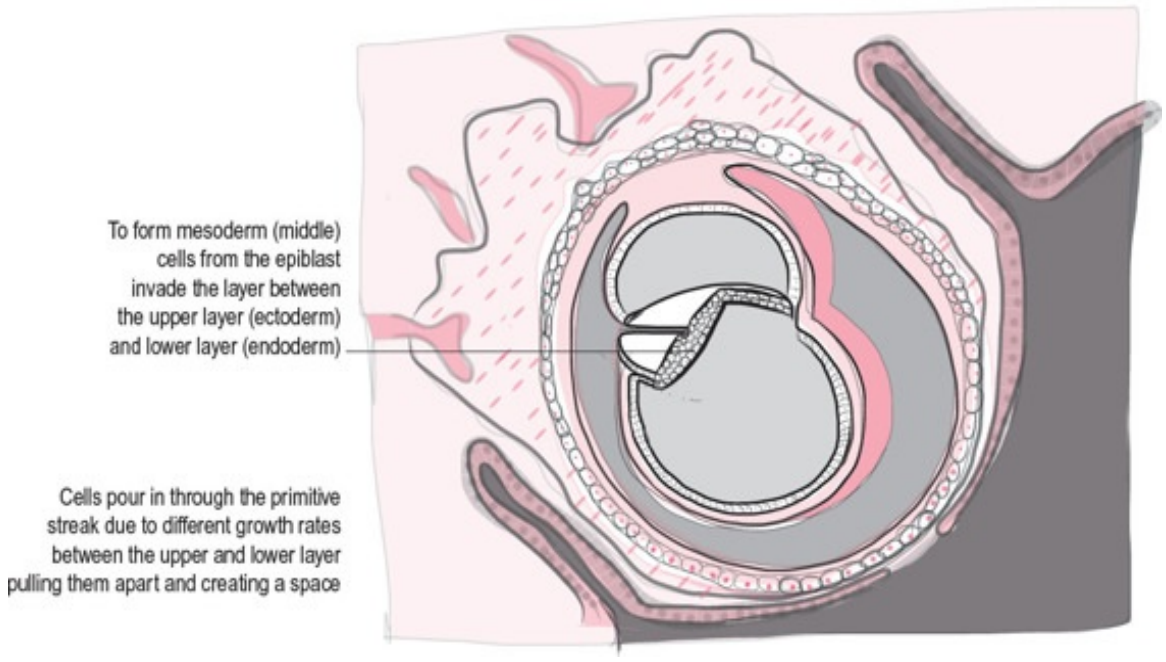
The flat embryonic two-layered (bilaminar) disc within its growing chamber. As Blechschmidt describes in *The Ontogenetic Basis of Human Anatomy* (see note 25): *"the apex of the axial process can be considered as the centre or, better, the null point of the developmental movements of the whole [bi-laminar] disc. The apex of the axial process provides a natural reference for interpreting all subsequent biomechanical movements and the action of biodynamic forces."* Modified after images available from the following website, where an excellent chronological visual presentation can be found: http://www.bionalogy.com/human_embryology.htm

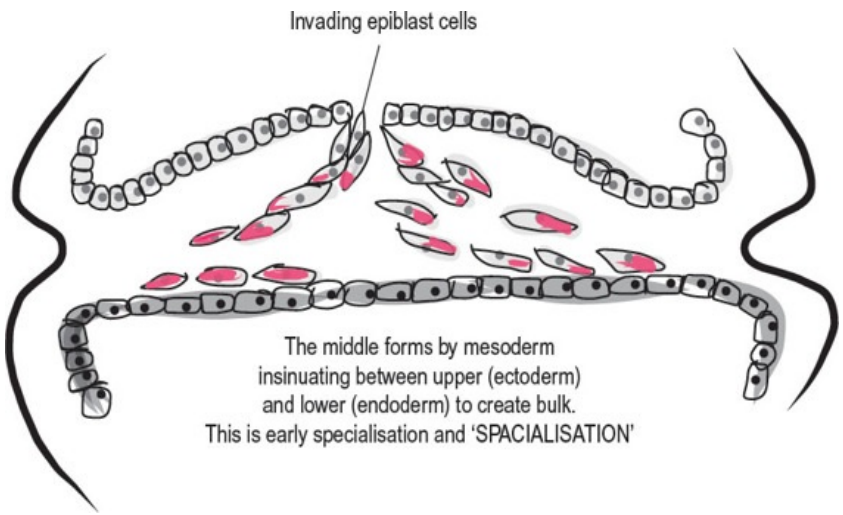
The cells from the upper layer subsequently lose some of their close organisation or structure (de-epithelialise) and pour into the space between the layers through the primitive streak (Figs 5.7 and 5.8). The first to arrive form the true endoderm by restructuring their close organisation. Thereafter, they fill the space between the lower layer (*endoderm*) and the upper layer, thus becoming the middle. The upper layer becomes the definitive *ectoderm*, while the middle layer is called the *mesoderm*.

Imagine a blue water balloon placed on top of a yellow water balloon. Where the blue balloon touches the yellow balloon, there will be a green-coloured disc, the soft ovoid shape where the two layers come together. Where they meet is going to become the upper and lower layer of the pre-embryonic disc. Its upper layer is the lowest part of the blue balloon. Its lower layer is the upper part of the yellow one.



(c) Neurulation (Fig. 5.10) is the transformation of the neural plate into the neural tube. In concert with the central part of the middle layer (paraxial), the upper (ectodermal) layer has to fold back on itself along the midline and form the neural tube. It does this by invaginating and joining the fold edges (like a zip) along its length. It eventually encloses and forms what will become the spinal cord, longitudinally. The somites, formed from paraxial mesoderm, line either side of the neural tube and will form from the base of the cranium position, growing towards the tail, in pairs, dividing the spine into segments. The number of pairs of somites gives rise to the age of the embryo, predicting and incorporating the length and structures of the axial body.





Figures 5.7 and 5.8
Cells from the upper (epiblast) layer pour through the primitive streak into the space forming between the upper and lower layers. Modified after images available from the following website, where an excellent chronological visual presentation can be found: http://www.bionalogy.com/human_embryology.htm

In the process of forming, the embryo can create structure and release it. This means it can pack cells close together to form a layer or lining (epithelialise) or release them into a looser aggregate of cells (de-epithelialise). In this way, tissue can respond to changes in genetic chemistry, signals, growth patterns and position by structuralising and destructuralising appropriately. Blechschmidt[14] identifies "metabolic growth fields" that significantly influence our shape-changing movements (kinetic morphology). Fluids and membranes are formed into primitive precursors of networks, systems and structures where some tissues are pulled apart and others are pushed together, folding and stretching, tensioning and compressing at different rates, but always connected.

Mesenchyme is defined as "any loosely organised tissue composed of fibroblast-like cells and extracellular matrix regardless of the origin of the cells".[15] It is thought to represent the primitive extracellular matrix of the adult form. (It is inclusive of the cells in the embryo.) This mesodermal layer, containing the mesenchyme, forms the "connectedness" that holds the other two layers together and at the same time keeps them apart. They are not so much separate entities as structuralisations (layers) around a middle aspect that plays a role in the structure of all our forms.

The mesoderm subdivides spatially, either side of the central axis into: (1) **paraxial mesoderm** (closest to the central axis), which becomes segmented into somites, predicting the vertebrae (see later); (2) **intermediate mesoderm**, which will give rise to parts of the urogenital system; (3) **lateral plate mesoderm** (outermost), which becomes divided into two parts, mainly due to the excessive growth of the embryo. One layer becomes associated with the upper layer or ectoderm (somatic mesoderm) and the other gets stretched away from the somatic mesoderm to form in association with the endoderm layer (splanchnic mesoderm). Some lateral plate mesoderm also invades the developing limb buds. These layers specifically form the shapes, spaces and characteristics of our head, body, viscera and limbs once the folds are in place.

This process, called gastrulation, confirms the formation of the three germ layers. In biodynamic terms, the middle part of the embryo represents many aspects of entering three dimensions. The transformation of the two-layered (bilaminar) germ disc into a three-layered (trilaminar) disc is the transition from the pre-embryonic stages to the true embryo. The three main classifications for what the layers will become are as follows:

- The upper layer (ECTODERM) becomes the brain, spinal cord, nervous system and skin.
- The middle layer (MESODERM) becomes the body wall, cavities, muscles, bones, connective tissues and blood.
- The lower layer (ENDODERM) becomes the gut tube.

The mesoderm. This middle layer (mesoderm) does not form a "derm" (layer) quite like the other two layers, above and below it. The network that the middle layer forms is a loose aggregate (of unstructured

(de-epithelialised cells) called mesenchyme. It could be thought of as a "mesenchymal milieu" of building materials. These include blood cells and other connective tissue cells such as those making fascia, muscle, cartilage and bone. These are the architectural components of the forms within and around the body walls and cavities. Mesenchymal cells can migrate and move around, serving and mediating the process of formation. This so-called mesoderm contains these undifferentiated "forming potentials" that respond kinetically and genetically to various signals, forces of growth and metabolic movement. This is the pattern of our species, that comes to be uniquely expressed by each one of us.

> *"The primary connective tissue of the body is the embryonic mesoderm. The mesoderm represents the matrix and environment within which the organs and structures of the body have been differentiated and, in fact, are 'embedded' … in harmony with the view that the principal function of mesoderm as 'inner tissue' is 'mediating' in the sense of 'connecting' (binding) and 'disconnecting' (shaping space and enabling movement)."*[16]

Within the mesoderm. The mesoderm also divides itself spatially, into three further aspects, either side of the central axis, out to the lateral edges (Fig. 5.9). As it forms, specialised cells move towards the head and form the prechordal plate, which is important in forebrain development, and the notochord. This predicts the spine and acts as a longitudinal support for the early embryo as well as a signalling centre for certain molecules. These play a part in activating and instructing cells in what to do and which specific tissues to form, according to the genetic blueprint.

The next stage concerns bringing the basic human form into being, predicting the placement of the human anatomy and physiology.

Week 4

This week includes the formation of the somites; transient features of the embryo that play a fundamental role in the structure of the spine. It is also the week of folding into form and developing the placenta.

The tiny heart awakens in concert with the somites (Fig. 5.11), orchestrating growth of the spinal structures and body walls, folding and forming in 360 degrees. This in turn causes the whole embryonic disc to fold laterally and longitudinally, growing omnidirectionally from the central axis, wrapping the body form around the heart.

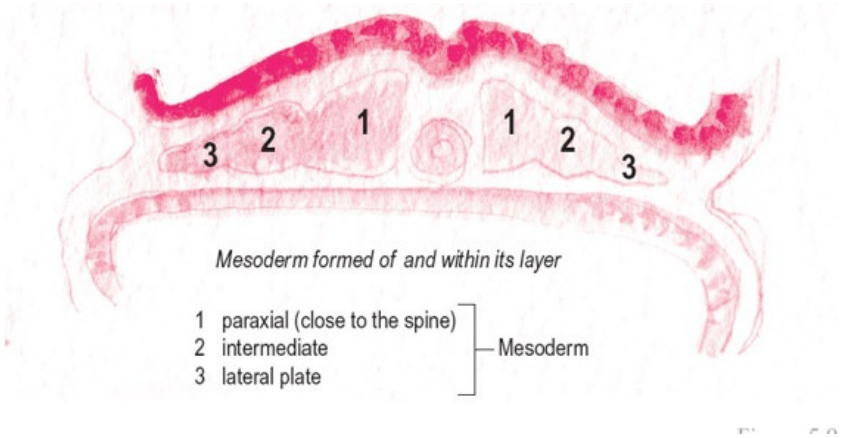


Figure 5.9
The other mesoderm cells, which form from the primitive streak, move out from the central axis and form inner (paraxial), in-between (intermediate) and more lateral mesoderm (lateral plate mesoderm).

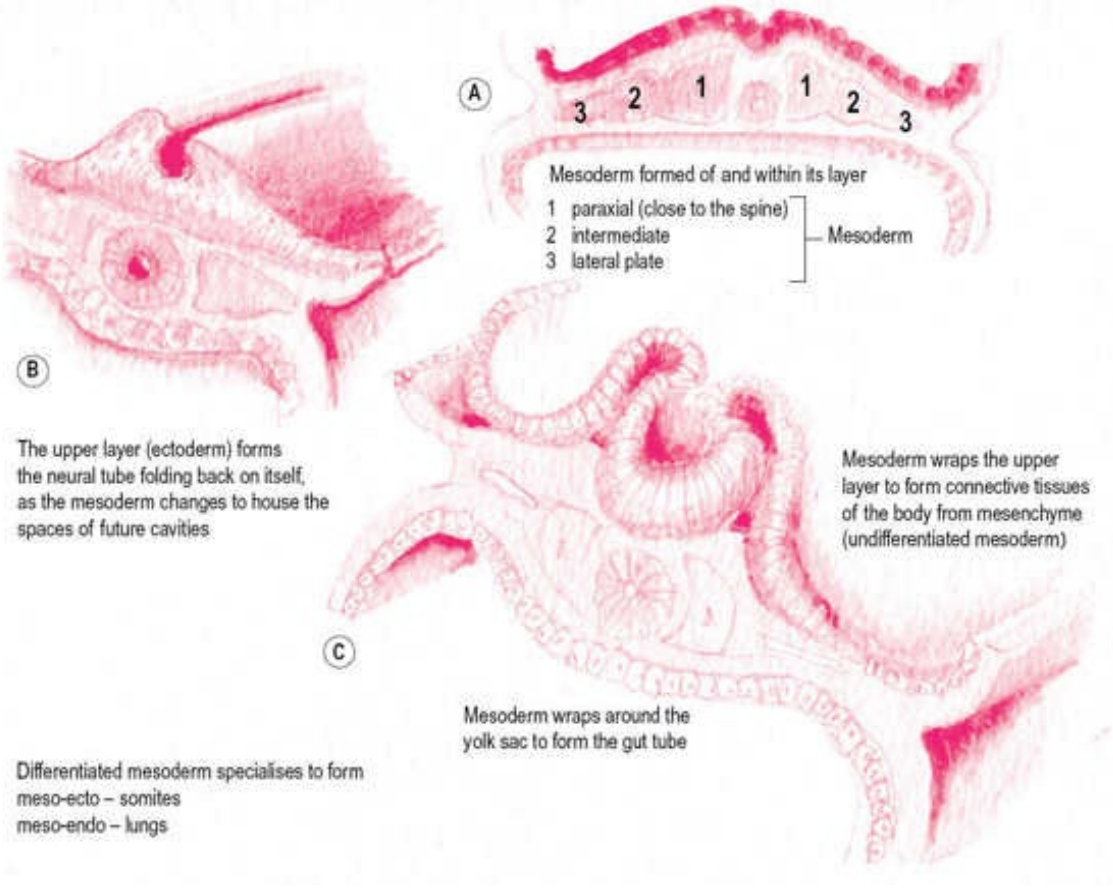


Figure 5.10

The neural tube forms from the ectodermal layer folding back upon itself, along its length (C shows how this begins in cross-section). See Fig 5.15 for a longitudinal view.

The ectoderm will form the tissues relating to our response to the outside world, that is, our outer skin and our innermost spinal cord, and the nervous system. It is evident that it does not do this separately from the mesodermal layer. Indeed, since all the cells forming the true endoderm and the mesodermal layers arise from the ectoderm, the embryo invites us to consider that they would all be sensory in nature and provide our inner sense of the outer world. (Perhaps also our outer expression of our inner world?) They may form into specific structures but the forming materials and processes all arise from the same original layer, indeed, the one cell (see Ch. 9).

With the forming potentials in place as three layers (and three aspects on either side of centre in the middle layer), the embryo creates its length (from head to tail), its depth (from back to front) and its roundness of form by buckling (folding), taking the amniotic sac with it whilst enfolding the yolk sac.

The midline of the developing notochord, neural tube and somites stiffen the back orientation (dorsal axis) supporting the embryo. The head end, the tail end and the lateral margins all grow around and fold to become the front and sides of the embryonic body. (They bring the whole amniotic sac they are contained within with them, so that the embryo grows inside it, surrounded by it and expanding into it.)

There are three folds; Head, tail and lateral. These attempt to explain this biodynamic origami so that it can be understood in all its three-dimensional (360 degrees) of shape-changing patterns.

Embryonic Folding

The head fold is first (Fig. 5.12). The embryo grows forwards and gradually buckles underneath, bringing the heart from beyond the crown to the front of the body (ventral); the body walls will form around it. A small portion of the yolk sac becomes enclosed with this fold, incorporating the future foregut (pharynx).

Lateral fold. The folding of the lateral sides of the embryo (along its length, making it a lateral fold) comes around the front towards the midline, creating a more cylindrical embryo (Fig. 5.13). As the abdominal wall forms, part of the yolk sac becomes enclosed and incorporated into the embryo as the mid gut (the anlage of the small intestine) and the beginnings of the abdominal (peritoneal) cavity. Mesenchyme and somites form the developing torso segmentally.

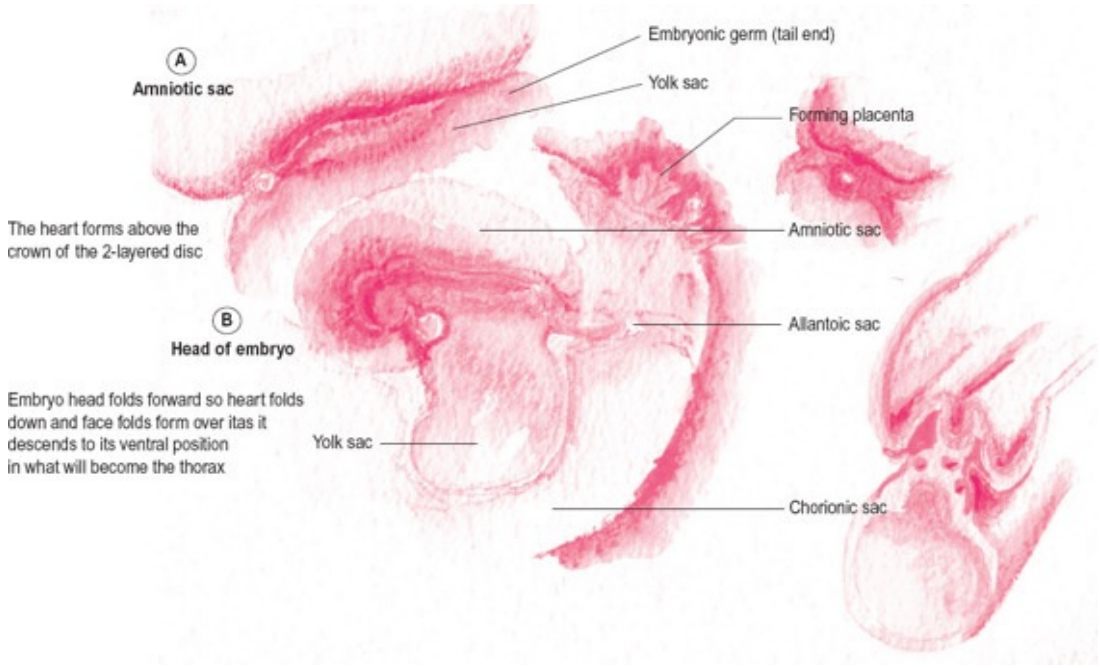


Figure 5.11
The heart starts above the crown.

Tail fold. The tail region of the embryo is last to fold (Fig. 5.14). It grows backwards, lengthening the axial body and effectively drawing the back of the diaphragm down with it as the somites grow towards the tail. It also buckles under the rest of the embryo, bringing the body stalk onto the ventral surface of the embryo and incorporating the hind gut.

Folding Consequences

The consequences of this process of folding are that the ectoderm, which was the outer or upper layer of the embryo, now covers the entire embryo except for the body stalk (Fig. 5.15). The heart and the body stalk are located at the front of the embryonic body because of the head and tail fold. The body stalk will form the umbilicus. Finally during this folding process, parts of the yolk sac become incorporated into the embryo. These gradually form into the gut regions, in concert with the middle layer (mesoderm).

Somites: The Spinal "Spacing"

The growth of the brain, spinal cord and central nervous system is critical for somite development, differentiation and specification (Fig. 5.16). The somites are related to the timing and spacing of how the body walls form (genetically and kinetically) and how the internal spaces are enclosed and segmented. They also play a role in limb formation.

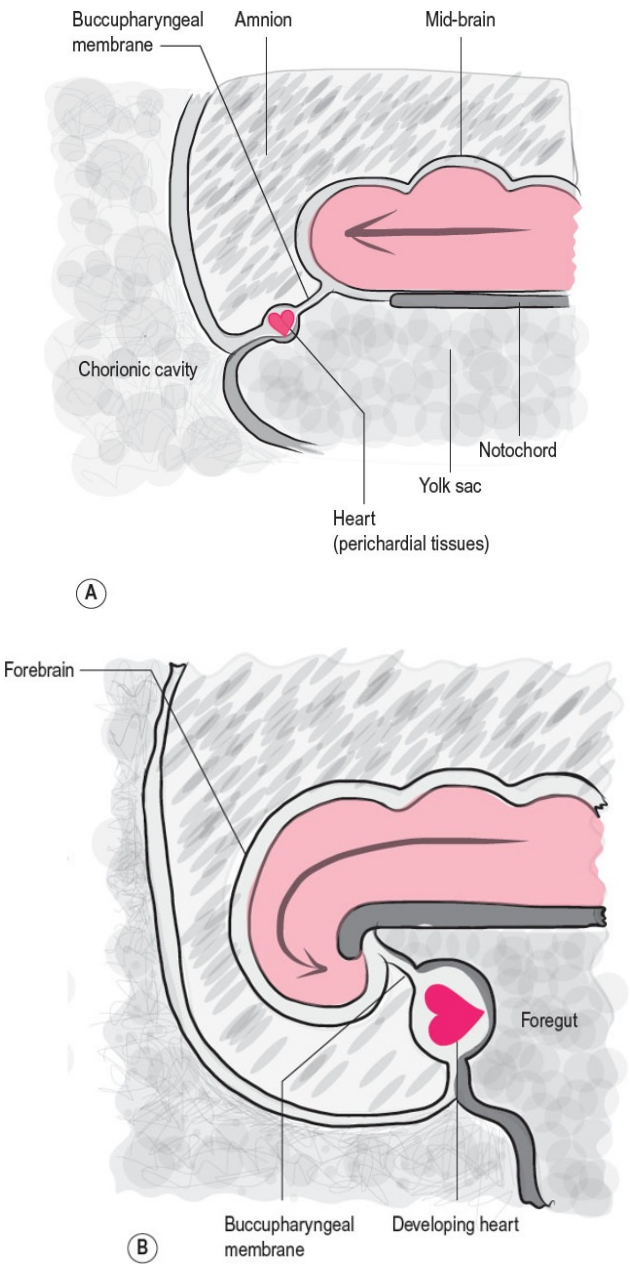


Figure 5.12

The head fold brings the heart to the front of the body.

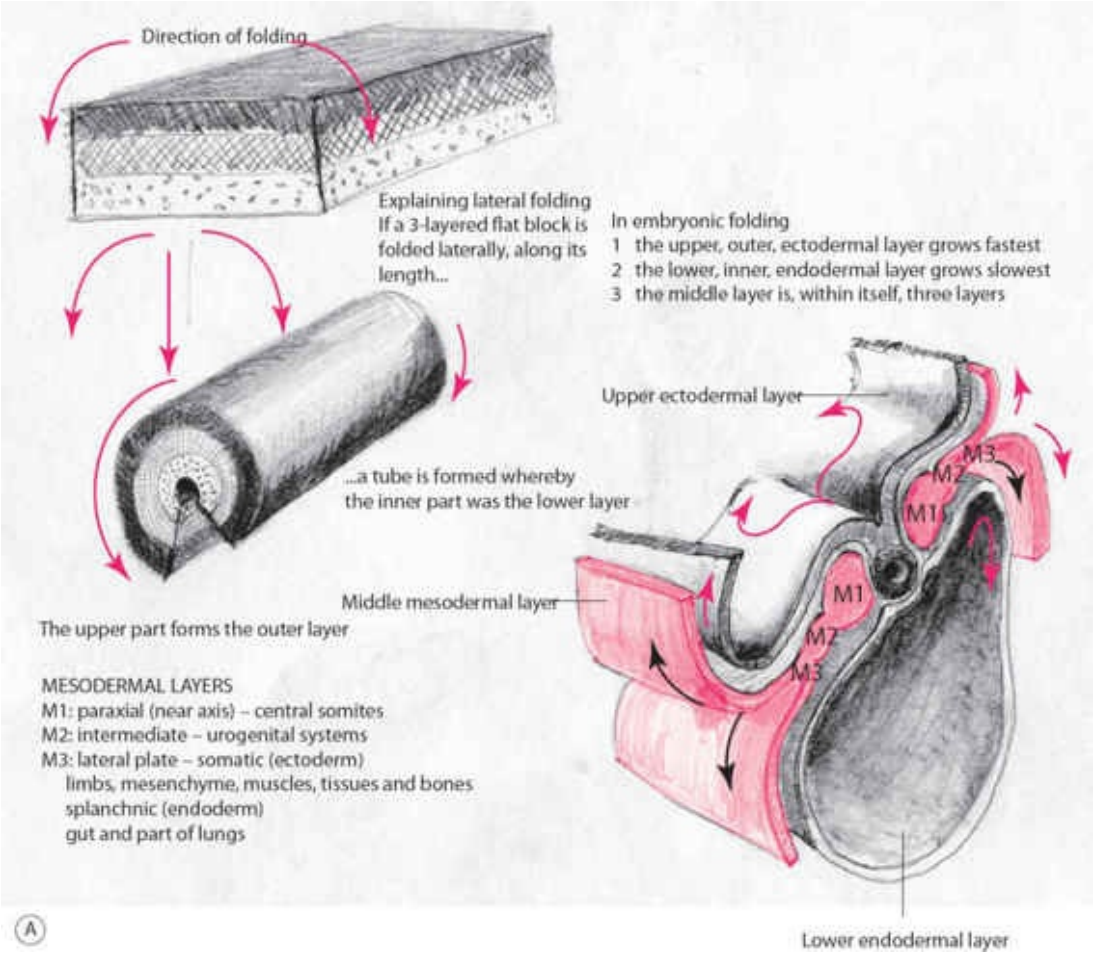


Figure 5.13 (A)
(A) Explaining the lateral fold.

Week 5

This developmental week marks the appearance of the limb buds on the outside and growth of the lung buds on the inside.

The lung buds first appear as an outgrowth from the front wall of the foregut, at which stage the anlage of the respiratory organs, the liver bud and the stomach is closely situated around the heart. The cartilage, myofascial and connective tissue components of the lungs are derived from the mesodermal layer (see note under Lateral folds).

Biodynamic growing forces are also considered to contribute to the formation of the lungs, suctioned outwards into the growing space around the heart that was formed in the folding described. Originating from the endodermal tissues, the mesodermal layer forms the sacs of the pleural cavities (from mesenchyme) and the lung buds grow with the tracheal lining inside their own compartment. Organised in part by the growing heart, nourished by it, and reciprocally enclosed by the pericardial sac, they will grow to fill the thoracic cavity together.

During this folding sequence, there is a gap that forms in the outermost part of the middle layer (lateral plate mesoderm), where it subdivides into two more layers. The gap becomes an internal cavity. This internal cavity then divides again into the primitive heart (pericardial) cavity and the abdominal (peritoneal) cavity. They become distinct and connected to each other by two channels, into which the primitive lung buds form (pleural cavity). Folds form within these biodynamic origamis. They wrap the heart and form between the lung buds and developing mid gut. At the same time they join with a thick plate of mesoderm called the septum transversum ("separating across"). This septum transversum will become the respiratory diaphragm through the intricate growth patterns that ensue. Thus what began as a continuous tube-like structure differentiates into three distinct cavities. The pleural and

pericardial cavities become differentiated and divided from the future peritoneal cavity. In other words, they form the main containers of the upper and lower body cavities. The changing, growing kinetic and genetic signals cause the skeletal muscle cells to infiltrate these tissues and the “crossing divider” (the septum transversum) becomes the future diaphragm, forming the roof of the abdominal cavity and always integrated with the heart and lungs above it. This is then pulled down at the back by the growth direction of the somites, as they predict the formation of the spine. It grows towards the tail as it lengthens and folds under the body. Where this septum transversum is attached to the front of the spine will become the legs (crura) of the diaphragm. In yoga practice we seek to unite breath and motion: the waves of the breath and the movement of the spine. The embryo guides us to recognise that their structures emerge from their original unity.

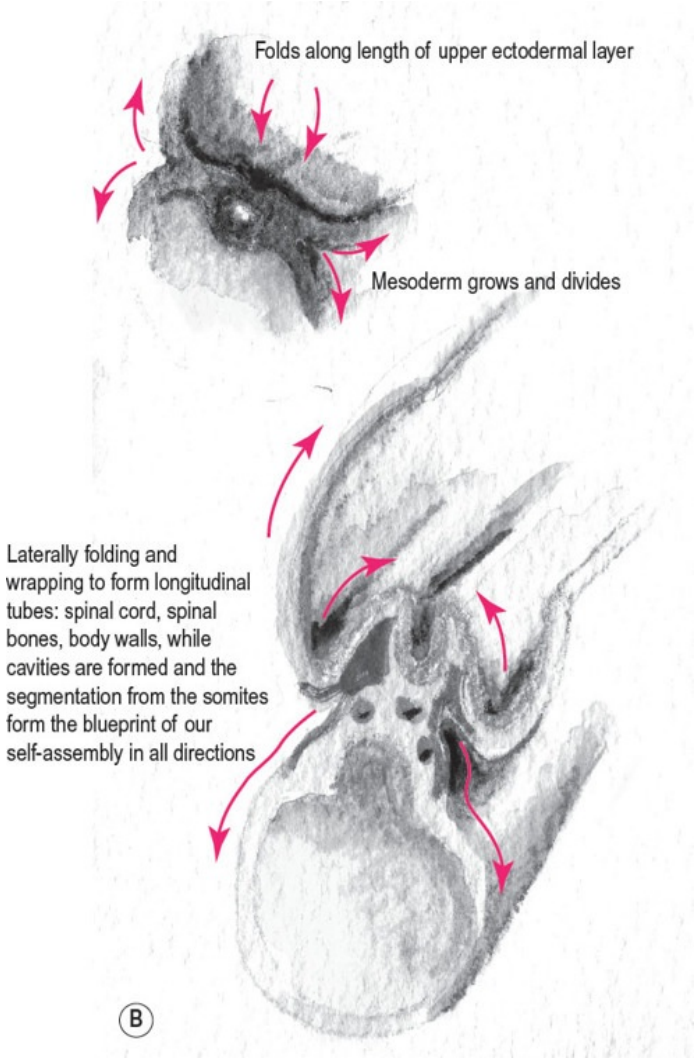


Figure 5.13 (B)
The lateral fold.

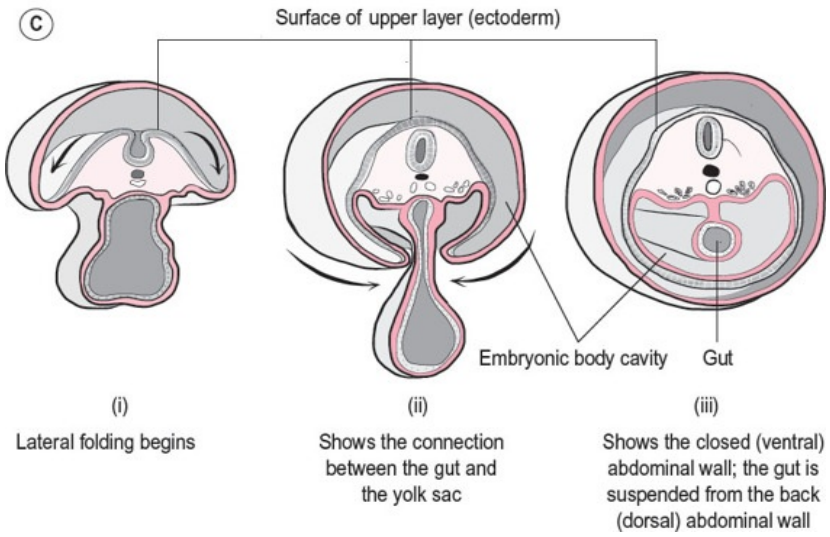


Figure 5.13 (C)
Image modified after T.W. Sadler, *Langman's Medical Embryology* (see note 15).

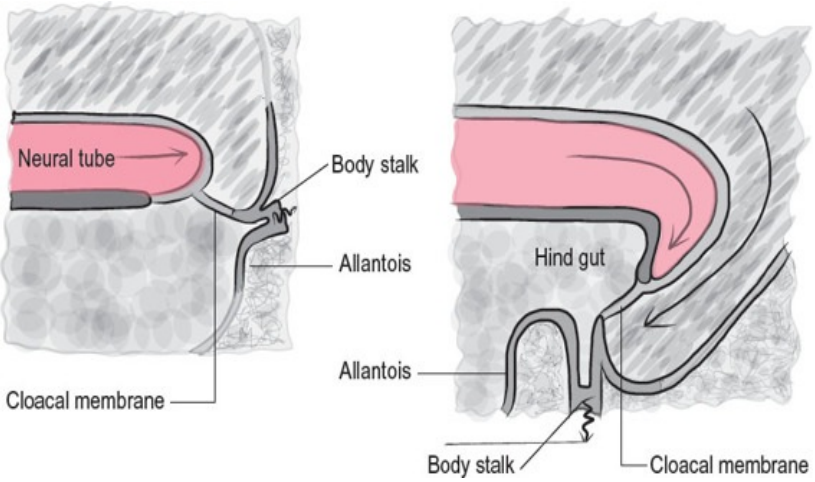


Figure 5.14
The tail fold.

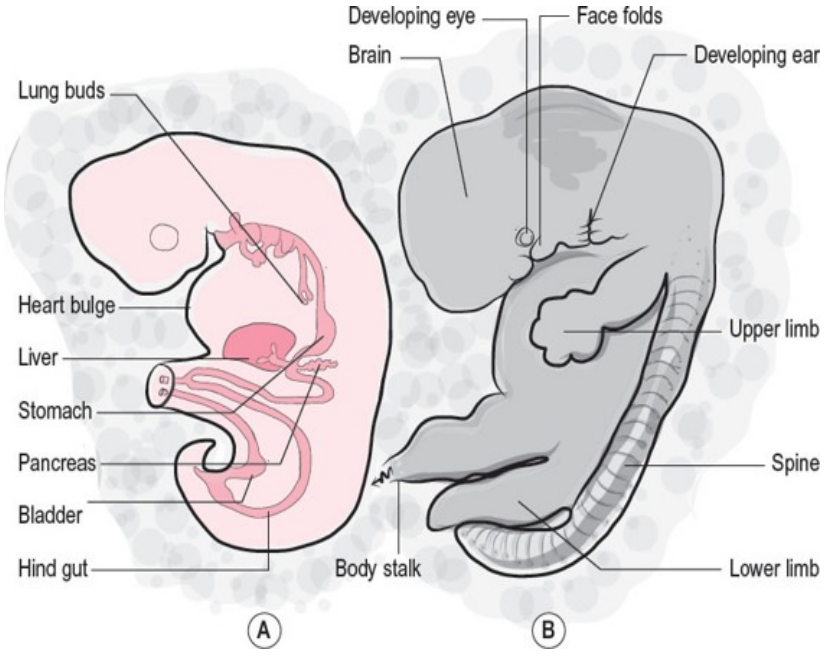


Figure 5.15
The folded embryo showing A: some of the gut development at approximately Day 31 and B: the formation of the face folds; developing ear

and eye (approximately Day 36). The hand and upper limb are forming before the foot and lower limb.

"The very development of the respiratory tract and the lung is therefore a remarkably differentiated beginning of the subsequent activity we call breathing. Strictly speaking it is incorrect to talk of the 'first' inspiration after birth. Breathing movements, by which air is sucked in and expelled from the lungs, are late consequences of the most complicated processes that were established and regulated long before birth."[18]

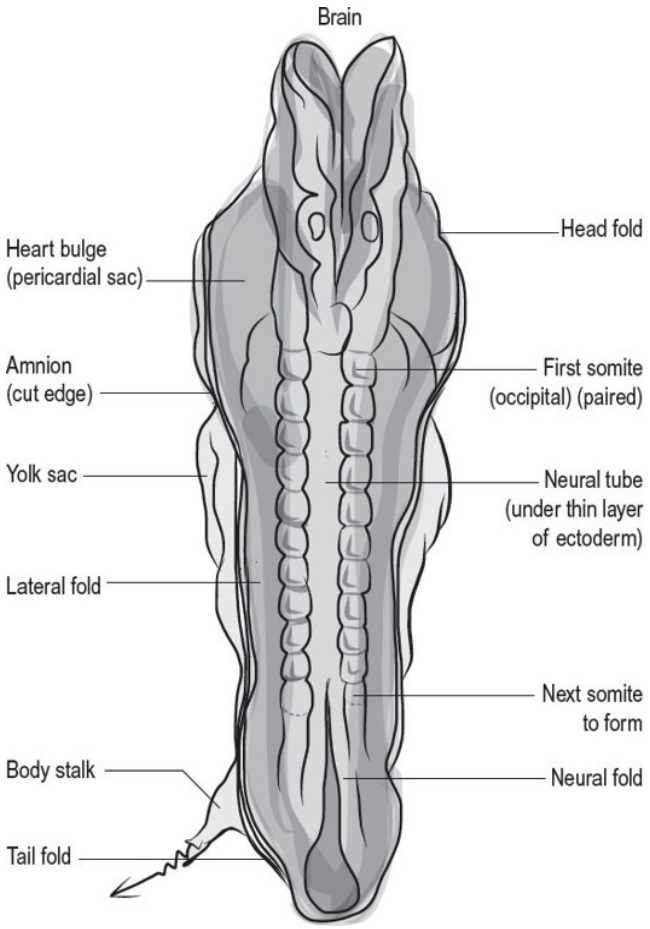


Figure 5.16

The somites grow from the cranial base towards the tail. Each pair predicts the upper and lower half of subjacent vertebrae; prescribing the spaces between them in the spine. They also grow and form the body wall; tubes within tubes and chambers within chambers. They play a primary role in designating the formation of what we might think of as our "growth rings" as well as their segmental arrangement. It is in all directions.

Somites are transient features of the embryo (they come and go during the embryonic period). They initiate tremendous change and transformation in that time. They form in pairs from the base of the cranium towards the tail, in concert with the mesodermal mesenchyme, into regions. These regions will become the parts of the outermost skin (dermatomes), the inner bones of the spine (sclerotomes) and the muscles and connective tissues between them (myotomes). Some of the somitic cells also migrate to enter the developing limbs.

Somites are particularly significant for our understanding of the spine. It is a common misunderstanding that a pair of somites gives rise to either side of a single vertebra. They certainly contribute to the length and depth of the spine in sequenced intervals; however, they do not just predict bony blocks. They prescribe the spaces *between* the vertebrae, where nerves exit and linking facets form. Each pair of somites represents what will become the lower half of one vertebra and the upper half of the subjacent vertebra.[17] They create the feature of vertebral segmentation, predicting placement of ribs, discs and organising tissues of the body wall.

The limbs. As the embryo develops roundness, there is an ectodermal ring all around the outside, like a kind of "side seam" of the embryonic body. As cavities form inside, limb buds appear at the upper and

lower points of the torso. At first they grow as undifferentiated mesenchymal buds, eventually forming flat, paddle-like structures.

In this fifth week there is further differentiation of the eyes and detail of the beginnings of the mouth and jaw formation.

Week 6

> These segments form the "disjoints" in the spinal organ that allow us to move the way we can, intimately linking the breathing, spinal and sensory structures of the torso.

By this time, there is more detailed formation of the ear and development of the torso myofascial architecture.

As the young limb buds appear they are *fed from the heart*, vascularised by circulatory vessels in the tissues. The anlage of the bone (cartilage) grows in a piston-like manner outward, while the softer tissue is limited and tethered by the growth of the blood vessels (from the heart) on the medial side. Blechschmidt[20] suggests that this contributes to a growth pattern of a medially rotated lower arm.

Also at this time in the embryonic sequence, the heart becomes more differentiated. The limbs grow, and grooves in the hand and foot paddles appear. In the following week, these will become spaces between the digits. (We might call this further differentiation in the process of spacialisation.)

Week 7

The rays of the fingers and toes become apparent (Fig. 5.17), and the eyelids begin to form. The eye primordium is completely embedded in mesenchyme, while fibres of the neural retina converge towards the optic nerve. The face begins to change, as the facial prominences fuse (the meeting of the lateral folds) and the jaw and nasal swellings form the upper lip.

Week 8

> *"Muscles, tendons, ligaments and bones take on identity in concert with arteries, veins, nerves and the organs and life plans they serve. The overall musculoskeletal signature of a bear or walrus is different from that of a mole or owl, and that difference is established by small, accumulating embryonic strokes that proceed in waves from the neural tube and somites."*[19]

The limbs become longer and bent at the elbows and knees, with fingers and toes free to move individually (Fig. 5.18). In van der Wal's way of seeing, they form the "disjoints" in the continuity of the soft tissue limb growth, in order that movement can be facilitated. This image shows how the anlage of the bones is first formed in cartilage. However, this style of presentation focuses upon the bone growth, when in fact the soft tissues *including the fascia* all play a role in the biodynamic kinetics (as well as the chemical genetics) from which the architecture forms itself. It is from the original meeting place of the amniotic sac and yolk sac. It never ceases to present emergent properties from the surrounding context of the mesenchymal milieu in which it resides. As such, Fig. 5.19 presents it slightly differently to include the surrounding tissues and growth directions of the whole form.

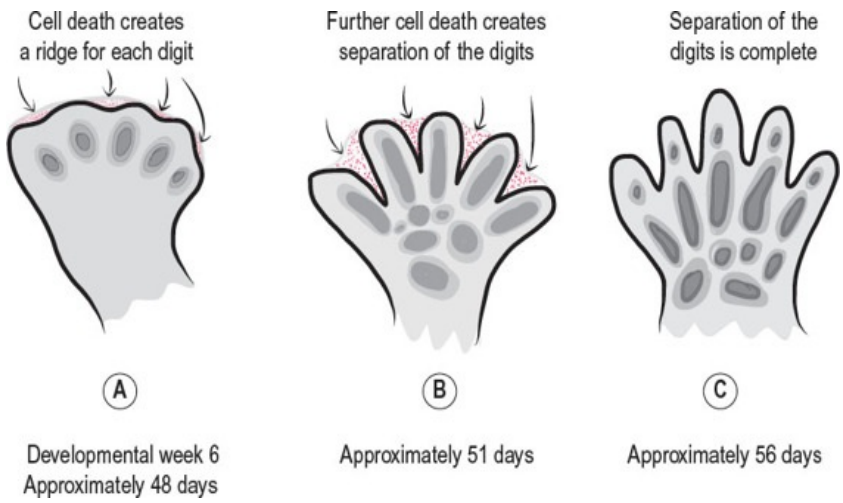


Figure 5.17
From a paddle shape, the hand begins to develop as spaces are formed between digits.

Blechschmidt suggests that all muscles grow into part of a myofascial sling:

> *"Seen from the perspective of developmental dynamics, muscles cross joints because the muscles develop in segments of various large [connective tissue] slings systems and joint spaces arise within the compass of the same slings. … the tissue at the periphery of the space becomes stretched forming the joint capsule. Those parts of the joint capsule that are particularly well stretched are called ligaments."*[21]

This is the basis upon which van der Wal considered the tissue-sparing dissection we referred to in Chapter 3. He revealed the continuity of the fascial slings that the muscle cells originally rely upon (see Evans et al.[22]). With the muscle element removed, the tissue continuity around the entire joint was clearly revealed. This emphasises the significance of fascial continuity as an essential part of our structure and our original motion. Perhaps we could regard it as a kind of soft scaffolding in the formation process. It also endorses ideas of myofascial continuity throughout our form, as proposed in the work of Tittel[23] and Myers,[24] among others: *"Fundamentally there are no differences between the organs of movement in the head, the trunk and the limbs"* (Blechschmidt[25]).

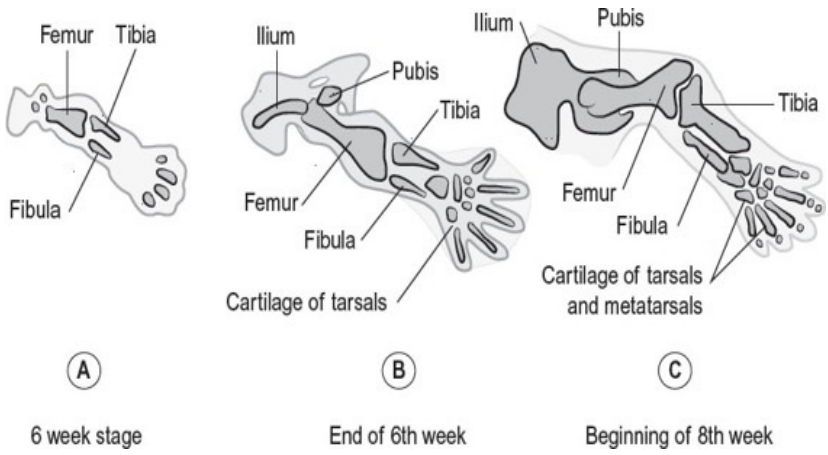


Figure 5.18
Detail of growing limb buds in their metabolic fields, surrounded by the amniotic sac, from which the embryo originally formed in part. The entire development of the embryonic tissues appears as a continuum, which is lost to the limitations of two-dimensional schematic diagrams.

Laying down the rest of the remarkable human blueprint. At this point the embryonic period is considered to be complete (Fig. 5.20). There is a great deal more to grow and form; however, the primary purpose of (a) getting the cells in the right positions, (b) bringing the basic human form into being and predicting the placement of the human anatomy and physiology has been achieved. From this point, the embryo becomes a fetus and (c) continues to develop the rest of the pattern of the remarkable human

blueprint, as the baby does, after birth and onward. It doesn't end in the sense that the baby might be said to continue to develop upon these themes, through all the stages from child to elder.

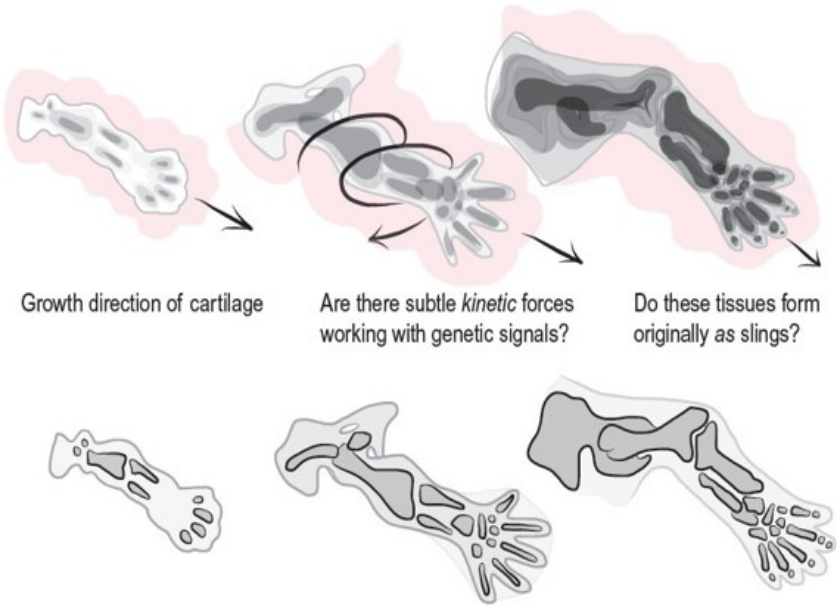


Figure 5.19

Earlier in this chapter we noted the question about connective tissue "the forgotten player" (see note 6) and its primary role in providing the motive force for muscle and bone formation. If it is indeed such a "keynote speaker" in the story of how our architectural self-assembly finds its way into form, how can the surrounding tissues be presented so that they do not appear to have a secondary role in the scheme of things?

Yoga Genesis

In yoga we seek to move and explore being alive in the body's own language, with a quiet mind. We prepare the body for stillness and meditation, another stage rich with embryological symbolism. The meditative practice is designed to heighten our awareness, the involution of our self-sensing senses. Yet it also allows us to absorb and reflect, cocooned in contemplation and conscious of being relatively motionless. We can emerge, nourished and new, reborn after a period of restoration that is part of the cycle of renewal that *Samsara* (meaning "continuous flow") speaks of in yoga. However we describe it, we continue as part of a continuum, stage after stage of ongoing development. Perhaps that is, in itself, the miracle of life.

Figure 5.20

The folded embryo at Week 8: Approximately Day 49. It is about the size of an acorn (30 mm). The eyelids are forming, the limbs and digits are present. It is still bathed in the fluids of the surrounding amniotic sac, from which it formed and emerged originally, the architect of its own architecture.

Notes

1. "The miracle of life", in Part 1 of Vanda Scaravelli, *Awakening the Spine*, 2nd edition, Pinter and Martin, London, 2011.
2. Darrel J.R. Evans, Vice-Provost (Learning and Teaching), Monash University, Melbourne, Australia.
3. Richard Grossinger, *Embryos, Galaxies and Sentient Beings: How the Universe Makes Life*, North Atlantic Books, Berkeley, CA, 2003.
4. Graham Scarr, www.tensegrityinbiology.co.uk/, article: "Geodesic". See also: "Biotensegrity: The Structural Basis of Life", Handspring Publishing Ltd., Pencaitland, 2014.
5. D.J. Evans, P. Valasek, C. Schmidt and K. Patel, "Skeletal Muscle Translocation in Vertebrates", Anatomy and Embryology (Berlin) 211 (Suppl 1): 43–50; 2006.
6. Ibid.
7. Deane Juhan, *Job's Body: A Handbook for Bodywork*, Station Hill Press, Barrytown, NY, 1987.
8. Jonathan, 2011 [YouTube: Morphogenetic fields in the developing frog embryo]. Video can be seen at:<http://phys.org/news/2011-07-frog-time-lapse-video-reveals-never-before-seen.html>
9. Stanley Keleman, *Emotional Anatomy*; originally published in 1985 by Center Press. Keleman has been the director of Berkeley's Center for Energetic Studies since 1971. He has sought to show "the geometry of somatic consciousness" based on the idea that emotional and psychological reality is expressed in physical human shape. Vincent Perez (anatomist and illustrator) depicts Keleman's concepts of somatic function in strong black-white-red artwork.
10. Jaap van der Wal: see www.embryo.nl for papers and courses in which these views are extended and further explained.
11. See Dr Guimberteau's work. Jean-Claude Guimberteau, MD (www.guimberteau-jc-md.com/en/). Both English and French versions are available at this address. His DVD: *Interior Architectures*, is available on the same site. See also *The Architecture of Living Fascia: The Extracellular Matrix and Cells Revealed Through Endoscopy*, Handspring Publishing Ltd., Pencaitland, 2014.
12. Erich Blechschmidt, *The Ontogenetic Basis of Human Anatomy: The Biodynamic Approach to Development from Conception to Adulthood*, edited and translated by Brian Freeman, North Atlantic Books, Berkeley, CA, 2004.
13. Ibid.
14. Ibid.
15. Thomas W. Sadler, *Langmans Medical Embryology*, 11th edition, Lipincott Williams and Wilkins, Baltimore, 2010.

16. Jaap van der Wal, “Proprioception”, Ch. 2.2 in Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012.
17. Darrel J.R. Evans, “Contribution of Somatic Cells to the Avian Ribs”, Developmental Biology 256: 114-126; 2003.
18. Erich Blechschmidt, *The Ontogenetic Basis of Human Anatomy: The Biodynamic Approach to Development from Conception to Adulthood*, edited and translated by Brian Freeman, North Atlantic Books, Berkeley, CA, 2004.
19. Richard Grossinger, *Embryos, Galaxies and Sentient Beings: How the Universe Makes Life*, North Atlantic Books, Berkeley, CA, 2003.
20. Erich Blechschmidt, *The Ontogenetic Basis of Human Anatomy: The Biodynamic Approach to Development from Conception to Adulthood*, edited and translated by Brian Freeman, North Atlantic Books, Berkeley, CA, 2004.
21. Ibid.
22. D.J. Evans, P. Valasek, C. Schmidt and K. Patel, “Skeletal Muscle Translocation in Vertebrates”, Anatomy and Embryology (Berlin) 211 (Suppl 1): 43–50; 2006.
23. Kurt Tittel, *Beschreibende und Funktionelle Anatomie des Menschen*, Urban and Fischer, Munich, 1956.
24. Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
25. Erich Blechschmidt, *The Ontogenetic Basis of Human Anatomy: The Biodynamic Approach to Development from Conception to Adulthood*, edited and translated by Brian Freeman, North Atlantic Books, Berkeley, CA, 2004.

CHAPTER
6

The Breath, the Bones and the Dermatomes

"Consider the psoas as a breathing muscle and the diaphragm as a postural muscle. What happens to the yoga postures or walking or sitting?"[1]

John Stirk

We have begun to reconsider some of the traditional views of the anatomy system to include the fascial matrix as its connecting "transanatomical architecture". Does that connectivity influence our classical definitions of the individual muscles and how they are considered to move? Does it change how we teach yoga and account for the motions of breath, bones and skin as we feel how the segments of the body move and manage motion?

The new distinctions of the fascia shift how we see the whole biomotional body architecture and invite new questions about how actions are allocated to individual muscles. Research presented at the worldwide International Fascia Research Congresses suggests the accepted lists of muscles and the specific movements traditionally assigned to them via the nervous system are simply not a reflection of how we, as animated beings, really move and organise our bodies. According to Robert Schleip:

"when discussing any changes in motor organisation, it is important to realise that the central nervous system does not operate 'in muscles', i.e. a muscle is never activated as a whole."

"To give an example: in real bodies, muscles hardly ever transmit their full force directly via tendons into the skeleton, as is usually suggested by our textbook drawings. They rather distribute a large portion of their contractile or tensional forces onto fascial sheets. These sheets transmit these forces to synergistic as well as antagonistic muscles. Thereby they stiffen not only the respective joint, but may even affect regions several joints further away."[2]

Let us consider what this means by taking as an example one particular muscle in dissection. If some of the traditional actions that classical anatomy assigns to the movements of individual muscles are not necessarily how we move, then what happens to muscle groups such as the "hip flexors", for example? Does it change the way we describe the designated "breathing" muscles? What actually happens in the yoga classroom?

Figure 6.1
Like all the poses, Eagle Pose (Garudasana) is a whole-body posture.

When we do Eagle Pose (Garudasana) we do not activate one arm, lever by lever, or muscle by muscle. However we might describe it technically, we intertwine the arms around the torso in a fluid, integrated gesture. Then we entwine the legs and stand upright, balanced and counterbalanced in global organisation, on one foot (Fig. 6.1). In practising this pose to each side, we ask our body (as a whole) a *kinaesthetic* question, in its own language. We *physically* pose the question of mediating easy respiration, balance and equilibrium throughout the entire organism, while gently breathing and centring ourselves. We ask "how can I express this pose and can I find stillness here?", or "can I transition to the next pose gracefully?".

Explaining how we do this biomechanically, by rules of levers and muscle–bone–joint anatomy, can make it appear to be a very complex process. Biotensegrally, by rules of tension–compression, we are experimenting with balancing and counterbalancing forces through the whole body in response to the ground. We are balancing the inside with the outside, the front to the back, the spiral to a counter-spiral as a whole dynamic architecture; including various soft tissues – all at once in a gravitational field.

Through physically experiencing the posture we are effectively asking the body "how is this now?", over and over again, moment by moment, through practising. By imitating, repeating and mimicking (the teacher, or what we did before), the body learns the poses. It can also explore and accumulate its own sense of balance and variation in different positions and transitions. It does so *in the language of balance and variation*. It amounts to sensing a feeling of poise. This felt sense might be a significant factor of structural integrity, in terms of somatic value (Ch. 9).

Tissue Glide

Far from any benefits of "freeing its wings", the "eagle" will take root while you sort out your supinations from your pronations and

make sense of the flexions, extensions, abductions, adductions and medial and lateral rotations. This is before you begin suggesting which plane you are in (sagittal, coronal or transverse) and whether or not you are strictly doing an anterior tilt of one part or a posterior tilt of another. Lordosis, kyphosis and scoliosis can all become quite subjective in a moment of suspended animation. In a class of flowing yoga sequences, stopping to define eccentric and concentric loading patterns is like discussing paint pigments while looking at an Impressionist painting. It misses the point. The body senses its way through the motions much more rapidly than we can talk it through. It experiences the coordinates by trial and error, developing them in progressively more articulate ways, over time. Just as we learn to walk in our early years, so we refine our movements by moving.

Lightness and grace are dynamic expressions *in motion*, that is, 360 degrees of experience, as felt on the occasion. It gets quite tricky in a movement classroom to work on still frames in an analytical, two-dimensional format. It leaves the movement centre disengaged. This is the *body language* seeking to be heard. It speaks for itself in a sense. It certainly does not speak English or Biomechanics; nor does it translate into them easily. This is the difference between hearing a symphony and describing it afterwards; they are distinct areas of our experience.

Physiologically, at a global and regional level, we are also inviting tissue glide, flexibility and various internal fluid exchanges by squeezing and releasing, folding and stretching, tightening and holding different parts of the limbs at variable angles. By practising the different poses (asanas) we are training the ability to focus and organise our awareness and our attention. As we might practise a language in different situations to expand our vocabulary and eloquence, so we expand physical literacy in body language by inviting different positions. We explore balance and containment by varying the shapes and listening to the different parts of the body doing the weight-bearing or providing the anchor. At the gross, or macro level of movements, however, we do not do separate things and wait for them to behave as if they are joined together. We work as a whole; we come from our connectedness, animating this body-wide signalling system that communicates at different amplitudes throughout the inner matrix, to explore the outer shape. Such sensory listening might be the key to understanding these tissues (Ch. 9).

Doing the different asanas varies the angles and forces through the joints. We can consciously foster the benefits of mobilising and hydrating the joint fluids and tissues so that they express the pose (asana) and our balance in a congruent, healthy way. Numerous subtle things are taking place that make sense if we seek to define them in terms of the whole matrix. They become cumbersome if they are reduced to merely anatomical descriptions or classical biomechanics.

You can try describing Eagle Pose anatomically and/or biomechanically and making sense of the experience of doing it in your practice. It is fun to attempt this exercise because it highlights the rift between the intellectual description of the pose and what your body experiences while doing it. The details of the postural mechanics somehow bypass the feeling of accomplishment and sense of balance you experience when you find the pose in your own way, on both sides!

Yoga teachers are not required to be surgeons or scientists in the classroom, nor are we managing machine parts. The muscle-by-muscle description of a movement can take longer than the movement itself. Ours is a participatory medium. We want to be in motion between speed and stillness, rather than describing it. **How do we use biomechanical terms if the basis of describing muscles as units is lost to the fact that they do not operate that way?**

Keeping Both the Baby and the Bath Water

Tempting as it is to run with the new and abandon the old, fascia alone is not necessarily the answer to everything either. Is it possible to unite classical wisdom with contemporary research and come up with something that makes more sense of both? Where can we look to make more meaningful distinctions in this triumvirate of locomoting tissues, in biomechanical terms, for the whole body, based on *what actually happens*? Bones, muscles and connective tissues work together. The fascial network of tissues

raises new questions but it does not answer them by itself, by definition. How do these united tissues function in a united form? There are several answers to these questions, and some of them wait to unfold in our own experience. Some are even unique to certain individuals and not the same for everyone experiencing a given pose. While the physical laws of gravity remain the same, we can interpret them variously and uniquely at the time.

New Questions Arising

If the purpose of a given movement and the individual yogic postures are divided into categories of purely biomechanical function and positional references, it is possible to lose the somatic point. Reducing the body to anatomical fragments at best creates incongruency in terms of speed and translation into actual movements in the classroom. It tends to leave us in the rift between, on the one hand, the tables in the anatomy book and, on the other, the people on their mats waiting for instruction. Evidently, the named actions of given muscles and muscle groups cannot always account for the subtleties of motion, awareness or micro-movements we (and all our students) are capable of exploring. That is not only in the held postures, when we are seeking stillness and balance, but also in the joined-up kinetic writing of the sequences in fast or flowing yoga practices. We do not "fall off" the asanas in transition, or pump ourselves up with enough breath to make a dash for it before the oxygen runs out. We find ways of organising the movements fluidly, moderating the breath accordingly and sensing where we are from moment to moment through reflecting exactly those possibilities in action. We feel through the skin and feedback from the ground, and our sense of the pose we are in and our relative location in space. We guide (or we are guided) to optimise the ease and grace with which we can flow or spring or hold a position. How do we do those "in-betweens", moving into and out of the asanas? Which biomechanical laws make sense of all of them, *in real time*?

> The body does not stop or wait to *think* about it, once we have become physically familiar with the choreography by practising on the mat. Arguably this is the point of yoga: to create a kind of moving meditation where the mental commentary can actually quiet down. Then we can begin to occupy our physical body from the point of view of the witness, the attentive observer, seeing itself as the observed.

Is there a biomechanical explanation for that whole experience? Are there physical laws of movement expressed by the range of postures that honour the variable ways we can do them? Are there theories that account for what happens, including standing on one leg and balancing on hands or shoulders? Or principles that include the stillness?

Somewhere in all this complexity, semantics begin to dominate somatics if we hunt for a linear explanation in classical biomechanical terms. For people who live happily in (and teach from) their kinaesthetic centre, this is putting things back to front.

The Power of Distinction: An Example

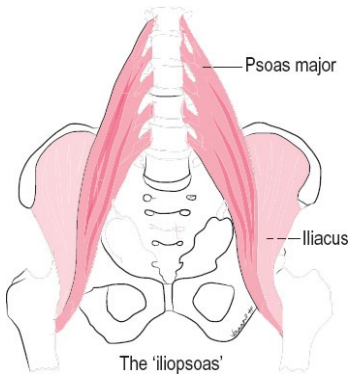


Figure 6.2

These muscles are commonly taught as the “iliopsoas complex”. I was curious as to why they are combined and called “hip flexors” (what we call things makes us think they “are” their names and, therefore, function as such).

One such case arises in considering the psoas muscles as a powerful example of semantics and somatics trying to express each other in real time (where movement classes take place). This is important because we are searching, essentially, for a new language in the new paradigm. How does this intriguing muscle, commonly known as a hip flexor, look before it gets into the anatomy books?

I recall teaching a class after I had spent a long week in the Laboratory for Anatomical Enlightenment in Boulder, Colorado,[3] with Tom Myers and Todd Garcia (2003), being trained in human dissection. It was the first human dissection programme focused solely on the individual Anatomy Trains™[4] described in the book of the same name, by Thomas Myers. We were each invited to choose a favourite muscle and ask to see it on every cadaver.[5] I requested the psoas muscle, intrigued as to why it is often referred to as one thing: the “iliopsoas complex” (Fig. 6.2). (Table 6.1 shows the muscles of the posterior abdominal wall, including the psoas major, in the classical presentation. This table separates all aspects of the anatomy and physiology of the psoas and refers it to iliacus for its actions, assigning them a joint role as one muscle.)

Nothing could have prepared me for the detail I saw in my dissection programme, or for the clear discrepancy between the classical definition and the architecture of this muscle-in-tissue, deeply embedded in its original, although not living, context.

Table 6.1

Muscles of the posterior abdominal wall					
Muscle	Origin	Insertion	Nerve supply	Action	Blood supply
Diaphragm	Xiphoid process, lower six costal cartilages, lateral and medial arcuate ligaments, crura (LI and LIII), median arcuate ligament	Central tendon	Phrenic (C3 to C5)	Chief muscles of respiration	Pericardiacophrenic, musculophrenic, superior and inferior phrenic arteries
Quadratus lumborum	Iliolumbar ligament, iliac crest, lower lumbar transverse processes	Rib XII and upper lumbar transverse processes	T12 to L3	Fixes rib XII, flexes trunk, flexes vertebral column laterally	Iliolumbar artery
Psoas major	Lumbar vertebrae	Lesser trochanter	L2 to L4	See iliacus muscle	Lumbar arteries
Iliacus*	Floor of iliac fossa	Tendon of the psoas major muscle and lesser trochanter	Femoral nerve	Flexes and rotates thigh medially, then rotates the thigh laterally, flexes vertebral column	Iliolumbar artery
Psoas minor**	Vertebrae TXII to LI and intervertebral disc	Pectineal ligament and iliac fascia	L1	Helps flex vertebral column	Lumbar arteries
*Joins psoas major to form iliopsoas muscle **Frequently absent					

(After Table 32.1 in K.P. Moses, J.C. Banks, P.B. Nava, D. Petersen, *Atlas of Clinical Gross Anatomy*, Elsevier Mosby: 2005.)

In *Anatomy Trains*, the muscles are referred to as "myofascial continuities". We learned in Chapter 3 that the fibrils, fibres, fibre bundles, forming muscles and groups of muscles are all wrapped in the "cotton wool-like" weave of the fascial network. It appears everywhere inside and around the muscle tissues. The deeper within a so-called "muscle" it is, the finer it is, being invisible to the naked eye at the innermost layers (endomysium). As such, we will often refer to myofascia where the word "muscle" might usually be used, since muscle tissue is entirely invested with fascia.

A number of things about the psoas became apparent from careful observation:

- It is *intimately* connected, myofascially, with the legs (crura) of the diaphragm (fascially it could be considered continuous).
- It is woven into the *fabric* of the *spinal soft tissues*, deep to the *spaces between* the lumbar vertebrae and the spinal fasciae. (These are strong, tough fibres; the spine does not appear as a clean bony surface as it is shown in anatomy books.)
- Its connection to the spine seems much more elaborate than that of iliacus. It appears as a kind of *guardian of the lumbar curve* from the inside, joining the lumbar vertebrae to the legs, over the pelvis. Thus it would seem able to contribute to pelvic tilt, especially if you include the fascia. Iliacus appears to have a distinct role despite their close affiliation; it lines the iliac bone rather than having direct connection to the spine. They have very different geometries.
- If it plays "best friend" to the iliacus, then psoas is "close cousin" to the quadratus lumborum myofascia (it lies immediately in front of it). This intimate relative is clearly a muscle of breathing. It anchors a floating rib to the back of the pelvis (iliac crest) and spinal tissues. While psoas might play a role in responding to movements with the diaphragm, its cousin might ensure a reciprocal balance behind it for the rib basket. (In some cadavers the quadratus lumborum can appear very small for a strong structural role?)
- Psoas at the front and piriformis at the back of the sacrum are most definitely BFFs (best friends forever) in terms of going nowhere without each other's cooperation[6] or kinaesthetic comment. It is in the architecture.

- The relationship between psoas and iliacus and all the other neighbouring continuities is far more *integrated* than any segregated sections of an anatomy book could imply or reveal (see Ch. 8).
- Paradoxically, however, putting psoas and iliacus together appears to be a somewhat arbitrary affiliation, in that several other muscles could be contenders for the role and be put together as a "complex" or "composite" such as this. They may share certain attachment but so do the psoas muscles and the diaphragm if they are cut out from the fascia differently.
- All these "close-to-the-spine" (paraspinal) muscles *live together* in association, intimately forming a composition of myofascial organisation, deeply woven into the soft tissues around the spine. The anatomy seems to tell a very different story when looking for connectivity, rather than components. Together they manage a cavity and if fascia is a communication system, then our range and detail of integrated motion and breath in the yoga class is endorsed. It calls, however, for new distinctions to make sense of the parts *as unified*.

"Same but Different"

In the opening quotation in this chapter, John Stirk planted a seed of curiosity about the psoas and its links to breathing and walking. We might *think* we know from the semantic label what the somatic effect of this muscle will be. However, seen as part of the fascial matrix (even deceased) its intricacy and detail is overwhelming. Once invited to look for it, the fascia clearly contains and connects spaces and encloses them, everywhere in the three-dimensional form. It is exceptionally difficult to come from such an experience and return to the same dry conclusions, based on schematic diagrams of parts, labelled for their mechanical actions.

Besides the different views of the psoas myofascia, it was also arresting to note the *anatomical differences* between individual donor bodies. Without realising it, one can assume that what is in the books is what will be in the body. While we all expect to look different on the outside, it is a surprise to discover that we are equally different on the inside too. (The anatomy of variation is what is so from the point of view of a continuous matrix: we might dare to say that the exquisite weave between these components is more reminiscent of Indra's Net[7] than as shown in our table.)

Needless to say, from this fascinating encounter, and many since, a similar "story" could be written about many (possibly all) "muscles" of the human anatomical form. None appear as segregated or able to exist or function in isolation. As we saw in Chapter 3, they are all attached throughout their forms.

Classifying the psoas as a "hip flexor" or calling it an "iliopsoas complex" does not make sense after one has seen it so intimately organised with the spine.

A Psoasic Matrix?

The myofascial role of the psoas is closely situated with the legs of the diaphragm (diaphragmatic crura). What could be its role in mediating exactly the moving relationships between the breath, the spine and the legs that we explore in so many different ways through yoga. Given its uppermost position (Fig. 6.3), it must surely be considered to play an intimate role in the shape of the spinal curve and its position in relation to the legs and the breath. When we fold our legs at the groin (hip flexion), does that action make sense of this muscle's classification as a hip flexor, as if it can be treated exactly the same as iliacus? Or looking at it the other way does calling it a hip flexor explain its movement, or risk reducing its scope and assets?

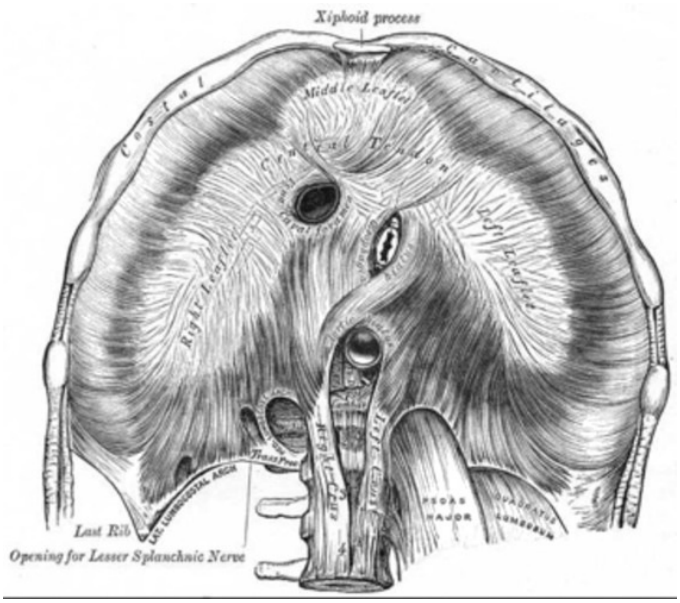


Figure 6.3

This image from an old edition of *Gray's Anatomy* shows how close the psoas is to the diaphragmatic crura. The visceral organs and vessels have all been removed and the visceral and neurovascular fascia, as well as the ligamentous fibrous covering of the spine have been meticulously excised to reveal these deep structures. The outer connective tissues are necessarily discarded to enable the illustration to be drawn as a very "clean" image of the diaphragm, psoas and quadratus lumborum, so that they appear as quite separate units. In fact they would originally have been ensheathed with strong fascial coverings forming layered continuities and relationships, of varying densities, that can no longer be observed.

Many of these questions are addressed in Tom Myers's Anatomy Trains™, assigned to the Deep Front Line. Whether or not these continuities are considered anatomically correct or universal, the point here is that these so-called myofascial meridians pose new questions when seen as global contributors to movement. My experience of the dissection programme had no small impact on my work in manual and movement therapy and training: it transformed my thinking and led me to a different quest.

I found myself privately wondering if I referred to the psoas as the "psoasic matrix" in my mind, would it help to make sense of the dissection I was seeing and the fascial tissues weaving it in to the context of the rest of the body, particularly the spine tissue? Clearly, folding the leg at the hip is a movement involving the psoas. However, one could readily see it plays a part when the leg would be extended, or rotated, or many other positions. Seeing it in the laboratory, before it is excluded from its natural environs, evokes questions and possibilities of something much more refined than hip flexion. Something that makes more sense of what I see in classroom and clinic.

In the classroom, in poses such as Eagle (Garudasana), Half Moon (Ada Chandrasana) and Triangle (Trikonasana), for example, how would this so-called hip flexor be authorising or assisting the integrated leg movements (not to mention animating the breath, balance and poise)? How would it express what happens differently from one side to the other? Graceful transitions are something life (with or without yoga) demands. It seems evident that there is a difference between the detailed sculpture of the tissues *in situ*, the movements assigned to them and the classification of "iliopsoas as hip flexor". It seems to reduce what happens on the mat, making it less than the architecture might imply.

New Distinctions

During a later dissection opportunity, Robert Schleip responded to my endless questions around this intriguing myofascial complex by saying, "rather than considering it as a hip flexor, think of it as a spine stabiliser and it will make much more sense to you". Considering iliacus as a hip flexor (with rectus

femoris) and psoas as a spine stabiliser also makes more sense of their roles in yoga, especially in the more complex poses. I liked the idea of multiplying up to a range of functions that moves towards our experience of subtle corrections and balances. When an asana calls for the breath to be integrated with balance and folding quite differently from one side to the other, the ability to find and respond to the position, breathing steadily, is far better explained this way (Fig. 6.4). A close relationship between the psoas and the spine, including the diaphragm, has to be available in the living body. It is evident in the architecture and the experience. In many postures, the pair of psoas muscles (the psoai) have to negotiate differently from left to right, obviously, in concert with many aspects of the surrounding architecture and the breath. This is what yoga explores and I began to see why the question posed by John Stirk in this chapter's opening was so valuable.

Figure 6.4
En route to full Head to Knee Pose (Janu Sirsasana).

In postures where the left psoas has to do something different from the right psoas (Fig. 6.5), the common denominator is the spine, not hip flexion. Doing the pose to both sides is an enquiry into instinctive balance. It is the variation and possibility of loading patterns whilst maintaining integrity of breath and poise that is the purpose of our enquiry. Do we bring variability and range by practising this ancient art, so that these deep structural myofasciae can get on with the integrated task they know anyway, whatever we have called them?

I have grown to appreciate and respect the psoai as mistresses of integration in breathing, walking and spinal stabilisation; that is, in rotation, counter-rotation, side bending (lateral flexion) and forward and back bending (flexion and extension) postures. They are in close partnership with far more than their adjacent iliaci. However, before further discussion about any one particular member of our bodywide myofascial family, let us bear in mind that such a story can be told about many individual muscles, before they are cleaned up for presentation as isolated phenomena. *The role of the psoas here is as a symbol of a new challenge*. How can we meaningfully expand and evolve our thinking to a more global context that makes sense of the whole spine within the collagen matrix? How can we name the hundreds of myofascial units operating in this whole tensional architecture called "human being doing" or "you in action" in an appropriate way without reducing them to "actions" that they are not limited to?

Figure 6.5
Lord of the Dance Pose (Natarajasana).

Maps and Territories

The London Underground (subway) map provides a useful schematic, a topographical diagram that indicates only the approximate location of the system's stations relative to the others on the line. It is very useful, as long as there is no expectation that it shows the correct distance between stations, or that the stations will look the same in the real-life experience of arriving at one of them.

Prior to the first dissection I experienced, it was apparent that I had lived with similar topographical notions of human anatomy *as if they were the territory*. I had collapsed the distinctions of anatomy and *natural* or so-called "functional movement". One is clearly not derived from the other, unless you restrict the definition to a very limited version of what can actually happen in the classroom.

> Anatomy may provide a kind of grammar, but it does not necessarily tell the different stories these architectural components can present depending on how each of us uses them. Any yoga practice, dance modality or physical performance is like a tale told by a kinaesthetic author: the person in action. The point is we speak that somatic language pretty fluently in as many and various dialects as we have bodies to express. Yoga can serve to support the range and subtleties we have access to.

Even my work learning and eventually teaching with Tom Myers, in Structural Integration and Anatomy Trains, had not prepared me for seeing muscles so intimately interwoven and continuous in longitudinal, lateral and layered relationships with all our parts and forms. They are *anything but* discrete units, even in cadavers. They are completely connected to each other and surrounded. Not even a suite of muscles can operate without affecting the rest of the matrix; it becomes obvious once dissection begins. Once again, Indra's Net seems a more appropriate model than Table 6.1.

The problem lies in the assumption that the "map" (and the action assigned to an isolated schematic of a muscle) explains functional movement and the form of the territory. Maps are two-dimensional guides and thus distinct from the experience of the territory. They are an entirely different quest to understanding yoga in the living body, which is unique to each of us. The latest research is making more sense of that as experience rather than reducing it to separate aspects of what we *think* happens. This is the shift to a bigger explanation for global movement of the whole body. It brings into distinction the communicating network of tissues within our whole form, working together. It does not necessarily make the

explanations/classifications for local parts wrong, but it does absorb them into a bigger context. The psoas does indeed play a part in hip flexion; however, while that may be its occasional job, its vocation is evidently to a higher calling.

En Route

We will go on to consider Myers's Anatomy Trains map in Part 2, as it helps to provide the sense of continuity that you see in the body, at least longitudinally, if it is suitably applied to movement. It is a stepping-stone towards realising that to some extent we each mould this matrix through the way we use it throughout our lives. In yoga, the Anatomy Trains provide a useful reference for assessment, guiding you in optimal ways to assist a participant (Ch. 12). With certain established common (tissue) denominators, we write our own story in our own language on the pages of our own tissues in our own way. (Some writing is more legible than others.)

What we are looking for is an intelligent basis for understanding how movement forces move through us and how we negotiate them *as we move*. Graceful transitions and fluid interpretations call for more subtle and less mechanical explanations than the names allocated to muscle actions might imply. *The way* we apply the classical versions of that knowledge is what we are curious about here: seeking a new context for all this content. You cannot necessarily deduce natural function from anatomical classification.

What Then?

Seeing the "psoasic matrix" at such close quarters ignites curiosity. There are four key things that stand out:
(1) the unified whole-body cavities; (2) the lateral diaphragms;
(3) the one and the all on every scale; (4) the proportion and primary role of the spine in the body.

(1) Unified (whole-body) cavities

Experiencing how completely unified all the layers and cavities of the torso are bridges the gap between the books about movement and the experience of motion. With the organs removed, the abdominal cavity appears as a whole container. The layers of transverse abdominis, internal and external obliques, rectus abdominis, pelvic floor and the diaphragm overlap and wrap to form the top, bottom, front, sides and roundness of the whole container, backed and supported by the lumbar spine curve. They enclose the abdominal (peritoneal) cavity in all its volume. Rather than considering them as if they are separate, if we look at them together, they multiply up to a complete and relatively thinly clad chamber. They are pierced above and below by the continuity of the gut, the neural and circulatory vessels and the urogenital openings, but otherwise entirely unified by the connecting tissues of these variously soft walls. They do not experience themselves as separately organised units in isolation, whatever exercises we think we are imposing on them, one at a time (like abdominal crunches for example). We saw in the last chapter how the embryo forms these cavities by enfolding them, in the original "bio-organic origami" process of embryogenesis. We are self-assembling forms, kinaesthetic architects of our own developing design – at all times a *whole* work in progress.

Figure 6.6

The diaphragm forms a double dome across the entire cavity, attached in 360 degrees to the inner body wall. We “know” this. However, seeing in dissection that the pericardial and pleural sacs are distinct but nevertheless exquisitely shaped by each other’s neighbouring forms (including the uppermost layers of the diaphragm) emphasises their intimate and original forming relationships (see Ch. 5). Seeing how their respective cavities are shaped by the neighbouring layers shifts the perspective irrevocably.

(2) Lateral diaphragms

The second aspect is experiencing the diaphragm as an arched, lateral myofascial sandwich that is tensioned across the whole torso, between the abdominal (peritoneal) cavity below and the thoracic cavity above (Fig. 6.6). It is deeply integrated with the heart and forms the base of the heart (pericardial) and lung (pleural) cavities: all are attached to the soft tissues of the thoracic spine and supported by its curves. (This is no surprise to us, after learning the basics of embryogenesis, but somehow they are more intimately interrelated than we might generally imagine from separate maps of them.)

The heart and lungs are all enclosed by the ribs, which are like wrapping, angled bones of a corset, tightly bound stiffeners issuing from between the vertebrae. They encompass the upper torso but remain deeply integrated with the body walls and distinguished by their respective cavities, all held open under tension. In a soft, living, breathing body they can act like stiffeners in the breathing, pulsing body wall.

In a later dissection in the programme,[8] the myofascia of the pericardial tissues surrounding and forming the heart cavity demonstrate continuous connections with the throat and tongue. This makes perfect sense in embryological terms, because of their forming sequence (Ch. 5); it is part of our most original developmental pattern. We speak from the heart both physically and metaphorically, if the interconnecting continuity of the fascial web is included.

The breath and bones and body wall of the torso are not separate anywhere. Mediated by the soft tissues and septae, *their relationships* and ability to glide, stretch, expand and squeeze and release are the foundation of our functional movements, that is, the moves we make to do the poses and the internal organisation that follows naturally. Indeed, function and form appear to be intimately co-creative elements of our living bodies. I no longer see the logic in naming specific muscles as “breathing muscles” or “accessory breathing muscles”. Part of our ability to breathe is in response to gravity, so can we wisely segregate muscles of breathing and walking?

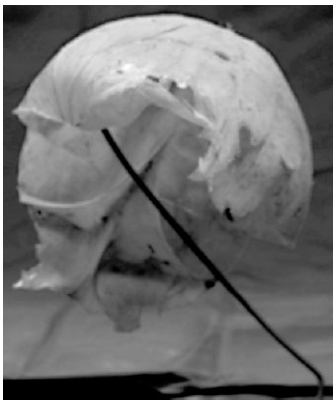


Figure 6.7
Some of the fabric of the fascia inside the skull and around the brain, dissected intact by Todd Garcia (see note 10) and photographed by Shane McDermott (reproduced with his kind permission). This enclosing tissue does not stop where it has been cut here; it is continuously expressed as a continuity throughout the form.

There is a pattern of organs contained by cavities; cavities contained by the body walls; adult versions of the embryonic chambers within chambers. We appear, from the outside, to move these as a whole, pre-stiffened or tensioned by our organisation. One that biotensegrity makes sense of as a constantly changing dance of uniting opposing forces to bring them to neutral balance (see Chs 7 and 8). We feel and sense these containers through the movements. They can yield to and authorise those movements at the same time, changing with our adaptable responsiveness.

Books describing the lateral myofascial bands and diaphragms[9] begin to make sense of the body, divided across or sectioned by the bandhas described in yoga practice. There are whole cylinders within cylinders, tubes within tubes, as Stanley Keleman and others have pointed out.[10] The brain sits in the highest position overall, enclosed within the cranial vault and its own continuous container of connecting tissue (Fig. 6.7).[11] There is continuity between these cavities, not just from the spine. The wrapping and interwoven nature of the tissues simply connects them all, yet distinguishes them at the same time. There is a paradoxical aspect to it.

How did we come to consider the parts of the body as anything other than entirely continuous? They are united by the fabric and forms of the axial (except girdles and limbs) and appendicular (girdles and limbs) skeleton, wrapping them in the continuous matrix of tissues and continuously wrapped in periost: the fascia around all the bones. In the embryo, everything grows from the original conceptus. In the adult, the connectivity of the whole form is still in place. Nothing is separate; everything can be traced back to everything else, via these tissues. They span the spaces as well as the organs and bones, forming the extracellular matrix. Is there anywhere they cannot be found?

(3) The one and the all

It becomes hard to separate any one from the all. Yoga is about the whole body, honouring all of its detail. This invites me as a yoga teacher in to the chasm between general academic anatomy or biomechanics and living, moving, breathing people, in all shapes and sizes, who do poses. Do we limit someone's ability by designating a muscle as responsible for a single action? More to the point, even if the psoas *is* a spinal stabiliser, or a hip flexor, do we need to know that in order to do yoga well? Yoga has been practised beautifully for centuries, without necessarily knowing much about the psoas, or that possibly the least of its roles is as a hip flexor. Yet the practice of yoga can and does free many a stuck pelvis or disorganised lumbar spine, when used appropriately, through the sensory refinement of the individual practising it (and

the guidance of their teacher). It *can* facilitate the body to sort itself out and relieve pain. Does intelligent movement become more kinaesthetically conscious if we name the parts involved? Can we make a bigger difference by appreciating the *relationships between* those parts as having more than a subordinate role? While it is clearly so useful to know the topographical map; how do we usefully guard what we make it mean?

(4) The proportion and primary role of the spine and axial skeleton

The fourth point is about the scale and strength of the spine, the spinal joints and the tissues that hold them together. It is about knowing that, in places, the collagen formation holding our bodies together has the equivalent tensile strength of steel wire (Ch. 10).[12]

The spinal segments are the dominant feature of the axial body. The larger part of the depth (front to back) of the torso is taken up with the spinal vertebrae, from the front of the vertebral bodies to the ends of the spinous and transverse processes. Their arrangement and the spaces (discs, foramen, etc.) between them, authorise the shape of the body wall and deeply connect the muscles, viscera and vessels. They invite us to recall the somites (and their echo in the dermatomes) from Chapter 5 (Fig. 6.8).

The body wall reflects the segmental rings first prescribed by the embryonic somites (they are organs of the body wall in our earliest stages of formation). They played an original part in creating these lateral rings – presented in the skin as dermatomes (see Fig. 6.8). (See Ch. 5, Fig. 5.16, for an illustration of the somites.) Their role in "spacialisation" of the spine designated the spaces between each of the vertebrae, where nerves exit from the spinal cord, discs organise and ribs and psoas integrate. We are more familiar with these segments grouped as sections of the spine (sacral, lumbar, thoracic and cervical).

The spine does not make sense if it is described only in sections, as if the sections are separate or as if it functions on its own, as it appears in the typical classroom skeleton. It forms one continuous structure. Our sense of its wholeness in yoga, in postures and in meditation, seems to be extremely valuable once it has been seen so entirely connected in dissection.

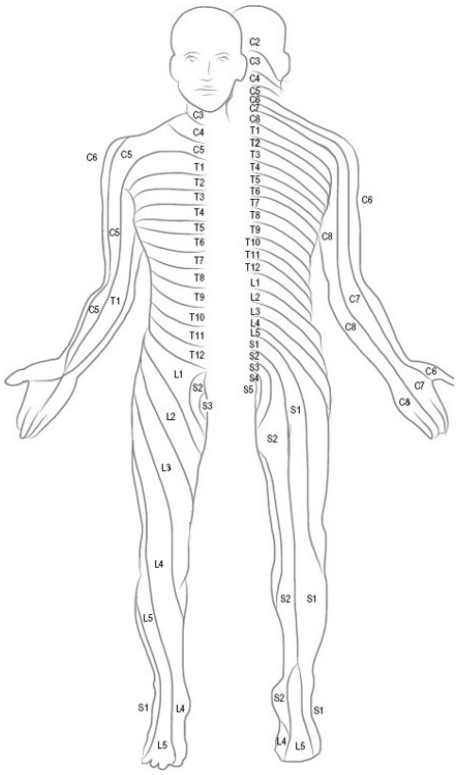


Figure 6.8
The dermatomes are illustrated on the body, sketched as rings with the related vertebral level, to show approximately where the skin is considered to be innervated segmentally.

"Each of the yoga poses is accompanied by breathing and it is during the process of exhalation that the spine can stretch and elongate without effort. We learn to elongate and extend rather than pull and push. Elongation and extension can only occur when the pulling and pushing have come to an end."[13]

How can we separate breathing from sensing and moving our innermost bones and outermost skin, communicating from the ground in any movement class? Perhaps yoga luminary Vanda Scaravelli was right about how important our focus is on the strong, graceful wave of the awakened spine. In practice, it shapes the breath and is shaped by it.

Now What?

Naming a muscle and classifying it is one thing. Finding out that muscles do not work as functional units is another. Understanding how a myofascial suite of tissues plays a role, within a body-wide web (possibly uniquely for each participant), is yet another thing to consider. How is it possible to understand something whole and connected; something more fundamental than the naming of functions and labelling of parts, especially if that makes each part (i.e. muscle) restricted to specific actions, when they are not? I was left wondering what could actually make a difference to my classes and give the teachers and students I work with something that makes sense for them.

A Fascialogical Context

With the fascial tissues in place, different questions arise. As we learn more about them, the need to shift how we see movement in an animated body is obvious.

Anatomists portray what they see, but they see it through the lens of a historical viewfinder that traditionally removes the fascia in order to see the parts "cleanly". Once removed it is hard to put back. Removing the ubiquitous fascial matrix (and presenting the parts as if they work *in function* without it) misrepresents wholeness, however you look at it. Despite the common acceptance of its legitimacy as a method, in the face of whole function it is simply not all that is there. Anatomy as traditionally presented may be an exquisite view of what is *left behind after fascia is meticulously removed and placed in the cadaveric bins*, but it is claimed to be something more. It is presented as being a perfect, clean dissection; as if that is the best way to learn about how our parts work.

Paradigm shifts can be uncomfortable, however enlightening they are. If we stay tuned to the yoga experience while we traverse the landscape in the rest of this book, though, we can expand to include new possibilities that account for what actually happens in class. We recognise that we experience the body as whole and complete by virtue of moving it. It may sound simplistic or even obvious, but in some ways, uniting the parts into one coherent whole clarifies everything. It takes us from the numerous different parts shown in the books to the unified whole being that walks into the classroom. We breathe, move our own skeleton, embedded in soft tissue, and sense where we are segmentally and globally as we do so, cavity by cavity, segmental wave by wave, and all with breath, bones and dermatomes intact.

Notes

1. John Stirk, Osteopath and Yoga Teacher, comment during a training session, 2000.
2. Robert Schleip, "Foreword", in Luigi Stecco and Carla Stecco, *Fascial Manipulation: Practical Part*, English edition by Julie Ann Day, foreword by Robert Schleip, Piccin, Padua, 2009.
3. Laboratory for Anatomical Enlightenment, Inc. (http://lofae.com/about-us/index.html).
4. Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009. Also note the DVD with this second edition as a resource.
5. The author would like to express her reverent gratitude to all donors and their families for the value of their donation.
6. Thomas Myers, "Poise: psoas-piriformis balance", *Massage Magazine* Mar/Apr 1998.
7. Indra's Net Wikipedia (http://en.wikipedia.org/wiki/indra's net). Indra's net is a metaphor for the non-dual nature of all.
8. See www.anatomytrains.com for DVD of this dissection programme.
9. For example, R. Louis Shultz and Rosemary Feitis, *The Endless Web: Fascial Anatomy and Physical Reality*, North Atlantic Books, Berkeley, CA, 1996.
10. Stanley Keleman, *Emotional Anatomy Emotional Anatomy*; published in 1985 by Center Press. Stanley Keleman, director of Berkeley's Center for Energetic Studies.
11. Todd Garcia, Laboratory of Anatomical Enlightenment, Inc. (http://lofae.com/about-us/index.html).
12. Dean Juhan, *Job's Body*: *Handbook for Bodywork*, 3rd edition, Station Hill Press, Barrytown, NY, 2003.
13. Vanda Scaravelli, *Awakening the Spine*, 2nd edition, Pinter and Martin, London, 2012.

CHAPTER
7

Spines, Lines and Automobility

"The commonly accepted 'tower of blocks' model for vertebrate spine mechanics is only useful when modeling a perfectly balanced, upright, immobile spine. Using that model, in any other position than perfectly upright, the forces generated will tear muscle, crush bone and exhaust energy. A new model of the spine uses a tensegrity-truss system that will model the spine right side up, upside-down or in any position, static or dynamic. In a tensegrity-truss model, the loads distribute through the system only in tension or compression. As in all truss systems, there are no levers and no moments at the joints. The model behaves non-linearly and is energy efficient. Unlike a tower of blocks, it is independent of gravity and functions equally well on land, at sea, in the air or in space and models the spines of fish and fowl, bird and beast."[1]

Stephen Levin

As movement teachers we have to hit the ground running. People who sign up for a yoga class want you to join the dots at the speed they can move and understand the ways they can do it. They want those ways optimised, so what aspects of biomechanics do we need to learn in order to enhance and ensure this optimal practice? In the last chapter we considered that muscles do not, in fact, function as units; which changes how we might explain their actions. There is still a difficult gap between classical biomechanical explanations of movement of our parts and the natural experience in the yoga classroom of how participants move, as a whole. This is especially challenged when considering the fascial matrix as a *tensional* network under the evolving laws of a biotensegrity architecture. How does the fascial context shift or expand these ideas in ways that can help us to bridge this difference?

Moving Architecture

In standard biomechanics the first thing a new student is invited to do is work from an imaginary axis: a central vertical line down the middle of the body that acts as a reference point for the planes: sagittal, coronal and lateral, separating the body into right/left and front/back and upper/lower aspects, in order to describe human actions by reference to these angles and dimensions (Fig. 7.1).

However, we do not in reality have a straight line down the middle of us, and we do not move in straight lines or flat planes. There are no such things in the body, nor can the body express them. We do not stand in the anatomical position and our spines do not behave as vertical columns that have to be upright to function. It is painfully difficult to make sense of yoga in these terms, even on paper, let alone at the speed of a classroom full of self-contained whole bodies. Does this then invite us to search for a more useful starting premise than this imaginary *straight* pole? Perhaps evolution gives us some clues. According to Serge Gracovetsky, Stephen Levin and others (see the notes and suggestions for further reading at the end of this chapter) it shapes our fundamental movement patterns profoundly.

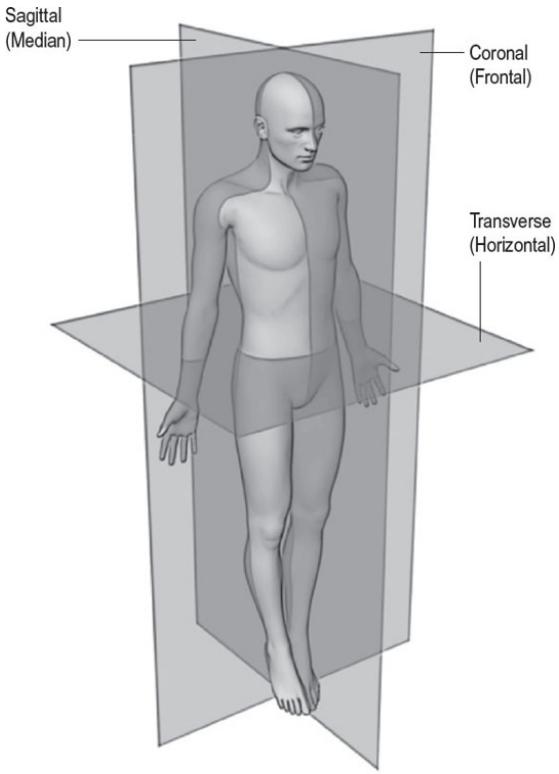


Figure 7.1
Body planes. Image used with kind permission from Martin Gordon (www.mothcreative.co.uk).

Contemporary Questions for Classical Assumptions

Into this inquisitive gap between the classical theories and contemporary interpretations walked Serge Gracovetsky PhD, to present at the first Fascia Research Congress in 2007, at Harvard Medical School, Boston, Massachusetts.[2, 3]

The Spine as an Engine

Gracovetsky emphasises that the human form is entirely designed for mobility, not for stability. His *spinal engine theory* (see also notes and further reading) is like water in the overheated arguments of a dry biomechanical desert. It is complex; however, it shows logically how the *whole* spine moves in all its various segments, dependent upon the intimate relationships between muscles and the collagen matrix to transmit forces (between the head and the earth, via the rotation of the shoulder girdle and the counter-rotation of the pelvic girdle), to and from the ground, that is, via the gears (locking facets) of the curved spine. When we bend forward or lift an object, for example, the spine naturally switches back and forth

within fractions of a second between the tensional strength of the collagen and the activation of muscular effort. Rotation and counter-rotation drive the spinal engine, based upon its curved structure and myofascial–skeletal organisation. He suggests that the spine comes first and the limbs come after as an advantage to energy management and conservation, refining our movement signature rather than dominating it.

It is not a common event to see a standing ovation at a scientific Research Congress. Nevertheless, Gracovetsky made so much sense of what actually happens in the real living spine, founded in the laws of motion and the geometry of the collagen matrix, that the audience celebrated his candid and highly researched reasoning with cheers. He pointed out that because there was an assumption that movement was based upon the musculoskeletal system, measuring devices were developed over the centuries that based calculations almost exclusively on examining muscular action, reinforcing the musculoskeletal basis of the anatomy and subsequent theories of function. Thus any living (*in vivo*) testing perpetuated the assumptions and allowed science to bypass the crucial role of the collagen matrix in movement. Traditionally, it was overlooked both anatomically and biomechanically, at least in terms of its ubiquitous connectivity. Recently advances in equipment and methods of investigation, particularly more sensitive ultrasound and MRI devices, have allowed the reading of fascial layers *in vivo* to endorse the essential role of collagen everywhere in the body, and most particularly in how it affects the spine. Science has also begun to ask different questions, hence this paradigm shift and the advent of a whole new level of curiosity and enquiry. Biotensegrity features largely in many of the emerging models.

"The wide range of human physical activities obscures the relative simplicity of the physics behind movement. From the moment the legendary fish emerged from the water and landed on solid ground, the development of anatomy was shaped by the need to conserve energy. In this context, the Earth's gravitational field became another natural resource that our species learned to exploit."[4]

In the gravitational field on earth creatures move around as a constant management system (or physical interpretation) of ground reaction force.

"GRF simply means that the ground is pushing back to whatever is pushing down on it, (Newton's 3rd law, for every action there is an equal and opposite reaction, If you push on a wall the wall is pushing back, etc.). If someone is walking or running, F=ma (mass times acceleration, Newton's 2nd), so the GRF would be greater." [5]

Serge Gracovetsky explains it another useful way, to emphasise further how completely we rely on this force in all interactions on the earth: using the legs to translate the energy we store temporarily with every step:

"To understand the concept, first note that you are not in a free fall, even if your body is subjected to the earth's gravitational field. This happens because the ground under your feet opposes a force equal to the weight of your body and hence your feet are in equilibrium. If something happened to the ground (a sink hole that would open up) then your body would fall towards the center of the earth.

The hummingbird, we learned, cannot maintain its ability to beat its wings at a rate of approx. 100 beats per second based on muscle energy. The mathematics of the energy required means it would burst into flames. Olympic weight-lifters raising anything over 50 kg would routinely explode if they really were relying on intra-abdominal pressure as the basis of their power to lift. Gracovetsky debunks what he calls the myths and fairy tales of musculoskeletal anatomy. Collagen plays a fundamental role in shaping and movement of the spine, whether or not it has been understood or accounted for. Importantly he emphasises its curvature.

Hence the ground reaction forces are nothing more than the forces that must be applied to your body to keep it in balance during your everyday life.
When you walk, the ground must oppose a force to your foot and that is what is called the 'heel strike

pulse'.
When you sleep, your body shape is imprinted into the mattress because the mattress is soft and crumpled when the ground reaction forces push UP into your body."[6]

What is ground reaction force (GRF)? In the simplest explanation, when you step on the scales, your weight represents the force you place on the ground and the immediate equal and opposite force that returns. It is equal to your mass.

In real terms, we *animate* different ways of expressing this relentless dependence on the mutual relationship between gravity and its counterforce (ground reaction force; GRF). We can dance "lightly" or stamp "heavily" depending upon how we tension our tissues, moment to moment, so the experience of it can change. The GRF remains the same, but we can actively modify how the forces move through our connected tissues. We can tension their connections *elastically*. In all cases, we use the ground as a temporary energy store. If the ground is covered in snow or sand, as distinct from being a flat road for example, then the *way in which* our tissues respond, changes. We then have to tension our tissues differently to account for that. Our experience then, might be less of a "bounce back" and we need to adapt and generate more (myofascial effort and metabolic) energy to move over that terrain, when its particles are not close packed. We naturally navigate this all the time. Your body already knows how to do this instinctively. It lives in a mutual balance between gravity's radial pull towards the centre of the earth and (any creature's) ability to occupy space in response *from it; i.e. in direct response or reaction from the ground.*

The ground interrupts the relentless pull towards the centre of the earth all the time. Our human ability to resist this pull affects our whole system, so much so that we do not even have to think about it. We *are* its consequences in space and time. Note that in outer space, astronauts have to negotiate a very different experience, where the absence or low amplitude of ground reaction force (relative to the change in gravitational pull) changes their bone density. We rely on these mutual forces for our structural integrity, whether or not we understand them.

Our bones (which Levin refers to as "starched fascia") are designed via the day-to-day management of forces, of our reaction to the ground (or pull of gravity towards it). We exist as three-dimensional form in relationship to this force and counter-force. We are not crushed and we are able to stand up and move around, away from the ground. We could say that ability is a unifying of triune forces. Just as in a tension–compression system we have three elements: tension, compression and combined tension–compression, so we have three elements of gravity and ground reaction force – the one, the other and their combination (our structural integrity: the result of their combined forces *as our physical expression*). Your ability to move around is an expression of how you interpret gravity and ground reaction force through your physical structure *at any one moment in time*.

From an evolutionary point of view, we have acquired the ability to manage ground reaction force (perhaps what Scaravelli refers to as our "anti-gravity reflex") in ever more refined ways. Newton is credited with discovering the distinction of gravity but, according to Levin, there are different interpretations for the way that biologic soft architectures move, independently of that gravitational pull. It may be also a question of how literally we translate Newton's laws. An equal and opposite force is at work in biotensegrity structures (tension and compression) at all times. However, they resist deformation naturally in omnidirectional ways. Studies of how our tissues respond to stress and strain suggest they do so in non-Newtonian and non-Hookean (i.e. non-linear) ways.

"This [tensegrity structural behaviour, measured in a stress-strain graph] *is radically different from the*

Hookean, linear behavior of most non-biologic materials and structures. In Hookean structures for each increment of stress, there is a proportional strain until the point of elastic deformation just before it breaks. Hookean structures weaken under load. In the tensegrity structures, there is rapid deformation with the initial load but then the structure stiffens and becomes more rigid and stronger."[7]

Levin goes on to explain how tensegrity structures explain our omnidirectional strength and ability to resist deformation. This challenges the "spring and dashpot" model as somewhat contrived and suggests something actually more direct for the way we see structure, given how we naturally move and respond.

Evolutionary Movement Requirements

According to Gracovetsky, our spines originated (evolutionarily) in creatures that had to be able to move over slippery mud when they emerged from the sea, and had to adapt accordingly. The side-to-side (lateral) motion of fish was not so efficient over land. The forward and back motion (flexion and extension) had to develop if the animal body was to move over rocky terrain and eventually find upright motion. To do this, these two planes of motion gave rise to the helical motion potential that could exploit the gravitational field, rather than be defeated by it. This was rotation and counter-rotation between the shoulder and pelvic girdles (the key drivers of the spinal engine[8]). This occurred in concert with the curvature of the spine and the evolutionary development of the limbs and extremities on land. The evolving gait patterns produced an integrated whole body movement capacity greater than the sum of the parts.

Spine First

"If the present paradigms of Newtonian based biomechanics hold true, then the calculated forces needed for a grandfather to lift his three year old grandchild would crush his spine, catching a fish at the end of a fly rod will tear the angler limb from limb, and the little sesamoid bones in our feet will crush with each step."[9]

> Gracovetsky debunks the theory that the lower limbs drive gait by asking what happens if there are no limbs. Does that mean the spine does not work (or "walk")? He filmed and monitored (with sensors along the spine) a man without limbs, who could nevertheless move along the ground in a natural walking gait pattern. Gracovetsky analysed the torso movements, which match those of a person with legs to walk on and arms to swing. Any theory of walking that presumes initiation in the legs is challenged by this research. (In close-up footage of the spine it was impossible to detect that the person walking had no arms or legs and walked directly on their sitting bones.)

Many theories of upright two-legged (bipedal) human movement suggest the legs authorise or initiate gait and the torso, or axial body, "*travels along as a passenger*". As Gracovetsky points out, from an evolutionary point of view: "*Locomotion was first achieved by the motion of the spine. The legs came after as an improvement, not as a substitute.*"[10] (This recapitulates the embryonic forming sequence, since the legs are among the later structures to grow, some embryological time after the spinal structures are in place.)

Gracovetsky shows that in human walking, the *lumbar* curve of the spine is paramount in the translation of forces to and from the ground, via the legs. It is not a passive passenger, carried along by them. According to Gracovetsky, the spine drives the limbs from above, which allows the legs to translate the *amplitude and quality* of the movement forces to and from the ground using it step by step as a temporary

energy store (via the heel strike pulse). As yoga teachers, we are well served by understanding this structure and Gracovetsky provides cogent reasons why it is an advantage to keep the body supple and mobile, to naturally translate energy as efficiently as possible (his work is referenced throughout the notes and in the further reading suggestions at the end of this chapter).[11]

The spinal engine theory is in fact congruent with Levin's tensegrity-truss model and Flemon's biotensegrity models. As closed kinematic chain models they naturally evoke the law of coupled motion (see later in this chapter). It begins to make sense of our ability in the yoga classroom to balance on hands and head, shoulders and elbows at various angles of poise in all but flat planes and the anatomical position. The spine becomes the common denominator: rotation and counter-rotation work both ways up. We could say that lying in Corpse Pose (Shivasana) resembles the anatomical position. However, even then, we can use that pose to experience and sense our natural curvature on the ground, using it for feedback directly (see Ch. 11 for a specific exercise). We are never flat.

This exercise makes sense of Gracovetsky's view suggesting that the spine acts, albeit upright, in the same way as the spine in any sea mammal, with the limbs adding balance and ballast and further facility, rather than necessarily driving or originating the movement pattern.

"*Lordosis [lumbar curve] emerges as the single most important parameter in controlling the force transmission between the legs and the upper extremities.*"[12]

Gracovetsky shows that the limbs help to translate forces, driven by the spine, to and from the ground, refining them to the most appropriate amplitude, or shape, for the spine to receive. His research suggests it is a sophisticated mechanism and relies upon the collagen matrix to balance our ability to move over the ground and spring off it, without "*breaking our sesamoid bones*" (see quote above from Levin). It also goes a long way towards explaining the helical basis of our movements as a whole structure in all the postures we can describe. (Walking gait can be transformed when appropriate attention is paid to this rotational integrity).

Sitting in Staff Pose (Dandasana) it is possible to fold the arms, slightly bend and stiffen the legs and "walk" up and down the mat on the sitting bones, sliding the legs along the mat (bend the knees and lightly place the heels on the mat). It reveals the natural rotational reflex through the spine to make these motions. After "walking" up and down the mat on sitting bones, try it in standing with the additional "lift" of the legs. It seems to immediately facilitate a lightness of step and quality of elastic momentum. There is a change in amplitude but not in the fundamental ability to make the movements.

Primary and Secondary Curves

The curves of the spine (Fig. 7.2) can be considered from both an evolutionary (phylogenetic) and a developmental (ontogenetic) point of view. The reason the spinal curves are named primary and secondary is that the primary curves are formed before we are born (*in utero*) and the secondary curves develop over time, later (*ex utero*) through movement patterns.[13]

One or Two Legs?

One of the not uncommon misunderstandings presented in movement research is the distinction of hopping. Animals "hop" on two legs. Human beings hop on one leg. The same word means two very different things depending on the species it is applied to. When we

walk, although the transition is seamless, the balance is unipedal. If we learn to sprint we effectively animate a series of powerful hops, in joined up kinaesthetic writing, at increasing speed.

Levin goes further to suggest we are designed for unipedal, rather than bipedal posture. Once we learn to stand on two legs, we frequently use them one at a time. Indeed, in walking we spend up to 80% of our movement on one leg and in sprinting, the body travels through the air and is invariably on one leg or the other. We even tend to favour standing on one leg rather than two. (Ask your students which is their favourite standing leg – most people prefer one as a default pattern). We can certainly afford to explore this idea with some enthusiasm, given the most basic list of yogic asanas that develop exactly that aspect of balance and physical literacy.

Animating our Curves in Three Dimensions

Gracovetsky shows that various laws of movement are animated by the fundamental design of a curved spine. His research makes sense of our yoga practice by acknowledging whole spinal performance. In walking, running, dancing and even sitting, we actually use the whole body, as we breathe. Gracovetsky emphasises the value of a curved central axis, rather than a straight one, such as our primate cousins are limited to. He embellishes the purpose of the primary and secondary curves. We have the natural ability to rotate, counter-rotate, side, forward and back bend. (We can do a lot more besides, incorporating subtle movements in between these main classifications that are not so easy to label in classical biomechanical terminology. See Ch. 18.) The spinal engine theory clearly makes sense of the natural design of our structural relationships to the ground. We will explore this through practice in Part 2.

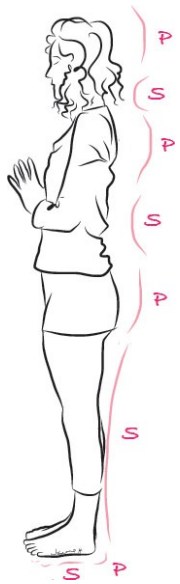


Figure 7.2
We can actually consider the back of the body as a continuous system of primary and secondary curves from toe-tips to crown.

Very soon after birth, the forward-folded form of the curled ball (primary curve) of a healthy newborn will attempt to lift its relatively large and heavy head (pressing down on mother's shoulder to push up, for example) and naturally begin to activate (through instinctive usage patterns) a curve at the neck (extension). This is the first of the two secondary curves of the spinal "S", crucial to our ability to spring and to the spine's ability to rotate and counter-rotate once we begin to fulfil our architectural promise.

Lumbar lordosis, the secondary curve at the back of the waist, is formed after the secondary curve at

the neck. It is prescribed as the baby learns to lift up from the ground and to twist. Animated by natural curiosity, a baby uses rotational movements and side bends, as well as forward bending and back bending, to roll over, lift its head (and eventually chest) off the surface it is resting on. Ultimately it strengthens its back enough to raise head and torso, curving the spine back (secondary) as well as forward (primary). This takes months, sometimes years, to fully elaborate to the point of standing. To fulfil the potential of balance on two legs rather than four (commonly termed upright bipedal posture) and walk takes time, and the human pelvis develops gradually over the first six years of growth in response to these efforts and their cumulative loading patterns.

Curved Poles

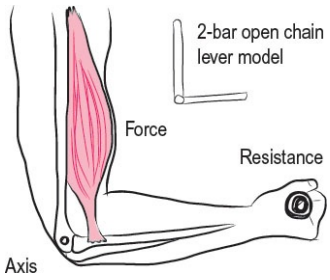


Figure 7.3
A lever is an open two-bar chain: shown here as a model for the arm (notably excluding other joints and structures).

What if we start from an imaginary *curved* pole through the middle of the body instead of a straight one? The laws of movement governing curved poles are very different from straight poles. Furthermore, the biotensegrity model challenges the notion of levers, which apply to linear structures. A standard lever, such as described for the movement at the elbow, for example, is represented as a "2-bar open chain mechanism" (Fig. 7.3). This refers simply to the fact that there are two bars (the upper and lower arm) and one pin (the elbow) representing a hinge joint. In biotensegrity architecture everything is joined together and we are seeking explanations for what we can do in a yoga classroom, which far exceed the limitations and range of levers. We do not move in straight lines with levered joints. In Jaap van der Wal's tissue-sparing dissection of the elbow, there was no angle at which the joint was not under tension. This expands the context to a new explanation that can be found in "closed kinematic chains" (see marginal note and Fig. 7.4).

From the ground up, closed kinematic chain structures give rise to multidirectional and unpredictable motion patterns that make far more sense of what happens on a yoga mat than many classical theories can account for. In considering some of them, the reader is invited to explore from experience and read further (see suggestions for further reading at the end of this chapter). In Part 2, we will consider these questions applied to adjustment in yoga specifically. They change our viewpoint considerably.

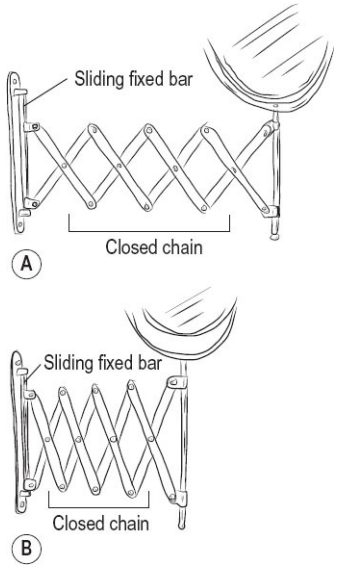


Figure 7.4

This is a four-bar linkage system with a fixed bar (where it is attached). It can squeeze and stretch (given its sliding hinge at the fixed bar) and remains in a closed kinematic chain. The "levers" are all joined up to form an enclosed linkage system that, in this symmetrical, example, has the properties of a lattice. In a steam engine, the bars have different lengths, as they do in biologic systems.

As human beings, we might organise from a "centrifugal sense"; however, there is no straight vertical axis for the body in its physical experience. It is curved. Our "null point" of embryonic development (see Ch. 5) forms ideally into a changing, continuous S-shape, just as Leonardo da Vinci first drew it. We use it as an upright reference but that is a balancing act in itself. We can "straighten it"; however, its default design is a series of beautiful curves that allow us all the privileges of helical motion. Furthermore, our most fundamental design is organised based upon mobility rather than stability. We have to actively stabilise, establish, release and re-stabilise ourselves from moment to moment. It is an integral part of our movement skills. In Chapter 8 we will look deeper into elasticity and make sense of this as our experience as a pre-stressed, non-linear, biologic system that changes itself (as a whole) from one moment to the next, just by breathing, just by being alive.

People are made up of three-dimensional shapes occupying space in roundish chambers. We are tubes within tubes, including various architectural forms that are mostly able to change and modify in a balance of motion and internal motility. We are constantly interpreting internal and external forces in graceful balance, wherever we can *all the time*. The geometries of biotensegrity and the adaptable fabric of the fascia are the common denominators of all these forms. Notions of biomechanics dependent on flat planes, straight lines and exact symmetries (or spinal stacks) were originally deduced, at least in part, from dead bodies that were moved by the anatomist, rather than on observation of living forms that animate themselves. The difference between the two conditions is vast, however established the linear, right-angle theories are.

Levers to Lattices

From linear theories, levers were devised as an explanation for how we move, joint by joint. In the absence of connective tissue a lever (a two-bar open chain linkage) answers the question of a muscle moving a bone at a joint, like a hinge, in one plane. This would give rise to the classical theory of antagonistic pairs of muscles to balance and counterbalance the lever. (It also satisfies Newton's third law that to every action there is an equal and opposite reaction.) But we now know we do not move one muscle at a time (or two) and we do not move one joint at a time either. This is a "local" view and it is a

struggle to make sense of it in its natural context of global movements. While a lever may show a version of how we *can* move, in the presence of the fascial matrix, it suggests a limited function when that matrix is based entirely on linkage, woven through and around our tissues on every scale, in omnidirectional containment. Its founding context is connectivity. It begins connected. If we think in van der Wal's terms, we form from the wholeness and create *disconnections* within it in order to permit movement. Thus he refers to the elbow, for example, as a "disjoint" in the tensioned continuum of the arm.

> Biotensegrity models explain the variety of our movements, including the helical patterns we enjoy as part of our biomotional structure. The actual biotensegrity models frequently include individual straight struts or lines of compression members and lines of tensional members, to demonstrate how the whole phenomenon of a tension– compression structure works. It is just an example, however.[14] It is not a literal reiteration of linear tissue, but a cogent model of their combined characteristics. Consider a spider's web. (It is not a tensegrity architecture because it needs an external frame. However it is a tensional structure.) There are apparent "straight lines" of pull (spokes) and lateral lines or cross-links forming the web but taking them out of context in isolation, as if they represent linear organisation, misrepresents their biologic function and structure *as a whole*. It also ignores their overall ability to respond to movement of the frame they are attached to.

Perhaps one reason it is so complicated to learn about levers and human movements is because levers do not represent what actually happens in moving humans. After all, these theories were deduced when fascia was routinely discarded by anatomists. Deduction was made in the absence of the connectivity. Could it be that we incorporate more intelligent means of *leverage*? As we have noted, there are no levers in biologic forms.[15]

Closed Chain

> They may appear as a web, across the branches of a rose tree, for instance, in more than one flat plane, even though it seems "flattened". It occupies space in a much more adaptable way than its flat plane representation can reveal or imply. The key thing is that in the living body, united, the webs form various types of lattices, or weaves, or helical envelopes or fractal polygons between structures, depending on where they are in our form and how they are used. That is "in the round". However you describe them, "straight they ain't" in the body. We cut and straighten the fascia out into flat pieces to examine it, or look for straight connections to make diagrams of them, but that does not lend them linear mechanical properties.

If the chain is "closed", then the bars are not levers, as such. They become what is called a four-bar (or multi-bar) linkage system, which happens to be the minimum to represent our movement. It suggests the possibility of the kind of dexterity and variety we can enjoy in our fingers and toes, at the end of our limbs. The structure becomes self-contained and the control mechanism changes completely. In a closed system, the control at one end is reiterated throughout the structure. In his article "The Scapula is a Sesamoid Bone"[16] Dr Levin suggests that the control of the arm and hand comes from the spine, via the shoulder blade (scapula). Thus it can authorise the integrated movement and subtle coordination we appreciate, based on a model such as the four-bar linkage system. We enter a much more sophisticated realm of geometry, congruent with our biotensegrity architecture. It is something that makes sense of the postures, the way we do them.

Something magical begins to happen to the geometry of a structure at four bars (or more) in a closed linkage system. They acquire a shift in stability and enter a state of potential mobility at different angles and position, at higher frequency. The slightest movement is communicated throughout and affects the whole connected structure *because it is linked*. There is integrity of form and movement: any change is communicated and transmitted *kinematically* (i.e. through the animation of the geometry of the structure). Even when it is squeezed, the structure "closes" but it does not reduce to a straight bar or a lever. It

multiplies up to a lattice. At the very least it is a woven fabric. If, as Kenneth Snelson suggests, weaving is the mother of tensegrity, then a pathway of enquiry from a woven lattice (the fascial matrix) to a four-bar system (of architectural design) seems worthy of some careful research. A four-bar can "squeeze" and "stretch" without losing its structural integrity (Fig. 7.4) or relationships. Four-bar systems have one fixed bar, from which the rest of the closed chain can be animated in a coordinated, intercommunicating way. Whatever movement occurs, despite the different amplitudes, the whole structure is part of the organisation.

What is a closed kinematic chain? Kinematic refers to the geometry of a structure, independent of the kinetic forces acting upon it. A closed chain means each link is attached at both ends. A lattice is an example of a closed kinematic chain, where every movement moves the parts, as a whole. The minimum number of bars in a closed kinematic chain is four. (Three bars give you a rigid triangle, that is a stable structure.) We are essentially unstable structures that actively stabilise. This too makes sense of our yoga. The work is not so much to be able to do a handstand, or one-legged posture, but to *hold* it there. A four, or multi-bar closed-chain structure has one fixed bar, from which it moves the rest. (See the shaving mirror in Fig. 7.4, for example.) Consider the ground as our "fixed bar", changing every time we place ourselves upon it, depending on which part we place and where.

If the bars in a closed kinematic chain have different lengths, they can modify the available shapes, movements, range and overall organisation that is available to the structure. However, they still remain intimately interdependent and related. With ball and socket joints added to the variety of frictionless hinges (like our joints), the arcs and ellipses they can describe become three-dimensional under control of the organising motor. If the spine is the central "motor", then control of the limbs can express the kind of patterns and shapes we see when we move them *the way we actually do*. When you consider the different shapes we make and balances we manage in a yoga class, the spine tells a much more mobile and intelligent story than a straight or stacked segmented pole can begin to account for. We use the straight midline axis as a metaphor – but do we remember it is a model of a pillar or a right-angled brick-built house when we struggle to interpret it as the basis of human biomechanics to explain Triangle Pose (Trikonasana)? To balance in this posture, we honour a triangle shape between the legs and the ground but we manage it through a counter balance of the spine, arms and head. Our central "midline" is a "mid-wave" through a curved tube that allows us to do what we do on the mat, with all our helical movements and deep twisting and binding postures to account for.

The wheels on a steam engine were designed as mechanical closed four-bar linkage systems, enabling a long, segmented train to be operated by only one motor. (There is no motor required at each wheel.) The whole train was precisely linked by the rotation of the wheels via the closed kinematic chain of the linkage system. This is a type of economical, integrated, mechanical system. We are capable of far more sophisticated motions than a steam engine but this suggests something multiplied up from levers, not reduced down to their most limited number or function.

We see three essential features of our movement patterns arising in a four-bar closed-chain linkage:

- The structure is self-contained, enclosed and variable within the range of the one whole organisation.
- One "motor" can drive the whole shape economically. Nothing is redundant or separated from the whole form.
- Everything affects everything else in a self-regulating architecture, based on its innate shape and the coordinating angles and rod lengths of the closed chain.

"Biological linkages frequently are compliant. Often one or more bars are formed by ligaments, and often the linkages are three-dimensional. Couple linkage systems are known, as well as five, six and even seven-bar linkages. Four-bar linkages are by far the most common though."[17]

In biology, many creatures favour a closed kinematic chain structural arrangement, based on four-bar linkage, such as the jaw dynamics of many fish. A perfect and obvious example (one of many) in our bodies is the knee joint, which attaches the upper leg bone (femur) to the lower leg bone (tibia) by the cruciate ligaments. These are referred to as an X-bar arrangement.[18]

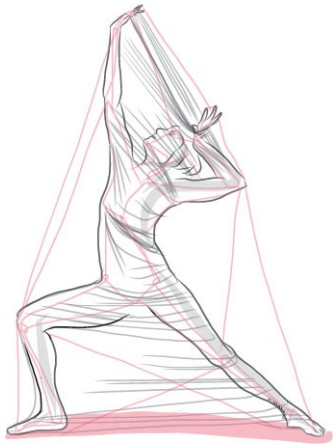


Figure 7.5
The whole movement, integrated via the fixed bar of the ground, is seen in its entirety as a multi-bar linkage. The system is compliant and self-motivated – a closed kinematic chain.

A linkage designed as a network, such as our body matrix, models a closed kinematic chain. As referred to earlier, one bar in such a system is fixed; from this the closed chain can move as a whole. Our fixed bar is the ground. *We* ourselves are not fixed. We are indeed compliant, but we can change our whole arrangement from moment to moment by incorporating the ground differently as we move (Figs 7.5 and 7.6). Effectively, we take the ground with us wherever we go on earth, using it under and between the parts of us on its surface, as we need to at the time. As Gracovetsky suggests, we exploit gravity to our energetic advantage.

"Life is the ultimate example of complexity at work. An organism, whether it is a bacterium or a baboon, develops through an incredibly complex series of interactions involving a vast number of different components. These components, or subsystems, are themselves made up of smaller molecular components, which independently exhibit their own dynamic behavior, such as the ability to catalyze chemical reactions. Yet when they are combined into some larger functioning unit – such as a cell or tissue – utterly new and unpredictable properties emerge, including the ability to move, to change shape and to grow.

Although researchers have recognized this intriguing fact for some time, most discount it in their quest to explain life's fundamentals. For the past several decades, biologists have attempted to advance our understanding of how the human body works by defining the properties of life's critical materials and molecules, such as DNA, the stuff of genes."[19]

Dynamic and Whole

Wherever we are and whatever poses we are in, we form a closed linkage system including the ground as one of the bars: the temporary fixed one. The simple recognition of our curved structures begins to

account for how we might see whole movement (as it is performed) and recognise that (1) we are closed chains and (2) there are no levers in our non-linear biologic systems.

The dynamic arrangements of bones, myofascial continuities and dynaments (Jaap van der Wal's term for dynamic ligaments) form webs, linkages and cross-links throughout our tissues. Obviously they are all joined up; as we are. Human biomechanics are far more sophisticated than levers, although we can include lever-like movements. We incorporate many more options in our three-dimensional compliance, naturally integrating fascia throughout our form. The closed kinematic chain might begin to redefine what we generally know as functional movement in the classical sense.

Figure 7.6

It is the same principle in any pose. In a biotensegrity architecture, the system is also under tension, which the external mesh invites us to imagine. (It acts as a visual metaphor for the internal living structure.) In every posture, the ground is the fixed bar from which we move.

As teachers, it is important for us to understand this, particularly in the context of adjustment. If we are moving someone's limb *as if it were a lever* when it is poised and active we might be unaware of the impact on the "joined-up" nature of the whole form. Change one part and you are inevitably provoking a counter-move elsewhere in the chain. If you work from a view that reduces living form to a two-dimensional diagram or if you treat one part as if it is only related via the next joint, you can disturb balance rather than confirm it. Effectively, if you touch one part, you are affecting all of it mechanically, if we recognise this model. Once we consider the fascial network as a subtle and sensory body-wide system, it is seen as even more sophisticated. We will put these aspects together in Part 2 and consider them in practice (Ch. 16).

Intrinsically Biphasic Movements

Moving one part always influences another part. Figures 7.5 and 7.6 are taken as moments in time and space. In the joined-up moment-by-moment sequence of their living performance they incorporate "biphasic movement". This is a feature of the body as a tensional matrix, in a closed chain. Each movement automatically triggers a corresponding bar. Two useful examples of this can be offered: the first is a bicycle wheel, the second is the children's toy known as a Jacob's ladder.

A bicycle wheel (minimum 12 spokes) is a biotensegrity structure in the round. The hub and the rim are the compression members, while the spokes provide the tensioning members. Imagine if the whole wheel is twisted (it resembles a Möbius strip). As soon as you attempt to untwist it, it goes past the mid-point and twists the other way. It naturally counter-twists. This is biphasic motion.

Figure 7.7
Jacob's ladder toy, showing poised tensional balance before the biphasic movements "click clack" through the length of the chain.

Move into the squat position, then stand up into Mountain Pose (Tadasana). Then repeat. Any move of any part of the leg, from a standing position, causes a corresponding move in the next segment. You cannot bend the knee without the hip and/or ankle bending too. It is the basis of our design, i.e. biphasic movement in a closed kinematic chain. That chain includes the ground under and between the feet as the fixed bar.

In a Jacob's ladder toy, if you hold it under tensional balance, every movement counter-moves the next block. The parts are organised by the ribbons as a closed kinematic chain (Fig. 7.7). There is a particular balancing point, on the other side of which the whole structure click-clacks its way naturally through a series of moves and counter-moves biphasically. The structural organisation naturally responds by changing the dynamics of the whole structure, because they are all linked as a closed chain. You only hold the "engine" of the movement (under tension).

These are technical descriptions of joined-up movements we naturally master in yoga sequences and in everyday life. Just by walking, climbing stairs, sitting down or standing up we activate these principles of functional movement. Try moving your forearm without moving any aspect of your wrist, hand or upper arm, or your lower leg without affecting the ankle, foot or upper leg. They are part of a closed chain and it is not possible.

Multi-bar Movement in the Round

If you hold the ball shown in Figure 7.8 very lightly you can instantly feel the sense of its arrangement as poised for pulsing, breathing motion and the way it occupies space. It immediately makes palpable sense of the kinaesthetic experience of breathing. The language becomes more elusive and difficult in describing it but the sense is more congruent.

Multi-bar movement in the round appears a little more complex (Fig. 7.8). When it comes to movements such as the breath through the torso, for example, another model is very useful to show that the same closed kinematic chain principles of a multi-bar system can well apply here too.

Every joint is interconnected and no one part can move without activating the rest. At the most basic mechanical level it is a force transmission system that relays the motion forces throughout the architectural geometry (kinematics) of the whole form. Since the ribs are curved, like the spine, and there are no straight structures in the thorax, it invites us again into a world of curved geometries.[20]

Figure 7.8
This multi-bar linkage ball expands and contracts kinematically as a closed chain. It represents the linked system of breathing motion as a possibility for a biotensegrity architecture.

The simple model in Figure 7.8 pulses and “opens and closes” with the slightest “effort”, much like the spring we will consider in the next chapter. We can breathe in all sorts of different ways. This is something we deliberately explore in yoga. What becomes apparent is that our biological compliance means we can make different shapes voluntarily but they are nonetheless linked. If you actively “hold” one part of the rib cage still, for example, to let another part move in a particular breathing exercise, it is still part of an intimately linked chain reaction (see Ch. 15). It demonstrates our power to actively stabilise one part and mobilise another at will. It confirms their interrelated function and adaptability.

The ball in Figure 7.8 represents the *kinematics* of our biotensegrity architecture as we see and experience it. There is no need to imagine a vertical line in the body. This happens as a curved, containing, three-dimensional structure, actively occupying three-dimensional mobility and moving in time, still frame after still frame in close transition: whole and complete throughout. It is much more sophisticated than levers (open chain mechanisms) can describe. The sum of the parts behaves very differently when it is united into one whole enclosed system (as a closed chain). We seem to include various types of link (joint patterns) to enable range at each bar in our systems but our movements (particularly in the yoga classroom) are clearly not restricted to balancing levers and sticks in purely horizontal and vertical planes.

Sliding Motion

Sliding motion is worth emphasising here as a fundamental tenet of our structure and its fascial integrity. The ability to glide between layers is crucial to our movement functions everywhere in the body: at the joints (so that they are frictionless), between the layers of the skin (as we observed in Ch. 3) and around the organs (so that we can move around without compromising them). The same ability allows the vessels within us to move with us. The serous fluid around the lungs, for example, is fundamentally designed for frictionless glide at every breath, contained by the visceral fascial layers and containers. Where are the levers in the lungs? The idea that they can be described as separate functional systems to movement is difficult to make sense of.

Figure 7.9

In young mobile tissue, the layers of fascia appear to be laid down in alternating directions, with a crimp feature. Ageing or sedentary tissues can show a more matted configuration. There really are no straight lines in the body matrix.

A Universal Pattern

The pattern of a lattice is another kind of four-bar system. The lattice is a universal pattern throughout the body, a basis of fascial tubing. It forms around vessels, muscles and muscle fibres (Fig. 7.9).[21] The layered tunicae of the blood vessels, for example, spiral around each other and these overlapping spiralling tubes, in cross-section, form a lattice arrangement (Fig. 7.10).[22]

The geometry of these patterns is the same on every scale and common throughout biologic forms.[23] Chirality in trees, for example, is a part of the repertoire for tree merchants and the industry concerned with forestry. Tree growth rings are known to occur in counter-chiral patterns,[24] although it is not known whether they are genetically determined or based upon environmental responses through the growth period of a specific tree. It is known, however, that if a log cabin is made from a tree that does not counter-chiral its growth rings (to grow straight), it will appear straight at first but twist when it dries out.[25]

Multi-bar Mobility

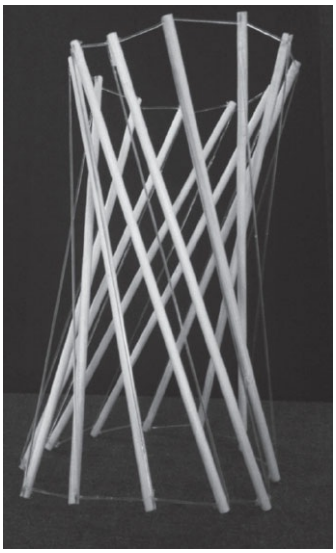


Figure 7.10

This model was made by Graham Scarr using tensegrity principles; the arrangement shows a spiral structure. Note that the pattern of spiral and counter-spiral in cross-section is a lattice. This structure holds itself open.

What all this information adds up to is a complex, self-contained organism designed for mobility via the ground, as we use it. It affects both ends of a given limb, as a feedback system under constant tension. (We will explore the tensional part in the next chapter.) Which acts as our fixed bar to move from depends on which part of us is engaging with the ground.

We *can* appear to hang the limbs from the body, so they look as if they move like open chain levers, as in Corpse Pose (Shivasana) as we lie flat on the floor. This would be an anaesthetic view. However, as soon as we animate (ourselves) and move, we instantly engage with the ground to get up from it. We also choose different means of creating our four-bar patterns, whether we place our hands and feet on the ground folding forward, backwards and upside down or on our sides, twisting or balancing. All of us responds.

Thinking about the variety of yoga postures, and of the body parts we place on the ground to do them, from head to toes, draws us towards a very compelling explanation of whole body movements. The common denominator becomes the ground and spine relationship, via the girdles and the limbs, however we choose to use them, seen as a whole organising shape, including the head – if not initiated by it. According to Leonid Blyum:

"actually I should put this statement even stronger – head control is not simply important for walking etc – head control is the single most important factor, the absolutely necessary condition and prerequisite of ANY controlled locomotion where a human body is in the contact with the ground!"[26]

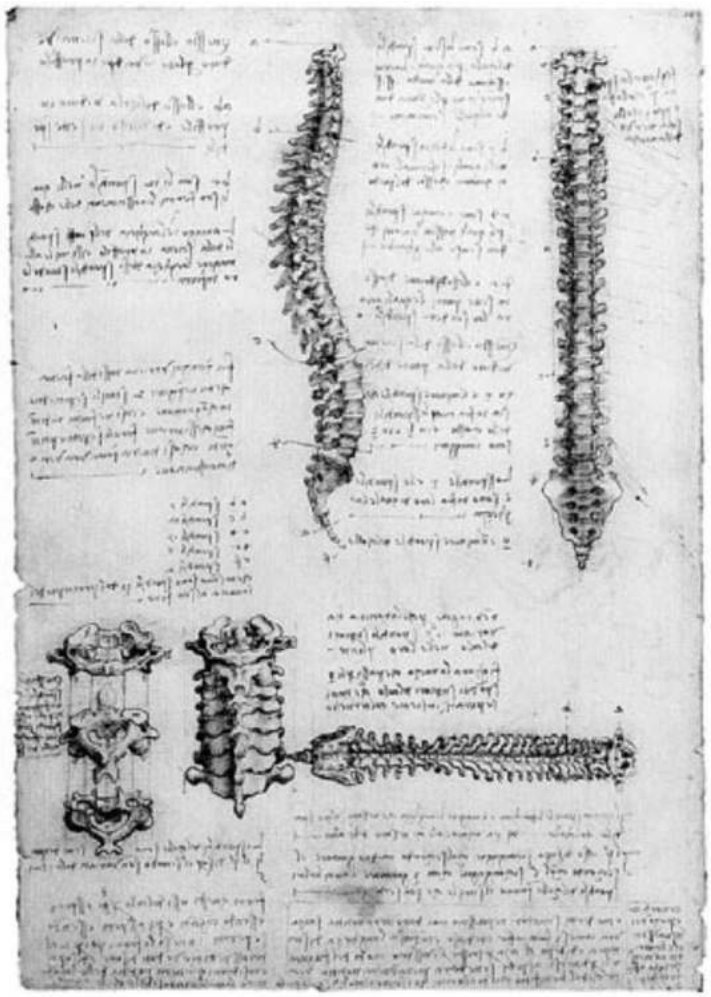


Figure 7.11

The S-shape of the spine in this sketch by Leonardo da Vinci arises even on a classroom model from the design and shape of the interlocking spaces between the vertebrae that the somites originally prescribed.

We have the "motioning" ability to change which angle we move in and which parts of us create the "joint" with the fixed bar (the ground), given the various lengths of the bars (i.e. the bones of our limbs and torso) and the curvature of the whole spine (Fig. 7.11).

This suggests our relationship to the ground is as profound and responsive as many a yoga guru would have us believe. Certainly, the yoga matriarch Vanda Scaravelli,[27] for example, attributes integrated movement to exactly that relationship, of breath and spinal wave, responding to the earth. Whatever shape we are making, if we include the ground in the wholeness of the posture, we begin to see how we use it constantly and even unconsciously.

When you next do yoga or watch a class, observe each pose as if it is part of a multi-bar chain. Include the changing invisible "joint" at the ground and notice how the whole system moves every bar in the "chain" from the ground. It could be the heels, but equally it might be the toes, the heels of the hands, the sitting bones, the elbows, and so on, depending upon the pose.

Finding Stillness

For centuries we have deduced anatomy and function from static bodies – dead forms that the anatomist had to move, using assessment based on non-biological linear systems, rather than non-linear biologic systems. What is particularly interesting is that in real (animated) life we actually struggle to bring our active mobility to conscious stillness. In a body designed for movement, it actually takes a lot of practice to stand or sit still in a held pose or a period of meditation.

Stillness can easily become either sedentary or rigid as we slump or experience "stiffening up". We do not always naturally enjoy being static in an active or dynamic way. The word *stillness* is used here, as distinct from slumped, or immobile. To see someone relaxed, awake, aware and attentive in quiet stillness is a relatively rare thing in our modern culture – you do not observe it often. Yoga explores and seeks exactly this ability to be still. We can do poses (and hold them) with the spine in all sorts of positions. So, how do we make sense of the classical theories of levers and straight vertical poles?

"In many postures, the adult human spine does not function as a column or even a simple beam. When the spine is horizontal, the sacrum is not a base of a column but the connecting element that ties the beam to the pelvic ring."[28]

Do closed kinematic chains and spinal engines begin to invite us into realms of biomechanics that make sense of yoga? If biotensegrity architectures account for whole, multidimensional structures such as we appear to be in every yoga classroom, does it draw us towards more holistic explanations of how we interpret this (and any other) movement art?

We begin to see a picture emerging that is worthy of further exploration. While Table 7.1 compares the difference between the classical and contemporary models, it is worth noting that the contemporary one represents a paradox. In a way it goes full circle to the ancient knowledge of the Vedic sages (see Ch. 21) and can be found in the drawings of the Sacred Geometry studied by philosophers and architects referred to in Chapter 2. Perhaps we are exploring a unifying process beyond the limits of dualistic thinking, the rebirth of what yoga actually stands for and a return to a deeper understanding of ancient wisdom.

New Eyes

We said earlier that we do not stand in the anatomical position and our spines do not behave as vertical columns that have to be upright to function. We are also beginning to establish that a key aspect of fascia and proprioception (our awareness in space) is our ability to sense ourselves. This does not just mean internally, absorbed in how we feel. It is our instinctive inner world response to our outer world; our *relationships* to it. We move *through* the body, not just from it and our physical literacy includes that which is around us. We will explore this in terms of body reading and adjustment in Part 2.

Figure 7.12

This is a moment of suspended animation, showing the body in a series of lateral turns, from a three-point Dog Pose (Adho Mukha Svanasana) to a three-point wheel (Chakrasana). This posture can be shown as part of a multi-bar linkage system from toes to hand, where Alex is naturally balancing and counterbalancing the movements at speed. Reproduced with kind permission from Alexander Filmer Lorch.

Figure 7.13

The same means of recognising the whole posture in space, as a multi-bar linkage system using the ground, can be worked with any pose, as a way of seeing the whole. This was a moment in time, captured as part of a sequence throughout which Alex experienced and expressed balance. (At no time was his spine like an upright or straight pole.) Image used with kind permission from Alexander Filmer Lorch.

Table 7.1

Classical model	Contemporary model
Parts (cogs – bio-mechanical)	Whole (re-cog-nise – bio-motional)
Compression	Biotensegrity (tension-compression)
2-D diagrams (duality)	3-D holograms (triunity)
2-Bar levers and pendulums	4-Bar and multibar linkages
Open chain mechanisms	Closed kinematic chains
Divided down into planes	Multiplied up into containers

Linear biomechanical systems	Non-linear biologic systems

Finally, let us consider seeing the body geometry in the context of our environment, or at least that which immediately surrounds us *from the ground*. It is the basis of our ability to know where we are in relationship to and with all that (and those) around us (Figs 7.12 and 7.13). Spacialisation *within* the body applies to our outer sense of *spatial awareness* beyond the skin. Visually we can begin to point to this, by seeing beyond the form and including the hidden geometry that includes the arc of our movements. Biotensegrity forces do not just transmit from the bones to the skin and back again. They do not stop at the bark and the outer growth rings of a tree. They relate profoundly to the forces operating around them, which respond to the shapes that allow the wind to blow at amplitudes and directions according to the terrain and what is upon it. The relationships from sunlight and hydration, to earth and gravity are relentless and go beyond our individual "inner-sphere", to its related "kinesphere" (see Ch. 14).

Notes

1. Stephen Levin, http://www.biotensegrity.com/tensegrity_truss.php: "The Tensegrity-truss as a Model for Spine Mechanics".
2. http://www.fasciacongress.org/2007/. Serge Gracovetsky, Fascia Congress Part #1 of 3, Boston 2007.wmv. Available on You Tube (with parts #2 of 3 and #3 of 3).
3. The presentations by Serge Gracovetsky are now available at: http://www.bodyworkcpd.co.uk/index.php/bpd-videos.
4. Serge Gracovetsky; his presentation on the spinal engine theory given in Brighton, England, in September 2011.
5. Need source of quotation about ground reaction force
6. Gracovetsky quote
7. Stephen Levin: www.biotensegrity.com.
8. Serge Gracovetsky; see suggestions for further reading, below. See also https://sites.google.com/site/gracovetsky/home.
9. Stephen Levin, http://www.biotensegrity.com/tensegrity_truss.php: "The Tensegrity-truss as a Model for Spine Mechanics".
10. Serge Gracovetsky's spinal engine theory; see suggestions for further reading, below, and https://sites.google.com/site/gracovetsky/home.
11. Ibid.
12. Ibid.
13. Leonid Blyum (http://blyum.com/) refers to the secondary parts of the upright "S" as "super curves" rather than demoting them to the term "secondary". Since they give rise to a much greater range and articulacy of movement, it honours the advantage the spinal engine theory elaborates. Rather than suggesting they are less important, or secondary, this elevates the curvature at the neck and waist to the assets it bestows on our range, elasticity and natural style of motion.
14. Graham Scarr, www.tensegrityinbiology.co.uk/, article: "Geodesic". See also: *Biotensegrity: The Structural Basis of Life*, Handspring Publishing Ltd., Pencaitland, 2014.
15. Stephen Levin, personal communication, 2013.
16. Stephen Levin, "The scapula is a sesamoid bone": www.biotensegrity.com. Letter to the Editor, published in the Journal of Biomechanics 38(8): 1733–1734; 2005.
17. Wikipedia, Biological Linkages, Linkage (mechanical).
18. X-bar linkage reference in N. Farhat, V. Mata, D. Rosa and J. Fayos, "A Procedure for Estimating the Relevant Forces in the Human Knee using a Four-bar Mechanism", Computer Methods in Biomechanics and Biomedical Engineering 13(5): 577–587; 2010.
19. Donald Ingber, "The Architecture of Life", Scientific American, Feature Article, January 1998.
20. Graham Scarr, www.tensegrityinbiology.co.uk/, article: "Geodesic". See also: *Biotensegrity: The Structural Basis of Life*, Handspring Publishing Ltd., Pencaitland, 2014.
21. R. Schleip, W. Klingler and F. Lehmann-Horn, "Active Contraction of the Thoracolumbar Fascia: Indications of a New Factor in Low Back Pain Research with Implications for Manual Therapy", in A. Vleeming, V. Mooney and P. Hodges (eds), The Proceedings of the Fifth Interdisciplinary World Congress on Low Back and Pelvic Pain, Melbourne, 2004. T.A.H. Järvinen, T.L.N. Järvinen, P. Kannus, L. Józsa and M. Järvinen, "Collagen Fibres of the Spontaneously Ruptured Human Tendons Display Decreased Thickness and Crimp Angle", Journal of Orthopaedic Research 22(6): 1303–1309; 2004.
22. Stephen Levin, personal communication, 2013
23. Graham Scarr, www.tensegrityinbiology.co.uk/, article: "Geodesic". See also: *Biotensegrity: The Structural Basis of Life*, Handspring Publishing Ltd., Pencaitland, 2014.
24. Jian-Shan Wang, Gang Wang, Xi-Qiao Feng, Takayuki Kitamura, Yi-Lan Kang, Shou-Wen Yu and Qing-Hua Qin, "Hierarchical chirality transfer in the growth of *Towel Gourd* tendrils", Scientific Reports 3: 3102; 2013.
25. Jeff Mitton (2005), "Spiral trees on windy ridges". Online: http://spot.colorado.edu/~mitton/webarticles/Spiral%20Grain.htm.
26. Leonid Blyum (http://blyum.com/) is the director of Advanced Biomechanical Rehabilitation (ABR). His extensive work and research in

the practical application of biomechanical principles is richly documented through clinical experience and an advanced education in mathematics. He translates complex models into practical applications for practitioners and parents of children where rehabilitation is required and in the rehabilitation of complex syndromes where biomechanical function is impaired.
27. Vanda Scaravelli, *Awakening the Spine*, 2nd edition, Pinter and Martin, London, 2012.
28. Stephen Levin, "The Tensegrity-truss as a Model for Spine Mechanics"; http://www.biotensegrity.com/tensegrity_truss.php.

Further Reading

The spinal engine theory put forward by Serge Gracovetsky, PhD, is explained and illustrated in very accessible form in Erik Dalton's book *The Dynamic Body* (Erik Dalton, *The Dynamic Body*, Freedom from Pain Institute, Oklahoma, 2011; http://erikdalton.com/products/dynamic-body/). Gracovetsky originally published his theory in 1987 and updated it in 2008. See also Appendices 6 and 7 of his 2010 publication *Non-Invasive Assessment Of Spinal Function Automatizing The Physical Examination: An Application Of The Theory Of The Spinal Engine*. **Appendix Six** discusses the concept of stability, an issue of importance for the determination of best posture, including the role of the sacroiliac joint. **Appendix Seven** explores the importance of the coupled motion of the spine and its application to sports medicine. The book is available from the author (gracovetsky@videotron.ca); from Amazon; or from the publisher (www.lulu.com). Space does not permit reproduction of any of it here but it is well worth further research by the reader. See also https://sites.google.com/site/gracovetsky/home for details of other publications by Serge Gracovetsky.

Stephen M. Levin's website (www.biotensegrity.com) contains various articles examining the logic of closed kinematic chains and how our bodies elaborate this model.

Tom Flemons's website (www.intensiondesigns.com) is full of tensegrity models and articles that carefully explain the application of tensegrity principles to human anatomy and biomechanical modelling.

Graham Scarr's website (www.tensegrityinbiology.co.uk) is full of highly informative articles and illustrations. It also includes models of the geometry behind the forms, referred to as Geodesic Geometry.

See, *Biotensegrity The Structural Basis of Life*, Handspring Publishing, Edinburgh, 2014.

CHAPTER

8

The Elastic Body

"It has been shown that fascial stiffness and elasticity play a significant role in many ballistic movements of the human body. First discovered by studies of the calf tissues of kangaroos, antelopes and later of horses, modern ultrasound studies have revealed that fascial recoil plays in fact a similarly impressive role in many of our human movements. How far you can throw a stone, how high you can jump, how long you can run, depends not only the contraction of your muscle fibres; it also depends to a large degree on how well the elastic recoil properties of your fascial network are supporting these movements."[1]

Robert Schleip

Everyone has a motion pattern that we could call a signature. Working in yoga and teaching classes, we develop an even more refined sense of people's individual style and expression, with reference to the asanas. As time goes on and experience accumulates, we develop finer distinctions for recognising them.

We are trained to see form and shape, to "identify" the forms of the postures and assist people in expressing them congruently. We learn to do this faster when we add the transitions in the joined-up kinaesthetic writing *of a sequence*. It could be thought of as a creative (physical) language skill that grows with us and our practice.

In the yoga classroom, it is tempting to think that good form matters more when we are in a pose, officially "doing yoga". The real test or value might be in what we can accumulate to improve our posture when we are not doing yoga. It is still a unique movement signature, but can we sign it with vitality and a flourish, or do we struggle to find relative ease and balance? How comfortably do we relax in our own skin? (This includes our resting posture.) Understanding fascia opens a new context for assessment and training.

Body-writing in Our Own Hand

There is no such thing as a right or wrong movement signature. It is what it is for each individual: a kind of personal hallmark. In the yoga classroom we can sometimes get caught up in evaluating each body in comparison to a perfect performance of the ultimate asana. However, one size *never* fits all.

Flexibility and stretching tend to be the celebrities in yoga, or at least, they are often afforded high

status. Those with naturally bendy bodies can get top marks while the stiff people, who feel they cannot stretch to twist and contort with ease, are often considered "not as good" as their naturally flexible companions. "I'm too stiff to touch my toes" is a not uncommon response from people explaining why they think they are unable to do yoga.

There is, however, a much more valuable and powerful distinction available, once we appreciate the myofascial body and its structure, which lies in recognising *elasticity* as paramount. Elasticity is the source of our energy storage capacity. Once we understand it – and there are a lot of misconceptions around it – we have an immeasurably valuable resource for vitality.

Stretching is one element that can contribute to elasticity. It can, however, be exactly the opposite of what an already super-bendy and hypermobile body needs to do to improve their elastic recoil capacity.

Stretching? It Depends

For some people, stretching can actually compromise their natural elasticity. Elasticity is a feature of fascia not only in terms of its recoil properties, but also of our *resting* architecture, our natural personal posture. Because of the way we are organised, under tension, standing or sitting still remains part of that individual movement signature just as much as being in motion.

We can all intuitively read movement signatures. It is part of recognising a friend walking towards you by their rhythm and pattern, gait and style of gesture. As yoga teachers we are naturally inclined to use this aspect of our proprioceptive awareness instinctively. Identifying elasticity, once we distinguish its true definition, is an extremely valuable teaching tool and an important "kinaesthetic dictionary" to build and refer to. This is partly because of its global application in reading bodies and partly because it makes sense of structural integrity. The means of obtaining structural integrity might include stretching, but it is by no means limited to it. It may not be useful to everyone.

Elasticity

We measure muscles using EMG (electromyography), which is based on active muscle contraction. However, there is more to the role of the muscle as part of a continuous tensional matrix, spaced by the bones in a tension–compression system. Even at rest, a muscle is part of the tensioning properties without being in active contraction.[2] At this time it would be EMG-silent. This is one of a number of ways measuring systems have affected how we attribute movement to specific muscle units. The distinction of elasticity or, more specifically, elastic integrity provides a healthy and intelligent foundation upon which to guide a movement practice. It relates closely to muscle tone; however, we are not using the term here, in order to establish "whole body awareness" and encourage thinking in terms of the entire organism rather than the parts.

Schleip refers to the elastic recoil properties of fascia in ballistic movements. However, as closed kinematic chains, if biotensegrity is the basis of the architecture of our collagen matrix, then it also has elastic integrity when we are still. The body benefits from the value of elasticity just as much sitting on a meditation cushion as it does when springing through an Ashtanga series.

Understanding and recognising innate elasticity is made more difficult by the many different meanings we have for the word "elasticity" itself. There is a general perception in yoga that it is associated with *bendiness, stretchiness and flexibility* (the archetypal heroes in our yoga movement story). The enemies might be seen as *tension, stiffness and strain or stress*. They are much maligned!

We need new and more favourable terms for these powerful "bad guys" because they are vastly misunderstood. Far from being the enemy, they are guardians in disguise. We are designed to stiffen up to

resist deformation, or to manage a movement that requires high tensional integrity. Tension, stiffness and strain need to be presented, free of their negative connotations, as values on a graph or scale of physical attributes that allow us to fine-tune and foster elastic integrity. If we focus only on stretching, then elasticity can get lost in translation. Elasticity is a powerful resource that the body exploits to save energy. Stretching is just one subject in a much broader picture.

Exploring New Terms

In order to see this as a general and global distinction for movement integrity and overall vitality (at rest) we can include the four main attributes of elastic integrity (Fig. 8.1). At first glance we could be forgiven for asking what stiffness is doing on a chart for yoga and assuming that we should err towards the bottom right hand corner of the figure. Fascial stiffness, however, has a whole other meaning and without it we can experience severe difficulties with stretching and speed. Its absence profoundly affects our range and elastic vitality.

The Middle Way

The useful schematic in Fig. 8.1 is deceptively simple. Balance and access come from the centre; it is a balance of suitable stiffness, which means suitable resistance to deformation. In fact, "Bendy Wendy" (see Fig. 8.13) might need more stiffness, not more stretching.

The terminology needs some reframing and the idea that yoga is synonymous with stretching might be a disservice to its powerful contribution to elastic integrity. Elastic energy is very low-cost metabolically; it is the essence of healthy, vital movement. On or off the mat, we seek a signature our body signs with vitality.

Confusion is also created by the use of elastic bands in building biotensegrity models. The confusion is between elasticity as a *property of any material* and "elasticated" bands. Biotensegrity models are actually optimised using non-elasticated materials, to demonstrate strength and accurate examples of how collagen behaves in our body architecture. It is the sum of their combined tension–compression organisation, the balance between the length of the struts and the density of the tensional elements, that provides elasticity to the different aspects of our overall form. This can be demonstrated with the models in Figs 8.2 and 8.3.

Elasticity is can be compared to one side of a coin. The other side of that coin is stiffness. Stiffness is the *resistance to deformation* of a material. Elasticity is the *ability for reformation*. The literal definition is "stored energy capacity" which is a function of elasticity and stiffness in balance. The amount of stored energy capacity is relative to the stiffness and elasticity of a material. On this basis, steel has higher energy storage capacity (elasticity) than rubber. A steel car spring has high stiffness, while a Slinky toy has low stiffness. Both have elasticity. The car spring (higher stiffness and elasticity) is better able to resist deformation and therefore to be supportive.

Viscoelasticity. In liquids, this same principle is measured in viscosity (thickness). Honey is more viscous than water because it resists deformation when you stir it. Water has relatively lower viscosity and is less resistant to deformation. Viscoelasticity acts as a "damper" (i.e. such as would be placed on a stiff car spring to modify the *rate of elastic return*). It is a time-dependent way of regulating elastic "spring-back".

Poroelasticity is a feature of geology that is also relevant to the extracellular matrix.[3] The combination of our tissues and contained fluids includes these characteristics as essential ingredients of our architectural form, from embryo to elder. They change constantly and yet remain in integrity, if we do not forget they are on a scale and remain too attached to one end of it (i.e. by focusing on stretching only).

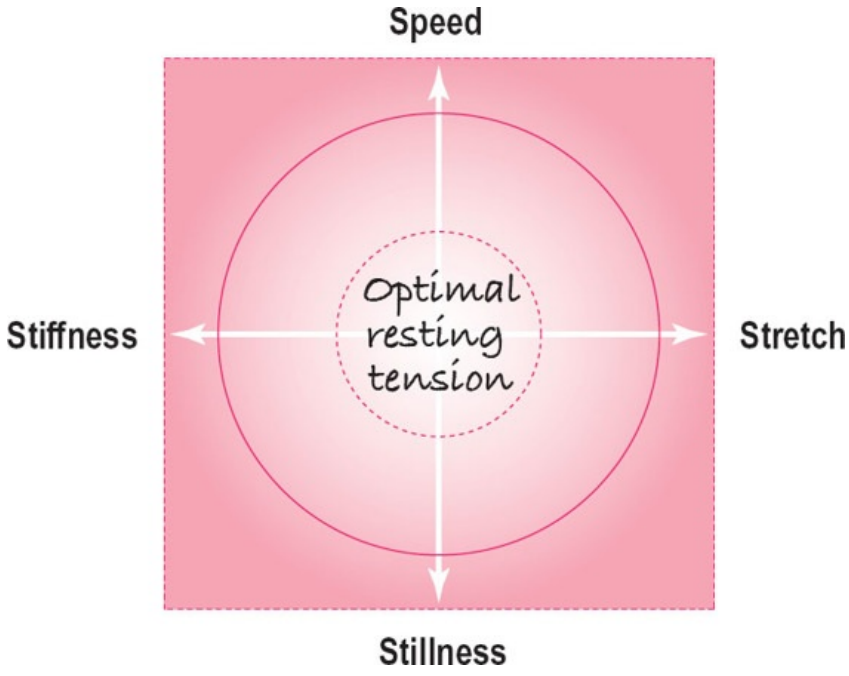


Figure 8.1

To balance the body in its full range of capabilities, we live in the range around the middle as pre-stiffened forms. This is important and one of the main reasons that elasticity and stretching get confused. Stretching is just one part or aspect of elasticity.

Stiffness as an Attribute of Biotensegrity

The models shown in Chapter 4 are made of steel (compression) struts and strong, non-elasticated (tensional) wires (also steel in some cases). The models made in the classroom include elastic bands for ease of construction (Fig. 8.2).[5] They appear to be "bouncy" because of their design and their *elasticated* connections. These particular ones are actually a good example of an untensioned tensegrity that has low resistance, low stiffness and therefore low elasticity (it does not bounce much). It still represents the geometry, albeit with less than optimal tensional integrity.

In fact, to appreciate a tensegrity mast, it is not necessary to have one made of elasticated materials. The structure in Figure 8.3 is made of guitar strings and hollow steel arrow shafts.[6] What happens as soon as you hold it is that you kinaesthetically appreciate how this multidimensional structure works. It is exceptionally light and encloses a maximum of space with the fewest materials. It is a triangulated structure and reveals a host of properties that we have throughout our tissues. It stands up, in all directions, by itself and, as a whole, it can bounce. (It is also a model of a closed kinematic chain with multibar linkage and no levers (see Chapter 7.)

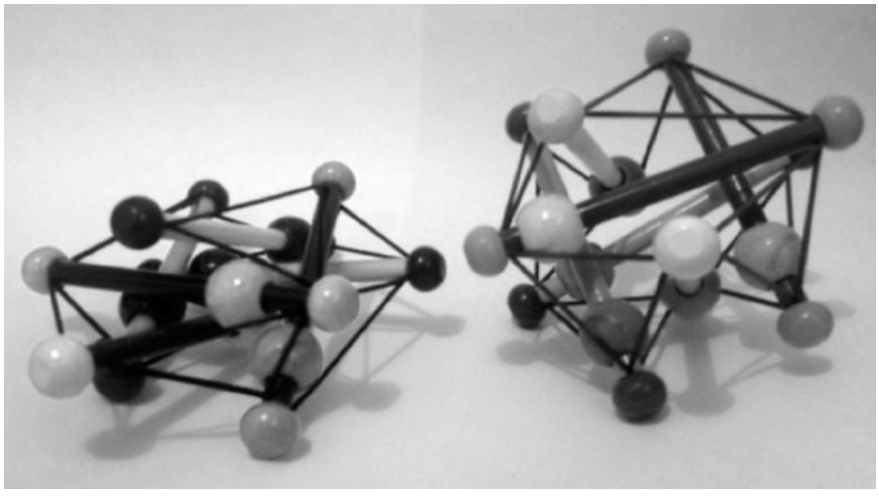


Figure 8.2

You may be able to see that the toy on the left is “soggy”; it has very low tension, or stiffness. The one on the right can bounce more. These are “Tensegritoys” (see note 5), with elasticated tension members and “compression” shafts made of wood. They make the point, however, because they are identical in size, but the left-hand toy has lost its tensile integrity and is more collapsed. It has low stiffness.

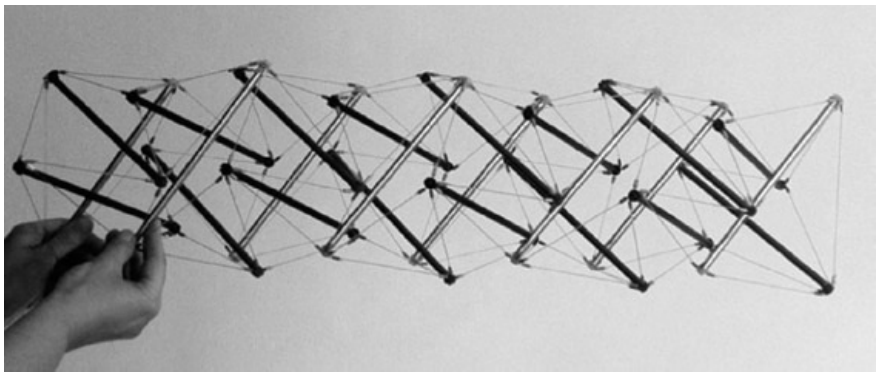


Figure 8.3

This biotensegrity mast has no *elasticated* components. It demonstrates high elasticity, because it has suitable stiffness. Model designed by Bruce Hamilton (see note 6) and constructed by the author.

While the tissue itself has recoil properties, a common misunderstanding is that the balance of elastin and collagen in the fascial fibres gives rise to our elasticity. Elastin fibres can elongate up to 150% of their length and restore or reform. It is, in fact, one of the suite of tissues the body calls upon in wound healing.[4] Suitable tensile properties in our tissues and their overall elastic integrity rely upon the stiffness of the collagen matrix, which is essentially low in deformation and relatively high in resistance to it (i.e. stiffness). (It stretches up to about 5% only.) This, in balance with our architecture, creates overall energy storage capacity. If we were too “elasticated” we could not function: the energy literally leaks. It can look like a soggy structure that needs strengthening.

Whatever direction you pull or push it in, the structure naturally resists deformation because:

- the force is transmitted throughout the structure
- the architecture resists you, whether you pull, push, bend or twist
- it naturally counters any movement by stiffening
- the whole structure bounces end to end in any plane
- it is independent of gravity, needing no support to hold it up or out
- it can move in any direction (assuming it is not torn or broken)
- it reforms immediately from deformation within its resilience range
- it conforms to the geometry of a biotensegrity icosahedral form
- any change anywhere in the structure affects the whole.

In these models, the “soggiest” one (Fig. 8.2) is the most stretched, which makes it the weakest of the three. Stretching is an ingredient of biotensegrity, but only in balance with suitable stiffness. The mast, with no elasticated fabric, retains its *elasticity* when it is still, just as we can.

Stretching

Here we are not saying that stretching is not valuable; rather, we are placing it in a specific context. Exploring stretching and elasticity in animals provides some interesting clues as to the value of certain types of stretching. Fascial research is reframing notions of stretching as preparation for action, in peak performance for example.[7] In our search for some of the common denominators of what might work, and when and why, we are invited to see through a different lens as we learn about pandiculation,[8] and the specific value of yawning stretches, to our fascial system.

"It is now recognized that the myofascial system is integrative, linking body parts, as the force of a muscle is transmitted via the fascial structures well beyond the tendinous attachments of the muscle itself (Huijing and Jaspers, 2005). It is argued here that pandiculation might preserve the integrative role of the myofascial system by (a) developing and maintaining appropriate physiological fascial interconnections and (b) modulating the pre-stress state of the myofascial system by regularly activating the tonic musculature."[9]
Is this perhaps Nature's way of maintaining the functional integrity of the myofascial system?[10]

Animal Stretching

Big cats. Consider the cheetah, for example (Fig. 8.4). All cats can rest and relax, stretch at a suitable time and move at great speed when they need to. To chase or pounce on their prey, they can sprint, leap and bound, deploying their powerful elastic recoil abilities in action. When they rest, they become languid and serene. After they have rested, they yawn-stretch their whole body to wake up their tissues after releasing them (i.e. through rest) for a period of time. This particular type of stretching yawn is called pandiculation.[11] It is a feature with a purpose in nature. It reactivates the tissues after resting them and reorganises the internal bonds and fluids, ready for mobility.

When a cheetah anticipates prey (think in terms of preparing for a peak performance), the last thing it appears to do is stretch. (Can you imagine a cheetah turning to its cub-in-training and saying: "keep an eye on that stray wildebeest while I stretch, won't be long …"). Quite the contrary, they squeeze their tissues by actively *stiffening* them. They stalk their prey, and seem to shrink their bodies by tightening – the opposite of stretching. It is a global action that can reduce the space they occupy and draw in, or contain, all their tissues.

Figure 8.4
This is a yawning stretch or pandiculation (see text). A wild cheetah in Up-Down Dog Pose, its own version of Adho Urdhva Muhka Svanasana. (Reproduced with kind permission from Shane McDermott, www.wildearthilluminations.com.)

This squeezing, which seems to be part of priming their bodies, makes the animal ready to deploy the potential to pounce or sprint as required. It seems they maximise their catapult capacity by tensioning the whole matrix. Even their fur stands on end, perhaps for super-sensitivity to the task. Cheetahs, like many

other mammals, focus and draw their tissues *in* to make them fit for purpose, globally. There is a time and a place, a dose and degree for them to stretch – and it is not *before* peak performance.

Springboks. On this theme of priming and tightening tissues to elaborate their recoil properties, springboks provide another detail that is of interest. If you watch them, even at play, they seem to practice "pinging" up in the air for the sake of it. Are they *priming* their tissues?

When you look at a large cat and a springbok together, one chasing the other, you see two very different means of deploying elastic recoil. Each depends on their particular kind of movement signature to survive. The cat, as we have pointed out, spring-loads to sprint and pounce, leaping in long strides at high speed, in clear directions. (Their velocity is their advantage, not their turning circles.) Now the springbok no longer pings upwards "for fun", but uses its *ability to do this* to run and leap in many different directions to evade capture. It darts and gallops in anything but a straight line, using short, sharp turning angles to confuse and tire the cat. Both types of animal speak their own kinaesthetic language as a survival mechanism, with both dependent upon elastic integrity.

Note also the distinct and different resting tension of the two animals. The springbok has long, stiff, highly tensioned legs and does not appear to indulge in the languid serenity of a cat, even at rest. The bodies of springboks are geared for tightly contained, ready-to-rebound structure. The cat, on the other hand, has a distinctive state of "resting tension" that seems to occupy a much bigger range between rest or release and stiffened animation or strength. Although they are designed for considerable speed, like most cats they have an almost meditative ability to rest, which the spring-loaded signature of the springbok does not seem to include. Do springboks yawn and stretch as much as cats?

Recent research suggests[13] that optimal preparation for peak performance in elite athletes does not include stretching during their warm-up period, as it depletes strength just before a sprint, for example. Priming the tissues with short, elastic-type recoil or rebound movements, such as jumping on the spot or springing in various ways, is reminiscent of what we see in the animal kingdom. It does not necessarily mean stretching is wrong, but it brings us closer to refining the dose, degree and timing (and time and place) of how and when we use it.

Bears. At the other end of the active scale, a research project on Grouse Mountain in British Columbia studied how hibernating bears[12] survive a winter of sleep without experiencing osteoporosis or degenerative conditions in their muscles even after months of inertia. The hidden camera in their den revealed an interesting instinctive habit. They get up around midday every day and do 20–40 minutes of movement. They do gentle yoga-like stretches in all directions, yawning and wriggling and pacing around, reanimating the tissues, before they settle back and sleep (hibernate) for the next 24 hours. They do this in the lowest state of energetic demand and vitality.

New Strategies

Perhaps we will benefit from considering stretch-like movements after rest or as maintenance, rather than before performance. That does not mean entering a movement session without suitable preparation. It suggests rather that "post rest" is a good time for stretching, while preparation for peak performance at least might include micro-movements of the tissues and "mini" versions of the work being prepared for, at low amplitudes. Gradually increasing the amplitude towards performance is worthy of consideration. Before we consider the implications in (or applications to) yoga, just in terms of everyday life, we might ask ourselves how often we remember to stretch and yawn after a period of relative inertia, given the many hours we spend in cars, in beds or sitting at desks. Do we counterbalance these periods with

yawning stretches to reanimate and maintain our tissues? No cat, dog or bear would forget to do this after a period of inactivity.

We, on the other hand, will force-stretch to reach the most extraordinary shapes as if *that* is the purpose of yoga. Our fascial matrix is actually designed as a profoundly sensitive system to transmit and respond to movement *forces*, as distinct from forced movements. For some people who are already at the stretchy end of the scale, stiffening or tightening their tissues may be more valuable than spending too long focused on stretching for its own sake. Let us first establish why this whole principle of elasticity relies so heavily on suitable stiffness and why it is also important to understand it as a feature of our bodies at rest.

Elastic Integrity as a New Value

A useful example is in research on the Achilles tendon. Classical kinesiological models suggest that in jumping, for instance, the Achilles tendon is the strong, supportive, relatively less mobile binding, connecting the calf (gastrocnemius) muscle to the heel (calcaneus) at the back of the ankle joint. The "movement" occurs at, or has been classically assigned to, the calf muscle (gastrocnemius), as it actively contracts and releases (i.e. based on the action assigned to that particular muscle). (See Ⓐ Fig. 8.5.)

Using modern ultrasound equipment capable of measuring the muscles and the fascial tissues *in vivo*, however, researchers were surprised to discover that in oscillatory movement, the muscle fibres contract, or stiffen, almost isometrically (without changing length) and the Achilles tendon in fact acts like a strong elastic spring (Fig. 8.5 Ⓑ).[14] This would mean the muscle can act more like a brake on the spring-loaded recoil of the Achilles, under such circumstances. This might suggest the muscles have a role in *modifying* or *regulating* stiffness and elasticity in appropriate length to tensional balance.

Over recent decades, the accumulation of research investigating the various and subtle roles of the tissues has given rise to the very paradigm shift we are now in. It even highlights different *qualities* of stretching to include classical stretching and the difference of *actively loaded stretching* (Fig. 8.6).

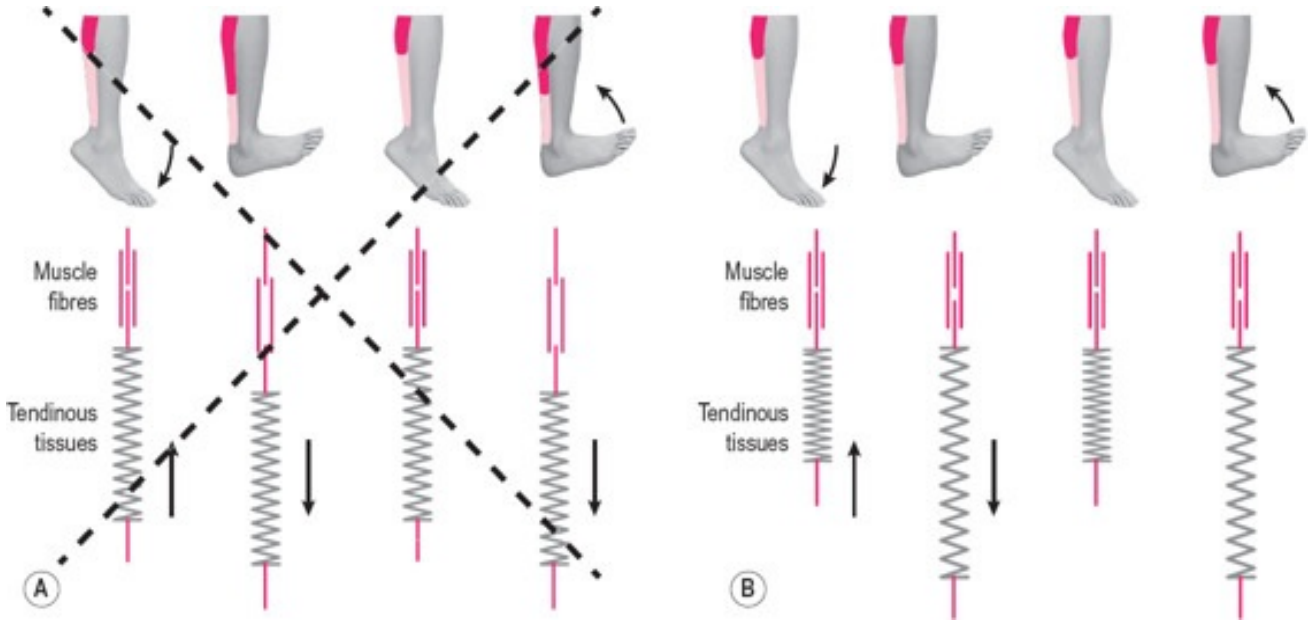


Figure 8.5

Images of research by Kawakami and colleagues (see note 14), after Schleip, showing the cooperation of muscles and fascial tissues. Effectively this suggests that the muscles act more like brakes, while the tendinous tissues lengthen and shorten like springs. Ⓐ is classical assumption. Ⓑ shows findings (after Kawakami).

The article from which the quotation below is taken points to the important role of tendon behaviour,

relating to *lack of stiffness* and the subsequent impact on adaptability and elastic storage capacity. The researchers also considered the different roles of tendons and tendinous sheets (aponeuroses) mediating our responses:

"During low tensile loading or with passive lengthening not only the muscle is elongated, but also the tendon undergoes significant length changes, which may have implications for reflex responses. During active loading, the length change of the tendon far exceeds that of the aponeurosis, indicating that the aponeurosis may more effectively transfer force onto the tendon, which lengthens and stores elastic energy subsequently released during unloading, in a springlike manner."[15]

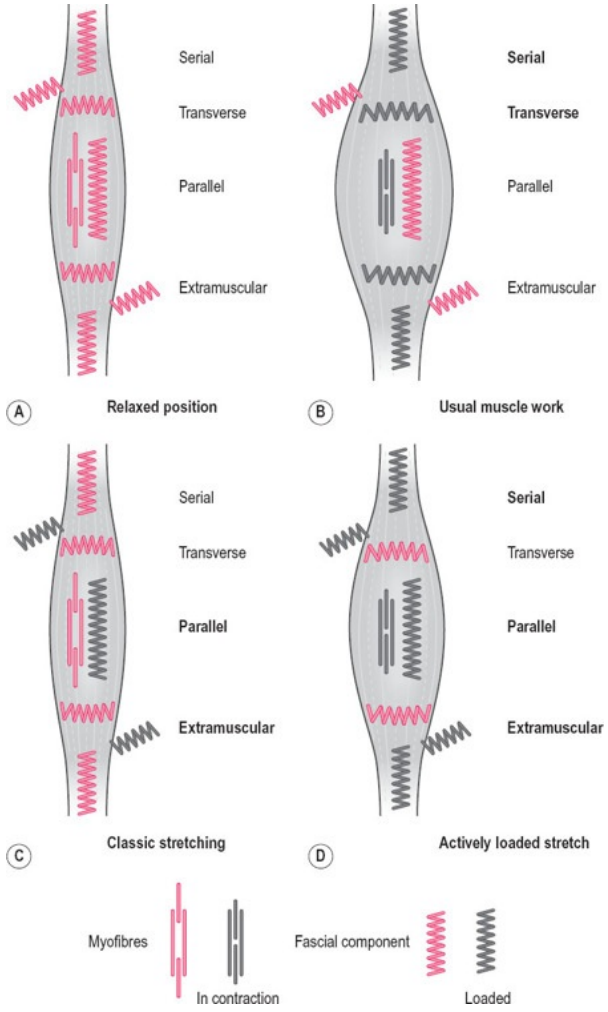


Figure 8.6

"In an *'Actively loaded stretch' the muscle is both active and also loaded at the long end of its range; it includes long myofascial chains. Most of the fascial components are being stretched and stimulated in that loading pattern."* After Robert Schleip, Terra Rosa e-magazine, Issue 7, April 2011.

The Anatomy Trains Human Dissection programme (Ch. 6) was also the first occasion of dissecting the Superficial Back Line (SBL) in a soft, continuous, seamless, uninterrupted continuity of tissues. Of course the bones no longer tensioned it. Thus as soon as it was removed, it took on a slightly different shape from the aspect of the body it had been removed from. Once it was laid out as a soft layer, its continuity irrevocably changed any notions of muscles working in isolation. The tissues that had connected the so-called SBL on either side, or underneath it, to the adjacent layers had to be cut away. Nothing interrupts their continuous connectedness in life. Even if they have been surgically cut during life, the adhesions appear as bound interruptions in a continuity, something like a darn in a sock. It affects the continuity of tissue *mobility* and *glide* (layers are clearly bound together in scar tissue) but it does not fail to be connected. This is the basis of changes in surgical procedures such as hip replacement. Rather than cutting across myofascial sheaths, they are parted somewhat like the segments of an orange but the fascial sheaths are mostly left intact. This is the structural basis for avoiding extra scar tissue and one of the reasons that hip replacement patients can walk within hours or days of such modern procedures.

One way it translates into the yoga classroom is that passively stretching alone (seeking length at all costs) is not necessarily the common denominator of preserving our elastic energy storage capacity. There is value in finding body movements that engage the long myofascial continuities[16] while actively loading the muscles in rhythmical movements, such as in a sequenced class. The quality of transition invites us to find a level of containment and refinement in the way we join up the movements. The achievement of length is not necessarily a forced stretch. It is a more subtle distinction of using our whole body in a contained way.

Magnusson and colleagues go on to elaborate the significant role of the fascia in maintaining adaptability where there is a suitable balance of stiffness. They show that far from playing a passive role in our structure, there is remarkably high metabolic activity in human tendon which "affords the tendon the ability to adapt to changing demands":

"With ageing and disuse there is a reduction in tendon stiffness, which can be mitigated with resistance exercises. Such adaptations seem advantageous for maintaining movement rapidity, reducing tendon stress and risk of injury, and possibly, for enabling muscles to operate closer to the optimum region of the length–tension relationship."[17]

We are invited by various research into the fascial matrix[18] to view the muscles as part of the continuity of myofascial balance throughout the tensional web of our architecture. The tissues clearly participate in the subtle translation and mediation of all types of movement. While this research focuses on different specific types of tendinous organisations, we must remember that the body itself does not go about getting agreement from each separate part. It organises and acts as an instinctive whole and the fascial matrix may be the uniting medium in which these specialisations occur.

Anatomy Trains[19] encourages us to see the muscles-in-fascia in longitudinal bands of continuity. This means both fascia (inclusive of tendons, ligaments and tendinous sheets) and muscle (in which it is profoundly invested) form integrating bands from head to toe (see Ch. 12). Whether you agree with the anatomical content of individual lines, slings or layers, Myers takes us towards an anatomical view of the body that endorses wholeness. He refers to the myofascial meridians as "lines of pull", which is an important distinction in terms of elasticity. They are "pulled" even when we are resting. The bones of our biotensegrity architecture maintain them under tension. They have to have something to pull *on*!

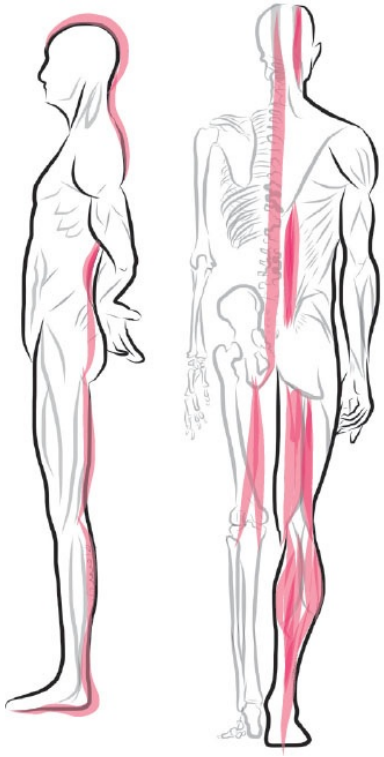


Figure 8.7
The Superficial Back Line is a metaphor for continuity. It is not separate in the living body from the layer beneath or those either side of it. In a movement class we do not have time to assess muscle by muscle – nor does the body move that way. (See Ch. 12 for a more detailed expansion of this theme.)

With regard to Figure 8.7, the so-called Superficial Back Line[20] of Anatomy Trains (which includes the tissues of the foot, the Achilles, the calf and all the way up the hamstrings, erector spinae and over the back of the head to the bridge of the nose) forms a continuous layer and band, *under tension*.

We have to expand our view to include the whole body to get a sense of why the bones play such an important role in creating suitable tensioning, or stiffness, in our tension–compression form. This is the quantum leap, from muscles as levers to muscles as *moderators* of stiffness and stretch, or stretch and squeeze, in the weave of our three-dimensional architecture.

This important distinction is to define this essential scale of elastic recoil as a predisposing property of our resting tension. Is there a relationship between the Anatomy Trains lines, or myofascial continuities, Chinese acupuncture meridians, and yogic nadis? Does elasticity as "energy storage capacity" provide a bridge between the esoteric associations with the "energy matrix" and the scientifically recognised energy (storage) matrix of our animated architecture?

"BIO-TENSEGRITY ENERGETICS: Both Snelson and Fuller emphasized that tensegrity models are physical representations of the underlying invisible forces that hold them together. The different patterns and geometries described [above] can be used to understand curvature, changing interconnections and transformations in energy, as well as multiple dimensions in space, but there is still a lot more to do to pull it all together."[21]

Understanding some fundamental tenets of elasticity might provide some clues about what provides the foundation stones of our balanced structure as we search for a context for all the postures and our respective ways of interpreting them. There are three main themes:

- the ability to globally expand and squeeze
- low-cost energy animation

- the basis of compliance and communication throughout our tissues.

Global Expansion and Squeeze

We have to expand the thinking from “circles to spheres” and recognise how tensional integrity works in a non-linear tension–compressions system with 360 degrees of movement potentials. Although we *can* do all sorts of things with our bodies, they rely on this particular biological architecture for one very fundamental feature: we can globally expand and globally squeeze to stiffen as a whole. (An example of this kind of movement pattern can be seen in a creature such as a puffer fish.[22]) It is an attribute of the movement of human structure; we constantly use it everywhere in our physiology.

Demonstration
Take hold of a strong elastic band (Fig 8.8) and place a finger at each end inside its loop, to hold it open but untensioned. Then pull your fingers apart to the halfway point. Then stretch it to its full limit. You have just demonstrated three stages of *stiffness*: (1) resting tension, (2) semi-tensioned, (3) fully tensioned. Beyond the third stage is the “elastic limit”, past which the band either tears or breaks.

Simple examples of this are found in various parts and functions of the body, from breathing to giving birth, from emptying the bladder to the movement of food through the gut via peristalsis. Although it operates along a tube, the method is an ancient rhythmical ability to expand and squeeze the tissues. They rest in the “middle state”, so that global expansion and global squeeze are always potentials.

Low-cost Energy

In the last chapter we elaborated upon the body’s primary concern for energy conservation. It starts with a pre-stiffened state of poise:

When you tension the elastic band and stretch it, you are sensing its resistance to deformation, that is, its stiffness. When you release it you are demonstrating its elasticity, that is, its ability to return/reformation. Two important facts arise from doing this exercise, which are:

- You need sufficient resistance to deformation (stiffness), or the band is floppy and pulled out of shape too readily.
- By fully releasing the band you do not demonstrate **resting tension** in the human body.

It is the halfway point of the elastic band, the semi-tensioned stage B (Fig 8.8), that demonstrates resting tension in the human body. We are “pre-stiffened” or “pre-tensioned” because we do not deflate. We do not experience the state represented by the elastic band at rest. In the demonstration above, we would start at the second stage, the middle way, which is our *default elasticity*. We find appropriate balance in life, essentially around the mid-point. It is a key to vitality.

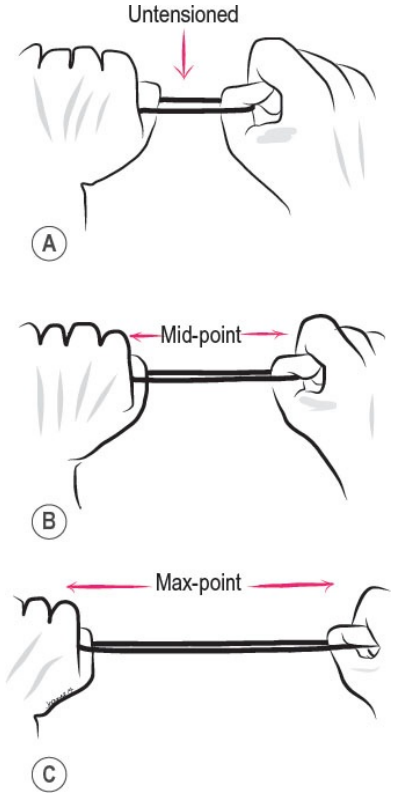


Figure 8.8
Demonstration of pre-stiffening.

Serge Gracovetsky points out that we are designed for mobility, rather than stability. We know from experience in the yoga classroom that stillness takes as much focused attention as movement. Holding postures is a skill in itself. Holding an elastic band at the mid-point of tensional balance shows precisely why. We live between stages B and C in our demonstration, (B & C in Fig. 8.8) in terms of living elastic integrity. If we go beyond C, however, and venture beyond our elastic limit, we can enter one of two states: these are plasticity (permanent irreversible change) and injury. Plasticity can be an advantage or a disadvantage, depending on the material and reason for changing it. Like elasticity it is a property rather than a value. It can mark improvement or injury, depending on whether the change it presents is valuable on that occasion, at that time, for that individual – or not.

Beyond the elastic limit of a material is a state called plasticity. Plasticity means that there is no ability to reform. Between elasticity and stiffness, deformation has reversibility, i.e. a capacity for reformation. The moment that natural limit is exceeded, deformation is no longer reversible. The material retains the deformation.

Imagine flicking a paper pellet with a metal school ruler. Within its elastic limit, the ruler would catapult the pellet across the room (high *elastic* energy storage capacity in the metal). If, however, you pulled the ruler back too far and exceeded its elastic limit, it would bend and stay there (it is non-reversible, no reformation). It would fail to "ping" the pellet. This is a demonstration of its plasticity. The exact boundary between plasticity and breaking point depends on the ruler's bendiness (ductility) or brittleness.[23] The ruler will effectively tire until it breaks, at the plastic limit. A plastic ruler, which has high brittleness and low ductility, will break at a point of much less strain than a metal one. These are properties of all materials; however, they are measured on a linear stress–strain graph. More confusion therefore arises for human bodies, since we "don't do" linear stress–strain graphs. Our tissues have to be continually stretched and strained repeatedly if we want them to retain deformation (see, for example, the practice of ear stretching, using ear plugs to expand the ear lobe *gradually over time*, but permanently). A graph of this viscoelastic deformation has what is called a J-shaped stress–strain pattern. It is "non-linear" because we are non-linear systems and it never goes to zero because we are pre-tensioned.[24] We never start at nothing; we always start at something. J-shaped stress–strain curves demonstrate lower energy cost. Note the same principle can apply if we wish to improve our abilities by repeatedly practising new, useful patterns. The time-dependency aspect of this principle of viscoelasticity can be to our advantage.

If we become overstretched, over time we can lose that "spring-back" facility if tissues are repeatedly

forced to exceed their elastic limit. Plastic deformation then becomes irreversible. If the elastic limit is reached too rapidly (these are time-dependent features), then damage can occur in the form of a tear, a break or the snapping of a tendon. Our tissues are sensitive to temperature, hydration, range and chemistry as well as *rate of change*.

One of the values of warming up (besides all the known benefits of stimulating circulation and preparing the body) is to wake up the tissues and activate their elastic potential and "interfascial glide" after rest. Elasticity is an energy asset throughout many forms of our internal and locomotive structure.

"the visco-resilient nerves are under a constant internal tension. The strength of these forces is seen in ruptured nerves. Simply because of their tremendous elasticity, the two severed nerve stumps shorten by several millimetres. In repair procedures, the surgeon has to use a considerable amount of strength to bring the two nerve ends together again … It is elasticity that allows nerves to adjust to the movement of a joint without loss of function."[25]

There are many aspects of our anatomy and physiology and biomechanics that rely on elastic integrity. These include, and are not limited to, the nerves, blood vessels, lungs, bladder, gut tube and locomoting tissues (Fig. 8.9).

"The collagen molecule exists in many different configurations and is a major component of the extracellular matrix (ECM) that surrounds virtually every cell. The matrix attaches to the cellular cytoskeleton through adhesion molecules in the cell membrane and forms a structural framework that extends through the fascia to every level in the body."[26]

The focus of this chapter is to recognise and apply these principles to whole body movements. The classical models rely on levers and inverted pendulums to explain human motion. However, watching a flowing yoga class for example, the body clearly has the ability to distribute forces throughout the system, changing the fulcrums and managing the form transitions seamlessly from the crown to the ground. These two-bar (lever) mechanics fail to explain fully how we can achieve the fabulous forms of yoga practice without shearing, breaking or falling off our own structural parts (as we explored in the last chapter).

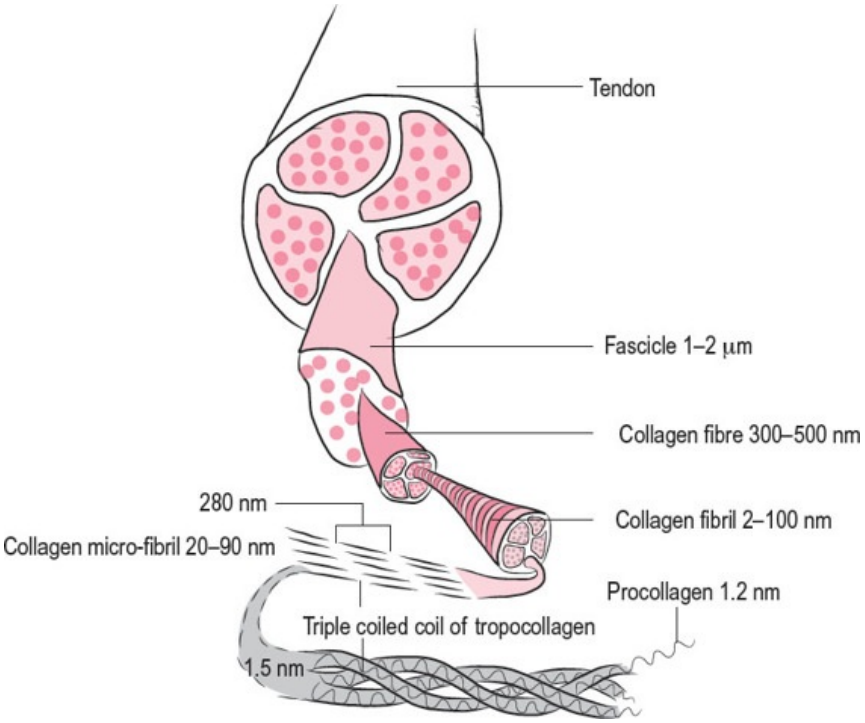


Figure 8.9

Graham Scarr (see note 26) provides detailed explanation of how the geometric principles of biotensegrity translate into a recognisable model of capillary formation, bone formation, "musculo-skeleto-fascia" formation and many other aspects of our form. (Modified after Graham Scarr, www.tensegrity.co.uk)

Further study[27] reveals the powerful potential of the biotensegral model as an explanation of our natural movements. What we do see, from the outside, is in fact relatively integrated movements that, over time, become more and more refined as we practise them and train our tissues, on every scale. The research that is accumulating on the study of biotensegrity is perhaps so compelling because it suggests a scale-free explanation of our movements; from organelles within a cell to the whole organism. We recapitulate at the cellular level the same micro-patterns as whole bodies performing macro-movements, on a scale from embryo to elder. This is simplified, but nevertheless honoured, if we recognise the whole "volume control" between stiffness and stretchiness, cross-referenced by speed to stillness. Altogether it forms a platform for guiding refinement towards elastic integrity. The focus on only one or other aspect of this crucial context of our form can be at the expense of the whole balance we seek throughout the practice of yoga.

The Graph in Practice

We can see this in Figure 8.10, with the *x*-axis representing stiffness to stretchiness. The *y*-axis is speed to stillness. (It is what I call a "soft graph". It is not really to be considered in a linear way, more a tool to interpret than a formula.) Appropriate tension is another way of saying stiffness in this context. Tension in a system invariably insists on the path of least resistance to equilibrium. What makes the tension work is the opposing compression. Graham Scarr refers to this as attraction and repulsion forces. For our benefit we have to recognise that these opposing forces coexist and create a third force through their combined polarities. We will still refer to that third force as neutral; it is the centre in this "graph".

The types of yoga that can animate the different aspects of the graph have been added to Figure 8.10. These are by no means definitive; they simply show a qualitative link between the different general themes of yoga practices. Many styles incorporate aspects of all of these attributes. (See Ch. 13 for the different body types and predispositions that match this graph.)

Rhythmical Springs

Between the pathways from speed to stillness, rhythm and direction also play a role in optimising balancing forces, under the heading of elastic integrity. Schleip uses a model to demonstrate this (Fig.8.8).

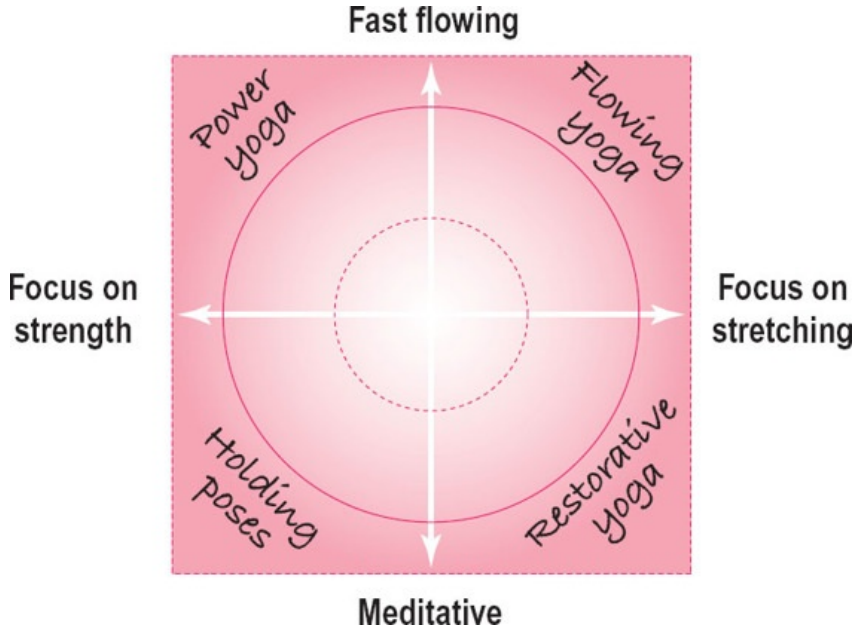


Figure 8.10

All different types of yoga can be placed here for their emphasis on different styles/types of movement. This schema can also include many ways, or pathways, for a given individual.

Demonstration

Find a length of coiled spring with a small weight on the end and a loop at the top (Fig. 8.11). Your finger becomes the muscle (activator) and the weight represents an anchor, such as the calcaneus. The spring is the model of the Achilles in this case but it symbolises fascial tendon. If you bounce the spring very gently, you will immediately be aware that it moves easily and continuously with very little "muscular" effort from your finger. The other thing you will experience is that if you change the rhythm a lot and alter the direction of the "action", the spring leaks its elastic integrity, it folds and jerks. This readily demonstrates how rhythm plays a significant part and suggests that it may be an advantage in covering distances to establish natural rhythm; this is a known feature of marathon running, for example.

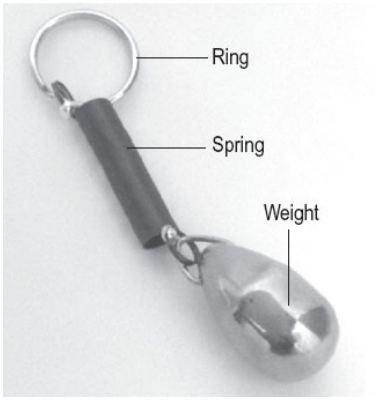


Figure 8.11

This is an example of how the fascia can behave, to help appreciate rhythm and rate as well as how little muscular effort (represented by the finger holding the ring) is required to release elastic energy to move the weight.

It seems that the sensory feedback of our subtle patterns is profoundly linked to rhythm and resonance:

"The neuronal circuit controlling the rhythmic movements in animal locomotion is called the central pattern generator (CPG). The biological control mechanism appears to exploit mechanical resonance to achieve efficient locomotion."[28]

This is what happens when we find and build *our own* rhythms, suited to the task. They are natural energy conservation patterns. If you allow the spring to bounce in a staccato way, or to go in many directions, it has to have suitable stiffness to do this without bending and folding too readily or randomly. (Think back to the springbok's legs; the resting tension is long and taut, so their spring-like movements can appear like vertical jumps from standing.) For long distances and steady rhythm, perhaps the cat is better assigned. With its extraordinary speed (and its counter-ability to completely relax) it can harness the broader extremes seen on the chart from speed to stillness.

Yoga has many different forms. Often they focus on one or other aspect as primary, such as power yoga or restorative yoga. There is a case for suggesting that each of us might benefit from a practice that includes some of everything (at least, that is, for optimum variability).

"A recognised characteristic of connective tissue is its impressive adaptability. When regularly put under increasing physiological strain, it changes its architectural properties to meet the increasing demand."[29]

Whichever way we do yoga we are looking for a place of elastic integrity, wherever we are (at the time) in terms of resting tension. While we are alive, we do not get to abstain from this choice. The "vote" for inertia sets up its own strain (or lack of strain) patterns. What is crucial is the timing of how our strain patterns are accumulated. Training at speed or training in stillness is not just about joining an Ashtanga class and doing it seven days a week or taking up meditation full-time. Our bodies self-regulate in very intelligent ways. The "myo" part of the "myofascia" (tensioned as we are by the bones) works together to modify stiffness and elasticity in balance. Each aspect responds in different time frames.

Muscle Focus versus Fascia Focus

> Napoleon was aware of the crucial value of timing and rest for his troops. In walking them from one region or continent to another for battle, the pattern he adopted for his army included 45 minutes walking per hour, with 15 minutes of rest. One and a half hours of movement requires several hours of rest to achieve the same optimal pattern. (Stress–strain graphs in non-linear biologic systems do not conform to linear mathematical formulae.) The result of Napoleon's method was that his armies could continue moving over extended periods throughout a long day and arrive with few injuries, despite the loads they carried and the terrain.

The myo(fascial) meat tends to react to training rapidly and thus the general experience of joining a gym, for example, is to see a fairly steep graph of improvement over a relatively short period of time (weeks or a few months). This is based on resistance training that focuses on isolated muscles in the upper and lower body. By doing this, the myo part of the myofascia is the focus and the effect is one of stiffening the matrix. (They never work in isolation – it is not possible.)

The pattern, in the most general terms, is a six to twelve-week rapid change and then a steadier line reaching a plateau. If you stop training it also tends to drop fairly rapidly. Typically a body builder who leaves the gym for a two-month holiday knows it can cost them their "peak form". It is a high-maintenance, metabolically demanding training. The frequency is usually advocated at alternate days.

By contrast, the fascial aspect of the myofascia responds to time period and timing of training in a very different way. In the short term it takes time to "deconstruct and reconstruct" after a period of intense movement. This process of reorganisation is called collagen synthesis. Research[30] shows that before this stage can be reached, the body requires a period of time during which it enters a phase called collagen degradation (Fig. 8.12).

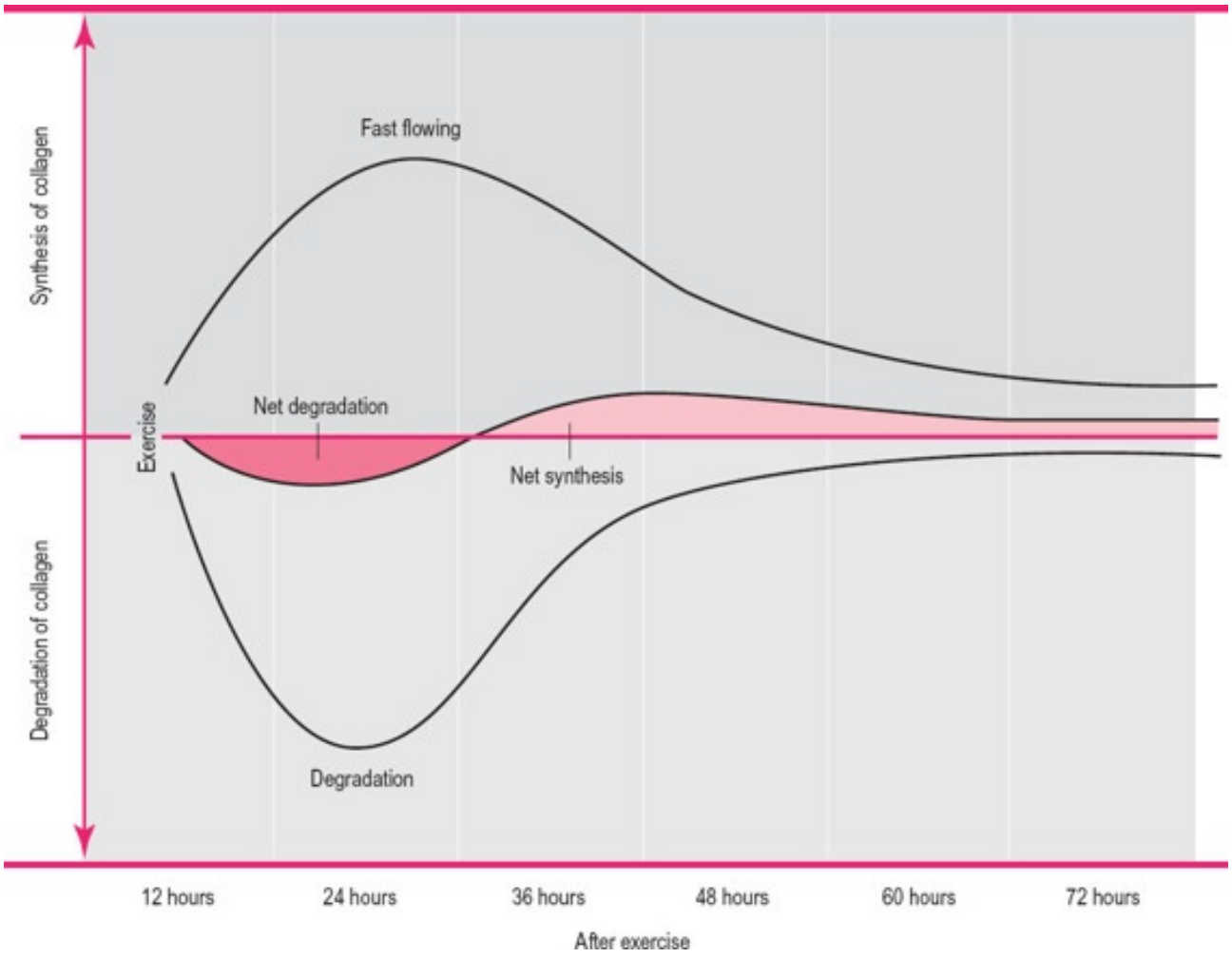


Figure 8.12

Perhaps this begins to explain why most injuries in athletics, sports and exercise are soft tissue injuries. Whatever the training, if it is intensely pursued without sufficient time to rest and restore the body, then the collagen matrix is in a phase of degradation and has not necessarily reached synthesis before the next training session. It is a clear indication of why forced movement and overtraining can conflict with elastic integrity. Modified after Magnusson[30].

In the long term, including the short-term repetitions, the soft-tissue training graph takes six to twenty-four months to facilitate collagen transformation.[31] This supports the value of working at less frequent intervals, over a longer period of time, to see the steady accumulation of balance and optimal training in the fascia. Schleip recommends we take the approach of a "bamboo gardener" who nurtures and waters his seedlings for many months, until they grow into healthy resilient plants that can reach their full potential.[32] This takes years, not weeks.

Stephen Levin was the first to bring these principles of biotensegrity to the study of human posture and movement. While Tom Flemons has created anatomical models, Levin has considered the evolutionary aspects of our reliance on this structural formation.

As far as yoga is concerned, this perhaps confirms an aspect of the difference between a twenty-four day (consecutive days) intensive training programme and the same number of days incorporated over two years, once per month. The mathematics may be the same on paper, but not to the body. We might say "use it or lose it" and add something about "gradually trained for change sustained".

Fascia-inclusive Training

Referencing Levin's work, Scarr writes: *"The erect spine and bipedal weight bearing capability of humans has traditionally*

been viewed as a tower of bricks and compressed disc joints that transfer the body weight down through each segment until it reaches the sacrum; but a vertical spine is a relative rarity amongst vertebrates. Most other species have little or no use for a compressive vertebral column, which is frequently portrayed as a horizontal truss and cantilever support system. As the main difference in vertebrate anatomies is in the detail it seems reasonable to suppose that they have some structural properties in common. Tensegrities are omni-directional i.e. they are stable irrespective of the direction of loading, and the spine, pelvis and shoulder all demonstrate this property (within physiological limits), enabling dancers to tip-toe on one leg and acrobats to balance on one hand" [35] … and of course yoga students to perform all kinds of balances.

This points to why the concept of training the fascial matrix is a valuable *addition* to many fitness approaches. The traditional main aspects are neuromuscular coordination, strength and conditioning, and cardiovascular and endurance training. These are completed and complemented by attending to the elastic component of our structural integrity. It includes working at a different pace, with a specific focus on the fascia and its elastic recoil and rebound properties. However, it requires sufficient and suitable rest. Yoga can and does enhance this complementary quadrant, if it includes a balance of all four aspects on the scale of stiffness to stretchiness and speed to stillness. Meditation is aware and conscious resting of the body, quite different from sedentary non-activity or sleep. It offers deep and suitable counterbalance to high levels of activity that allows the mind, body and being to enjoy all aspects of elastic integrity.

What this suggests is that we rely on elasticity perhaps more than we realise. The revelations about the fascial matrix are shifting the explanations we have for biomechanical function. They also raise many new questions and begin to make sense of why describing the experience of animating yoga postures in terms of levers, for example, is so awkward. According to Dr Levin

"*there are no levers in biologic systems. Anywhere.*" [33]
"Muscles are not functional units, no matter how common this misconception may be. Rather, most muscular movements are generated by many individual motor units, which are distributed over some portions of one muscle, plus other portions of other muscles. The tensional forces of these motor units are then transmitted to a complex network of fascial sheets, bags and strings that convert them into the final body movement"[34]

This "final body movement" is contained. In yoga sequences, for example, it rapidly and seamlessly transitions into another final body movement. Each one is like a still frame, literally animated by us into a fluid motion-picture sequence of transitions. Furthermore, we breathe continuously while we move. How does this get so gracefully integrated in our practice? We do not change form when we are holding a pose, rather than performing a sequence of postures. We might change the shape we are describing *with our form* but we remain whole as we transition. This means we resist deformation and have the ability to reform, which is the same as saying that we have elastic integrity of form. (And suitable stiffness!)

The quotation at the beginning of this chapter refers to the fascial recoil mechanism in ballistic movements. However, once we start to examine what biotensegrity means as a *three-dimensional* architectural model (as a basis of our elastic integrity), it invites us to consider that elasticity is actually fundamental, in varying degrees, to every part of our healthy mobility and internal motility at rest. All these tissues are organised and tensioned (or pre-stiffened) in three dimensions, even when we are in seated meditation. We are perhaps defined as biotensegrity architecture that is "elasticity incorporated" to varying degrees. Think about the elastic band we stretched to position (B) (see Fig.8.8). This position is the most difficult to hold. This is our resting tension, designed for mobility and poised for it.

Figure 8.13
Super “Bendy Wendy” types might not always have the best advantage for elastic integrity!

So how do we put all this together? We uncover a body-wide explanation that includes using muscles for strength and tensioning, while benefiting from using tissues for stretch and flexibility. It begins to explain motion in 360 degrees.

Posture Profiling® (see Part 2, Ch. 13) compares different body types to what we might call the “movement archetypes” that we have addressed here (i.e. speed, stillness, stretch and stiffness). Fascial body types are linked closely to reading bodies through their elastic integrity. (Everyone has it; there is no “good or bad” classification.) The questions to take with us are (1) “Does this individual’s elastic integrity serve them optimally?” and (2) “Is there a yoga practice they could do over time to enhance and preserve it?” This skill of recognition together with your experience can serve as a fast-track guide to optimum practice, one that can embrace everyone, and not just the “Bendy Wendy types” (Fig. 8.13)!

Figure 8.14
This is a wonderful image of biotensegrity in action as a global aspect of functioning form. Perhaps apart from its ears, this basset hound is containing its whole architecture in a focused balancing act to avoid tipping. (Reproduced with kind permission from Shane McDermott Photography.)

The dog in Figure 8.14 is not actually stretching in the technical sense to reach the pool and drink, even though it is "a stretch" to get there. In order to do so without falling in or swimming, it is actually *stiffening* its tissues throughout the length of the whole form, to balance from the tip of its tail to the end of its nose. In fact, it even reaches out its tongue very carefully to avoid disturbing the whole-body balancing act required to reach the water. Every part of its structure is engaged in coordinating the task it intends to complete.

This can obviously also be said of doing yoga.

Notes

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3. Leonid Blyum (http://blyum.com/).
4. Adjo Zorn and Kai Hodeck; Erik Dalton, *The Dynamic Body*, Freedom from Pain Institute, Oklahoma, 2011; http://erikdalton.com/products/dynamic-body/).
5. Tom Flemons made and sold toys designed on tensegrity principles for many years. His "Skwish" toys were licensed to a local company to manufacture in 1987. Manhattan Toys subsequently bought that company and the licensing rights in 1995. (See also Ch. 4.)
6. Bruce Hamilton's designs can be seen at www.tensiondesigns.com.

7. A.G. Nelson, N.M. Driscoll, D.K. Landin, M.A. Young and I.C. Schexnayder, “Acute Effects of Passive Muscle Stretching on Sprint Performance”, Journal of Sports Sciences 23(5): 449–454; 2005.
8. Luiz Fernando Bertolucci, “Pandiculation: Nature’s Way of Maintaining the Functional Integrity of the Myofascial System?”, Journal of Bodywork and Movement Therapies 15(3): 268–280; 2011.
9. Ibid..
10. Ibid.
11. Ibid.
12. Grouse Mountain in Vancouver; http://www.grousemountain.com/wildlife-refuge. There is a “BearCam” facility and it is possible to watch bears Coola and Grinder in hibernation. Researchers and rangers in the park run a blog and show films about the bears (and other wildlife at the reserve) and their hibernating habits.
13. A.G. Nelson, N.M. Driscoll, D.K. Landin, M.A. Young and I.C. Schexnayder, “Acute Effects of Passive Muscle Stretching on Sprint Performance”, Journal of Sports Sciences 23(5): 449–454; 2005.
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15. S.P. Magnusson, M.V. Narici, C.N. Maganaris and M. Kjaer, “Human Tendon Behaviour and Adaptation, *In Vivo*.” Journal of Physiology 586: 71–81; 2008.
16. Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009 (see also 3rd edition 2014).
17. S.P. Magnusson, M.V. Narici, C.N. Maganaris and M. Kjaer, “Human Tendon Behaviour and Adaptation, *In Vivo*.” Journal of Physiology 586: 71–81; 2008.
18. Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012.
19. Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
20. Ibid.
21. Graham Scarr, www.tensegrityinbiology.co.uk/, article: “Geodesic”. See also: *Biotensegrity: The Structural Basis of Life*, Handspring Publishing Ltd., Pencaitland, 2014.
22. Stephen Levin: www.biotensegrity.com; lecture at the University of Leuven, Belgium, October 2013.
23. Doug Richards, University of Toronto, Assistant Professor, Medical Director, David L. MacIntosh Sport Medicine Clinic. Also see www.**youtube**.com/watch?v=7qYYhkfu_vc for a 45 minute presentation by Doug Richards called “Stretching: The Truth”.
24. Stephen Levin, www.biotensegrity.com: “Tensegrity: The New Biomechanics”; Fig. 18. Published in M. Hutson and R. Ellis (eds), *Textbook of Musculoskeletal Medicine*, Oxford University Press, Oxford, 2006.
25. Jean-Pierre Barral and Alain Croibier, *Manual Therapy for the Peripheral Nerves*, Churchill Livingstone, Edinburgh, 2007.
26. Graham Scarr, www.tensegrityinbiology.co.uk/, Biology page. See also: *Biotensegrity: The Structural Basis of Life*, Handspring Publishing Ltd., Pencaitland, 2014.
27. Graham Scarr’s website www.tensegrityinbiology.co.uk offers a range of explanatory pages with well-referenced material written in clear and concise terms. It includes various links to current research as well as a wide range of applications of these principles.
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29. Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012.
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CHAPTER
9

Sense and Sentience

"Biology textbooks often state that the most important characteristic of organisms is the ability to reproduce, and then proceed to give an account of DNA replication and protein synthesis as though that were the solution to the fundamental problem of life. The ability to reproduce is only one of the properties of living organisms, and it could be argued, not even the most distinguishing one. For there are a number of other characteristics, scientifically speaking, which leave us in no doubt that they are alive; their extreme sensitivity to specific cues from the environment, their extraordinary efficiency and rapidity of energy transduction, their dynamic long range order and coordination, and ultimately, their wholeness and individuality."[1]

Mae-Wan Ho

Sensory refinement is an important quality in all our yoga practices. New discoveries about fascia shift the perspective on how it arises, why we seek it through the somatic awareness that yoga fosters, and how intimately it relates to our self-sensing regulation and autonomic function.[2] Fascia, in all its richness and variety, provides a new context for understanding movement. This fundamental change in context has taken place while, as yet, we have only the old language to describe it; we therefore need to develop new and subtle distinctions.

A list of functional or anatomical detail is interesting in terms of mechanics (which is often the bias of technical information about functional movement), but there is an invitation here (particularly for those of us who teach any form of movement) to find new terms to describe somatic refinement and sensitivity. Apart from anything else, scientific research is discovering new proportions and ratios for assigning senses and sensory responses to the forces that travel through our tissues in motion. The discovery that the fascia is one of the largest and richest sensory organs of the body[3] has made many people start to reconsider the traditional view of how the nervous system animates. As a new context, it is ground-breaking news. It does not, however, make the nervous system redundant. Rather, it redefines the qualities, transitions and characteristics of *how* we sense and what parts of us are actually *sensing*.

Six Senses or More?

We hit semantic difficulties here too. “Touch”, “feelings” and “sensing” are all words that have a multitude of possible meanings in the English language. You can be touched physically or emotionally; you can touch something literally or find a sentiment “touching”. In using the word “feel” you could be describing a multitude of experiences that provide an even wider mixture of possible meanings, from a literal change in temperature or texture, for example, to a profound emotion. “Feeling” something can be a physical description of a shape, an esoteric response to a poem, or a comment about its non-physical properties. “Sense” can also take many different aspects, and any effort to define its many meanings in scientific language is a little like herding spiders.

How would our cultural history have been different if, rather than learning that we are creatures with five senses, able, ideally, to hear, see, touch, taste and smell, we had learned that we had six senses, or more? The phrase “sixth sense” is often used to describe intuitive or inexplicable knowing. It is thought to explain the mysteries of hidden talents in individuals and can sometimes hint at occult domains that may not always be measurable by the physical sciences. In basic anatomy and physiology, as generally taught, you will find the nervous system treated as one entity (with a central and a peripheral aspect), including the five senses of sight, sound, smell, taste and touch. The last of these, touch, is usually the hardest to define and the one that accounts for a broad range of sensory faculties.

Perhaps inherent to the language we use to express ourselves here is a deep knowledge that there is much more to it, certainly when describing human beings.

Is there a place where our primary sensing and our feelings actually become one in the body? Could the new definitions of the fascia unite the physical with the metaphysical, honouring the whole purpose of yoga in its ancient wisdom and contemporary values? Sentience is not usually discussed under the heading of the nervous system, although it is arguably one of the aspects of being human that yoga lives to explore.

Emerging Definitions

In another field entirely, that of robotics, these changes in how we view the living body are corresponding to developments in “soft robots”. Newly invented robotic dogs, for example, mark a departure from previous ways of thinking: rather than just being guided by bigger and better central computers (i.e. a bigger brain), they have been given many more sensory processors in the joints and fabric of the actual model. “BigDog” (Boston Dynamics) is an example of this thinking:

Different branches of scientific research (neural science, developmental biology, psychology, embryology, fascia research and so on) are confirming that not only does the fascial “proprioceptive substrate” constitute a sensory organ but, given its exceptional surface area throughout the body, it is the largest and richest we have. Robert Schleip has contributed hugely to this expansion of our knowledge, organising a network of scientists to come together and validate findings. That is by means of practical dissection and via the most authoritative research laboratories around the world,[4] using advanced techniques to measure and explore the fascia (including in his own laboratory and by the group of collaborators at Ulm University[5]). Thanks to notable figures in the field such as Thomas Findley and Peter Huijing facilitating the Fascia Research Congresses, many highly respected scientists and specialists in this area have been able to draw together their extensive bodies of work to bring about this paradigm shift in our understanding.[6]

“BigDog’s on-board computer controls locomotion, processes sensors and handles communications with the user. BigDog’s control system keeps it balanced, manages locomotion on a wide variety of terrains and does navigation. Sensors for locomotion include joint position, joint force, ground contact, ground load, a gyroscope, LIDAR and a stereo vision system. Other sensors focus on the internal state of BigDog, monitoring the hydraulic pressure, oil temperature, engine functions, battery charge and others.”[7]

The ubiquitous network of fascial tissues that exists throughout the most finely detailed aspects of the human body is sensory in nature. It is being described as master of our sixth sense of proprioception. However, further differentiations in how we perceive our inner and outer worlds, and how they respond to us, are encouraging new areas of research and distinction that might at first seem unconnected but in truth are anything but. These include our sense of our inner selves and our autoimmune responses, and, as we will come to see, can address the profoundly integrated practice of yoga at its best and most valuable.

Mechanoreceptors

This means that the robot dog can walk over different terrains, such as ice and mud, and orientate different loads without being interrupted. An adaptive space- and surface-sensing system that can respond to pressure and friction changes, joint and locomotion forces is producing a more "sensitive" robot. We "non-robots" can already do all that, and new research is evoking new distinctions about how exactly we manage it.

Recognising the fascia as a sensory organ makes sense of exactly this facility in the human body. There are "sensors" (mechanoreceptors) of different types of sensitivity within the fascial matrix.[8] They are situated in the tissues, particularly at joints, along the fascia at the bones (bony periosteum) and between the layers of the fascia, where they can detect the subtlest shifts in motion and changes in terrain, through glide, through shape change and through deformation of the tissues. They sense, communicate *and essentially respond to* variations in temperature, tension and torsion, layer by layer and even cell to cell. The body you live in really is exquisitely sensitive and interconnected. Sensory biotensegrity is a new universe for distinguishing movement and its revelation is inspiring once you translate the fascia, form and functional movement it organises and authorises.

These mechanoreceptors (which we might also consider as types of motion sensors) give us all the different faculties described above, and more. They begin to explain the finesse and detail with which we can modify our actions and responses in such refined ways, adapting to the ground we walk on and the terrain we explore, on or off the yoga mat. They play a role in detecting subtle mechanical changes in local tension to give us not only some of our finer skills of dexterity, but to answer why we can do things (including yoga) the way we can.

The main "sixth" sense is considered to be our sense of proprioception (see Ch. 1). It is used to judge where our internal movements are in relation to each other. It also "calibrates" us, instinctively, so we know where we are in relation to our inner and outer environments as we unify both and bring them to a state of optimal congruency and the neutral balance we referred to in Chapter 6. It is our sense of space and relative position in distance, time and form as it informs the body of such tangibles as weight, density and the energy required to balance or transmit a load, without us necessarily thinking about it. That is the "load" of a needle and thread, just as it is the "load" of moving ourselves through a yoga sequence.

Fascia: a Sensory Organ?

Far from being an inert connecting material that happens to contain the vessels of the nervous system, the fascia is shown to be a sensory architecture that feels its way into forming and our way into the forms. The distribution of free nerve endings throughout the tissues shows that it is far more than a kind of carpet, over and under which lots of wires are laid down. The actual communicating means or the "current" is also in the tissue itself. This highly responsive matrix does not just have nerves in it, in that they reside in its matrix (although it does, and they do); it is far more detailed than that. Rather, it is completely

innervated.[11] By its tensional, or more specifically *tensioned*, nature it is also extremely sensitive to the slightest movement (or resonance, of vibration). The presence of different types of movement sensors (mechanoreceptors) in the layers and joints throughout the tissues has revealed a variety of sensitivities to a variety of subtle movements or forces on or through the structure.

Tensional integrity is an essential characteristic of biotensegrity architecture and elasticity (see Chs 4 and 8). It is *deformation* that the mechanoreceptors can detect: a change in tension or a shift between layers. Essentially, the tissue detects these subtle changes in the internal and external bodily environment. Notably, the essence of such a structure is that to varying amplitudes, a force is distributed throughout the structure, almost instantly. The corresponding movements required to balance (to naturally seek reformation and restore "neutral") and organise in relation to those changes include the response to the radial forces of gravity (and therefore ground reaction force). By its architecture it can respond biomechanically in very subtle ways via the whole sensory, communicating mesh of the fascia. Bear in mind that while the *understanding* is emerging; the ability is natural and ancient.

This calls forth new distinctions and provides an altogether different perspective on the nervous system. Robert Schleip points out:

"Many people think of the nervous system as an old-fashioned telephone switchboard system of the industrial age and therefore incapable of representing finer and more complex processes such as 'life energy' etc. The reader is cordially invited to consider this to be an out-dated model."[12]

Definitions:

Proprioception. This comes from the Latin *proprius*, meaning "one's own", and the word perception, so it translates to our sense of self-perception and relates directly to our positional sensing facility – knowing where we are in space and how we relate to objects. A task such as picking up a glass to drink from, for example, involves many refined recognition processes to assess the content, weight, balance and energy required to ensure we do not end up wearing the contents. To sip a drink, as distinct from gulping it, to use and adjust the right amount of effort as the content goes down, are all refinements of our proprioceptive awareness, communicated through our tissues. Children develop this sense gradually, progressing from grabbing wildly at a cup to being able to pick it up by its handle and eventually handling an open glass without tipping it too much or dropping it. These are progressive sensory refinements of proprioception. We use them constantly, if not consciously.

Interoception refers to the internal sensing that could be likened to a "gut reaction". It is not new, although newly named. It was originally termed coenaesthesia: "the neurological model of a mostly unconscious sense of the normal functioning of the body and its organs".[9] There is much new research around this faculty and proposed correlates with consciousness.[10] The interoceptive centres are distinct from proprioceptive centres in the brain. Interoception includes the sensation of pleasant touch but it refers to a less tangible, but nevertheless aware, instinctive knowing.

Nociception is the perception of various stimuli throughout the body, including the sensation associated with pain recognition. Interstitial free nerve endings are known to be able to change from nociceptive qualities to proprioception.

In 1991, more than twenty years ago, David Butler wrote of the nervous system:

"Arguably, there is no other structure in the body with such connectedness. Stresses imposed upon the peripheral nervous system during movement are transmitted to the central nervous system. Conversely, tension can be conveyed from the central nervous system to the peripheral nervous system.

If the nervous system were to be considered as an organ rather than the multi-segmented structure it is commonly thought to be, it would lead to a far better understanding of the system and of the patho-mechanical and patho-physiological consequences of altering its mechanics. One of the greatest implications of 'organ thinking' is that, if there is some change in part of the system, then it will have repercussions for the whole system. The continuous tissue tract makes this inevitable."[13]

Butler goes on to refer to the distinct aspects of the nervous system that focus on conduction of signals and also defines those others that primarily protect elasticity and mobility of the signalling branches. What is currently happening in research is the discovery of that interconnectivity throughout all the physiological systems. There is a collective recognition of the fascial matrix as the connecting organ common to *all the systems* of the body, including, but not limited to, the nervous system. Effectively, they are redefining each other.

The connectivity (and elasticity) Butler refers to is part of the circulatory and locomoting and structural systems too. It is the body-wide architecture which effectively forms lattice-like tubing and webbing around muscle fibres, circulatory vessels and neural vessels (neurovascular tracts), with cross-links and structural webs between them. It also forms "ropes and ladders" (tendons) and sheets or planes of tissues (aponeuroses), as well as the looser layers under the skin and between organs, for example. Together these form a mechanoreceptive substrate throughout the body, intimately embedded in the extracellular matrix. This includes the tendons and ligaments (or "dynaments", as van der Wal refers to them). It includes the wrappings of the muscles and their fibres and fibrils, as well as the tendinous sheets (aponeuroses) of fascial fabric between muscles and surrounding them. It includes the joints van der Wal calls disjoints. Van der Wal terms the entire matrix a "proprioceptive substrate" and points out that the mechanoreceptors reside between the layers where, as subtle movement sensors, they can detect deformation, that key component of elasticity (Ch. 8).

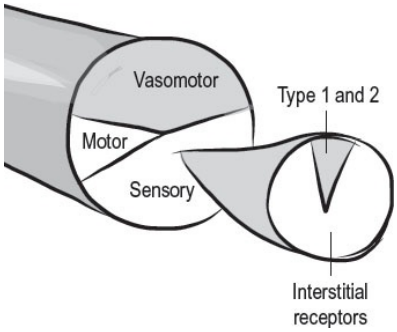

Figure 9.1

This means the fascia detects or senses movement anywhere and everywhere because it is, in fact, *sensory*. This discovery validates Butler's presentation and expands it somewhat to include the whole architecture. Indeed, the patterns he describes as beneficial to the protection of the nervous system's architecture when the body is mobile are apparently those of the fascial matrix throughout the body.[14] (See Fig. 9.1)

"If one studies a typical muscle nerve (e.g. the tibial nerve), it consists of almost three times more sensory fibers than motor fibers. This points to a fascinating principle that sensory refinement seems to be much more important than the motor organization."[15]

Sensing the Sensing

We rarely stop to describe how the tendons slide on each other – unless they do not. If you invite a participant to do Dog Pose and they have a condition such as carpal tunnel syndrome, where the movement of the wrist can be impaired to varying degrees, they might describe in detail what hurts and why they *cannot* do it. It may not be apparent that the lack of neck pain, for example, is an expression of a healthy body experiencing its own fascial compliance and innate coordination. If that begins to hurt too, they might begin to *experience* a connection between the wrist and the neck or upper spine. In terms of the fascial matrix, they are intimately related, not just because they appear on the same myofascial meridian.[16] It is also because the tissue connecting them is sensory in

nature and responding to elasticity (or the lack of it) through their *whole* tensional network. It began as one piece embryologically and one could say, it continues that way. We are still one piece, just bigger and more complex.

We practise yoga, think about the poses and how we change from one to another, while taking it entirely for granted that the lymph, blood, nerve vessels and glands, organs, soft tissues and bones will all just participate in our activity, folding where they need to fold and restoring themselves rapidly after the event (of a pose). They usually do! We do not have to check we can bend our elbows. We bend our elbows and find out whether or not they can "do" the pose. The tissue itself feeds back and says "yes" or "no" to the attempt by carrying out the action (or not). It also gradually responds over time to our repeated efforts to train it. The invitation is to develop our awareness and ability to distinguish the signals accurately enough to prevent injury to our tissues and to benefit from their aptitude for adaptability. This is the point of being taught, coached and guided. As guides, we seek the optimal way of doing this and communicating suitable feedback for each of the individuals we are invited to train.

The hardest part of any yoga teacher training is getting the practice diary written. One of the difficulties is that the language of movement is written in movement, which occurs in the moment. In seeking to describe movement, particularly in terms of sensitivity to it, we are often left with the language of pain or difficulty. When our body is working in healthy response and feels willing and able to do whatever we ask of it, be that Tree Pose, Headstand or a Vinyasa Flow sequence, then it is the *lack of* pain and difficulty that hallmarks the ease and grace of the movements.

The Common Denominator

Research suggests that the fascia, including the extracellular matrix (they are not separate, although distinct), becomes the common denominator of all the tissues' connectedness and sensory intercommunication. We are invited to consider it as an important context for mobility and internal motility of all vessels, organs and structures of the body, on every scale. Bear in mind it is all in a fluid environment, including the neural network.

Robert Schleip seeks to debunk the traditional notion of the nervous system as a being anything like an electricity wiring diagram:

"Current concepts in neurobiology see the brain more as a primarily liquid system in which fluid dynamics of a multitude of liquid and even gaseous neurotransmitters have come to the forefront. Transmission of impulses in our nervous system often happens via messenger substances that travel along neural pathways as well as through the blood, lymph, cerebrospinal fluid or ground substance (Kandel, 1995). This global system for rapid body regulations is inseparably connected with the endocrinal and immune system. Rather than picturing the nervous system as a hard-wired electric cable system … picture it in your mind's eye as a wet tropical jungle (Schleip, 2000). This jungle is a self-regulatory field with an amazing amount of complexity, continual reorganisation and plasticity, even in adults."[17]

So far a lot of work can be found in terms of mechanical function and anatomical structure, and even psychological implications. However, those are not necessarily the most helpful in a class. We need a language of context for the felt sense that swiftly translates at the speed of classroom activity. It has to come from the same place as, for example, learning to ride a bike or swim: discovered by the participant as their own sensory experience. We might describe the learning process of these events as more "transformational" than "informational". They rely upon the person doing them to discover how they can work. It is a language of participation, spoken in structure and accumulated in subtle strokes.

This local regulation is an intimate expression and finely detailed feedback system of both the mechanoreceptors and the architecture in which they reside. It reveals a continuity of the nervous system, an expansion that includes and transcends what it was classically considered to be. Imagine the central nervous system as represented by the primary colours red, blue and yellow. These colours can appear in many shades and variations to symbolise all that we are familiar with in descriptions of the neural network and its range of sub-branches; the secondary colours perhaps. However, the fascia expands this whole realm of colour to include all the tonal variations, subtle mixtures of pastel shades, warm, cool, hot, cold, bright, and the rich variety of the millions of shade variations we can make on a colour wheel. They are not separate, rather they can be seen as a much more refined potential, for finer differentiation: a more subtle palette. Fascia expands and deepens our understanding of the nervous system, rather than replacing it.

A Model of Movement

> If we regard the nervous system as an electrical circuit, we treat signals to and from the limbs, for example, as messages that travel to the brain (central fuse box) and back, in order to be conducted. What is meant by a "mechanical response" in this context is that the shape resists naturally, it responds automatically, in a manner of speaking. The tissue itself is responsive, via the various mechanoreceptors found in it. They form part of the pathway that can convert a stimulus to a nerve impulse or a chemical response, making the range, complexity and subtlety of our sensory nature much greater than historically presented. It is a kind of instinctive intelligence. The implication might be that our sensory vocation is perhaps more articulate than we realise – it has a broader vocabulary and qualitative nature than is often accounted for in scientific reasoning.

How this body-wide sensory system works could be likened to a kind of hierarchy in a walled city, where everyday details of the housekeeping do not bother the "head office" of the central nervous system: the brain. In this metaphor there are gatekeepers, regulating at various levels of management, throughout the whole connected sensory architecture. Not every subtle move we make is a major "call" to the main cables, firing a neuron that goes direct to the brain. Even at the level of individual cells, there is a biomechanical response or self-regulatory facility, as Ingber has shown through his extensive studies in tensegrity architecture as a principle of living micro-organisms.[18]

"Ingber (1993) and his co-workers elegantly provided evidence that the entire cell behaves as one tensegrity system. They devised ingenious ways to apply precise, local mechanical forces to the cell membranes. For example, specific receptor-proteins in the membrane are individually tagged with a microscopic ferromagnet, which, when twisted in a magnetic field, caused the entire cell to stiffen up to resist the twisting. These and other experiments have shown that mechanical signals are involved in regulating many cellular functions"[19]

This is exciting knowledge, if we are to step out into what Butler calls "organ thinking" and beyond systems thinking. In yoga, we work in "organism" thinking as we move the whole body and explore its sensory awareness and how we respond to our sense of attention. It encourages us to see the sentient body–mind–being as a whole and look for where it is integrated rather than where it is segregated. It is a view to celebrate from our position as yoga teachers. It seems much more complex but, paradoxically, it is actually simpler – all of you is sensory.

A New Way of Seeing an Old Way of Being

I have been challenged with the statement “just because there are nerves in the fascia, doesn’t make it sensory”. Peter Huijing’s answer to that question provided a segue into the scale of misunderstanding we operate under, while we seek to understand fascia from the outmoded context of anatomy such as it has been classically taught. New understanding requires new language and Huijing invited me in to that domain with another question: “Have you ever heard the sound of a neuron firing?” I have not (or if I have, I do not know that I have). Peter Huijing took the trouble to explain to me that the degree and quality of sensitivity in the human body is such that if every signal it translates had to go via the brain the noise would be unbearable:

“Many things can work, function and operate in self-regulation in the context of a sensory matrix. The sound of a neuron firing is very loud. Actually, you couldn’t stand the noise if every little thing you did to function every day wasn’t self regulating to an appropriate extent.”[20]

In search of a clear example of how this works, I have found the image in Figure 9.2, which provides one aspect of this story but lifts it into application. It shows many spider webs around a hedge and perfectly illustrates, in three dimensions, one aspect of the many ways in which the fascial matrix gives us access to our “extreme sensitivity”. You can readily see that if you were to reach *under* this hedge and shake the stem of one of the branches, it would shake the other branches, and the connecting tissues of the web would be disturbed, because they are held under tension. In other words, without touching the web itself, you can *affect* how it is structured because it connects all the leaves and branches. No part moves without affecting (or communicating the vibration to) the other parts to some degree; the amplitude changes. Imagine this network was contained in a very dense skin and that the webbing itself was sensitive to shifts in resonance and movements, able to communicate it as a signal, joining to and through the skin and layers beneath it. Thus any change within or around the contained area would be detected and the related forces transmitted through it. Furthermore, sensitivity would not be restricted to the movement or vibration of the fibres; the water droplets (visible in close-up) and the gases and other solids contained would also affect each other and the surrounding webbing, by moving them and being moved by them. They would experience the vibrational forces, to greater or lesser degrees, throughout their individual and collective architectures. The detail is unimaginable. The essence is that it is sensory and, essentially, self-sensing, via the tensions, oscillations and micro-movements of the inner-to-outer force transmission and translation. Humans do that constantly and precognitively. We do it without necessarily thinking about it. We enclose this facility entirely and instinctively. Animals do too. We just want to be able to explain it!

The impact of this revelatory information is not only in the science itself. It also resides in the scientific *confirmation* of the sentient nature of the human architecture. This is an important statement. When you make it clear to people that they are feeling in this level of detail, they often light up with the validation of their personal experience. It can confirm that feelings sometimes treated as metaphysical might be a more physical sensation.

What we do on the yoga mat is invite exactly this inner sensing, in a healthy way. It is a subtle response to the outer forces and an equally subtle influence over them. The development of this sense of sensing and sensitivity, and the ability to purposefully manage, move and expand it, is the basis of healthy practice. We will look into optimal ways to prepare a class with this goal in mind. First, let us flesh out some of the science behind the sensory nature of the fascial matrix and then explore how we can find appropriate and useful language for this in class.

Manual and Movement Therapy

The whole area calls for new distinctions of pain, as it can include a variety of sensations. Certainly, the sensation of stretching and "releasing" stuck tissues, or that associated with myofascial release, is very different to stubbing your toe, for example. One (the stubbed toe) seems to have a promise of random increase and rising amplitude of discomfort, while the other stops as soon as you do (or the practitioner does).

Robert Schleip has devoted his research to exploring the neural dynamics of fascial plasticity and making the practical implications known to manual practitioners and movement instructors in every field of endeavour.[21] Medical practice is gradually changing too because this one piece of information, that the fascia is the richest sensory organ of the body, transforms the way we *perceive* our clients, students and patients. It has implications in every field of medicine, from pain management and surgical intervention to recuperation and recovery: both physiological and psychological therapeutics. It goes beyond pathology to performance relative to any individual.

Pathology is outside the scope of this book; however, it is noteworthy that research includes the discovery that proprioceptive input strongly inhibits spinal cord processing of myofascial nociception. (Nociceptors respond to a variety of stimuli in different parts of the body. They also carry pain signals from the peripheral to the central nervous system.)[22] This is a complex area of study and any brief summary greatly oversimplifies it. However, what it means fundamentally is that if someone can consciously develop their body awareness, interoception and proprioception, they are less likely to experience myofascial pain. In practice, this points to the value of yoga as a pursuit that deliberately seeks to bring us into more conscious awareness of our body, both internally and externally, improving proprioception and interoception. By so doing, there is an active possibility of reducing myofascial pain, or even preventing it. The system can work in a cumulative way, building both gradually over time. Structural integrity appears as an asset for body, mind and being.

We often tend to keep still in order to avoid chronic pain. Research into low back pain suggests that such immobility results in matted tissues (see Fig. 7.9) and patients show decreased proprioception.[23] Thus, the implication is that improved proprioception, and the fostering of appropriate movement and awareness of it, decreases the experience of pain. This does not necessarily mean gross movements that involve huge effort and range. It includes tiny micro-movements that encourage and foster subtle proprioceptive awareness in the tissues. Of course, there are different circumstances mitigating each case and a lot of new research is emerging all the time. However, the research done so far has already changed

the general view and it certainly endorses the reasons to do yoga in an intelligent way and apply it appropriately, depending on the age, stage and condition of a given participant. It also points to why a restorative practice can have as many advantages as a power-based one; and vice versa. It depends upon the individual.

More than Mechanics

Schleip, as a practitioner, movement teacher and researcher, has covered many aspects of the fascia as a sensory organ in a series of articles for the *Journal of Bodywork and Movement Therapies*.[24] In these he demonstrates that the tissue has many and various properties beyond the purely mechanical; neural dynamics for example. There are three aspects particularly relevant to yoga practice. They are:

- Adjustment: how do we enter the kinaesthetic conversation with our clients? (see Part 2, Ch. 14)
- How do we foster sensory awareness?
- The direct relationship to autonomic system regulation.

> One participant in my weekly class, who began yoga at 75 years of age and is 84 at the time of writing, commented one day that he frequently stands in Tree Pose (Vriksasana) while cleaning his teeth, just to test his balance. In the morning he does it on his left leg, at night the right leg. He loves it because he has the sink for support if needed. Perhaps unsurprisingly, he walks easily for some distance daily and claims to be growing younger by the day. Upon falling on a muddy slope he laughed it off and showed no more ill effects than would be expected of a young man. Perhaps our sensory calibration is cumulative to an extent? (Case presented with permission of the participant.)

Yoga knows how to deepen our self-sensing of conscious and autonomic functions. It is, arguably, an important part of its purpose. However, it is fascinating to see how science is revealing the subtleties of exactly what works, and why. There is a great deal of compelling evidence to show that the more we explore our proprioceptive and interoceptive qualities of subtle movement, the more value this awareness can accumulate for our whole body and being.

"Mechanoreceptors have been found abundantly in visceral ligaments as well as in the Dura mater of the spinal cord and cranium. It seems quite plausible that most of the effects of visceral or cranio-sacral osteopathy could be sufficiently explained by a stimulation of mechanoreceptors with resulting profound autonomic changes, and might therefore not need to rely on more esoteric assumptions (Arbuckle 1994)."[25]

It is reasonable to suppose that the subtle movements and quiet aspects of certain yoga practices replicate the effect of some gentle treatment modalities in manual therapy. Self-sensing the cranial rhythm through subtle breathing techniques and meditation has also been shown to have a beneficial effect on the autonomic nervous system.[26] Realising the connecting tissues of our form are sensory brings together the reasons why understanding fascia can have such far-reaching and valuable effects. In some ways it validates the experience of a congruent yoga practice.

The Mechanoreceptors

Golgi

Golgi receptors are found at myotendinous junctions, where tendinous sheets (aponeuroses) attach, ligaments and joint capsules, or "dynaments". Their style of response relates to muscular contraction and stronger pressure of touch.

It was originally thought that Golgi receptors (Fig. 9.3) respond to slow stretch, such as would be achieved through Hatha Yoga postures. However, it has been shown that this happens only when muscles are being contracted at the same time as they are being stretched (see Fig. 8.6), because of the way the Golgi receptors are organised with the myofascial fibres. They assist in decreasing tonus in skeletal myofasciae, modifying the architecture. This promotes an approach with an understanding of tensioning or priming the body to allow for length to be *accommodated*, rather than pulling on tissues for length at all costs.

Stretching with yawning or squeezing (i.e. a lengthening contraction) has a different effect on the body and stimulates the Golgi tendon organs to provide feedback for dynamic changes. Actively loaded stretches, such as those in Hatha Yoga that include stronger holding patterns or rhythmical sequences, can also be beneficial and we will explore these in Part 2. We find our balance work has a close relationship to developing suitable reflexes:

"Studies of the fine antigravity regulation in bipedal stance have also revealed a new functional role for Golgi receptors. In order to handle the extreme antigravity balancing challenges as a biped, our central nervous system can reset the Golgi tendon receptors and related reflex arcs so that they function as very delicate antigravity receptors."[27]

Levin[28] goes further to suggest we have the ability to be unipedal and, since we explore balance on one leg a great deal in yoga, it is arguably a valuable resource in pursuit of sensory refinement. In the "use it or lose it" paradigm that the fascia invites us to explore, the practice of these postures plausibly develops ever finer distinctions for the Golgi tendon receptors to play a part in and expand their powerful contribution to sensory refinement.

Pacini

The Pacinian corpuscles are found in myotendinous junctions, deep to the spinal ligaments and a variety of myofascial tissues. Their style of response is to vibratory or excitatory stimulus; increasing local proprioceptive attention.

Pacinian mechanoreceptors (Fig. 9.4) are thought to be responsive to deep pressure and excitatory, fast or vibratory techniques, increasing local proprioceptive attention. These categories apply to manual therapy. However, in movement they are used as deep proprioceptive feedback for kinaesthetic control. This may improve our more subtle adjustments to remaining contained during fast sequences. While it is very useful to use this metaphor, we have to bear in mind that these receptors work in concert. The danger of applying reductionist thinking is imagining they separate their roles or work in linear or isolated ways. We are non-linear biologic systems that have access to all kinds of subtle possibilities that these distinctions invite us to expand into and include at any given time.

Ruffini

Ruffini corpuscles are found in the peripheral joint ligaments, the dura mater, and in tissues that are associated with stretching. Their style of response is particularly to lateral stretch (in manual therapy) and they can also increase local proprioceptive attention.

Stimulating them inhibits sympathetic tonus.

Ruffini mechanoreceptors (Fig. 9.5) are especially responsive to tangential forces and lateral stretch, and slower, more sustained pressure. They are associated with longer-term changes. Unlike Pacinian receptors, they tend to ignore excitable moves and enjoy long, slow, deep changes to the tissues, which would bore their Pacinian brothers! They are involved in the inhibition of sympathetic activity (fight or flight) and so naturally promote a calming effect on the whole system. Their effect may not be limited to their locality. In the preparatory practice of Pawan Muktasana (see Part 2), it may be these receptors that most enjoy the sense of gentle balance to the overall system and calmness of focus.

Interstitial Receptors

The “interstitial sisters” in Schleip’s metaphor – that is, the interstitial free nerve endings – are shown in Figure 9.6. Free nerve endings are by far the most abundant of all the receptors (see Fig. 9.2). They are found almost everywhere in the tissues of the body and have their highest density in the fascia covering the bones (periosteum). They are pressure-responsive, half responding to high-pressure and half to low-pressure changes.

Figure 9.3

Figure 9.4

Figure 9.5

Figure 9.6

These “sisters”, the interstitial receptors, are sometimes called the “witches and angels” of the system because they can move around and change their nature. Half of them respond to high pressure and half to low pressure stimulus. They also awaken local proprioceptive attention. Their relationship to the autonomic nervous system is gaining great attention; they increase vasodilation and rate of respiration. Their relationship to nociception (the sensation of pain) is where they get their nicknames. (Note the inverse relationship between proprioception and nociception).

“It seems that a major function of this intricate network of interstitial tissue receptors is to fine tune the nervous system’s regulation of blood flow according to local demands and that this is done via very close connections with the autonomic nervous system.” [29]

Schleip points out that

“when discussing any changes in motor organisation, it is important to realise that the central nervous system does not operate ‘in muscles’, i.e. a muscle is never activated as a whole.”[30]

He likens the tissues to schools of fish, changing direction en masse; when one or two go the other way, others might follow if a more coordinating or optimal flow is invited. It is a movement response a little like starlings in airflow, circling and making patterns across the skies (exactly what we observed in the “embryonic soup” of Ch. 5). The collective movements of starlings invite a change to the airflow that affects the air currents themselves, thus inviting different collective responses. The one and all work together at the same time, moment by moment. They sense and cause change simultaneously. According to Professor Darrell Evans,[31] this is also a fitting description of how the embryonic cells flow and form in

what we might call “crowd control patterns”, where the fluid flows induced by the kinetic changes change the kinetic patterns and the influences of the movements in concert.

Bodies are not linear systems and do not respond in a linear manner. A yoga practice invites us to take the tissues into different directions and, over time, they respond by gradually accumulating some changes and releasing others. This builds the loading responses in the fabric of the body and so we are able to respond to the cumulative effect of training or teaching the body (Ch. 8).

“An attitudinal shift is suggested, from a mechanical body concept towards a cybernetic model, in which the practitioner’s interventions are seen as stimulation for self-regulatory processes within the client’s organism.”[32]

One of the points of physical yoga practice is to become more readily and relatively steady and balanced in a variety of directions. Another is to develop the ability to be still, as a matter of choice and counterbalance. This research suggests that such a practice is very valuable for its support of neural regulation and function. It validates many of the suggestions of established yogic practices that they enhance balance and calm the body, by working on the nervous system. This suggests there is perhaps more than poetic value in the idea that changing the body to optimal function has a reciprocal effect on the mind therein, and the being: “*asanas are designed to have specific effects on the glands and internal organs, and to alter electrochemical activity in the nervous system*” (from the teaching of Swami Sathananda Saraswati).[33]

Sixth or First Sense?

This sense of proprioception is being referred to as our “sixth sense”. Could it be that the sense provided by this tissue of organisation is not so much our sixth sense but rather our primary or formative sense (if indeed there is a hierarchy)? Could the fascia provide the context in which the generally accepted five senses occur? Some epigeneticists suggest that the embryo forms and senses chemically, mechanically and biomotionally as it grows.[34] It certainly seems feasible that we continue to do that as we grow up.

Research implies that we actually have at least six senses, including the proprioceptive sense associated with the fascia. If we go back to embryogenesis, in the light of our forming blueprint this might not be so surprising. Given that the mesenchyme and so-called mesodermal layer arise originally from neural crest cells, one might be forgiven for asking the most naïve of questions, which is “Why wouldn’t our connective tissues all be sensory?” Until relatively recently, however, there has been no context for that question to be examined, let alone answered, on quite such a global scale.

The fascial matrix transforms proprioception and its distinct aspects into THE common sense of our organising matrix. It changes how we see not only the “musculoskeletal” function but also the nervous system and the categorisations assigned to physiological systems in general.

Not only does the fascia act as a body-wide sensory organ, but it would also appear that there are different qualities of sensory orchestration from different organs. While research suggests that we have specific interoceptive awareness, like a “gut brain”, other areas of science suggest we have a specific ability or sensory awareness in the “heart brain”.[35]

Heart-felt Becoming

In the embryo, the heart begins its development just beyond the crown, where the upper and lower layers

of the embryonic germ disc are formed (see Ch. 5). Thus the heart takes neurological tissues with it as it develops, forming, folding and feeding them as it itself is formed and surrounded by them. It grows at the same time as it provides food for the brain and spinal cord to grow, deepening its own faculty as it is called on to provide the nourishment for the rest of the body and organs to deepen theirs. The sensory, fluid, forming matrix is one at the outset. Needless to say, the architecture of the heart is entirely formed in fascia.[36]

"The heart is not a solo player in the quantum jazz of life. Instead it is in symphony with all other players, intermeshing and syncopating with their varied rhythms … it is the complex rhythm of the organism dancing life into being, in which every single player is freely improvising and yet keeping in tune and in step with the whole."[37]

The last 20 years have also seen considerable advances made in heart research. The Institute of HeartMath® (in Bolder Creek, California), for example, has shown that key information about how the heart functions lies in understanding the variability of the spaces in its rhythms. Heart rate variability is an important non-invasive tool for the assessment of well-being as it correlates with health and a sense of happiness on a number of measurable levels.[38]

"The heart has an extensive communicative network with the brain. Input from the heart not only affects the homeostatic regulatory centres in the brain but also influences higher brain centres involved in perceptual, cognitive and emotional processing."[39]

Although we generally do not consider the heart to be a component of the nervous system but rather to be part of the cardiovascular system, a growing understanding of fascial architecture may be changing this view:

"HeartMath researchers propose that the heart's electromagnetic waves may interact with the fields of organs and other structures to create hologram-like interference patterns that 'inform the activity of all bodily functions'. The other half of the process is that the heart is also informed by the activity of all bodily functions, which is reflected in its rhythmic variation from moment to moment."[40]

We are building a picture here of why segregating yoga into the classical construct of reductionist thinking does not work. Yoga only ever espoused the heart-felt wholeness of body, mind and being. This makes sense of a practice that centres on self-awareness to honour the source (you) in order to serve and become a resource to others. Science is endorsing yoga. There is no need to break it down into component parts that suggest a far less sophisticated organism than the one we move around in and sense our selves to be.

Presence and Pre-sense

The joy of a yoga practice is that state of presence to itself. It contains all our knowing and remains untroubled by the meanings we attach to our knowledge. It is simply the experience of the experience. This kind of consciousness can be developed, practised and accumulated. It allows us, undistracted, to give attention to our bodies and our tissues as they change, in the moment of the movement. It does not have to be a self-absorbed way of being. On the contrary, it is nurturing the centre from which we can teach in a quiet kind of listening, without the commentary of a busy mind.

Meditation is practised to ultimately release the sense of "suffering" in the body and seeks to transcend it. There are many highly advanced yoga practices that take this ability to the point of subduing the entire physical body to a state akin to hibernation and even controlling pranic energy (life force) to its minimum

expression of stillness, while still alive. Ultimately a Swami Yogi can attain “mahasamadhi” which is described as “a *yogic accomplishment of discarding the body at will to become one with the universal consciousness*”.[41]

Most of us find this extraordinary. Yet the discoveries about how subtle and intricate our structural matrix really is move us closer to the idea that we are all born with more exceptional faculties than perhaps traditional education has led us to believe. Imagine discovering that the very architecture of your house was a sensory, communicating organ and always had been!

The classical model of the skeleton is one of a frame that is moved by muscles, and in which muscles are organised via a kind of electrical wiring system to the brain and back. This idea has, however, lost its hold, taking with it the notion that a muscle pulls with equal force on the origin and insertion point of its attachment to the skeleton. The finer instrumentation now available shows this is not the case.

This is why understanding biotensegrity is so crucial to recognising the fascia in our form and functional movement. As a system under tension, it is sensitive to tensional changes throughout the matrix, including very finely tuned vibrations at subtle amplitudes. If you hold an elastic band at the half-tensioned point, it is extremely difficult to keep it there. This is the kind of poise we live at, even in relaxation. This is one of the ways that our sensory awareness can distinguish with such refinement and sensitivity.

The biology, chemistry, physics and geometry of this arrangement all facilitate sophisticated means to regulate and manage our responsive energy conservation throughout our sentient lives. In the research and presentations arising from investigation there is a recurring theme which includes the “spaces in between” parts and processes, the connections and transitions.

The mechanoreceptors have been found to proliferate at joints and interfaces where the layers move over each other.[42] The reason they are called “mechanoreceptors” is because they sense mechanical changes. This means effectively that they can respond “instinctively”, adding to the faculties of the fascia. They contribute to its role as a sensory organ that is supremely sensitive to changes in movement perception and able to adjust to them in self-regulation. The tissue will respond sensitively and instinctively to meet demand and this is why it is so important to ensure that we provide suitable loading patterns since they can become habitual or repetitive strain patterns if the same planes of movement are repeated too frequently or undertaken for too long at a time. Used wisely, however, they can expand our range and become more refined and resilient as we mature. We are designed for variability and adaptability and we can train the body to optimise those assets as we age.

Yoga practice lives right here, encompassing many aspects of exploring our form, via our felt sense and our sense of self, so that we can welcome this expansion of the basis of our personal anatomy and physiology. Yoga is certainly not comfortable if it is restricted to the biomechanical analysis of the postures on a one-size-fits-all basis. If anything, this containment and time spent in moving on our mat is designed to bring us into the present sense of our presence, or even “pre-sense”, to become more aware and more attentive to the experience of being-in-a-body, for the sake of it. It can also enhance our ability to anticipate.

We do not necessarily divide our practice into an inner world and an outer world but we do accumulate very subtle levels of distinctions for ourselves. Rather we seek to be a conscious interface, or a kind of conduit, that can make sense of the difference between, say, a feeling of poise and a sense of being still: being ready to dance and enjoying being present to being. We become the balance between inner and outer forces, developing sensory refinement *as* the membrane between them, moment by moment.

Notes

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3. Robert Schleip and Heike Jäger, Ch. 2.3, "Interoception: A New Correlate for Intricate Connections Between Fascial Receptors, Emotion and Self Recognition", in Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*. Churchill Livingstone/Elsevier, Edinburgh, 2012.
   Ulrich Hoheisel, Toru Taguchi and Siegfried Mense, "Nociception: The Thoracolumbar Fascia as a Sensory Organ", Ch. 2.4.
4. See www.fasciaresearch.de (Ulm University) for detailed information and various articles for both scientists and clinicians; Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012; Robert Schleip and Amanda Baker, *Fascia in Sport and Movement*, Handspring Publishing Ltd., Pencaitland, 2014.
5. See www.fasciaresearch.de (Ulm University) for further details. P. Barlas, D.M. Walsh, G.D. Baxter and J.M. Allen, "Delayed Onset Muscle Soreness: Effect of an Ischaemic Block upon Mechanical Allodynia in Humans", Pain 87(2):221–225; 2000. R. Schleip, A. Zorn and W. Klingler, "Biomechanical Properties of Fascial Tissues and Their Role as Pain Generators", Journal of Musculoskeletal Pain 18(4):393–395; 2010. Robert Schleip, Adjo Zorn, Fascia Research Project, Institute of Applied Physiology, Ulm University, Ulm, Germany. Werner Klingler, Department of Anesthesiology, Ulm University, Germany.
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7. See http://www.bostondynamics.com/robot_bigdog.html.
8. Robert Schleip, "Fascial Plasticity: A New Neurobiological Explanation", parts 1 and 2, Journal of Bodywork and Movement Therapies 7(1): 11–19; 7(2): 104–116; 2003.
9. Robert Schleip and Heike Jäger, Ch. 2.3, "Interoception: A New Correlate for Intricate Connections Between Fascial Receptors, Emotion and Self Recognition", in Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*. Churchill Livingstone/Elsevier, Edinburgh, 2012.
10. A.D. Craig, "How do you Feel – Now? The Anterior Insula and Human Awareness", Nature Reviews Neuroscience 10: 59–70; 2009.
11. Examining the tissue cell make-up is called histological study, which is the basis upon which the extensive research has been conducted.
12. Robert Schleip, "Fascial Plasticity: A New Neurobiological Explanation", parts 1 and 2, Journal of Bodywork and Movement Therapies 7(1): 11–19; 7(2): 104–116; 2003.
13. David S. Butler, *Mobilisation of the Nervous System*, Churchill Livingston, Edinburgh, 1991.
14. See Dr Guimberteau's work. Jean-Claude Guimberteau, MD (www.guimberteau-jc-md.com/en/). Both English and French versions are available at this address. His DVD: *Interior Architectures*, is available on the same site. See also *The Architecture of Living Fascia: The Extracellular Matrix and Cells Revealed Through Endoscopy*, Handspring Publishing Ltd., Pencaitland, 2014.
15. Robert Schleip, "Fascial Plasticity: A New Neurobiological Explanation", parts 1 and 2, Journal of Bodywork and Movement Therapies 7(1): 11–19; 7(2): 104–116; 2003.
16. See the Arm Lines in Thomas W. Myers, *Anatomy Trains*: *Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
17. Schleip As note 8.
18. Donald Ingber, "The Architecture of Life", Scientific American, Feature Article, January 1998. Ingber's research has since advanced considerably; see his website at http://web1.tch.harvard.edu/research/ingber/Tensegrity.html. An article on Ingber in the Encyclopedia of Tensegrity is hosted on the wiki: http://tensegrity.wikispaces.com/Ingber,+Donald+A. Available in full on http://www.scribd.com/doc/35190367/Architecture-of-Life-Scientific-American-by-Ingber.
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29. Robert Schleip, “Fascial Plasticity: A New Neurobiological Explanation”, parts 1 and 2, Journal of Bodywork and Movement Therapies 7(1): 11–19; 7(2): 104–116; 2003.
30. Ibid.
31. See Ch. 5.
32. Robert Schleip, “Fascial Plasticity: A New Neurobiological Explanation”, parts 1 and 2, Journal of Bodywork and Movement Therapies 7(1): 11–19; 7(2): 104–116; 2003.
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34. Donna Jeanne Haraway, *Crystals, Fabrics, and Fields: Metaphors that Shape Embryos*, North Atlantic Books, Berkeley, CA, 1976, 2004. Foreword By Scott F. Gilbert, another epigeneticist.
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36. Doris Taylor, PhD, Director, Regenerative Medicine Research at Texas Heart Institute, http://texasheart.org/Research/RegenerativeMedicine/.
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38. Christopher-Marc Gordon, Physiotherapeut PT.hcpc. UK Heilpraktiker Osteopathie Naturheilmedizin; research at Ulm University.
39. Mae-Wan Ho, *The Rainbow and the Worm: The Physics of Organisms*, 3rd edition, World Scientific Publishing, Singapore, 2008.
40. Ibid.
41. From the Satyananda Yoga Tradition.
42. Robert Schleip, “Fascial Plasticity: A New Neurobiological Explanation”, parts 1 and 2, Journal of Bodywork and Movement Therapies 7(1): 11–19; 7(2): 104–116; 2003.

Further Reading

Pathology is outside the scope of this book. However, yoga is becoming as interested in the therapeutic effects of its science as it is in the performing of the art. We are inevitably working with the fascia and, if we are able to improve its resilience, adaptability and health, it could naturally have profound overall effects on well-being. The following interesting extract from an interview between Dr Robert Schleip and Professor Stuabesand may be indicative: “Another and more specific aspect is the innervation and direct connection of fascia with the autonomic nervous system. It now appears that the fascial tonus might be influenced and regulated by the state of the autonomic nervous system. Plus and this aspect should have ramifications for your work - any intervention in the fascial system might have an effect on the autonomic nervous system in general and upon all the organs which are directly effected from the autonomic nervous system. To put it more simply: any intervention on fascia is also an intervention on the autonomics.

http://www.somatics.de/artikel/for-professionals/2-article/120-interview-with-prof-staubesand

CHAPTER
10

The Fascial Forms

"It is easy to forget that the concentration quotients of salts (NaCl, KCl, $CaCl_2$) in interstitial fluid [in the body] and in water of an ocean are nearly identical. Our cells are, in a manner of speaking, swimming gel-like structures in an ocean of interstitial fluids, and we are carrying that ocean around with us."[1]

Guido F. Meert

What is Fascia?

All fascia is connective tissue; however, not all connective tissue is fascia. Blood, for example, is a form of connective tissue that is not fascia. In the nomenclature used in this book, bones, cartilage and blood are excluded from fascial terminology. (Please note they are considered connective tissues but not fascia.) This raises difficulties among some researchers (see Ch. 3) who suggest that the periosteum (the tissue surrounding the bones) mediates and plays a significant role in the embryonic formation of cartilage that ossifies to become bone, but remains an intimately linked inner tissue to the periosteum. Others suggest that bone is a denser and more stiffened connective tissue that is so intimately engaged in the tension–compression forces of biotensegrity that to segregate these tissues is to challenge their profound interrelatedness. According to Dr Levin's research, to refer to bone as "starched fascia" is not inappropriate.

The term "fascia" is gradually being accepted in bodywork circles as the overarching term for the connective tissue of our body architecture, particularly, but not limited to, the forms of the "musculoskeletal system", or what is known as the locomotor apparatus: the structural means by which we move. What follows is an overview of how fascia forms to enclose everything in our bodies, for as well as itself being part of the forms of muscles and bones, fascia wraps everything, including the vessels and organs. It also includes the material that joins all those parts together: the extracellular matrix that is the surrounding tissues and fluids of all our organs and systems. It is the "stuff of the in-between", and it forms and contains the basic materials from which we are built.

Lines, Layers or Volumes?

One reason connective tissue is difficult to define is that it has different qualities depending upon its

regional and local situation in the body. It takes on shapes and properties according to organisation. In Guimberteau's films of the soft "shearing zone" under the skin (see Ch. 3), it appears open and fluid. Between the muscles it appears as sheets, and around the bones it is a tight wrapping. According to Deane Juhan:

"In the tendons and ligaments its tensile strength is superior to steel wire; in the cornea of the eye it is as transparent as glass; it accounts for the toughness of leather, the tenacity of glue, the viscosity of gelatin. Invest it to various degrees with hyaline, a nylon-like substance exuded by chondro-blasts and it becomes the various grades of cartilage; invest it with mineral salts and it becomes bone."[2]

Where Does the Fascia Begin?

We learned in Chapter 5 that the fascial tissue arises from the mesodermal layer (the middle, between the ectoderm and endoderm) of the embryonic form. Many tissues organise from the mesoderm; however, this occurs in concert with all the layers and forms. These include various fibres (fibroblasts) and connective tissues, such as cartilage cells (chondroblasts), bone (osteoblasts), marrow, muscle, blood, lymph, ligament, tendon, the linings of the body walls and cavities, the coverings around the bones (periosteum), the joint capsules, and many of the wrappings around the organs, the urogenital system and ducts. We have already noted how this ubiquitous fabric binds everything to everything else, wrapping nerves and vessels and weaving all the internal structures into place. It is referred to as the "organ of organisation".

When you are about to cook a chicken, examine the white, shiny film around the chicken breast, or around the bones, or between them before you heat it: this is the connective tissue. It is made of a protein called collagen. It comes in different forms, not just in the dense sheets of these filmy layers. It can appear like webbing or lace between structures or like dense, fibrous parcel-strapping holding certain joints together and as part of the joint capsule. As Juhan suggests, it is the same material (albeit invested with hyaline) that forms the cartilage or knuckle of the bones. According to Levin, the bones themselves are like a starched fascia, invested with mineral salts, and so on.

According to Juhan, collagen is the "most abundant protein in the animal kingdom".[3] In short, fascia to an animal or human body is cellulose to a plant. Cellulose occurs in as many and various forms and thicknesses as the different types of fruit, flower and vegetable that can grow. It also has different qualities within the parts of a particular form of plant. Think back to the orange we examined in Chapter 3. Although the pith between the skin and the fruit is different from the layers of segments, it is the same principle at work, namely the architecture of forming structure: chambers within chambers containing fluid on every scale, in finer and finer pockets of connective tissues – the metamembrane. We also saw this principle of formation of chambers within chambers in Chapter 5, describing the development of the human embryo.

In the Beginning

All these questions are being asked in new ways, now that we take the fascia into account and no longer discard it in the cadaveric bins in anatomy laboratories. No longer considered unimportant, it is recognised as having a very significant role in the running and organising of the "house" we keep and live in (our body). Thus fascia has been affectionately nicknamed "the Cinderella tissue of the locomotor system". Fascia is also referred to as a matrix, an organ, a system and a context for all the other matrices, organs and systems. Defining it is therefore something of an issue.

"as groups of cells began to merge into primitive organisms – some kind of 'metamembrane' became equally necessary in order to glue the whole mass together, again to resist the scattering forces of currents in the surrounding liquid medium."[4]

The chemical building blocks in the original "mothering sea" in which primordial life began are still a requirement to the life of each cell within the multitudinous complex living organisms that have evolved to survive in the sea, in the air and on land. Thus the "metamembrane" had to form in such a way that folds and forms, tubes, pockets and pouches could create the necessary shapes to organise more sophisticated organisms. Nevertheless, the tissues of the folds had to maintain the motion of fluids appropriately, throughout the internal structures of these forms. For the organism to stay alive, the channels and tubes had to allow for the inner and outer fluids within and surrounding the membranes to be moved around, sustained and kept fresh and flowing. This is true regardless of the size of the organism (the logic of the forming principle has to work in a whiting as well as in a whale).

The "metamembrane" is the body-wide fibrous mesh that brings the skin together and around us and also fixes it to the structures underneath, connecting them to each other. The logic of how we move on land is related to how we solve the problem of walking around, holding this internal "sea" up, while maintaining structural and functional integrity. Indeed, in yoga we ask our structure to do far more than walking; we explore many more directions than simply balancing in upright bipedal posture. We seek to be able to "swim and balance" on land almost as if we were in water!

How does this network divide us? How does it provide a binding agent that unifies all our details into one, yet keep them all distinct? How does it allow us to do all that and move around? How can it transform the pull of gravity and kinetic forces into the mathematics, physics and chemistries of a volume that can move around in space, on land, in such a self-contained way? How does it translate all those functions within our biological forms coherently?

Fascia is also an organ of adaptability. It changes at a relatively rapid rate as we grow and slows down as we age, although many aspects of it remain versatile and adaptable as long as we are able to keep it hydrated and activated. The remarkable human blueprint is such that the way we incorporate these different constituents (be they fluids, cellular, fibrous or crystalline components of the tissues) can change and respond to change. While the body honours the basic organisation of our species, the shape (or morphology) of the connective tissue is invariably expressed uniquely by each one of us. That is because it responds to use, to nutrition, to hydration, to gesture and to us, as individuals. It depends on who and how we are and how we use it, all the time.

Ground Substance

What follows is purely hypothetical and metaphorical, but I liken the idea of the body's ground substance to the "body's earth", just to get a sense of how fundamental it is. Its quality and chemistry matters; its balance of hydration has structural and supportive implications as well as important roles in metabolic health. Just as variations in the quality of soil affect which vegetables and flowers a particular patch of earth can support, so the ground substance has different characteristics and capacities which affect how it can support us. It is as intimate a part of the extracellular matrix as earth is to a garden or a forest. It is not the *whole* garden, but without it there can be no garden. Its health is crucial to the quality of everything that grows there. It binds the trees and plants, mosses and ferns, fauna and flora which reciprocally bind and nourish it. They work together. Without the one, the other does not survive. Connective tissue and ground substances are the extracellular matrix. They do not function without each other, any more than the fluids they guard and translate. Like the layers of water and aquifers in a forest ecology, so ground substance and the connective tissue matrix permit fluid flow and translation of the detailed chemistries in our bodies. It is a major part of an exquisitely detailed and intricate internal ecology.

Present in all of the body's connective tissues is something called "ground substance", forming part of the "internal sea" we contain. Ground substance, which resembles egg white, is a viscous fluid that plays multiple roles in the body everywhere there is connective tissue. It is distinct from blood plasma, hormones, nutrients or the materials and waste from metabolism. The extracellular matrix facilitates the translation, or "transitioning medium", through which these other fluid exchanges can take place. Ground substance is also produced by the fibroblasts that originally occur in (but are not restricted to) the embryonic mesoderm.

Different parts of the body have different kinds of ground substance. They provide something like the mesenchymal milieu in the embryo, and the "internal environment" completed by the extracellular matrix in the adult. (In the embryo, mesenchyme includes the cells. By definition, the extracellular matrix refers to that which is outside of the cells.)

Like earth, (see margin note) ground substance can take many and various forms, from viscous and gooey to thin and fluid. It can influence the exchanges it allows, of gases, antibodies and various bodily chemicals. It can form many sizes of molecules to allow different states or thicknesses (gel-like or more soluble) in the body. It facilitates irrigation and translation of chemical exchanges and can act as a barrier too. Ground substance is the body's glue, essentially composed of complex carbohydrates combined with a protein chain. It is part of a kind of intelligent internal management system. Considering a body from the point of view of only the muscles and bones is like focusing all your attention on the roses in a rose garden and ignoring the soil, the hydration and the structure of the plants. Their environment has a distinct and reciprocal role to play in the beauty and sustainability of the rose garden. Thus it is for the body.

Collagen Fibres

Collagen fibres form the matrix in which the ground substances reside. (To return to our metaphor, think of deforestation leaving the land as a dustbowl to get a general sense of how the binding nature of the filaments and fibres holds the matrix and its essential fluids together.) The tough strands of collagen give form to all our building materials and their finest fibrils maintain the ecology on a microscopic scale.

In the embryo, these fibres form a kind of neutral facilitating range of building potentials, responding to what is required locally but invariably connected to the global network of tissues. Some researchers consider kinetics to play as crucial a role as genetics in how our parts are formed. This tissue network is considered to respond to tension and compression forces as well as chemical and genetic signals, thereby organising accordingly as it grows. For example, tissues under the most compression possibly become densely packed and closely woven into the hardest bone. Tissues under the most stretch are tensioned, forming lattice-like layers around the forms (muscles). Together, these two aspects form our tensegrity-type structure. Between these extremes and their corresponding chemistries are the different building materials of the tissues, from cartilage and myofascia to the dura of the nerve to the wrapping of a lung. There are different densities of soft tissues, for example the sliding layer between the skin and the deeper muscle (myofascial) layers of the body walls. Variability is the hallmark of the fascia.

Research into cadaveric specimens where the connective tissue is carefully preserved has shown that it is structured somewhat as continuous bands and stratified layers. However, Jean-Claude Guimberteau, in his film *Interior Architectures*,[6] is at pains to point out that this is something that becomes more obvious in cadavers. Stephen Levin endorses this view, suggesting that the basis of our structure allows certain variability throughout our lives. In the living body, the connective tissue is ubiquitous, and we must guard against assuming that it forms definitive lines and layers the same way in everyone, or the same way that it appears after the tissue is deceased. In many cases there are subtle gradations of density between what seem to be layers but are not specific separate entities.

It appears that the structures respond to proportion, use, type and treatment. These have unique elements to each body in terms of exactly how they organise the individual form.

On the macroscopic level, the extracellular matrix and ground substance(s) remain part of the parts and the whole of all these forms. Together they enclose this “mothering sea” in which all our organs and cells reside. On the microscopic level, the finest variations of these tissues (microfilaments and microtubules) form the cytoskeleton inside each cell. They connect from within the cell to the extracellular matrix. Where does it stop?

Advanced Technology

The variety of lattice arrangements and layering in the fascia is becoming better understood with advancing technology and the opportunity it provides of seeing subtle gliding and changes in tissues. The modern instrumentation also allows scientists to observe tissue continuity with more specificity. Improved detail at increasingly finer layers from ultrasound and MRI, for example, is enabling researchers to see the different ways the tissues respond to various forces and subtle changes in hydration and chemistry, movement and metabolism.

It appears that the responsive nature of the tissues means that they become more hydrated and agile when they are moved and more solid and “matted” when they are immobile. In younger tissues, the fibres show a crimped pattern while in older tissues they can appear more like matted felt (see Ch. 7). This is thought to relate to hydration and the level of toxins in the body tissues, from accumulated metabolic waste as well as mobility (or lack of it). It seems we are designed for movement everywhere we look, to promote tissue glide and hydration as well as circulation and healthy posture. This is not news, but the idea of how essential it is to all parts of us has a global context given the connectivity and continuity of the collagen network. The extracellular matrix and ground substances play a role in our immune system too, so keeping this “sea” fresh and flowing is an essential contribution to a healthy organism.

The body is known to respond to its loading history and it seems that appropriate dynamic stresses encourage mobility, responsiveness and elasticity of these tissues. Small gestures can accumulate to make a big difference (after all, that is how we learn yoga). Variability and adaptability, even at the micro-movement level,[5] seem to arise from exactly those attributes; it is as if the fascia works on a “use it or lose it” principle, at least in part. It grows and changes as we do.

Let us consider a brief overview of how the matrix of connective tissue forms.

The Web we Weave

The collagen molecule is one that we could say is specifically designed to make netting and cabling in the body, as it originally forms in long strands. It is also designed for weaving, both into flat fabrics and to form volumes (tubes for example, such as the tunicae of the blood vessels). Snelson, who first made tensegrity structures (Ch. 4), suggests that weaving is the mother of tensegrity.[7] Levin shows how tensegrity volume forms structures that he suggests become closed kinematic chains (Ch. 7).[8] In a way, these make our limbs and torso something more like articulated soft “baskets”, woven together within and around each other, rather than mechanical joints bolted together like a robot. (Though that is not a precise representation of how we function either.)

The Collagen Molecule

In the fibroblast, the collagen molecule begins its formation as a long chain of free amino acids in the cell's protoplasm.

These amino acids link in an order, so the chain is made of repeated similar units. The attraction/repulsion nature of these complexes results in the chain forming a left-handed spiral, as a helical chain. It is fragile and floats randomly. As they come into contact with each other these helical chains begin to spiral together in threes, twisting to form into a strand with a right-handed spiral. Thus they become like a three-stranded rope.

Hydrogen Bonds

> We note here the innate properties of polarity, paired to form a triune whole. This is not just the three-strandedness of the collagen chains. It is the left chirality of the individual strands, uniting in a right chirality arrangement when they twist together. Their combination forms one collagen fibre. In ancient yoga, this is "triune harmony". (We will explore this triune harmony in Part 3. It is innate to our geometry and fundamental to the metaphysical aspects of yoga.)

This chain (the three-stranded rope-like helix) is a single collagen molecule, eventually attaching to other similar molecules by hydrogen bonds. Once formed, they are exuded into the ground substance as separate units, with no specific structure.

"Specific local qualities of the ground substance and the surrounding tissues then dictate the specific manner in which these molecules join together to create the collagen structure with the qualities needed for that specific area."[9]

The same sequence of events recurs. Just as the chains formed fibres, so the fibres then bind with further hydrogen bonds, overlapping like bricks and forming strong tensile cables called collagen fibrils (Fig. 10.1). (These can be stronger than steel wire, which requires a load 10,000 times its own weight to stretch it.) We also have very stretchy fibres called elastin. They are part of the suite of tissues the body calls upon in wound healing. We rely on the very high resistance to deformation in the collagen for our true elasticity.

> In our bodies connective tissue is the fabric loosely woven under the skin (loose areolar connective tissue) and the gossamer-like network between muscle fibres, for example. It can also have specific directional fibres (in myotendinous chord-like structures, for example), or it can be organised in densely packed, multidirectional fibres where structural reinforcement is needed (such as the lumbodorsal fascia). This is called dense connective tissue. At the microscopic level between the muscle fibrils it is so fine that it cannot be seen by the naked eye.

The fibrils bind into all the structures we refer to in this work, including the muscles, ligaments, tendons and so on that form the locomotor apparatus. Despite their different characteristics, they are essentially all being called fascia (Fig. 10.2). However, care has to be taken regarding the names of the specific forms of these fascial tissues. Clinical and movement practices have different needs to surgeons and anatomists. As ever with a new paradigm, a new language is required. These different structures appear to have the ability to vary and change, so direction, density and destiny are difficult to separate in assigning their definitions. They do not have identical demarcation lines in each body and they are all connected.

Connective tissue is also one of our most reliable repairing mechanisms, acting as a barrier to unwanted chemicals as well as healing wounds to restore integrity after injury. Fascia is everywhere in the body. It constitutes the immediate environment of every cell, "*wrapping and uniting all structures with its moist, fibrous, cohering sheets and strands*".[10] Modern schematic diagrams tend to show muscle tissues in preference to the fascia. Strictly speaking, a muscle cannot be, or function as, a muscle without connective tissue. What we have to realise is that the contractive power of muscle is completely useless without the tensioning cables of the connective tissues in which the muscle resides. It contracts to tension a tensional network that connects the body to itself and contains everything. It has to pull on something. Thus it is referred to as a pre-tensioned or a pre-stressed structure; the whole body is in a tensional network of these tissues.

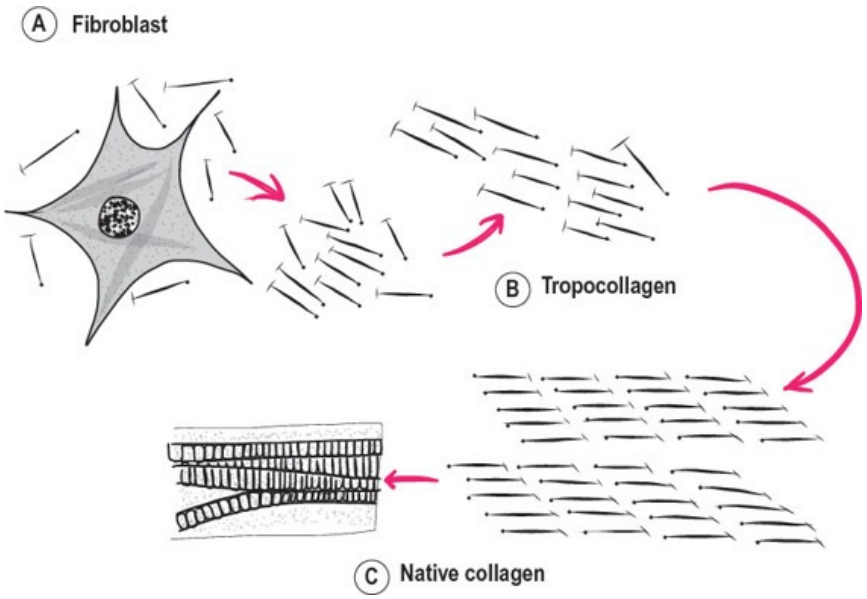

Figure 10.1

A fibroblast exuding tropocollagen (free collagen molecules). This will then assemble into fibrils which will organise themselves into structures. (Image after Deane Juhan, 1987, Fig. 3.17; see note 2.)

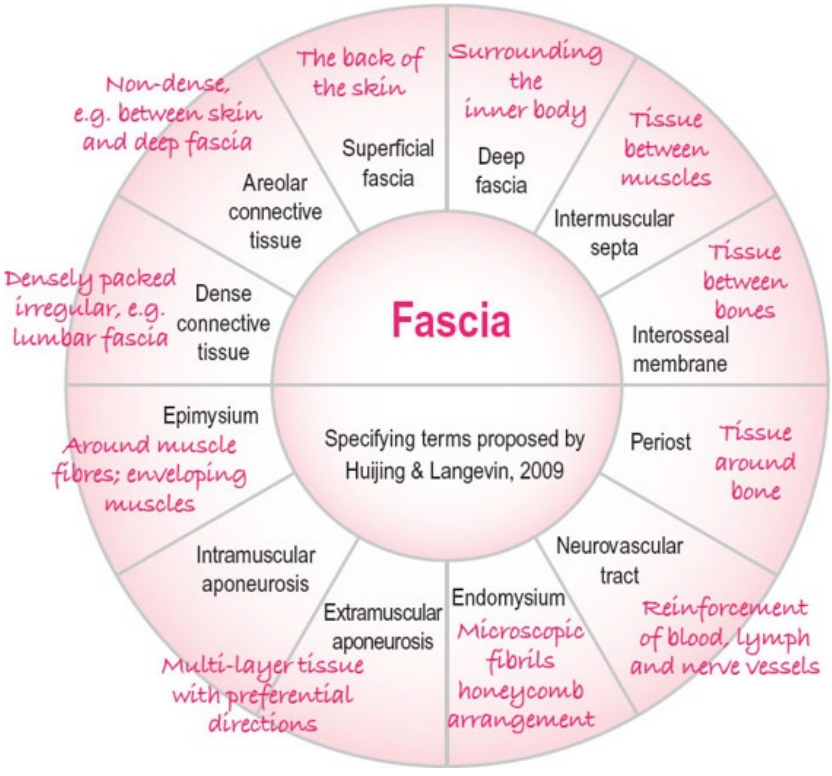

Figure 10.2

These are the twelve main distinctions of the fascia within the body. Besides each one is a note of the particular area or quality it refers to. Note that in this terminology, bone, cartilage and blood are excluded. They are considered to be connective tissue, rather than fascia. In the case of bone, for example, this is due to the fact that they are discontinuous whereas fascia is technically considered to be continuously tensioned throughout the matrix. There is controversy over this fact. Jaap van der Wal, for example, suggests the periost precedes and mediates the bone and Levin considers it to be "starched fascia". In tensegrity structures the compression members are discontinuous by design; they coexist in a mutual synergistic relationship with the fascial continuity.

That Which Does not Kill us Makes us Stronger

Extensive research is now being done into the nature of water and its *structure* in the body, its profound structural relationship to protein and the intimate relationship between the connective tissues. A simple example is that of gelatin. If you make a jelly in a mould, the finished product is still 98% water. Yet, at the right temperature, it stands alone. If you take a spoonful out of it, no water leaks, nor does the structure necessarily collapse.

The ability of the collagen to bind and make fabric and form in our bodies is also what can cause us discomfort when it binds too much or, through injury or lack of movement, becomes sticky and dehydrated. Over time, some tissues tend to pack more closely and form denser hydrogen bonds, especially if they are not used. Simple yawning stretches are considered to assist the releasing of these bonds after periods of rest as a natural way to "recalibrate" and revitalise tissues (see the discussion of pandiculation in Ch. 8).

Chronic pressure and immobility can cause this gluing together of the tissues to the degree that they become very stuck. For this reason they are called "adhesions". One particular area of new research is into the nature of scar tissue. Recent findings[11] suggest that gentle tissue manipulation can prevent the over-production of fibroblasts in wound healing and reduce the adhesions that result from it. The principles being researched in the context of the fascial matrix are the relationships between macro- and micro-mobility, hydration and adhesion. We need sufficient adhesion to hold us together and act as a barrier, while too much can reduce mobility and inhibit tissue glide. The search for balance between the extremes is paramount; the middle way becomes a valuable context.

The One and the Whole

Water is also being reconsidered in the light of its ability to bind and release.[12] It is now considered to have four, rather than three phases. Typically we think of it as vapour (steam), liquid or solid (ice). The fourth phase is called "liquid crystal"; here the molecular structure is more organised[13] and bound in the tissues (bound water) rather than freely flowing (bulk water). The fascia, in this instance, acts something like moss, holding bound water in and to the tissues. (Interestingly, timber merchants are very familiar with the treatment of wood to account for what they call bound water and free water. Since we live in a reciprocal relationship with trees to breathe, perhaps they can teach us more about our organisation. They live at the opposite end of the scale from stiffness to stretchiness to us, but there are many more structural and chemical correlates between our natural forms.)

Now that we know the fascia is also a sensory organ (Ch. 9), we begin to account for things that have more commonly been spoken of in more holistic terms of "energy" or "intuition". It seems the fascial matrix offers bridges and new pathways in these hitherto separate domains. What we speak of in terms of developing subtle awareness, or sensory literacy, or refinement of movement seems to be accounted for in these connective tissues, one way or another. It also needs to be understood as a global matrix and an energy storage system. The fascial matrix holds us together at every level. It is more than our organ of form, able to transmit forces throughout our tissues to prevent injury wherever possible. It also accounts

for our ability to push ourselves to exceed our standard performance and reach higher levels of health and agility, as appropriate. It communicates and signals and accumulates change.

Two of the most important characteristics of the fascia are its ubiquitous nature and its continuity. However, blithely calling everything "the fascia" may lead us to throw out the baby with the bathwater. While fascia lends itself to all the aspects of yoga in which we celebrate wholeness and body-wide intelligence, it does not replace muscle and bone, but expands our concept of how they work together.

Fascia Distinctions

As research into connective soft tissues becomes more widely known, some schools appear to insist that "fascia is everything" and decline to mention muscle. Whilst any practitioner may benefit from seeing the tissue as entirely connected, it is patent nonsense to suggest that everything learned in medical or sports science to date has been overturned by fascia research.

Figure 10.2 suggests clarification of the general terminology that the term fascia encompasses. The reason why so many clinicians are keen to use one term is exactly why yoga benefits from understanding fascial anatomy. Its unifying nature throughout our form is relentlessly present and connected. By naming each aspect of it separately, the invitation is to break it down into parts and risk misunderstanding its wholeness. The continuity itself shifts certain perspectives and allows us to see it as a communication system, a force transmission system, an organising matrix, a means of sensory refinement and proprioceptive awareness. That it is ubiquitous (everywhere) cannot be emphasised enough. In the end, it is the unity of these characteristics that makes it so compatible a basis for the understanding of yoga, in all its variety of forms.

In the more advanced practices of yoga, the subtle qualitative aspects of the energy system are noted. Perhaps this is the direction in which the process of languaging the fascia is going.

The Whole Structure

As far as overall structure is concerned, focused on throughout the book, whole body movement includes these elements of the connective tissue matrix. Hydration and form, structure and functional movement are intimately related. That is what we are working with on the yoga mat.

Surgeons and manual practitioners both legitimately require very specific definitions for locations in the body. What is called for is clearly an expansion of distinctions, perhaps recognising the tissue continuity and its multiple roles. It certainly changes many accepted explanations of how we function. Perhaps what we sense as yoga teachers, while it might not replace the anatomical specificity required of an expert surgeon, may guide our inner sense of movement beneficially. Sensory awareness is certainly key to practice and referring holistically to the wholeness makes it easier to explain and teach. However, it does not release us from the need to recognise and respect what has gone before. It expands our understanding of the topographical maps we have learned and allows us to include the three, or even four, dimensional awareness of ourselves moving through space and time.

In Part 2, we will consider the fascial matrix from the point of view of how we work with it – as a whole and on the mat. We will consider how to "see it" in a way that is relevant to the volumetric form in which we (and our class participants) move around in it (and move it around), i.e. uniquely and variously, just as there are unique and various ways of practising yoga.

We will also refer to what we feel from our own mat and how we assess instinctively and learn to adjust others appropriately. Given that the tissue is the largest sensory organ of the body, it suggests subtle possibilities for how to assist students in fostering self-regulation and safe practice for themselves. The

fascia is influencing how we define “functional movement”. It might be a very individual matter. We will also consider how the breath facilitates elasticity all the time. Movement is, after all, a sign of life and our ability to breathe is the evidence. Vitality is made up of more than just functioning anatomical parts.

Notes

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PART TWO

Animating the instinctive body: applying the new paradigm

CHAPTER
11

Animating the Architecture

"the fascia may be viewed as a single organ, a unified whole, the environment in which all body systems function … The fascia is the one system that connects to every aspect of human physiology. Langevin (2006)[1] and Langevin & Yandow (2002)[2] suggest that the fascia is a metasystem, connecting and influencing all other systems, a concept with the potential to change our core understanding of human physiology."[3]

James L. Oschman

We arrive on the yoga mat much as we first arrive in the world, complete and pre-tensioned by our whole architecture-occupying space. We then explore moving, taking the ability to "feel our way into forms" through the postures and practices. They may be more sophisticated than our first attempts to move in the gravitational field soon after birth, but the movements themselves are nonetheless emergent responses in the moment. They accumulate *as history* of our form but they actually occur in present time.

To experience this physical event is quite different from activating the intellectual aspect of us, thinking about how we move. It occurs at a different speed, where the body behaves in its own field of animation. Even if several people are doing the same pose or sequence, they cannot experience it for each other. Nor will they experience it in identical ways. The physical intelligence of the moving body takes on a quality of awareness that can absorb our attention in a different way, unique to each of us but universal at the same time. We incorporate paradox via the proprioceptive nature of our animated fascial form.

Intellectual Information

The question most often raised in teaching workshops is that of the optimal balance of theoretical to practical training. The practical sessions, even if they take up half the training period, are often experienced as seeming much shorter than the studying time. The instinctive movement centre learns at the speed of instinctive movement. It is much faster than thinking.

There is an obvious parallel in learning to drive a car. Think of a *first* driving lesson. Every stick, lever, wheel, mirror, pedal and direction seems to compete for your attention, with different instructions for each limb.

When we are writing or reading about our movements, we tend to sit relatively still, absorbed by acquiring the intellectual information. Once we are on the mat, however, we are invited to absorb *the thinking process itself* and expand to include it, while we pay attention to the shapes of the postures. Yoga was developed for Western culture in a particular way. The movements have a primary purpose of

getting us out of our conceptualising thoughts and entering the moving "business". All the attributes of that world become available through *being in it* and participating.

Once you have practised and repeated a practice physically, however, something accumulates "in soft developmental strokes" (see Ch. 5) that has a resonance and a momentum of its own. Whether it is driving a car or doing yoga, over time, a process that is initially intellectual gradually becomes instinctive, so you can begin to do it without thinking about every little move. When that happens, you can begin to relax and your attention is not absorbed in remembering things *about* what you are doing. You can focus on the task in hand, the present situation (constantly changing), and, with practice and experience, anticipate and respond rapidly and appropriately. You can recall and pre-empt with presence and prescience (see Part 3). This is the witness state in practice. This is yoga.

Instinctive Movement

There are a whole host of external variables you never imagined when you watched someone able to drive *instinctively* because they have done it for years. Experienced drivers appear to carry out the necessary actions seamlessly and without thought. What makes it even worse that first time is that you are also supposed to anticipate what all the other drivers on the road are *going* to do. (There is enough to do remembering the Highway Code and all these different mechanisms, without worrying about the *future*.) Until and unless the practice has been repeated enough times to become *instinctive*, the task can appear fragmented, complicated and full of conflict.

Movement is instinctive. However, human beings, unlike certain animals, can only learn to stand up and walk around independently over a period of time. Just like the developmental movement patterns, learning specialised movements, such as dance or yoga, can also become second nature. We can use the same method of imitation and repetition to establish new movement patterns throughout our lives.

Yoga is an opportunity to practise animating our tissues intelligently, if we honour the innate intelligence of our physical body and act congruently with *and from* where the body is at the time. It does not discriminate with regard to size, age, ability, religion, health, or human performance. Yoga is much less of a noun in many ways than it is a verb. "To yoga" is to practise at, and explore unifying in practice. It confounds the mind – and it is supposed to.

Already Listening

In the Landmark Worldwide education programme[5] (a public self-development forum) there are many distinctions, one of which takes us into the domain of practical yoga with grace. It is the concept of "already listening". When describing the mind, such a term refers to the past, like being "stuck" in a mindset. It points to a natural tendency of human beings to see the world through a prescribed filter made up of our expectations, interpretations and history (i.e. our previous experience). We do it all the time. We filter what we see through the mesh of what we are looking for. If you are looking to validate how muscles and bones move the musculoskeletal system and operate the machinery of the locomotor apparatus, guess what you will find?

In the domain of the fascial matrix, we can shift the context of "already listening" to a powerful recognition. The fascial matrix is already listening proprioceptively, in present time, all the time. (Recall the ratio of listening sensory nerve fibres to motor nerve fibres in Ch. 9.) It is a doorway to being present, a way of "*changing the body about the mind*".[6]

The Power of Listening

> My favourite yoga class of all time was a workshop with Elizabeth Pauncz. This took place long before I knew anything about anatomy. We were learning her interpretation of the Egyptian Sun Salutation.[4] Once the postures had been explained and demonstrated and we had familiarised ourselves with the transitions, the choreography began to come together in the group. Elizabeth had stopped talking altogether. Despite the fact that there were over twenty participants at different levels of ability, we moved instinctively, in silence, as one group. The salutation to the sun was saluting itself. No words were necessary.

The essence of "already listening" for the body (as distinct from the mind) is that our form, with its preference for listening, is already aware of where and how we are, relative to ourselves and the world around us. It does not "talk" about it. It experiences it. The body is an intelligent, self-aware communication system, so we need to take care of it (and the art of moving it) with due respect.

Yoga is a rich and rewarding forum for exploring this respectfulness. However, it is a process of trial and error. Serge Gracovetsky suggests that we use a gauge of "*how we feel the next morning*".[7] At one end of the extreme, if we sit on the sofa reading a book about yoga, nothing much will happen. At the other end, if we over-stretch or force movements the body is likely to raise its proprioceptive voice the next day and point it out to us in no uncertain terms. Somewhere along this scale we have the opportunity to work out our own optimum. As teachers, we get to experience finding our own balance points and then working with others to establish theirs. We gradually learn (one practice or class at a time) to recognise and communicate this ability to our class participants, if they choose to invite us. Teaching this is a process of imitation, repetition and mutual respectfulness that engenders more of the same.

A Point of Ethics

The sensory nature of our being is a hot topic in some areas of therapeutic practice. Most teacher trainings have several references to it within their code of ethics about appropriate behaviour. The most powerful comment I have heard in this area is "What is in your heart?". If you do not know, or if it is not to teach yoga (if you are teaching yoga), then what are you doing there? Being grounded is not just a physical principle, but an ethical one too. If you are teaching yoga, then Satya and Ahimsa (the concepts of truth and non-violence) are the grace field you work in. Do not work there if you cannot tell what truth and non-violence mean. *Honesty and good manners and respect are simple enough ground rules.*

Ground Control

What begins to happen as we surrender to and practise this instinctive aspect of our being is that we move towards less effort, more energy and more conscious awareness. This is vitality. It is essentially animated from the ground up, whichever way up we are.

"The pull of gravity under our feet makes it possible for us to extend the upper part of the spine, and this extension allows us also to release tension between the vertebrae. Gravity is like a magnet attracting us to the earth, but this attraction is not limited to pulling us down, it also allows us to stretch in the opposite direction toward the sky."[8]

When our movement practice spontaneously delivers this effortless quality of elastic recoil, it feels like a revelation. Scarvelli's reference is to a "revolution", which her original approach to yoga effectively

provoked.

"We make use of the force of 'anti-force', which gives us a new flow of energy, – a sort of anti-gravity reflex, like the rebounding spring of a ball bouncing on the ground."[9]

This experience of expansion and elastic return is innate to our breath-in-motion. It points to the intimate relationship between movement and breathing that we will explore in more depth in a chapter of its own (Ch. 15) and take into a more meditative practice in Part 3 (Ch. 18). There is a natural and innate quality of elastic recoil available in every pose, as Scaravelli points out, "*through the much more powerful wave … produced by gravity and breathing*".

The reference also points to the rhythmical sense of the body moving. It reveals itself as a wave through the spine that is palpable from ground to crown in standing (Tadasana) or from sitting bones to crown in sitting. In a headstand the same sense can be found from crown to feet, since the body is inverted but the ground reaction force remains the same.

Our whole fascial form *forms a responsive, closed kinematic chain,* from moment to moment in every pose (Fig. 11.1). Between the two polarities (of the preparatory counter-movement and the release in the opposite direction) we find and contain our breathing space: neutral. Perhaps this is the joy of intelligent body-wise movement.

Figure 11.1
In this Wheel Pose (Chakrasana) the hands and feet press in a downwards direction to release the front body into an open upper curve, away from the ground. It is exactly the same the other way up in Dog Pose (Adho Mukha Svanasana), where the hands and feet go down to push the back body up.

Biotensegral Movement

Biotensegrity structures are economical space-containing mobile organisations. This is our breathing space, changing breath by breath from the inside out, the outside in, and through the middle of our structure. Its compliance and fluid transition hallmarks our yogic "performance". Locomotion and respiration are not separate in living organisms, and biotensegrity might provide a context that makes sense of both aspects of our physiology *as it works in class.* Yoga manifests this unifying context.

Beyond Words

There is a difficulty in bringing biotensegrity into the domain of experience. The descriptions of biotensegrity structures may make little sense until you can actually hold one in your own hands, or build one yourself. Immediately their nature translates into kinaesthetic language.

When you experience the quiet spring, or animated release into a headstand or a back bend, as if you are uncovering your own body's innate elastic integrity, its "already listening" motion-in-potential, it is a wonderful feeling and a striking experience of apparently effortless movement. One almost has to get out of the way to reveal it. It naturally springs. It is impossible to describe, even having experienced it, although you can recognise it immediately once you discover it for yourself.

Once on the mat we begin to *feel* and sense our way to the revolutionary thinking Scaravelli referred to thirty years ago. In essence, her teachings and work accounted for the natural elasticity of our (biotensegrity) architecture. Our awareness of this architecture is partly in the living sense of a force and an anti-force united in neutral balance *in any poised position*. Those three aspects, unified, are the one and the whole together. It is so simple and yet can remain so very elusive to our learned way of thinking.

How do we see that in practice, and how do we foster it for our students' benefit?

Biotensegrity in Action

Figure 11.2
We stand in upright curves. The spine is not designed to be straight.

"All movement, of the body as a whole or of its smallest parts, is created by tensions carried through the living matrix."[10]

Whether or not we understand the biotensegrity details of icosohedral or triangulated geometry in our human form, we can begin to explore the spring-loaded and adaptable nature of our tissues and awaken our spines in accordance with its natural laws.

There is an element of surrender in the practice, to an innate balance of forces. The tissues of our form are "already listening"; we cannot *think* that balance into place. It is a natural expression of our organisation. Having said that, "surrender" is sometimes taken to mean slumping, or be referring to a kind of soggy release. "Softening into a pose", as if one is giving up holding the body together by *releasing tension*, is a misinterpretation of surrender. It actually refers to a quietening of the mind and a permission to allow the natural forces of movement to do some of the work. It is the revealing of what is present; the revelation Scaravelli describes.

Somewhere between the extremes is a place Scaravelli refers to achieved in sending the part on the ground down and releasing the part moving away from the ground, away. The space occurring between the two is effectively a sense of the spine releasing in two directions simultaneously (Down and up).

In order to experience this feeling of spaciousness and containment throughout the torso, we work with simple poses, such as sitting and standing. One place where we can "trip up" on semantics, however, is that we do not honour the spine by sitting or standing up "straight" (Fig. 11.2). We can honour the spine through a balance of curves, whether in the upright or supine position. We do not force the curves into place or hold them in place rigidly. It is a more subtle distinction of releasing compromise rather than controlling shape.

We are poised in semi-tensioned potential at all times, *curved*. Our self-contained, breathing architecture is poised for motion and designed for mobility. We do not have to do it. Rather we can be with it how it is, and then explore, enhance and develop. If we can find it, it is available through experimenting with this sense of recoil, in person, on the mat. Ironically, it is not actually accessible from reading about it; despite the feeling of recognition if it "speaks" to you. You still have to work with it in participation.

Whatever style of yoga you favour, being able to stand or sit still in animated ease precedes being able to move into the postures comfortably. It allows us to restore ease in the natural, spring-loaded potential of our resting tension. Before we get to any extreme asanas, we can develop the practice itself to bring the simplest of movements to a place of ease. Yoga can deeply enhance the "middle way" of being relaxed in these apparently simple positions of standing and sitting. For although they may appear relatively effortless, they are not necessarily the easiest postures for everyone to be in.

Before the Repertoire

Gracovetsky emphasises that we are built for mobility and this is endorsed by the difficulty many of us seem to experience in sitting still in an animated way, or standing in quiet comfort. There is a huge difference between conscious or dynamic stillness and a sedentary slump that might be described as "still", but only because it is not moving. Rather it expresses inertia. In yoga, we learn the value of stillness as an animated option, a personal choice, a vital aspect of any pose. In a way it is an expression of poised movement. We practise the ability to restore this elusive, neutral condition of balance

throughout the tissues, from speed to stillness and back again, developing the ability to adapt from one to the other in smooth transitions.

Yoga has a significant contribution to make to our well-being if it only teaches us to sit in a way that does not build in sedentary slouch patterns. If they are not countered, these patterns, left in place as default positions, accumulate in the tissues and become our loading history. The cumulative effect over time can leave our ability to move around impaired by postural stress and compensation. Yoga can train us to sit and stand still in comfort, generating a state of quiet attentive awareness that is nonetheless restful. It is also promising a more optimal loading history to grow into and develop from, at any age.

The Sit ‘n’ Slouch Gym

If there is a twenty-first-century side-effect to the joys and benefits of driving, travelling and Internet communication, it is the consequences of sitting for long periods of time in anything but aware and attentive stillness (Fig. 11.3). The resulting “sedentary stoop” is a daily practice for a huge majority (and I include myself in this). Consider the daily repetitions of this pose at the frequency many of us tend to do it. It is often the case that we are not sitting on our sitting bones as such but on a combination of the back of the pelvis and the sacrum. This inevitably changes the shape of the trunk and all things connected to, and enclosed by it.

Figure 11.3

Many of us sit for long periods peering forwards to communicate or engage with the screen in front of us. There is a consequence to the posture. It is not complicated to rectify and it is important for optimal function.

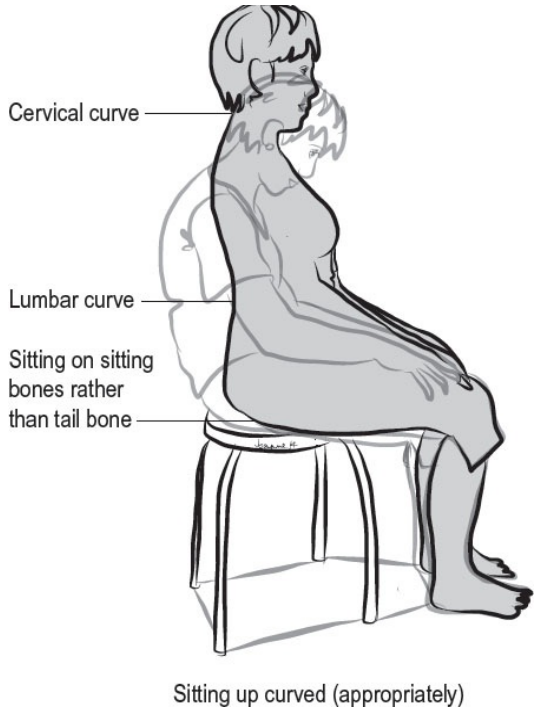


Figure 11.4
In the upright position on the sitting bones (ischial tuberosities) the sacrum is free (rather than being sat on) and the torso can hinge at the hip, rather than the spine. The posture can honour the secondary curves (cervical and lumbar).

This is not rocket science. The body responds to loading patterns. If we load it in the fetal position for long enough it will adapt to it until that pattern becomes comfortable. This does not imply that it is optimal. It just means it becomes habitual and easier in the short term. It changes the position of the pelvis, the torso is distorted, the spaces between the spinal segments, the shape of the abdomen, thorax, neck and shoulder girdle, diaphragm, lungs and viscera, all change with the dominant slumping of the internal and external form. They are designed to respond to and accommodate their loading history and adapt to it. How can our organs function properly if the shape they reside in is distorted?

We are not structurally designed for quite so much stability or for the sedentary loading patterns of inertia. We have extraordinary range and potential, so an understanding of at least the fascial components of this invites us into a huge possibility for health and performance. Practice (of useful loading patterns) gets us closer to optimising both these possibilities.

If we continuously fold the body in half for long enough and carry on feeding it and expecting it to function by itself, it will not be long before it needs some help. At the very least, the tensional balance between front and back, spine and abdomen goes out. Of course, we adapt eventually but do we want to adapt function to optimise the slumping, or adapt the slump to optimise function? The choice is not complex if you have the health and mobility at your disposal.

Happily, it is not difficult to correct the default “sit ‘n’ slouch” training. The key is what you are sitting on. It does, however, take practice if you have become comfortable in your habitual slump. Just as you built in a less than optimal pattern, so it takes repetition to build in a better one. There is a need to stay conscious of extended periods of sedentary slouching if you prefer not to develop the disadvantages of the sit ‘n’ slouch training. (It gets reinforced over time by continuous micro-movements we do not even notice if our attention is fixed on screen, phone or managing an inbox. The body adapts if it can.)

Our optimal position allows the spine to move in all directions, safely. This is what we are designed for. The net results of this change are frequently described in the following terms: I feel so much less tired…I don’t get headaches…I’m more attentive…I don’t get indigestion…I can think more clearly… I breathe better… I’m more tuned in, it’s as if my mind is clearer.

Part 1

Sit in a slouched position, on the back of the tailbone, with the spine curved as in Figure 11.3. (A commonly observed variation includes crossing the ankles and tucking them under the chair.) Keeping the slouch position in place, try to side bend, then to rotate. Note the range of motion, without going to extremes.

Next, change the shape of the seated posture with two movements: (1) place the feet under the knees and (2) sit "up" on the sitting bones, finding the front part of the pelvic base. Usually the lumbar and cervical curves "appear" naturally just by activating the sitting bones and placing the feet (Fig. 11.4) Take a second to feel the alignment of a balanced head, supported from below, relax the shoulders. Now repeat the side bending and the rotation. In most cases, these two small changes in position (of the feet and the sitting bones) give rise to a fuller range of motion through the spine in all directions.

Part 2

Next lean forward from the sitting bones. This activates a fold at the hip (instead of the mid spine, as if we still had a dorsal fin or a dorsal hinge). If the desk is at the right height, and you sit on a cushion that slightly raises the hips above the level of the knee, this will allow an open angle at the elbow and a relatively relaxed head position.

In a therapeutic context the benefits of training this in, as a preferable "default pattern", changing the "Sit 'n' Slouch" for the "Sit 'n' Smile", are remarkable.

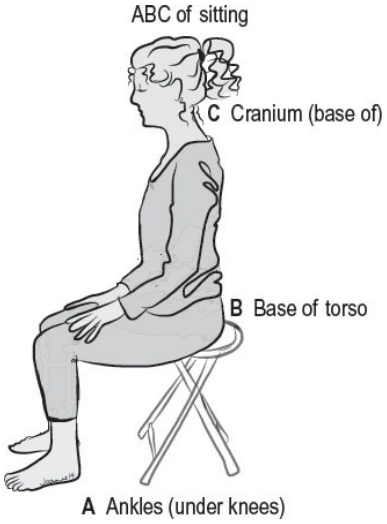
Freeing the Tailbone

If we sit on our sitting bones, as they are designed, we honour both the fold at the hip and the lumbar curve (lordosis). The gluteal muscles are meant to feel "behind us". If we sit slumped onto the very back of the sitting bones, with the "tail tucked under", we are sitting on the sacral roof of the pelvis, instead of allowing the coccyx to float in its natural tensegrity architecture[11] and the tail bone to be free. We are effectively following the primal instincts of an animal, wearing our "tail between our legs" in the same way as a dog that is unhappy or frightened.

By throwing out the second secondary (lumbar) curve, since the spine is naturally an S-shape, we throw out the first secondary (cervical) curve and are obliged to recruit all kinds of neck and back myofasciae to pull the head up and peer forward. (The body will always seek relative balance.)

The active need to lift the head up, out of a default slump, is effortful and, in its mission to save energy, the body will eventually accept and adapt to that loading pattern as a requirement, at least to save muscular effort of maintaining it. One day, after enough time has passed (and loading has accumulated), it will not elastically release and will become the norm. The tissues are then recruited for a less functional holding pattern. Therein lies the beginning of a negative feedback loop. Often pain (such as would be attributed to a chronic postural set) leads to less movement (note the way they can express an inverse relationship in Ch. 9) so we can get stuck in a cycle. If yoga can begin as a gentle restorative enquiry, to tease out (and ease out) habitual holding patterns, there is huge benefit to the smallest movements and sense of a more optimum position. (See Ch. 17 for a series designed specifically to train optimal sitting patterns for the spine.) We just have to repeat the optimal version little and often enough (once or twice a week might be enough, given the active attention on *not* building the less desirable pattern). As I have said, we are a continual work in progress, and we have power over which direction we progress towards (Fig. 11.4).

Ground Control



The ABC of Ground Control This is a more formal format to the above exercises, as a basis for any preparatory work and a simple sequence to enhance sitting and standing postures. The exercises bring about a naturally more comfortable place for the body, whatever poses are being taught. They are pre-poses in a way. Rather than simply focusing on the "right posture" for achieving specific asana shapes, we are bringing in awareness for the body in everyday life to enhance structure and function as a whole. Fascia responds all the time, so we can consider what we do in our default patterns as part of its training and loading history. Ignoring it all day and then remembering to "sit right" just for the yoga session, is asking a lot of that yoga practice.

The image shows the three sets of metaphorical "feet" we have to activate; the feet at the bottom of the legs, the "feet" at the base of the torso (sitting bones) and the "feet" at the base of the head (atlanto-occipital joint). The first two will give rise to the third.

Ankles
This refers to the space above the foot. It wants to rest over the foot in such a way that it is balanced and feels spacious and poised, directly under the knee. Thus the foot is able to feel the ground in its entirety, informing the upper leg.

Base
This refers to the sitting bones. They are designed to support the torso, biased towards the anterior aspect because that is how the pelvis is designed and organised to express our upright gait blueprint. This allows for a natural lumbar curve. If the hip joint is raised slightly above the level of the knee (with a cushion for example) it naturally encourages this posture. This frees the sacrum and coccyx to "float" as they are designed to do.

Cranium
The "feet" of the cranium then align naturally with the sitting bones, and move in an appropriate way to balance the head, supported from underneath by the whole torso and neck. The space is facilitated for the upper vertebral bones (atlas and axis) to work as they should, offering all kinds of subtle movements of the head. If the spine is dropped into one continuous primary curve, given that the top of that curve is the head, then the relatively heavy cranial vault has to be actively lifted from behind to bring the eyes level with the horizon to see a screen. We naturally shorten the back of the neck. When the torso is balanced, in natural support of the head, these extra "holding positions" are simply not recruited. The architecture leads naturally to a balanced head position, poised for its natural range of motion and attentive to all that surrounds it. Typically computer screens might need to be raised, just as rear-view mirrors in cars seem to be in the wrong place when people adopt this position.

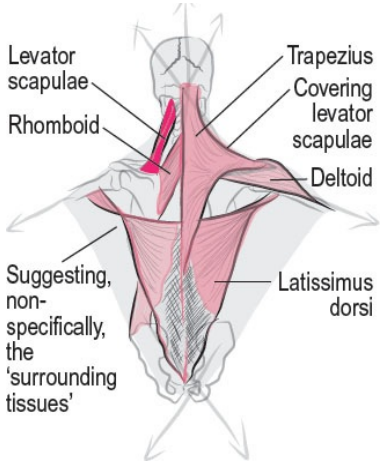


Figure 11.5

This basic practice underpins all the seated yoga poses and helps all the standing ones, if we translate the "polarity" principle to all aspects of the asanas: down to go up, back to go forward, and so on.[12] We breathe more easily in the space between the two.

Tom Myers nicknamed the levator scapulae muscles "capitus preventus going forwardus", and it is an apt description in the huge majority of cases I see in class or on the body work table. It is tiring to maintain a seated slouch position.

The levator scapula myofascia and its surrounding tissues (Fig. 11.5) get knotted and tensed as part of a story of sustained "dis"-integration and it leads to a classical condition I call "mouse shoulder". There are cases where the "lump" in the shoulder (initiated around the levator scapula being trained for so long each day in the "hang-on-in-there" gym) is particularly clear and palpable on the side the client uses their computer mouse. (It can also be counterbalanced on the other side, so it is not always a simple compensatory pattern.) Relief comes from lengthening the front tissues and encouraging the client to sit up in this way and raise their position, to open the angle at the elbow. (It can also help to train ourselves to use the mouse on the other side and regularly alternate. Taking breaks helps too!) It frequently transforms the daily working demeanour and can make a huge difference to overall postural issues over time. If nothing else, it also allows for more optimal breathing patterns because the diaphragm is not squished. (This optimal posture can affect digestive function and visceral motility in a beneficial way, where the abdominal organs can move more appropriately.)

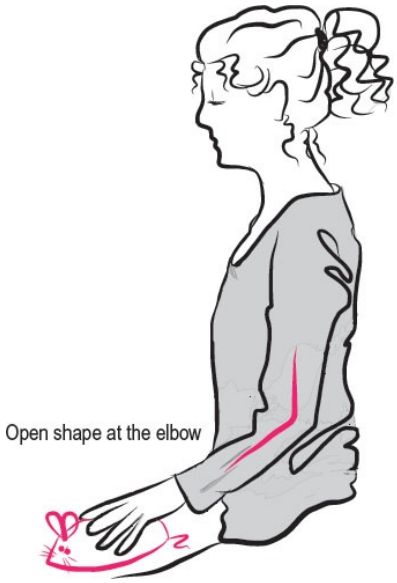


Figure 11.6

People at desks with their elbow dropped below the height of the wrist often exacerbate “mouse shoulder”. It is my repeated experience that by raising the height of the chair and the computer so that the hip and the elbow can work at a slightly open angle, while the eyes look straight forward, “mouse shoulder” and extraneous postural tension are relieved to the clearly related benefit of improved attention and tensional integrity (Fig. 11.6). The feet become an active component of the seated posture. The body often seems to suffer less from being inert and enjoy these daily at-the-desk micro-movements that train the fascial loading history to accumulate a much more useful and varying pattern.

Back up
Sit (curved-upright) slightly towards the front of the chair on the sitting bones, (Fig. 11.7A) with feet placed comfortably apart (hip width) and flat to the floor, knees at right-angles.
Contain (or stiffen the body very slightly), rocking back on the sitting bones a little. This is a small movement: a slight rocking back before rocking forward as the feet are pushed down (to the ground) to then go up. It is one smooth transition, although repeating the rocking first can help. With practice the client may not need to use the hands at all.
The movement cue is “back to go forward and down to go up”.
Feet off the ground as the body rocks BACK (holding the right-angle at the knee) i to ii
Rock FORWARD on the sitting bones, until the feet touch the floor iii
Press the feet DOWN as the tail lifts iv
Push into the feet to send the body/head UP in one fluid movement, to standing v

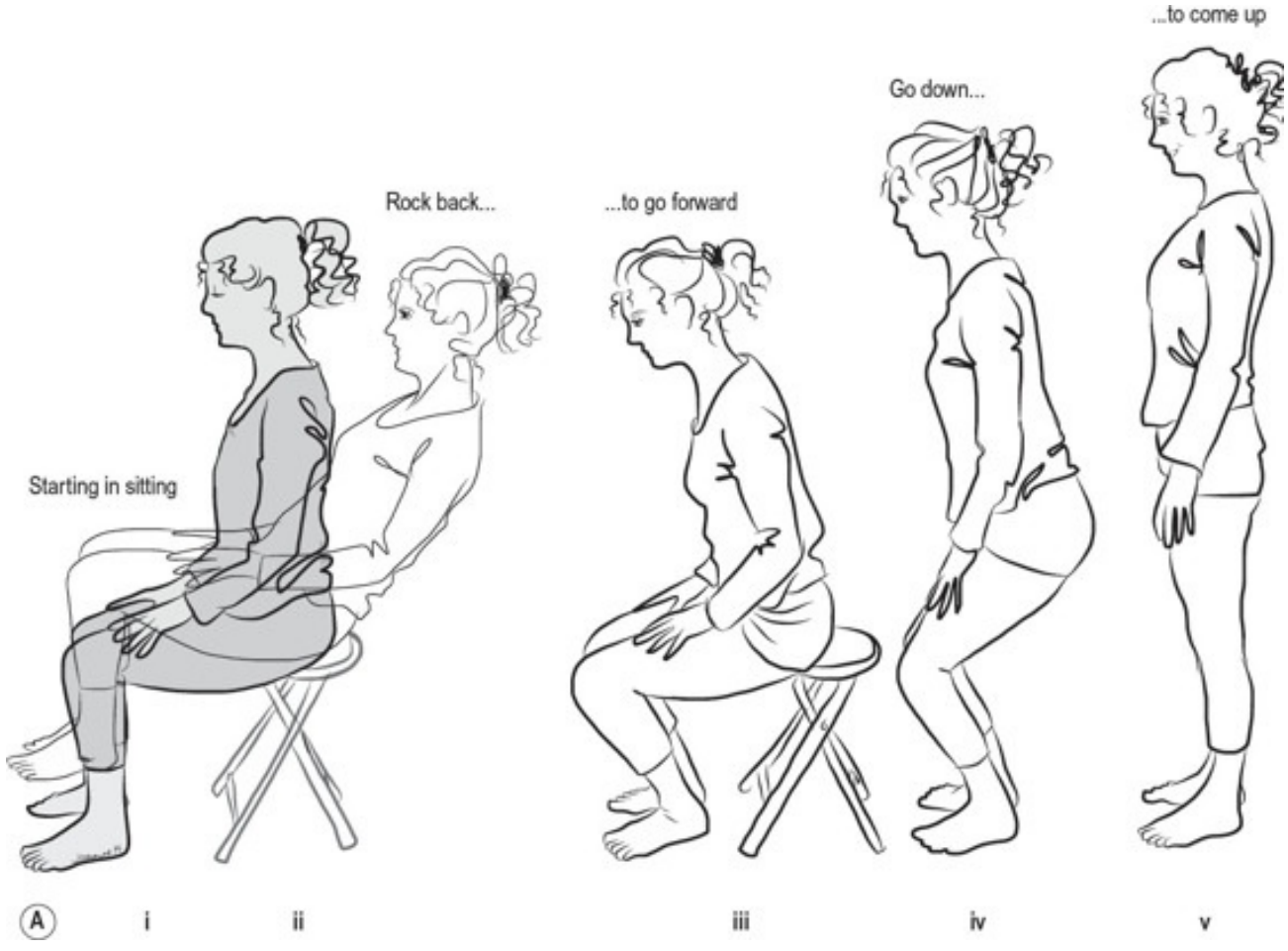


Figure 11.7A

Seated poses
Sitting postures on the mat can incorporate the use of blocks to begin with to open the angle at the hip slightly. This helps to learn to find graceful upright sitting, with comfort. (Please note, this is optimised if care is taken to avoid hyper-extending the knee; a half block is

ideal, or a roll put in to the end of the mat, to slightly lift the sitting bones; Fig. 11.9.)

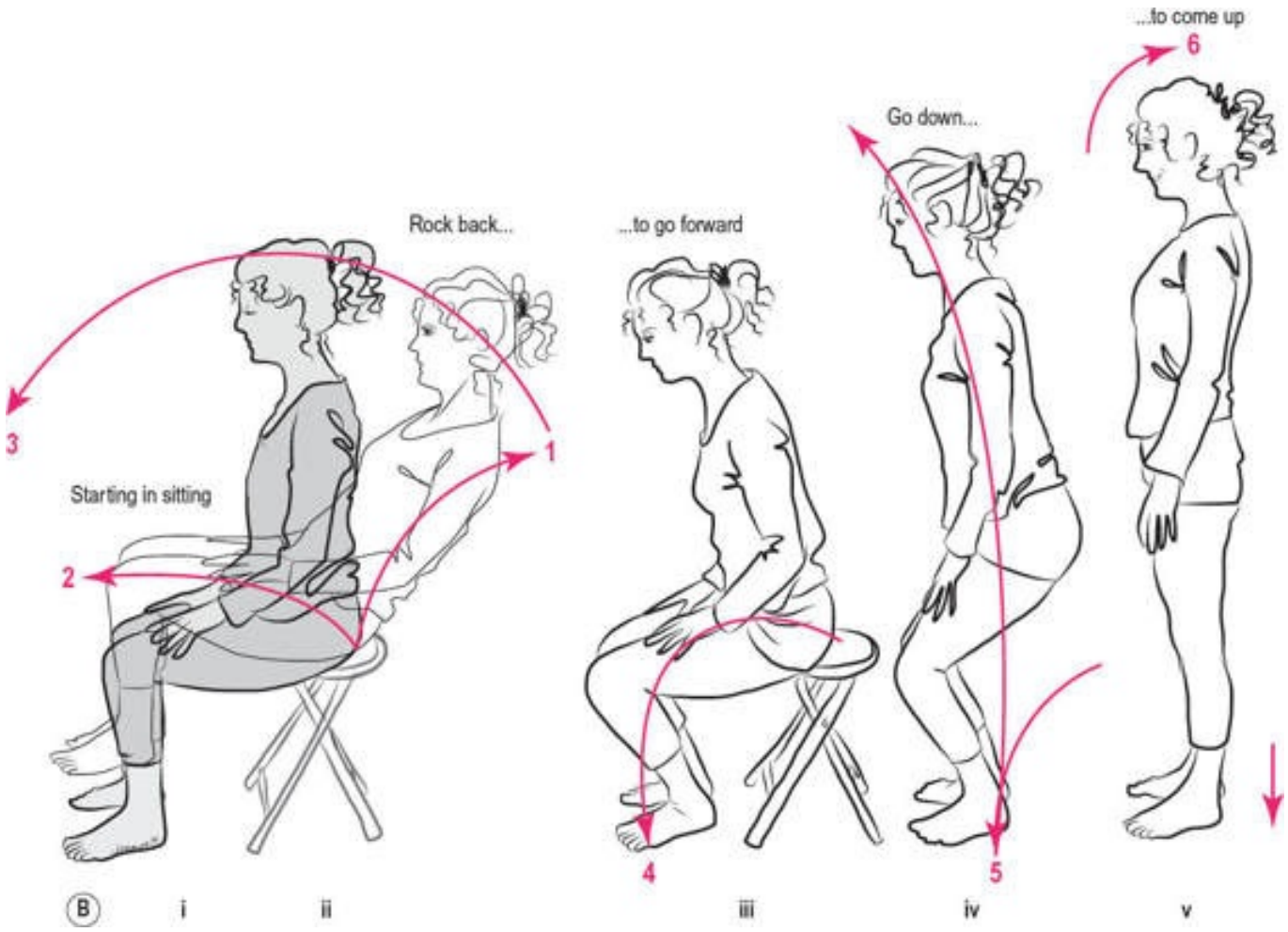


Figure 11.7B

In terms of fascial elasticity, this principle, which Scaravelli refers to as a "rebounding(ii-iii)", is termed "preparatory counter movement". The basis is incorporated here: by rocking gently back to go forward (B–C); then pressing the feet down (iii-iv) to go up – there is a natural elastic recoil that is experienced as effortless movement. If anything, the participant has to "manage" the spring-loaded bounce to arrive steadily and sweetly into Standing Pose (Tadasana) (v). Sthiram, Sukham – the steady and the sweet – are ancient principles of the yogic postures.

In Between: The Sit-to-standing Technique

As I work frequently with older people, I have observed that if the body is tired or aches, in order to stand up from sitting, a client will often fold forward, place their hands on their knees and press down hard on their (upper) legs to push themselves up from a chair. A lovely freedom arises from teaching this simple sit-to-standing exercise (Fig. 11.7A and B).

People are amazed how effortlessly they can move by containing the tissues, using this principle of polarity that operates our biotensegrity architecture as a whole. For the more active, it can also be used to rise from a supine position to sitting up (Fig. 11.8). (For the very contained, it can be taken from supine to standing, via a squat position).

When mature participants discover this, they become highly animated by their body's ability to move more easily than they imagined, just by using it to counterbalance itself. It invigorates and inspires them. It is great practice for many age groups (with the caveat that you are working with individuals you know and regularly teach and they have no spinal injuries).

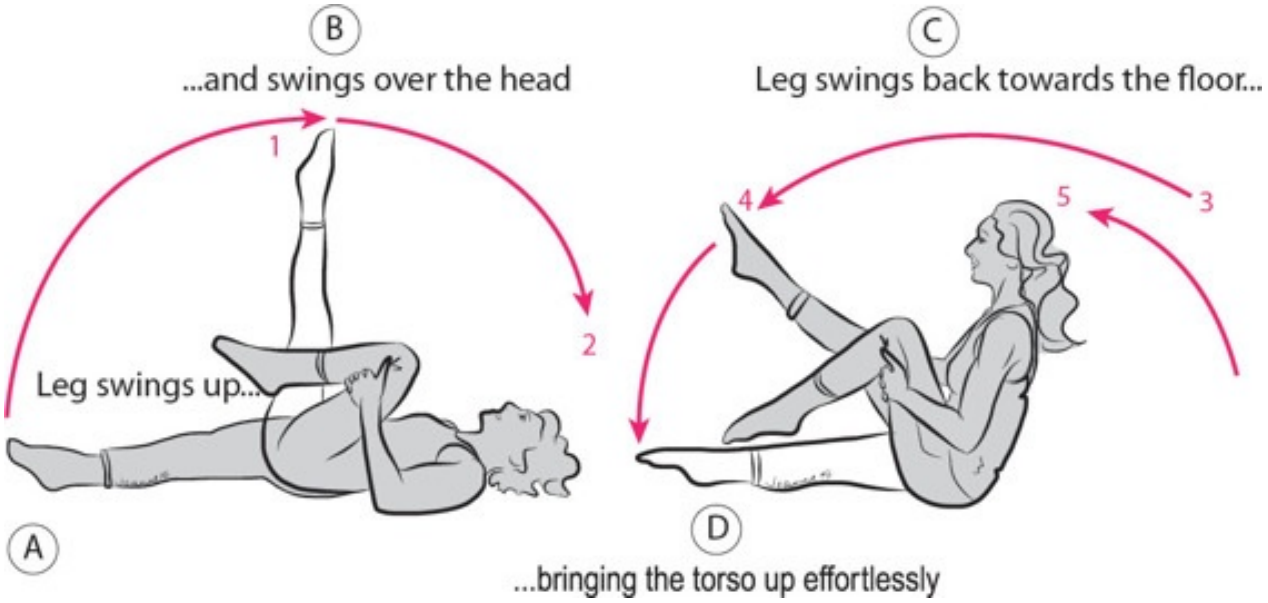


Figure 11.8

Begin lying supine. One leg remains held as shown, both hands behind the knee with fingers interlocked. The leading leg swings up and over the head to gain the elastic momentum. As it swings back down towards the floor again, the head and torso lift from the ground into sitting. Interlock the hands behind one knee, take the legs back towards the body (and slightly up to lift the pelvis off the floor) and swing them back to go forward and down to go up (into sitting). At the same time relax the sitting bones down into the ground and it releases the torso up as the legs swing down, elastically. It feels completely effortless.

Sensing the Curves of the Supine Spine

In Part 1, we established the importance of the organisation of the spine in its primary and secondary curves. These play a key role in postural organisation, structural support and the optimal breathing patterns: all foundations of our fascial form in functional movement.

Figure 11.9

Before we explore the breath in a chapter of its own, we can use this simple preparation exercise, which helps participants to relax upon arrival and simply settle before the start. This preparation asana can be used to bring awareness and attention to the body and sense these curves in relation to the ground. It also helps in preparing the body with any supine breathing techniques as the ground provides a sensory feedback. Our bodies change throughout the day, becoming gradually more compressed, and they usually

decompress through rest overnight. Developing sensory refinement includes the time taken to be aware of how and when we practise. Forcing stretches rarely works but for different reasons at different times of the day. Encouraging gentle yawning stretches, after rest periods, primes the tissues and can serve us in accommodating these differences (see Ch. 8).

We find ourselves in a unique place that yoga can take us to. It is a place where there is nothing to *do* as such. It is a state of being, conscious of sitting and standing upright, curved. We can be in our form, responding movement by movement in subtle, pulsatory awareness of the ground, the shape we make from it and the heart-centred balance this awareness can bring us. Sensing ourselves as a sensory, whole, animated architecture.

Figure 11.11

Supine Spine Curves **(Fig. 11.10)**

Lie on the back with knees bent, feet hip-width apart and toes turned inward slightly to allow the knees to drop softly together. This simply relaxes the legs and helps to release extraneous tension in the lumbar spine, pelvis and particularly the inner thigh myofascial organisation.

Place the hands under the back of the waist so that the middle fingertips touch. This allows the sense of a gentle lumbar curve, not so much that the back of the waist does not touch the back of the hands and not so little that they are pressed to the floor. (The hands can then be removed and placed comfortably on the floor or the abdomen, once this suitable shape has been found.)

This makes sensing of the primary curves very clear, from the toe tips to the crown, arching under the toes, the medial foot, from ankle to hip at the back of the leg, the lumbar spine and cervical spine.

Figure 11.10
We start by feeling how the tissues meet and greet the ground to register them in our sensory field, thereby becoming more conscious of where we are in space.

Bringing gentle, subtle attention to how the curves change (if they do) as the breath moves through the body is a simple way to encourage sensory refinement, while the body remains relaxed and supported by the ground.
This also serves to bring an uncomplicated focus inward to begin a class, if it is appropriate to your style of teaching.
PURPOSE: The purpose of this exercise is to sense and experience the arrangement of primary and secondary curves through the back of the body. This uses the ground as feedback.
SUPPORT: The body is fully supported by the ground, which can be further engaged as a sensory feedback mechanism for the breath. An appropriate support at the head can be used if a participant has a strong thoracic curve (kyphosis) such that they have to tip the head back in order for it to rest on the mat. A small block or cushion may be used so that they can clearly feel the back of the cranium as a primary curve. In general, however, I discourage use of a cushion or block under the head unless it is necessary. Neck discomfort is often alleviated by a rolled blanket or towel supporting the secondary curve at the neck. While the "automatic block support" might seem useful, it can also encourage the exact default habit we are seeking to transform.

Notes

1. H.M. Langevin, "Connective Tissue: A Body-Wide Signalling Network?", Medical Hypotheses 66(6): 1074–1077; 2006.
2. H.M. Langevin and J.A. Yandow, "Relationship of Acupuncture Points and Meridians to Connective Tissue Planes", The Anatomical Record 269: 257–265; 2002.
3. James L. Oschman, "Fascia as a Body-wide Communication System", Ch. 2.5 in Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012.
4. This is available through Helen Noakes, on video. It is a beautiful practice that can be downloaded via http://www.helennoakes.net/shop/.
5. Landmark Worldwide education programme, http://www.landmarkworldwide.com/.
6. This was one of Tom Myers's strap-lines for the Kinesis Myofascial Integration (KMI) School) (visit www.anatomytrains.com for details of the training in Structural Integration).
7. Serge Gracovetsky, presentation at the Lighthouse Centre, Brighton, UK, September 2012.
8. Vanda Scaravelli, *Awakening the Spine*, 2nd edition, Pinter and Martin, London, 2012.
9. Ibid.
10. James L. Oschman, "Fascia as a Body-wide Communication System", Ch. 2.5 in Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012.
11. See Stephen Levin, www.biotensegrity.com for an animation of the biotensegrity of the pelvic girdle.
12. In Fascial Fitness training principles this is referred to as preparatory counter-movement. R. Schleip, D.G. Müller, "Training Principles for Fascial Connective Tissues: Scientific Foundation and Suggested Practical Applications", Journal of Bodywork and Movement Therapies 17: 103–115; 2013.

CHAPTER
12

Yoga and Anatomy Trains

"All organs of an animal form a single system, the parts of which hang together, and act and re-act upon one another; and no modification can appear in one part without bringing about corresponding modifications in all the rest".[1]

Baron Georges Cuvier

The concept of Anatomy Trains™, as laid out in the book of the same name by Tom Myers, remains controversial. I have had the privilege of working closely with both the book and the author, first as a student and later as an assistant and teacher, so I remember the earliest challenges and efforts to translate anatomical continuity into some kind of manageable and meaningful portrayal for practical application.

Myers carved a path through a very dense forest and cleared the way for kinaesthetically biased people to travel more easily between the classical anatomy texts and the world of practice. It is one thing to do that for manual therapy and another to do it for movement professionals; used in a particular way, Myers' work is a resourceful contribution to both.

As we have seen, anatomy can become lost in translation somewhere between the page and the person it is being used to define (in real time). Myers has created a means to traverse that divide, articulately, in a kinaesthetically appropriate way, with some relevant and applicable guidelines. The pathways of the Anatomy Trains are worth learning, if only to steer a coherent course between the schematics of muscle units (as classically taught) and the concept of continuity, as myofascial unity is physically experienced. It is a relatively uncharted route. Yoga postures occur as an expression of natural continuity, so this work is a valuable bridge from historical analysis to the contemporary classroom.

Myers has challenged assumptions about the architectural organisation of the body. For a long time his chapter "The World According to Fascia"[2] was the only available work on the fascial matrix that someone outside scientific research could use to point to the whole body at once, including the context of connective tissue. Before biotensegrity was fully appreciated and tested to the extent it is now beginning to be understood, Tom Myers offered it as a possibility for considering how bodies occupy space and move in a way that makes sense of them, essentially as a whole. This is very different from trying to fit bodies into anatomical categories and theories of motion mechanics that feel reductionist in the context of a full-bodied yoga class.

As yoga practitioners, we seek lightness of foot and spirit, anchored in an articulate conversation with the forces of gravity, framed and explored in forms (asanas). Some of this resides in seeing the obvious: often things are not quite as cloaked in mystery as scientific reasoning might at first seem to imply. It is certain, for example, that movement does not happen in individual units of action that somehow organise themselves into the asanas done by the coherent beings that attend our classes. People can already move.

Yoga is, among many other things, one of many ways to specialise, refine, practise and differentiate the details of our mobility or "motionality", if we can use such a word. Its very nature is joined up, as is ours: "*these meridians [Anatomy Trains] girdle the body, defining geography and geometry within the myofascia, the geodesics of the body's mobile tensegrity.*"[3]

In our role as teachers, we are imparting ways of exploring those "geodesics" that wrap our forms in the forms we can make. We are not teaching movement as if movement itself is a mystery. If we have invited a teacher to raise our game or refine our style (or been invited as a teacher to do this for someone else), then the purpose is to share access to another domain. Using Anatomy Trains to do this, in terms of reading whole postural balance *in asanas*, is a great tool to have as a reference for finding the coordinates for an individual expressing a particular posture in their way. There are, however, a few points worth emphasising, especially for movement.

The Anatomy of Continuity

Anatomy Trains is less of an answer to everything than it is a possibility of stepping-stones towards a vantage point that yoga teachers can use to great benefit. It becomes particularly useful in adjustment (see Ch. 14). Teaching someone to drive does not include the assumption that every car is the same, every driver the same and every journey prescribed in advance. Anatomy Trains is a first class vehicle from which to generate exploration for you and your particular style of teaching.

A careful read of the many resources that Myers describes in his introduction to the second edition of his book *Anatomy Trains* is highly recommended. In this section ("Laying the Railbed"[4]), there is a reference to the German anatomist Tittel,[5] who depicts what he calls "*muscle slings*" in the active postures of athletic pursuits and dynamic movements. Myers refers to them as more "movement specific and momentary" as distinct from the Anatomy Trains fascial fabric connections, "which are more permanent and postural".[6]

The point is to recognise the echo of Blechschmidt,[7] perhaps, who suggests that even from our embryonic origins our muscles, tissues and bones were formed according to a plan that grew them *as slings*, in continuity (Ch. 5). Given our basic human design format, our expression of these "slings" in action is partially individual, as is our personal form. However, their continuity is global and universal. Paradoxically, while that makes us all unique, we are the same in that. There may indeed be several ways of presenting these continuities – as slings, meridians, trains or planes, for example. However, the fact that movement is expressed as slings throughout the body is the keynote. Perhaps they are not so much "set in stone" (as classical anatomy might suggest) as they are organised and developed according to use and, to some extent, what is available. In other words, while they are part of our design (as continuities) they also express our individual form and movement abilities.

Both resources (Myers, Tittel and others) suggest the value of seeing *in continuity* and this is the basic premise of learning either view. Tittel did not name the functional bands he described in the way Myers has; however, his depictions are visually very powerful in terms of making sense in the movement classroom.

We have to work in joined-up moments and once we develop appropriate ways to see in continuity of form, we can intervene wisely and sparingly to foster awareness and balance without imposition (Ch. 14). Other researchers[8] also refer to slings in specific therapeutic or pathological contexts which are beyond the scope of this work. It is, however, an essential foundation to the recognition of whole, animated, healthy movement.

Mapping Contours

Anatomy Trains provides a kind of "contour map" of the anatomical continuities together surrounding the biological architecture of our form. From a biotensegrity point of view, they are indeed considered "lines of pull" and are necessarily optimum lines, or common denominators of general posture. As with any book on anatomy, these lines offer an average possibility: indeed, in some cases even common postural tendencies. They certainly provide us with valuable metaphors for understanding the limitations imposed by considering muscles as isolated and discrete units (since we now know that this is not how muscles really work[9]) and moving towards seeing continuous "myofascial meridians" (although we may not yet know exactly how these work in everyone). We could say Anatomy Trains provides an exceptionally useful and honest way of seeing the body in joined-up anatomical writing. It is a most valuable resource in any yoga training to see balance as a global possibility if we remember it is a metaphor and hold the following four fundamental tenets in mind:

- Anatomy Trains is a particular kind of map that emphasises connectivity and connecting pathways and layers. It is nearer reality than many topographical maps but still not the territory.
- Myofascial Meridians are not necessarily synonymous with function. They are useful possibilities that suggest how refined balance might be found or revealed in the whole structure. It depends how you apply them. They are an excellent platform upon which to stand while developing the art and the skills involved in seeing myofascial continuity.
- The *rate of application* is entirely different in a movement class to a manual therapy session, where the client spends much of the session (relatively) passive on the table receiving treatment. Herein lies the quantum leap we have to make as movement teachers: to harness the power of the tool and benefit from a particular aspect of its genius, which we will explore (see below, for example).
- The body occurs in volumes (something Myers refers to) rather than in lines. If the metaphor of the anatomy train tracks is to be really useful in a movement class, the tracks have to work (at least) in pairs, relative to each other. Then they can be used for denoting form, rather than fixtures. Otherwise you need much more time to body read, thus leaving the realm of the movement classroom and entering into the realm of therapeutic practice. However valid that is in itself, it is not the remit of this book. In a movement class we are using this valuable tool to read bodies in motion at speed and optimal alignment, *in yogasana*. Thus we need pairs to see volume, as we will explore below.

Speed-Reading Prompts

An individual in motion cannot be globally defined at the speed of the class, whether using classical anatomy, biomechanics or Anatomy Trains, since movement is not an intellectual process, particularly in real time. If we remember that Anatomy Trains is a guide (and an upgrade on single muscles-as-means-to-move), then we can now travel first class into the territory called contemporary yoga using Anatomy Trains appropriately. It is an invitation to see in shapes and identify useful balance and less useful restriction, via a pose in progress.

Yoga does not really fit into the Anatomy Trains lines (there are no lines, flat planes or perfect symmetries in the body; we do not all move the same, or slowly enough to read or be read as we move; nor are lines of pull the same in each person). Anatomy Trains can, however, be made to fit into yoga in an extremely intelligent and useful way.

You will need a broad brush, a relaxed "watercolour" style, and an eye for light and shadow and for

“relative to”. We will assume you have acquired the text of Anatomy Trains (or at least the posters for reference) as it is thorough and well illustrated and an excellent resource for the anatomical definitions of each “line”, referencing the muscle units in their fascially continuous and bony integrations. (A summary of each is included here for ease of reference.)

Broad Brushstrokes

In a movement class, specifically yoga, we adapt and balance according to our structure and the pose we intend to incorporate. Animated movement uses all of the body all of the time. Some parts of it are engaged in stillness to counterbalance other parts. Some parts are engaged in more obvious mobilisation. In balance these form (together) the sum total of our transitions at any given point in time. As previously stated in Chapter 7, there are three states: move, countermove and the neutral sum of their combination, at any point in time.

I have personally dissected all the Anatomy Trains lines and, while that does not make them “real” in the living form it does make them valid for consideration as a way to represent continuity in our tensional body form. How they work for each individual is one thing. Whether they exist in the body as separate or distinct “entities” is another. They do occur in continuity, as continuous layers of composite tissues, just as individual muscles can be found in dissection. It is not their reality that is being discussed here, however, but *what we make them mean*. Anatomy Trains in yoga is a subject for a whole other book on its own. It works at the speed of instinct and intuition in class, so it will seem like the Fast Track version in this format. You will see why when you seek to apply it. I have included some fun exercises for learning it at the end of this chapter. After you have learned all your origins and insertions, it provides a useful context in which they can make sense of our fascial form.

We have to learn to see in sweeping motions and get a sense both of balance, and of where balance is missing. We sometimes work in “still frames” if the focus is to hold a pose. However, this is a very active or dynamic kind of stillness, engaging the body in slings of myofascial continuities over a period of time. It is not experienced as static or sedentary by the body, as it has to be actively held in place, which requires strength and poise. (As we have noted previously, we are designed for mobility, so globally speaking it takes specific focus to hold a “still frame” in a posture.) It is invariably an expression of balance between tension and compression, attraction and repulsion. Equilibrium equals the balance and freedom between these states.

Anatomy Trains starts off as a very useful interpretive guide to upgrade this seeing and we find ourselves viewing in bands rather than bits. We are left reading the body *at speed* and, in order to do this, we first focus on balancing between polarities: back to front, front to back, side to side, spiral to spiral or pose to counter-pose. We develop a sense of up to down and eventually an ability rapidly to see where grace is and where continuity is interrupted, relative to the individual in action (and their relationship to the ground).

Motional Modifications

Another very useful work is *Dynamic Body, Exploring Form, Exploring Function*, by Erik Dalton.[10] Myers is one of the contributing authors to this book and his overview of Anatomy Trains is an excellent resource and introduction, without all the fine details of application to therapeutic intervention included in the full version of the original work.[11]

We are entering a domain that goes beyond scientific analysis into the beautiful realm of aesthetic movement. It cannot be appreciated using purely anatomical knowledge based on post mortem studies or the only mechanical principles of motion. Dancers, and some yogis, particularly those working really fluently in Vinyasa Flow, know something that is simultaneously exquisitely complex and

profoundly simple about the experience of movement in whole body sequencing. It is something that resonates with biotensegrity and is, to some extent, answered by it. *There is, however, a lot more research to do in considering exactly how we animate these complex geometries on the scale of joint anatomy:*

Movement comes *through* the body, rather than *from* it, at this level of performance. It also uses the ground and the gravitational field in a very instinctive way. A dancer leads with their head, moving forward from the back body, backward from the front, and so on. Dancers are trained in the polarities that become so refined they are *only* described by the body moving, in continuous transition. The analysis is only analysis. Freedom of expression using the kind of movement that a dancer can command can bring an audience to tears of emotion, a fact that is not easy to explain. It is something in and of itself that even absorbs and transcends the dancer. It is as if dancing is dancing. In Vinyasa Flow, which means "to place in a special way", it is expressed as continuous movement. The quality of otherness beyond analysis is harnessed and surrendered to, *through practice*.

Below you will find a few notes for working with Anatomy Trains in motion to optimise their application in a movement classroom. These are adaptations to the full Anatomy Trains details found in Myers' book. Some key points are:

- The Deep Front Line is a container, which at speed we read via the breath. It represents a volume and, since we cannot touch it directly, it may be that watching and cueing the breath can be the access. It also means that breathing and movement integration (Ch. 15) are distinguished as a basis of optimal organisation and functional movement.
- The Functional Lines do not "function" as such in yoga, unless you include the feet and hands and continue the lines beyond Myers' defined limit of the elbows and knees. We do not move by hovering above the ground. We integrate from it. Whatever the argument for calling Functional Lines functional lines, they reach the ground in this impressionist art of recognition on the mat. Furthermore, movement is usually our response to a task and our intention. We choose to do yoga, explore Eagle Pose (Garudasana), for example. Hands and elbows work in concert, so any line stopping at the elbow (or knee) does not get to be identified as "functional" in this context unless it is *actually* the physical end of that extremity.
- Fascia is not limited to Longitudinal Bands such as defined by the Anatomy Trains. They are an extremely useful means to read overall body shape in such a way that gives us relatively fast access to seeing continuity of form and balance. We can also learn to recognise whether breathing function is optimised or compromised, by seeing their relationships. The emphasis, however, is on *continuity* and *breathing* rather than on any specific line per se.
- There is indeed something like a Back Spiral Band! Many dancers (particularly ballet) and Yoga Flow practitioners learning Anatomy Trains animate the sense of the exact opposite of the so-called Spiral Lines. They report a long continuous band down the front (recapitulating and overlapping the Superficial Front Line from the back of the head down the front to the forefoot), to stabilise a helix that wraps around the back. The helix is accounted for, in part, by the Back Functional Line. However, there is a much more complex and integrated relationship between the front and the back in helical motion. The body interprets sequential transitions in ways that are not always readily reduced to Anatomy Trains' configurations. As Myers points out, Tittel offers bands that are related to "momentary movement" rather than postural set (Fig. 12.1).

In life, people acquire something we might refer to as the possibility of "biotensegral choice" when their bodies become strong and variable in fast movement sequences. They will use all the power of anticipatory motion that the myofascial matrix can bring them, balanced in elastic integrity, between stiffness and the ability to stretch or lengthen. In other words, the recruitment of myofascial continuities of a Spiral Back Band wrapping around in a helix (or any other variation on this kinaesthetic theme) will depend to some extent on the next move. It certainly leaves some questions *in experientia*.

Figure 12.1

Longitudinal Myofascial Meridians

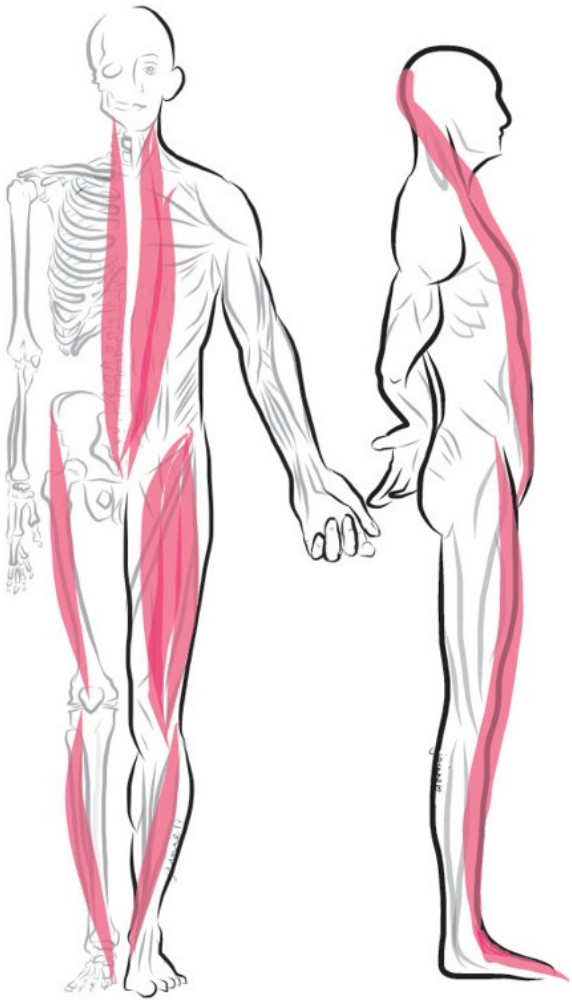


Figure 12.2
The Front Band(s).

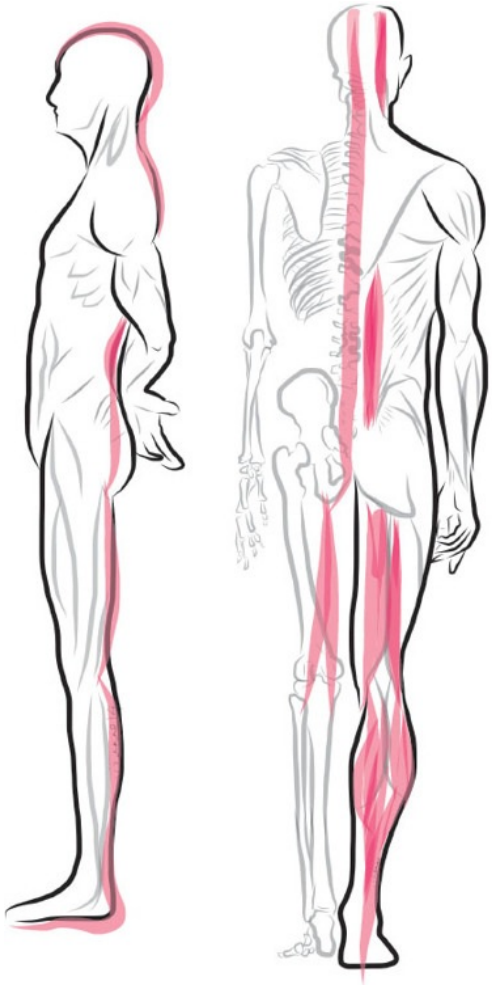


Figure 12.3
The Back Band(s).

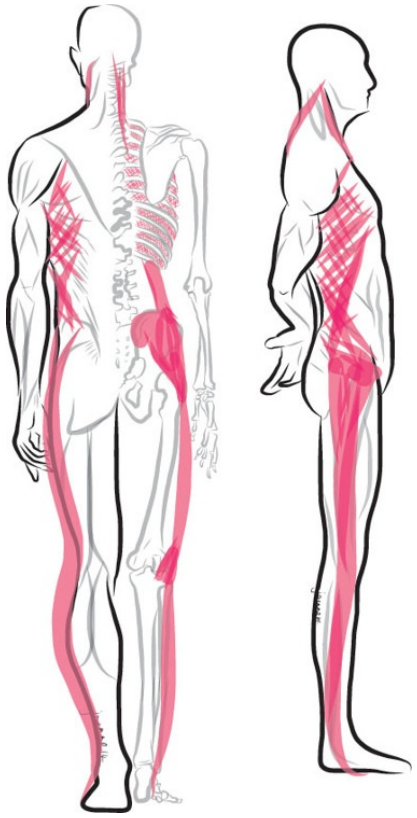


Figure 12.4
The Lateral Band(s).

Longitudinal Myofascial Meridians

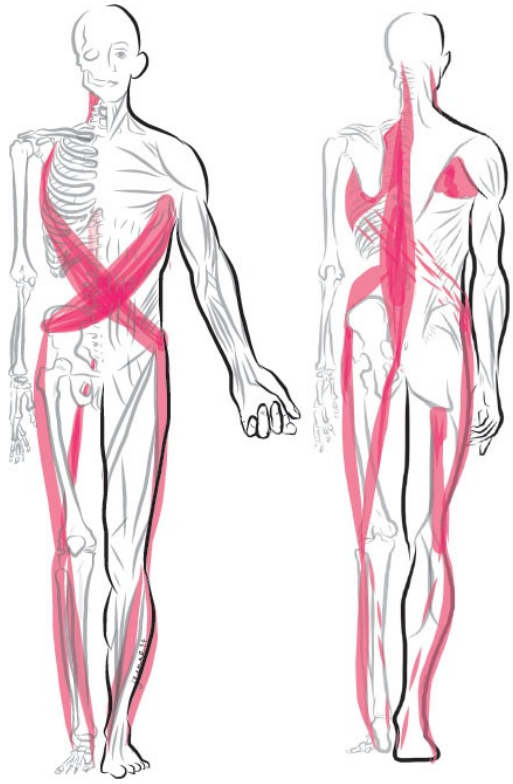


Figure 12.5
The Spiral Band(s).

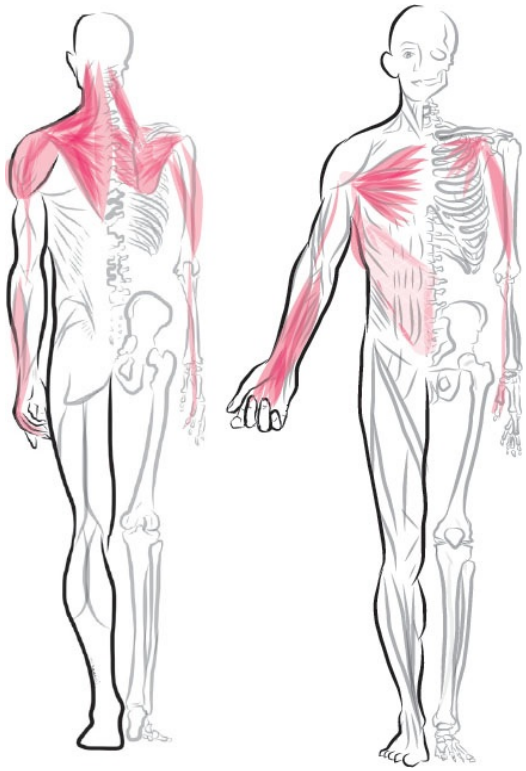


Figure 12.6
The Back and Front Arm Band(s) (superficial and deep).

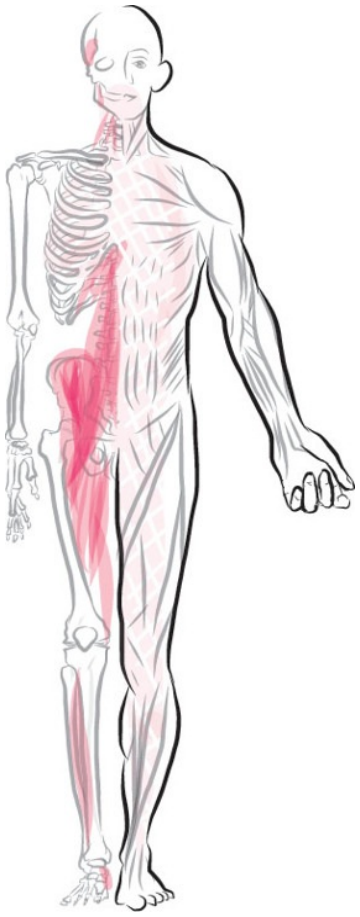


Figure 12.7
The Deep Container (Deep Front Line in Anatomy Trains).

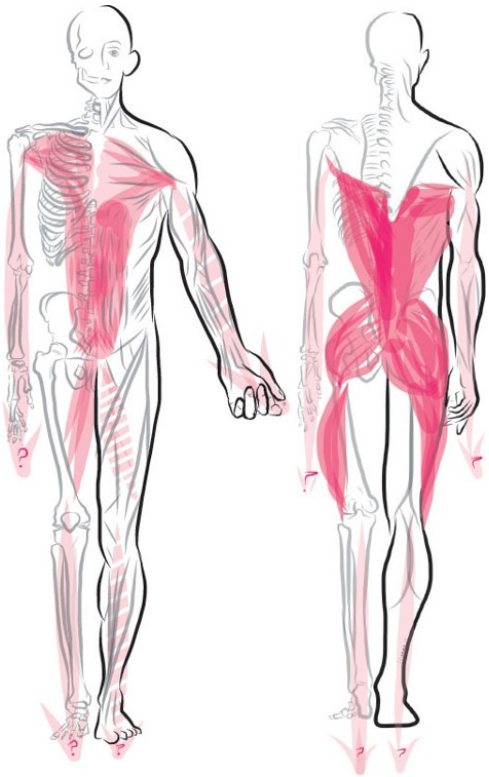


Figure 12.8
The Front and Back Functional Band(s).

Starting Points for Anatomy Trains in Yoga

Finding the “Back Spiral Line” feels like a combination of the Back Functional Line and the Superficial Front Line, mediated always by the full body’s breath. Perhaps it cannot be explained.

Technically, if you follow the rules according to the Anatomy Trains, there is no means to take a helical band around the back of the body on a continuous layer. I am therefore left with the question of how it feels. In truth, the lines will not get you to the practice. However, they can help you to usefully read it.

These bands provide starting points, or references in the conversation between practitioner and participant. They are languaged kinaesthetically, as we will see when we go on to use them in adjustment.

We will begin with: showing the lines as sweeping impressions of continuities, or parts of continuous sheaths or bands, which is how they appear in the clothed participants that we see arriving in the classroom; presenting the impressions of each line in paired soft architectures to give an overall sense of fascial form, in motion at speed, relative to each other; emphasising that all the lines can be distinguished individually or collectively in any posture. They are very useful indicators in pairs, of restriction, balance or lack of tensegrity; working in wholeness. We will not go into the detail of all the layers, as found in Anatomy Trains. Rather we will focus on relationships: seeing the front relative to the back, for example, in simpler terms, such as we see in class.

N.B. ALL the lines are relative to the Deep Container; it is seen via the breath; which gives us access to the structural balance between the lines (Fig.12.15).

Longitudinal Myofascial Meridians of yoga based on Anatomy Trains

Please note these are broad brushstroke impressions of the bands that are detailed comprehensively in *Anatomy Trains* by Tom Myers. These are in no way designed to replace or change the anatomy. They are provided here as a reference, without specific labels, as a guide to what is actually seen in the classroom and how we can work with them in natural motion. It is highly recommended that you obtain your own copy of Myers’ book.

Working in Related Pairs (Overview)

In the yoga classroom we are working with animated beings. These sketches are designed to give an overview of how to “see” the bands relative to each other balancing front-to-back, side-to-side, spiral-to-spiral and so on.

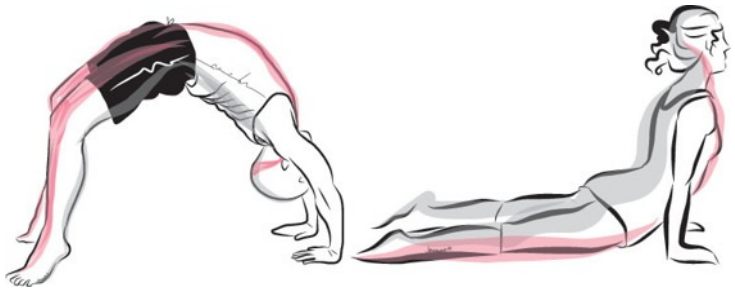


Figure 12.9
See the front relative to the back.

Figure 12.10
See the back relative to the front.

Figure 12.11
See the Lateral Lines relative to each other in the torso and to the Deep Front Line, in the legs.

Figure 12.12
See the Spiral Lines relative to each other.

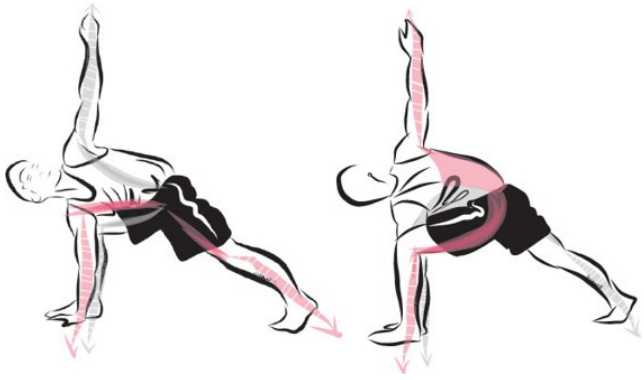


Figure 12.13
See the Back and Front Functional Lines (working from the ground to the other extremity).

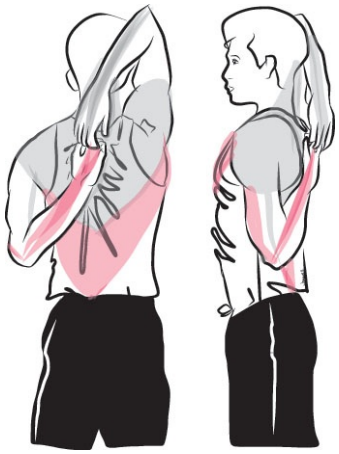


Figure 12.14
See the Back relative to the Front Arm Bands.

The arm bands are complicated by the fact that we can (as seen in this image) rotate our arms, such that the front and back can be twisted in yoga poses. The front and back balance relies to some extent upon reading the postural balance between the main Front and Back Lines and seeing the shoulder suitably aligned with the side (Lateral Line) – as shown. By seeing the lines in pairs, you are then able to see balance between them, via the relationships of the body volume to and from the ground. It is not complex and it is designed to facilitate tensional balance in the torso and ensure that postures are not done at the expense of length, depth or breathing. These are paramount features preparing the body for practices through which we can progress.

Figure 12.15
The Deep Container (Deep Front Line in Anatomy Trains).
All the lines can be related to the idea of the breath "filling" the deep container.

There is a great deal more going on in the fascial form at the different joints. However, this premise works extremely well as a global balance in lying, seated, inverted, standing and bending poses, as well as twists (given our broad brushstroke, water-colour approach). If the spinal integrity of the primary and

secondary curves is honoured, strength, length and tensional balance are progressively optimised. The elastic integrity of the whole body can then be fostered as we work with the different practices, detailed in later chapters (or those specific to your own style of yoga).

The Purpose

The purpose of putting the lines into pairs and reading the balance between the lines, or bands, is to ensure that movement of a given line, in a pose, is not at the expense of its opposite line. This will encourage the integrity of the volume that the lines outline, especially if you work with the breath as mediator. Essentially it is quite simple.

For example, in Cobra (Bhujangasana) it is one thing to simply lift the head, pushing the ground with the arms and stretching the front of the body. However, if this is *at the expense* of freedom, length and breathing through the back body, then it is less than optimal for that individual. The same can be said for forward bend – if it is achieved at the expense of a long back, or in counter to the natural curves, it is encouraging a less than optimal posture. This is clear in Figures 12.16 and 12.17.

Worth practising

It may seem like a lot to learn for such a simple purpose; however, it is much more straightforward in practice and deceptively powerful in helping your clients:

- move honestly
- progress appropriately in relation to their own architecture
- explore postures from within their own limits
- expand their own limits at an appropriate rate for them
- gain confidence as the body feels safe in balanced polarities
- integrate sensory awareness and refine it
- animate focused attention in presence, whatever the pose
- accumulate elastic integrity as a resource, gradually over time.

As a teacher you can readily:

- deepen your ability to see and assess
- recognise movement forces expressed in each person
- confirm balance relative to individuals
- ensure safe practice that is people centred, not pose centred
- manage progress at a suitable rate
- facilitate awareness and attention in neutral balance
- establish a basis for confident adjustments (see Ch. 14)
- become adept at optimising elastic integrity.

These features can expand your confidence as a teacher and the confidence a group has in you. Once this way of seeing becomes instinctive, you can (just as you did when you learned to drive, for example) relax about the applied anatomy and call forth the deepened breath, the moment of attention to a heel and the awareness of a part of the body in its context of the whole myofascial organised form. Just as with driving, eventually the knowledge becomes so instinctive it allows us to direct the class and anticipate at the same time. In time this gives rise to more grace for each person as they acquire mastery in the different poses, whatever your preferred style of yoga and your unique way of teaching it.

The same can be seen in side bending or rotating. It is a fast way to identify someone forcing themselves into postures they are not ready for. It also shortens or squashes the cavities of the torso and the spine can then be forced to accommodate this. At its most beautiful, and when a person is ready for its fullest expression, a pose invites the body to express its integrity. All this, in order to sit relaxed and quiet and still, at ease and without compromise.

Going Behind the Lines

The essence of the Deep Front Container and the foundation of the body as a volume in space are visible and outlined from every angle by *watching the breath*. We will examine this further in Chapter 15; however, it is fundamental to every aspect of the body. Apart from anything else it may be that by breathing more consciously into a given aspect of the torso, we can bring it into conscious awareness and revitalise it through the breathing movements. When they are in congruence with our natural rhythm, gait is enhanced and something light, an elusive spring, restores our step. I have seen it happen time and again. It arrives spontaneously when we stop striving.

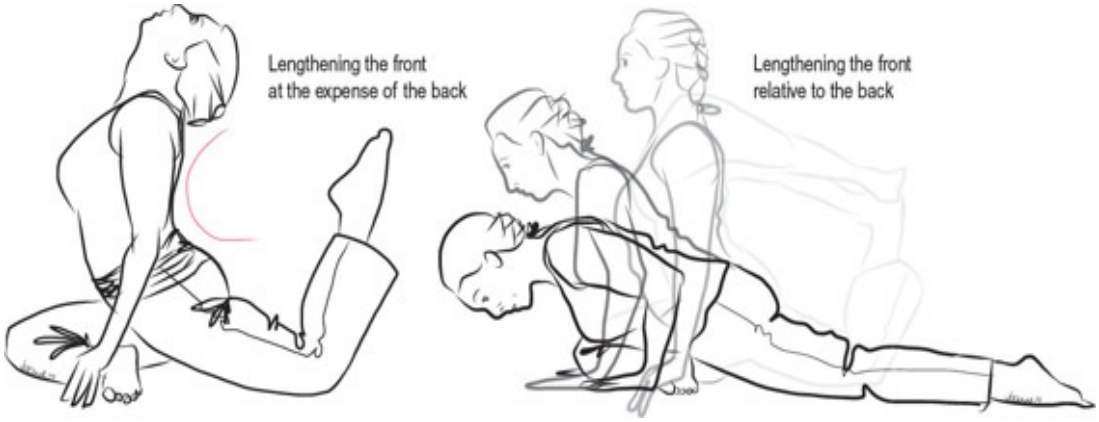


Figure 12.16

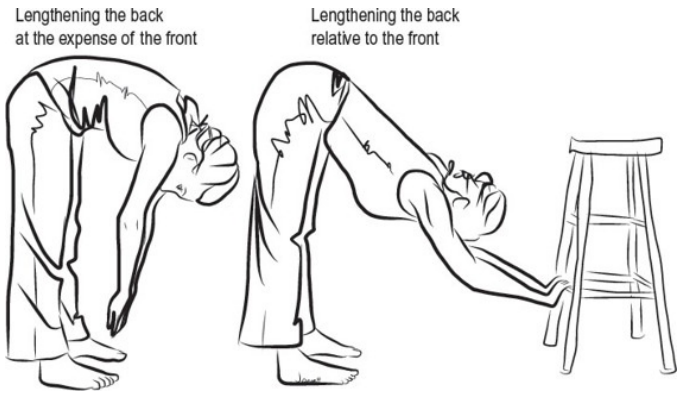


Figure 12.17

Applying Anatomy Trains in Motion

One of the values of working with the Anatomy Trains idea, given that our form occupies three-dimensional geometry, is reading the balance between the “lines”. Of course, although they might appear as lines in that they are silhouettes in profile, they do not act as lines. The silhouette is invariably around a volume. They behave as longitudinal coordinates of curved planes and they are powerful basic guides for movement and tensional integrity, if we learn to read them in *relation to* (not in *isolation from)* each other.

The illustrations provided here simply denote where the lines would be on the body if it were static: captured in a moment in time. They can be used to guide both Posture Profiling (Ch. 13) and adjustment, explored in more detail in the following chapters.

This approach generates the “field” referred to in Chapter 1. It is a grace field that works as a

collective of people with a common interest, passionate about making a difference to each other. Intellectually you are applying a working anatomy that makes sense on the mat. Instinctively you become more and more adept at interpreting it in an appropriate place to meet. Intuitively you can acquire mastery that looks like the smallest intervention (adjustment) for the optimum difference. Enjoy exploring the field *"beyond ideas of right doing and wrong doing"* (Rumi).

Notes

1. Baron Georges Cuvier, *Histoire des Progrès des Sciences naturelles depuis 1789*, vol. I, p. 310., quoted in E.S. Russell, *Form and Function*, 1916 (http://www.gutenberg.org/ebooks/20426).
2. Ch. 1, "The World According to Fascia", in Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
3. Introduction, "Laying the Railbed", in Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
4. Ibid.
5. Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009; Kurt Tittel, *Beschreibende und Funktionelle Anatomie des Menschen*, Urban and Fischer, Munich, 1956.
6. Introduction, "Laying the Railbed", in Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
7. Erich Blechschmidt, *The Ontogenetic Basis of Human Anatomy: The Biodynamic Approach to Development from Conception to Adulthood*, edited and translated by Brian Freeman, North Atlantic Books, Berkeley, CA, 2004.
8. Introduction, "Laying the Railbed", in Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009; D.G. Lee and A. Vleeming, "Impaired Load Transfer through the Pelvic Girdle – a New Model of Altered Neutral Zone Function", in Proceedings from the 3rd Interdisciplinary World Congress on Low Back and Pelvic Pain, Vienna, Austria, 1998.
9. "The simple questions discussed in musculoskeletal textbooks 'which muscles' are participating in a particular movement thus become almost obsolete. Muscles are not functional units, no matter how common this misconception may be." Robert Schleip, "Introduction" in Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012.
10. Erik Dalton, *The Dynamic Body*, Freedom from Pain Institute, Oklahoma, 2011 (www.erikdalton.com).
11. Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009 (see also 3rd edition, 2014).

CHAPTER
13

Yoga and Posture Profiling

"There are thoughts which are prayers. There are moments when, whatever the posture of the body, the soul is on its knees"[1]
Victor Hugo

Posture Profiling is not limited to any one particular protocol (such as the Anatomy Trains discussed in Ch. 12). Rather it is used to understand some of the general fundamental differences between different fascial "body architectural" types. The word "profile" is used here in a neutral way; it implies neither right nor wrong, better nor worse. It exists relative only to itself. The value in Posture Profiling lies in finding suitable coordinates for appropriate change. This amounts to accessing a starting point and choosing a suitable direction to move towards. The caution is to beware of becoming too literal or using this to "brand" people, since that is precisely what Posture Profiling is designed to move away from.

The Ground Rules

Posture Profiling is not designed to be a substitute for such practices as Body Centred Psychotherapy, Hokomi or any of the many valuable protocols that speak in specific ways to the psychosomatic whole we live and dance in. It is an accessible, softly spoken framework, like a sketching template, for movement teachers. It captures a moment of the physical, connected soft-tissue *living* architecture and places it in a temporal context with usable coordinates.

We are not anatomists, carefully studying dead or inert forms in miniscule anatomical detail. This profiling is for movement teachers, and more specifically yoga teachers, working *at speed*. We are inviting individuals to discover more possibility, range and comfort for themselves. Part of our role is to provide useful feedback. Perhaps we can provide fast track access to that process of processing *in*formation to allow *trans*formation, physically.

Essentially, however, the discovery belongs to the participant. We are not teaching them how to move, for they already know how to do that. We simply have access and more practice in our favoured modality.

Posture Profiling begins as a map of a set of coordinates, based on fascia types. Using this map, our task is to recognise and place an individual on a useful path of progress. It provides a sense of which direction to take them in. It also expresses whole anatomy at the speed of movement, which is the realm we work in.

Intellect, Instinct and Intuition

Here is where anaesthetic, kinaesthetic and aesthetic come together in action. By learning to trust our

instinct and intuition we can develop the skill of Posture Profiling. Eventually it supports clients to become self-referencing in terms of their own balance and well-being and self-sensory refinement. It is, to some extent, an interpretive art.

As a yoga teacher, you have a huge advantage, which is the ability to be present. This is the blank page everyone begins on. The difficulty (which diminishes with practice) is the speed at which you have to recognise profiles. You do not have months to develop your idea and prove your theory. You have just moments to download your instinctive sense, to activate, animate and illuminate the movement. Then you get to do it over and over again.

Eventually something extraordinary happens. Your intuition kicks in, so fast it feels like it is in advance of you. It becomes an awareness that is pre-emptive in nature. It can be brilliant, yet it is hard to explain because by definition it is momentary; any explanation is of something that is already past. It is in this domain that we have to build the appropriate experience, from people-watching and class observation, over and over and over, to develop this skill at intuitive pre-emptive speed.

Fascia itself is an anticipatory tool (Ch. 9). With cumulative practice, we become like the experienced car driver who eventually relaxes at the wheel (of familiar protocol) and instinctively recalls their historical knowledge of due procedure, anticipating events with wisdom and hindsight operating together. It is an invaluable part of your repertoire.

Below, we divide Posture Profiling into its intellectual, instinctive and intuitive aspects.

The Intellectual Aspect

The information upon which this is based is founded on fascial body type and morphological body type. This is a tool in the field, so to speak. It is a metaphorical sketch of a person in real life. It is not competing with scientific or academic charts. We are working in nature and non-linear biologic forms, animated by extraordinary individual people. It is invaluable for ensuring different fascial body types can optimise and balance their training in a more personal or specific way. These are considered to live within a range designated as being between the extremes of what Robert Schleip refers to as the "Obelisk" cartoon character and the Indian Dancer types.[3] In this iteration we will call that range "Viking to Jungle" and make it the *x*-axis.

The X-axis

> This system has evolved out of a long training and teaching in Body Reading at the KMI School.[2] Please be sure to sense these types as archetypal possibilities to distinguish optimal practice. They are not in any sense good or bad, right or wrong, better or worse. They are absolutely not to be used to criticise or diminish people or suggest they would be "better if only ...".

Viking: this is the build of the strong, resilient body that is capable of endurance, particularly at lower temperatures. Schleip invites us to think like a Viking, wrapped in furs, carrying the family and worldly goods, trekking stoically across the rocky altitudes of the Northern European landscape. At the campfire, the Viking body shields the family from the cold with strength and resilience and places a high priority on stamina, bulk and brute force to carry everyone through. The shoulders are broad and the fortitude is archetypally powerful. If there is a small space between some boulders, the Viking may not be able to bend or squeeze through the gap but instead may be able to move, remove or overcome the rocks. In terms of the elastic body, we would place the extreme Viking body towards the stiffness end of the scale.

Jungle: this is a very different build to the Viking, representing the opposite end of the scale. Although it is no less powerful, it has a very different kind of ability. There is no bulk or brute force, rather a fine-limbed or sinewy kind of potential that might be associated with a tropical climate and the ability to move silently through tangled undergrowth. The Viking would find that kind of movement difficult. This Jungle movement archetype, however, would be less naturally equipped for endurance and more for momentum and the kind of flexibility that could swing and bound, slide through smaller spaces and bend and twist with refined detail and the least of tracks. They might lack the "brute force" and fortitude but they will embody a lighter, wirier frame for swifter motion and dexterity. In terms of the elastic body, this is the stretchiness end of the scale.

There are many variations on these themes, of course. They live somewhere along this particular line in terms of fascial types in a movement classroom. It is a soft motional interpretation and it is further defined by the vertical or *y*-axis.

At right angles to the horizontal axis, is the *y*-axis that denotes shape. These types are used as much for their general application in biology, referring to inner, middle and outer, as they are for any historical applications of particular personality or physiological traits.

The Y-axis

These "somatotypes" were originally described in the 1940s by William H. Sheldon and were closely associated with different body types as regards their fat-storage tendencies and also psychological patterns. (This is reminiscent of Ayurvedic principles of how different types contain bodily fluids.) They are used here in a very simple way and chosen for their association to shape (morphology), which is such a keystone of fascia.

From a slightly different perspective we could consider these morphologies from a sensory point of view. There are *all* highly responsive to the internal and external environment and in this context they are used to express movement preferences, in a neutral way, as much as they represent physiological tendencies.

For example, if Viking is West and Jungle is East, then Ectomorph is North and Endomorph is South. Meso is in the middle and, just as it is in the embryo, it actually denotes the in-between. That is the place other than all the other places that distinguishes them from each other and also unites them. It is not a goal of perfection. We are using these as symbolic coordinates to guide our instinctive sense of direction. It is a direction that we move through at different times and actually begin from, as the pre-stiffened resting tension of the elastic body.

Everyone has Mesomorph in them. We are looking to point towards a preference, given the whole context. Does the individual have a tendency towards a "neurological" bias and tend to prefer their intellectual centre, a "locomotive" bias that prefers their movement centre, or a "digestive" bias that likes to take time to consider things, to act more slowly perhaps?

We will use these categories and add some notes here for ease. Please expand them and add your own finer distinctions. It is as much to differentiate where someone is not as it is to assess where they are.

Ectomorph: the ectodermal layer comes from the Greek word meaning "outside" or the space beyond an external boundary; the outside of the shape. The ectomorphic type, in this context, denotes a sharpness of more active attention outward: an animal such as a bird, perhaps, or a squirrel, with a highly tuned sense of alertness to its surroundings. This type has a tendency towards a nervous disposition, staccato

movements, high-speed bursts of energy and very finely tuned awareness and attention to detail. It might tend to focus on what is happening outside the body, while remaining sensitive to what occurs within.

Meso(morph): meso comes from the Greek for "middle" or intermediate. It suggests a halfway point but can also refer to something between the internal and external function and orientation. In some cases this can refer to "moderate" and leads into the sense of mediator, as in finding the middle way. Here it suggests the place between the other main types but also one that expands to include them. In tissue terms it is a balance of both outward and inward attention and awareness, possibly more inwardly focused than the extreme ectomorphic characteristics but less so than the more extreme endomorphic characteristics.

This type tends to prefer a balance of activity with thoughtful or reflective pursuits, needing to occupy their physical or instinctive body, with high regard for steady energy output. It sits in the middle, on the horizontal axis, because it can include both the strong, muscular body and the strong sinewy body of the Viking to Jungle extremes. At resting centre, it implies neutral, meaning "both and neither" at the same time.

Endomorph: this comes from "endo", meaning "within, internal", from a Greek origin. The endodermal layer of the embryonic structure refers to the internal gut tube, the forming of our digestively orientated systems and organs. This type can appear calmer or more reflective, certainly preferring a slower or more deliberating style of movement to the Ectomorph. It is not necessarily any less sensitive or fast, rather preferring a different rate of flow and a less staccato rhythm. If we were to use a sound scale, the Ectomorph would take the high notes, while the Endomorph would take the lower notes. Their focus might naturally be more on the inner world than what is happening outside the body.

We could say that we all have elements of all these morphologies; however, there is a tendency towards one of them, or some more than others.

Centre: if someone appears to be perfectly balanced, both physically and in terms of their range of movement, then place them in the centre. For all people on the chart, the task is to *move towards* the central aspect as it provides the optimum choice and range. If someone is already at the centre, then the game is to fill in the circle out beyond it and practice expanding in all areas.

Posture Profiling Chart The Goal

Figure 13.1 depicts a Posture Profiling chart.

The goal is simply to move people from whatever point they are at towards the centre. It is not to make everyone the same. Rather it is to invite a strong Viking type towards a greater range or balance, by increasing the lengthening, stretch-style movements of the Jungle body. The aim is not to turn the person into a different type, but to invite for them a greater range, a more optimal balance and elastic integrity.

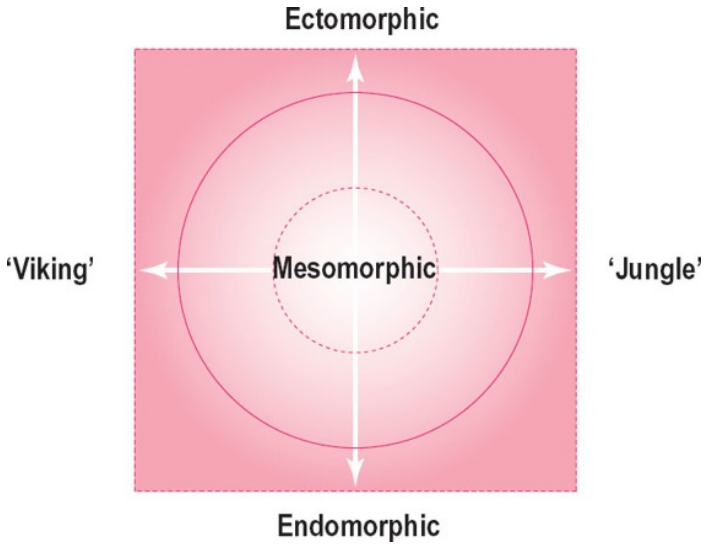


Figure 13.1
Using a broad brushstroke chart, we become artists more than scientists to "place" people on it and find appropriate coordinates.

A naturally very flexible Jungle body will be more likely to experience balance by considering more tensional patterns, higher stiffness to ensure optimal strength and what we might call "biotensegrity" in the tone of their tissues. That might include a more active or power-based yoga style. It might mean longer holding positions in suitable postures to tune strength, for suitable stiffness, rather than stretch.

A slower, more sedentary morphological type can "improve" by becoming more active and might find more vitality by attending a well-paced class on a regular basis. If they were placed towards the right side of the chart, then perhaps bringing in a strengthening focus would animate them and sustain their vitality. If they found themselves experiencing stiffness or having a naturally strong build then possibly stretching would balance their particular profile.

The ectomorphic type, which is associated with more staccato movements and a tendency to fidget, will want the opposite. For them, practising to enhance their ability to slow down a little and find the power of stillness might be of more value than focusing on speed and change. They can benefit in finding the Middle Way their way, through training a little more strength and restfulness in the body. If they reside in the Viking side of the chart, it may be that longer, slower stretches are helpful.

Posture Profiling is swift and simple. It is designed to give a general cue to managing a class in which everyone is different. It allows us, as teachers, to optimise the fascial matrix of a given body type and assist that participant to find their balance in a way that is appropriate for them and the way their tensional matrix is generally organised. It is designed to improve elastic integrity over time, for the type they already, naturally animate.

Examples

Here are four practical examples to show these broad brushstrokes, or archetypal movement patterns, placed on the soft graph. To optimise elastic integrity for each type, the optimum focus will include the comments in "towards the centre" for each example.

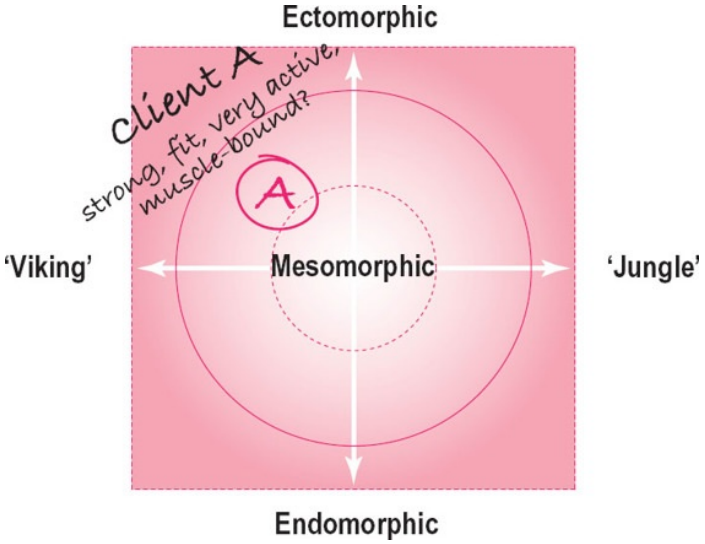


Figure 13.2
Example A.

Example A (Fig. 13.2): strong, Viking type. Very fit (weight training and has strong bias towards strength and conditioning style workouts). Very active, tends to be less happy relaxing and sitting around. Can do yoga out of strength rather than sensory invitation or subtle cues for sensory refinement.
Towards the centre: stretching and stillness optimal. Meditation restorative practice, with emphasis on length over strength.

Example B (Fig. 13.3): very bendy and able to stretch, although sometimes experiences over-tiredness or lethargy. Well built with a tendency towards slower movements. Can do yoga poses involving flexibility well but has more difficulty with contained movements that require control. Tires relatively easily. Extension postures easy, tends to need holding back from naturally achievable range as can "drop" into extremes without difficulty. However, can struggle to come out of the extreme or find the counter-pose.

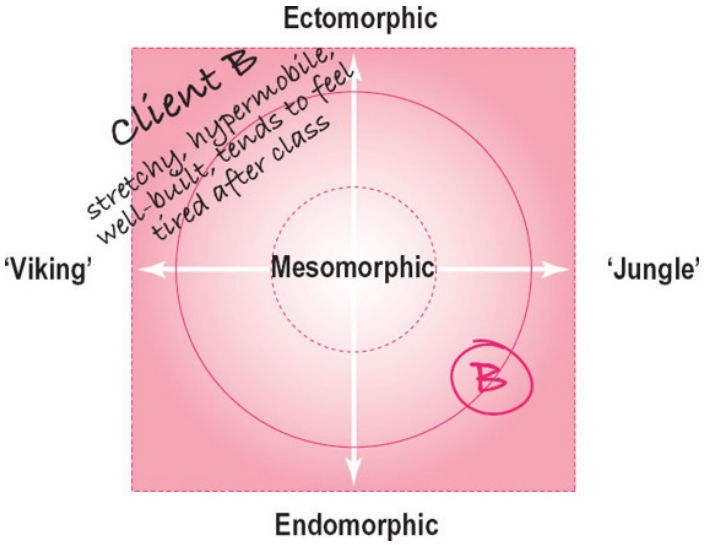


Figure 13.3
Example B.

Towards the centre: strength and speed. More containment than stretch may be optimal.

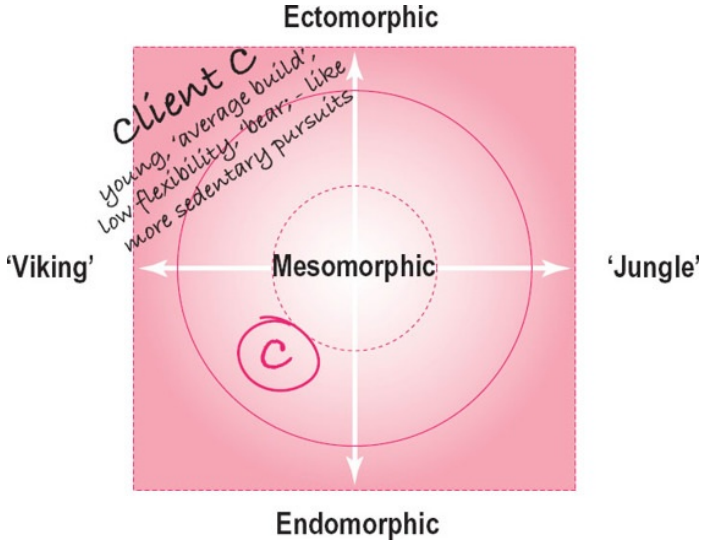


Figure 13.4
Example C.

Example C (Fig. 13.4): early 20s, not very flexible or bendy, good strong build, neither petite nor tough. Preference for sedentary pursuits, prefers to "chill out". Think "bear"-like lope and very calm. So laid back it comes across as indifference. Prefers the sofa to the mat but wants to be more agile and organised, wants flexibility.
Towards the centre: stretch and faster practice. Speed and agility over strength.

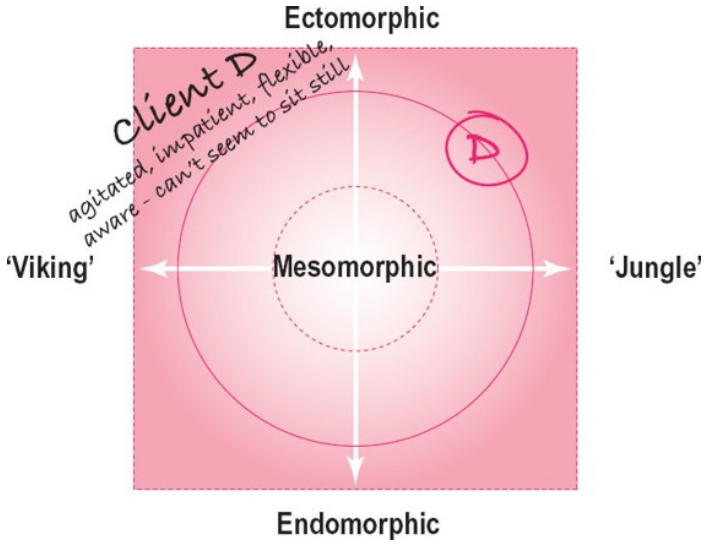


Figure 13.5
Example D.

Example D (Fig. 13.5): fast moving type, think squirrel, quite agitated. Thin and reasonably flexible (not hypermobile but does "hang off the knees" in forward bend) but cannot sit still. Wants to do yoga to relax and build strength. Enjoys the stretches, does them easily, but does not wait to experience or assimilate. Seeks more strength than further length.
Towards the centre: strength, stillness optimal. Meditation and strong practice.

This is not meant to be complicated. It is designed for ease of use and improved congruency, in terms of practice, and recognising fascial typing as a component in choosing ideal types of practice. Both yoga practice styles and yogis / yoginis can be usefully plotted on this soft graph. To start with they are simply placed in terms of the *x* and *y*-axes. To foster elastic integrity, they are invited towards the opposite tendency via the centre.

The Instinctive Aspect

Having developed a sense for these general quadrants and positions, and where people "sit" at any given time in the squares, you then have to hone the instinct for where they are relative to where they want to be. If we have the goal of optimal balance and variability, then we move in a general direction towards *their opposite* quadrant via the middle. This is done gradually over time. If the collagen matrix takes 12–24 months to change, the purpose is to gradually accumulate a suitable loading pattern in a suitable direction *for the person in question*. It might mean choosing a different type of yoga entirely.

If someone is in an extreme combination, they will land in a square, outside the main (dotted) circle. The first task is bring them inside the main circle at least. It takes time and practice to establish that first phase. The key thing is that it is unique to everyone and you are working with that individuality. Very small steps look like progress relative to the individual. If the participant is in their 80s and trying yoga for the first time, it is not necessarily the yoga form that will inspire them. Progress in small degrees that improves *their* mobility and balance will be relative to their ability.

To make progress, we seek to move from within the outer ring, into the centre circle. For those people that find the centre point, the task is then to expand out from it, to improve range and possibility in all types of physical expression and movement. They gradually move in the opposite direction to their tendency, establishing balance and elasticity. Much like life itself, it is a game in which there is always something for us to work towards, both so we can play it and so we can expand what we did before.

Archetypal Movement Patterns

Clearly, an Olympic shot putter does not want to live at the centre; it is not optimal for them. They want to be in the Viking side of the *x*-axis and free to move with strength. However, they may gain more power in their overall fascial matrix from occasionally practising at working towards the centre to optimise their flexibility and glide in the fascial architecture. Just a little. Yoga that focuses on power and improves strength, speed and flexibility might be ideal for them occasionally. However much they might long to be an Olympic gymnast on the balance beam, it is archetypally beyond their scope.

If you have a student who comes in to your class, clearly built as a mesomorphic type but soft and flexible relative to the Viking, although not wiry, they will settle somewhere along the *x*-axis right of centre. If they have a tendency to be nervously oriented, they will be above that horizontal line.

The value of this chart is that you look towards the centre. If you need to go up the *x*-axis, you are seeking more movement and possibly speed. If you need to go *down* it to get toward the centre you are seeking more relaxation and stillness and the value of slower, more deliberate and contained movements.

If, to get to the centre you need to go right on the *y*-axis, you are seeking more flexibility and length. If you need to go left then it is more containment and strength that will optimise balanced tone in the biotensegrity (or elastic integrity) of your overall form.

The point (and the value of this chart in terms of overall fascial awareness) is that giving someone who is hypermobile and tired (example B) a session of long, slow, stretchy movements might not optimise their tissue in the way that a faster and more powerful practice will. It may take time for them to be able to fully participate in a flowing or strengthening class (e.g. Vinyasa Flow or Ashtanga or Power Yoga), but the value might become clear in a few weeks of gradually strengthening their tissues by moving them *towards* (not to) a stronger and possibly faster-paced practice.

If, on the other hand, you have a student who is very strong, Viking-like and naturally loves strength and

conditioning training, for example (example A), they might not need any more of that kind of training. The beauty of yoga is its versatility. This person might find huge benefit in the occasional slower, stretch-based class that might have exhausted our previous client.

A recovering "sofa slouch", or someone with a tendency to a more sedentary life-style or who is recuperating from injury (example C) will benefit first and foremost from simply moving (upward along the *x*-axis) and keeping up some kind of momentum. For them a shift from sedentary to any degree of regular movement will occur as a big change. If they are a senior participant, that might be in very small and appropriate increments. The point is the *direction towards* which their practice is headed will be up the *x*-axis and angled towards the dotted centre circle, rather than across the lateral coordinate they start on.

Dose and degree of any (movement) "medicine" has to be grounded in common sense and softly implemented. The effect accumulates. Schleip recommends we have the approach of a "Bamboo Gardener" as the tissue changes over 6–24 months, while the fascial architecture responds fully to optimal loading patterns.[4] This tissue responds cumulatively over time. It resists fast and forceful sudden movement unless it is trained for it. It is designed to resist, in order to prevent injury. This is one reason why warming up and cooling down, or "priming the tissues", is so essential to prevent soft tissue injury (Ch. 7).

At the top of the chart is the staccato-style, fast burning character (example D) for whom rest is the bottom of their list. They may be very strong if they have channelled their energy into training (place them left of centre). They could also tend to be of a softer architecture and hold extraneous tension awkwardly in the body, but the tissue tone or texture does not match the inner taughtness. (In that case they would be right of centre.) It is an interesting combination.

Yogic Gunas

The principles of preservation, creation and transformation can be related to mesomorphic symbolism. Think of the hungry caterpillar, active, animated and driven to seek nourishment with urgency to preserve the species and progress towards freedom. It spins a thread towards the opposite state. At the opposite end of the scale, the next stage is one of darkness and inactivity, bound by a cocoon, a state of being retained and still. The result of these opposing forces combined is the emergence of the butterfly: able to walk on the ground, but also able to fly and express transformation. The butterfly lays the eggs that are the next generation, symbolic of the united forces of creation. It is important to recognise that all three forces are present in all three gunas or tendencies. Like a tension– compression system, they all reinforce each other in honour of balance, order and clarity. A point in time marked by the cycle of creation: metamorphosis on every scale.

This chart can deepen in relevance to contemporary yoga styles, by incorporating the ancient wisdom of the yogic trigunas. These are three tendencies that correlate to the ectomorphic, endomorphic and mesomorphic attributes on the vertical axis. The three gunas could be described as rajasic, satvic and tamasic *traits*. A guna literally refers to a thread in the sense of a natural propensity or a tendency. They are used in Ayurvedic medicine and as such are not entirely unrelated to the "humours" of Hippocrates (Ch. 2).

Translation from Sanskrit, which is a symbolic language, is much more subtle than the literal meanings we might try to ascribe. However, in this sense it is actually very useful here. We begin to find confluence between the manner of applying anatomy to understanding fascial form and yoga complementing each other rather than conflicting. They do not represent states and actions, but rather tendencies and innate preferences.

Innate to understanding the gunas, is the respect for the theme throughout this work of balance between

opposing forces, united to form a third state. Satvic means “being”, the essence of the pure “is-ness”, so it might be seen as the neutral centre. The gunas also encapsulate force and anti-force, both of which are needed to animate change or transformation as a balanced expression (Table 13.1). Thus one is active and dynamic, one is more passive and still (associated with holding back) and balance is found by uniting them. It is precisely how biotensegrity works.

Table 13.1

Guna	Related to	Tendencies or traits	Principle
Rajasic	Ectomorphic	Active, animated, dynamic, seeking change, new light	Preservation
Satvic	Mesomorphic	Balance, order and clarity	Creation
Tamasic	Endomorphic	Inactive, dark, boundaried	Transformation

Balance

When there is congruency in someone’s movement loading, a balance of strength, length and tensional resilience, their tissues have natural elasticity. It can be synonymous with vitality, which is why such emphasis is placed upon it. A participant can feel where it is missing and you can see it. It is not right or wrong, it can just be more or less optimal for their comfort and ability to do yoga to the extent they might like to. When the balance of practice is right *for them* you see it reflected in their architecture. It is different in everyone and it usually works with containment as well as flexibility. It is the kind of poise and grace of movement that comes from being relaxed and at ease but free to run, if required, or ready to rest and be still in comfort. The principles of elasticity and biotensegrity (as an expression of optimal tensional integrity) are reflected here. At its simplest, it is expressed as the ability to do a pose and a counter-pose with balanced ability to reach and return in both directions. This builds a congruent loading pattern and magic happens.

What Next?

Once people are placed on the chart, ways of doing yoga get overlaid to direct the style of practice or the overall emphasis. They can choose which pathway to take, via strength and stiffening work or stretch and softening work. What seems most suitable from your observation and their self-sensing awareness? It becomes clearer from recognising their movement archetypes. We can begin to put two charts together. One denotes the participant and the other guides the practitioner (Fig. 13.6).

This interpretive art also includes the teaching experience, the style of yoga and the length of time you have known the individual. Another example to consider is the theoretical case of the finely boned gymnast who won medals for Olympic ribbon dances deciding to go for a weight-lifting medal. It is archetypally incongruent. This whole approach lives inside the variations either side of centre. The extremes are more obvious. Our gymnast can move away from stretchiness to stiffness and strength but even with the best teacher in the world, the gold medal for lifting weights might remain elusive.

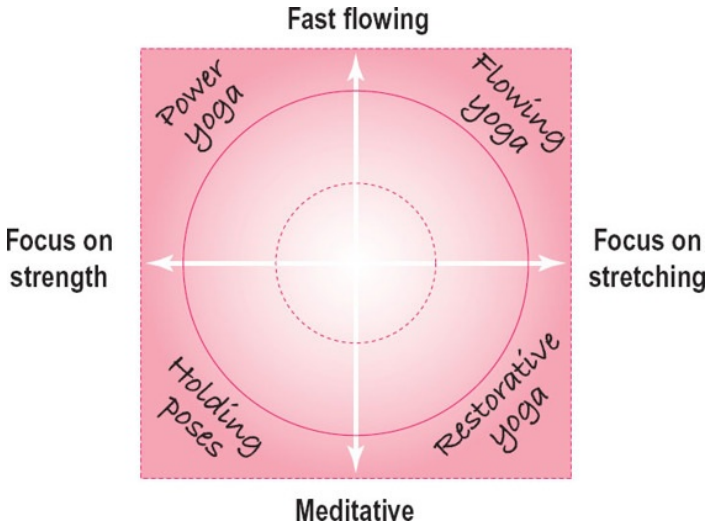


Figure 13.6

This is not a definitive chart of types of yoga, as many teachers interpret different combinations within a style. It is soft guide for interpretation, a framework to provide a context for recognising fascial body types.

The Intuitive Aspect

Once people are placed on the chart, you can use other tools that might be more specific, such as Body Reading (Ch. 12), for example, or any other assessment tool that applies in manual practice. For a movement class, these are swiftly seen and sensed at speed when working to full advantage.

There are three major rules to follow to become adept at Posture Profiling. They are: *observation, observation and observation!*

You will learn to see subtlety and to interpret soft expressions of congruency and balance, reading movement signatures in individual writing styles. You will even accumulate or refine the ability to anticipate imbalance. You can sense when you have taken someone beyond their comfort zone to their benefit, or if they need to hold back from their limits to become more contained, centred, or stronger. These are the skills of top choreographers and teachers in elite dance, athletics and sports fields as well as in yoga. Experienced coaches recognise what is missing and call for something beyond what the individual *thinks* they can do. Not too much, in case they injure themselves, not so little that it makes no difference. Over time, optimal balance becomes available.

Once you learn to see many different bodies moving, observing as many classes as you can get yourself into, you will begin to build this intuitive sense. It is worth your time on every level because the reward is higher degrees of sensory refinement in your own Posture Profiling, assessment and adjustment skills (Ch. 14). You will match a profile to a pose and a way of doing it that speaks almost instantly to the individual. It is transformative knowledge and it can literally alchemise the participant. Time and again I have watched students eyeing the mat suspiciously and then relaxed and grinning as they find the posture for themselves. It grows almost on its own. They “flower” into it, from their own natural way.

Here are some great ways to craft this skill and develop mastery in it. Observe people in these environments. As you travel, you will notice cultural fascial archetypes, including tendencies or styles of movement:

On holiday: pool, beach or hotel.
At the gym: weight training, cardiovascular, endurance and so on.
Classes: in all kinds of movement rates and styles.
The shopping centre: notice moods and speeds of movement.

The park, where you may start to watch the movement signatures of people of all ages (Not to mention their dogs!).

Developing your Intuition

It has been my privilege to train with Caroline Myss for several years and find deep confirmation in the idea that intuition is not the gift of a chosen few but rather a skill that we can all practice and become more skilled at recognising. We have to learn to distinguish the voice of intuition from the voice of reason. The two have very different tones and qualities (Ch. 19, Part 3).

With practice, you can fine-tune your inner listening and distinguish intellect from instinct and intuition. Yoga is designed to develop these skill-sets naturally, since we spend time in meditation becoming present to being present. It is the most wonderful way of learning to create a blank page or a kind of inner silence, upon and in which fine detail can be seen, heard and recognised accurately. It usually arrives in swift symbols, very different in nature to reasoned argument and logic. It becomes possible to get out of your own way and generate a neutral observation platform upon which someone can be clearly seen and recognised. They are not so much judged as observed. This is a field of grace, not government.

The keynote distinction of the intuitive aspect of Posture Profiling is its "instantaneous" fleeting nature. Myss refers to "first hit, best hit". It is invariably faster than the rationale that follows it. That rationale comes from the intellect and uses the chart. It is the confirmation. You will be surprised how many times you place someone very accurately if you simply "sense" the map and "place your pin" intuitively.

Seeing Skills for Living Forms

Let us consider a very clear aesthetic example of this, which makes some sense of why it works and why it is worth persevering with the practice.

"The first challenge in figure drawing is to see the whole figure as one shape. Our prior knowledge of the figure as an individual person encourages us to see it as a collection of various parts, whose relative importance is skewed by experience. We might be particularly interested in eyes, but not in elbows and if we draw in this way then the resulting drawings will never be cohesive."[5]

The text goes on to teach you to see an "assembly of forms" as overall shapes, which is essential. Posture Profiling is a kind of visual sketching and follows similar rules of seeing, in wholeness, the unified form. Although it is in honour of the individual, paradoxically, it is impersonal. That is in the sense that an archetype is considered *transpersonal*. Form and morphology are transpersonal and these "inspirational sketches" are designed to be exactly that, even though they support the individuality of each class participant.

Practising Posture Profiling

Ask yourself a series of questions and practise by going to any one of the places mentioned above and "pinning" randomly chosen people on the chart. Stay detached and work at speed. The essence of developing your intuitive impression is to work fast and observe yourself doing it. Suspend your

judgement of yourself (the observer) and those you are observing. It is simply to practise placing many people on the chart for the fun of it.

A useful list of questions might be:

- What is your instant impression of where this person sits or lives on the chart?
- What made you choose that particular aspect?
- If they were in a line-up applying for an Olympic team, would it be weightlifting (strength), gymnastics (flexibility), athletics (speed), a general sport (needing all the above, such as swimming, diving, field events), cycling (stillness and endurance) or would they prefer to watch it from the sofa and not participate? (This is designed to place them relative to the extremes on the chart.)
- Could they do all or any of the above?
- Make up your own questions.

This is for a soft impressionist sense of where that individual might be relative to the middle. Just playing this observational game will improve your skill in making more refined distinctions. It is as much about training you, the observer, as being accurate about those you observe. That will come with time, trial and error in accumulated strokes of experience.

Notes

1. Victor Hugo, French romantic poet, novelist and dramatist 1802-1885.
2. KMI (Kinesis Myofascial Integration) School; http://www.anatomytrains.com/at/kmi/.
3. Robert Schleip, various presentations on Fascial Fitness and Fascianating Fascia.
4. Ibid.
5. John Raynes and Jody Raynes, *How to Draw the Human Figure: A Complete Guide*, Parragon Publishing, Bath, 2000.

CHAPTER
14

Adjustment of the Fascial Form

"The heart of healing lies in our ability to listen, to perceive, more than in our application of technique … interventions are a conversation between two intelligent systems."[1]

Tom Myers

Fascia research is shifting many of the parameters by which we measure and account for change in the body. Its impact on manual therapy has been considerable, and although movement teachers are not generally classified as manual therapists, adjustment in yoga is an area in which these two fields can overlap powerfully. It was over a century ago that Andrew Taylor Still, the founder of osteopathy, wrote:

"the soul of man with all the streams of pure living water seems to dwell in the fascia of his body. When you deal with the fascia, you deal and do business with the branch offices of the brain, and under the general corporation law, the same as the brain itself, and why not treat it with the same degree of respect?"[2]

Imaginary Shapes

Chapter 7 describes the standard classical biomechanical task of working from an imaginary axis, viewed as a straight pole or vertical line down the middle of the body that acts as a reference point for the sagittal, coronal and transverse planes. What happens if instead of imagining a straight pole we start imagining a tube enclosing the participant we view? Let us call it the membrane between us and the "kinesphere" surrounding us. They blend beautifully into what we see. We shall refer to what is inside the kinesphere as the "innersphere". This changed viewpoint expands the postures from two dimensions into the three dimensions they actually occur in. It can provide access to a completely different understanding of adjustment.

What is a Kinesphere?

Sallie Brook is a graduate of anatomy science and the Laban school of dance. At the time of writing Sallie worked in the anatomy laboratory at King's College London. Her fascination with the fascial matrix led her to join my workshops and "kinesphere" was her word. It is a brilliant description of something that we can distinguish but not necessarily define in literal terms.

In the yoga classroom, the placing of the hands in prayer position, with a small bow (denoting respect)

and the word “Namaste” is a salutation, meaning “the divine in me salutes the divine in you”. It denotes a Grace Field, a silent shape around each of us, which we naturally sense. We also know immediately if it is ignored. Even if they are subtle, the kinespheric language of proprioception is full of signs and codes that we instinctively understand. We know when those codes are broken too. We “know” when someone is just too close, or just too far away, so that their adjustment feels like a placatory tap rather than an aware conversation between intelligent systems, as the quotation from Tom Myers at the beginning of the chapter suggests is desirable. It is “body language” by any other name, but this is more specifically about the “shape” of that language. There is no question as to its presence when we become present to it. Once we relinquish the biomechanical language of levers and recognise the expression of our wholeness in kinespheres, we become eager to articulate the subtle distinctions of that signalling. Nowhere does this apply more than in appropriate, proprioceptive adjustment.

Proprioceptive Awareness

It is this field that each of us animates, that fosters self-containment and self-regulation, once we recognise its value and include it in our adjustment repertoire. It is key to a self-practice that is fun, safe and appropriately accumulated. We can improve, we can grow, and we can go beyond our own limits. At the same time, we are invited as teachers to feed back to any participant where their own kinesphere surrounds them. They can then become more refined and sensitive to safe practice and gradual accumulation of postural range in the various asana practices. Giving participants this kind of acuity is extremely valuable on a number of levels, not least of which is self-regulation and sensory respect for their own boundaries. If we imagine ourselves as having a kind of “energetic bank account”, it is an advantage to us if we do not overspend or over-stretch our vitality and tempt injury while we are still expanding and deepening our investment.

Exploring this idea of an innersphere and kinesphere from which to see the postures gave rise the to the images that were taken and developed inside tubes of fabric, as seen in the photographs used for the opening spreads of Parts 1, 2 and 3.[3] It is immediately obvious that these tensional surrounding “skins” provided sensory feedback to the whole body. The models Katie and Samira reported a deep sense of confidence and responsive awareness from working within them (see also Figs 14.1 and 14.2).

A New Perspective

Three very significant points have to be made here. In these terms, the moment we touch someone, the two organisms combine to become one closed, joined, kinematic chain. This is very important. When you, the practitioner, adjust a participant you abide by the same rules running throughout yoga practice. This is the law of three, in which there are two polarities and a third aspect of their combination. You join to become one enclosed kinesphere: one closed kinematic chain with a larger ground print (Figs 14.3–14.5).

Figures 14.1
(See cover photograph) These tensional surrounding “skins” provided sensory feedback to the whole body and provide a visual metaphor for the tensional network of the inner fascial net.

A pose is not a suit of armour that a yoga participant is obliged to fit. It is a reference for them to express and work towards from within the body. By adding one or two informative links to improve their feedback system (their management of ground reaction force throughout their own matrix), you need very little action.

Two whole intelligent structures are now working together as one, *both speaking the language of the body*. One body does not become disabled while the ability of the other is relied upon 100%. Teacher and student are working at 100% capability plus 100% capability, as one whole information exchange. Just as our parts add up to something greater than the sum thereof, so too can the appropriate combination of two organisms, in mutual respect, bring about unpredictable possibilities and help to transform our practice. It is one way that we might go beyond our beliefs about our personal limitations, to the benefits of renewed confidence.

Figures 14.2

Adjustment becomes a relationship formed with the ground over a larger surface (an extended ground

print) with more tension and compression struts, joined at the point of engagement between teacher and student, practitioner and participant. In practice, this changes a few assumptions about adjustment.

The General Basis

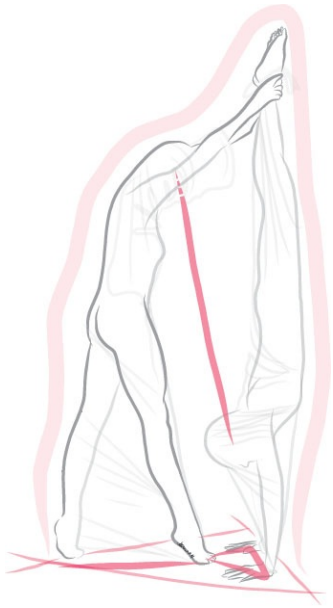


Figure 14.3
An imaginary kinesphere allows a perspective inclusive of both the adjustor and the adjustee, moving together as one closed kinematic chain.

Adjustment is a major topic in yoga teacher training programmes. Many books on the subject have three common denominators that our enquiry into fascia may shift or expand and possibly influence to some degree. The first of these is the emphasis on the **posture**, or asana, i.e. asana-centric; the second is **assistance**; and the third is **placement**.

Posture being adjusted Authors readily acknowledge that the participants in a yoga class are all different. Nevertheless, the key or purpose of an adjustment is usually based on the ideal shape of the pose being activated. Adjustment instructions are based upon the ultimate aim of the particular asana and the correct form it predisposes (pun intended).

The second of these is **assistance**.

Assisting the participant If someone in the class is aiming to complete a pose, to whatever level is appropriate for that class (beginners, intermediate, advanced, etc.), the idea is to provide aid so they can reach or achieve the posture by helping them to extend or (and this the word most commonly used) "stretch" sufficiently.

The third of these is **placement**.

Correct placement for adjusting or assisting the pose Where do you place your hands or body in order to achieve the above, i.e. help the participant stretch or reach into the posture, the correct form, that they are seeking to emulate? Most books suggest the most appropriate positioning of the adjusting hands (or feet) in order to achieve the pose.

These are all valuable assets to teaching and key components of adjusting. If someone is in a Warrior Pose, for example, and their knee is out of alignment, then a small adjustment of their knee can transform their ability to interact with the pose and find their optimum balance. However, in a different context, your hand upon their standing foot or spine might animate a self-corrective alignment response, so the participant *naturally* draws the knee into a more appropriate place.

Figure 14.4
The ground print in this image includes four legs – the sum of the overall shapes is a part of the adjustment process.

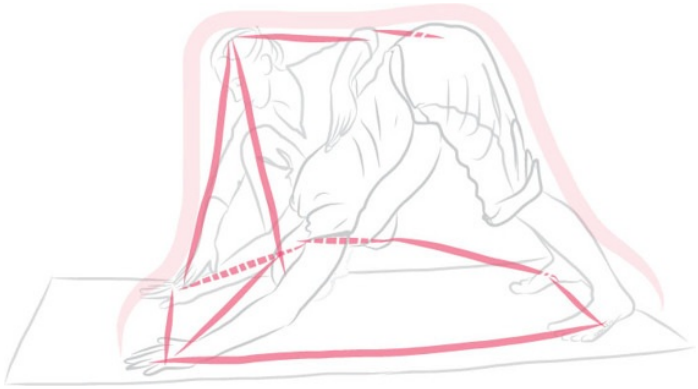


Figure 14.5
The ground print in this image includes the whole body balance of the facilitator as well as the four limbs of the participant. For a moment they form one architectural "body".

The Adjustor

Touch is an essential means of communication throughout the animal kingdom, including among humans. Human beings do not necessarily suffer or die with the onset of blindness, or deafness, or an inability to smell or taste. However, lack of appropriate touch does diminish them. Understanding the fascial network as the keystone of what is possibly our most important sensing faculty, by means of which we differentiate life's rich landscape and navigate our way through it, is essential. The importance lies in upgrading the quality and understanding of this paramount aspect of yoga training.

When you join a class, you seek to learn something you do not know from someone who does know. Indeed, what is the point of going to a class, if the teacher does not assist and adjust? You may as well do it at home alone, with a book or a DVD. Touch skills are an essential part of teaching a physical movement form, if only because they occur in the same kinaesthetic language as the movements. Nevertheless, adjustment is a domain in which the power differential comes in to play and this is a hot topic for debate in manual therapy.

How can we serve our students, adjust appropriately, yet honour the self-regulatory advantages of a take-home wisdom for their personal practice? As practitioner, you can provide necessary feedback. How can that best serve the participant so they retain it and alchemise it for their own benefit?

Here too, we need new distinctions and new definitions. Understanding fascia and tensional integrity, given its role in sensory refinement, calls for new views. The authentic exploration of structural balance can bring us an "upgrade" on the journey towards awareness and self-confident self-regulation. Is there an optimum way to consider this, *between two intelligent systems*?

Dose, degree and direction

The fascial matrix, and its highly tuned role in proprioception, shifts the foundations of traditional principles, so we need to change from a basis of biomechanical adjustment (based on correct form, angles of joints and so on) to something that can facilitate self-regulation. I like to call it "biomotional" interaction, which is based on respect for self-sensory "nous".

If the fascia is the largest sensory organ of the body, the communication network from skin to brain and back, then adjustment raises some interesting questions.

- How subtle a touch is needed?
- Where should I touch, if the fascia is everywhere?
- Are there key places that make a difference to every pose?
- Are there fundamental principles that we should adhere to?
- What is the point of adjustment; should we intervene at all?
- If not posture-centric, then what guide or grid makes sense of poses?
- Does fascia affect the biomechanics of adjustment?

Finding some Coordinates

Robert Schleip's two-part series on "Fascial plasticity", published in the *Journal of Bodywork and Movement Therapies*,[4] answered some of the many questions manual therapists have about what exactly changes under their hands, when they effectively adjust their clients.

Schleip recommends an attitudinal shift that is clearly beneficial to both manual and movement practitioners. It errs towards fostering self-regulation as the purpose of any intervention, rather than creating dependency upon the teacher. (Table 14.1).

Table. 14.1

Classical Approach	Contemporary Approach
Teacher as guru	Teacher as guardian
Posture as perfect ideal or result	Postures as potential idea or reference
Separate definition of structure and function upon which form is imposed	Integrated distinctions of structure and function as united expressions of form
Pain as a signal of the nervous system	Refined sensory awareness as a pre-emptive guide to prevent pain signals
Adjustment seen as authoritative intervention	Adjustment seen as respectful invitation
Local directive of correct positioning	Subtle implication of congruent self-placement
Teacher as master of form	Teacher as midwife in formation
Leading hands	Listening hands
Performance induction	Pre-formance intention/preparation
Imposed correction	Exposed congruency
Body as linear, mechanical structure, governed by laws of linear relationships	Body as a self-assembled, self-organising non-linear biologic system of conscious awareness, attention and vitality
Competitive and striving attitude, toward goal-oriented perfection	Presence of inner stillness, enquiry and curiosity
Local view of joint angles in gravity	Global view of whole-body response as contained ground reaction force
Guidance to maximise stretch and reach goal of pose	Restoring sense of centre and self-containment to unfold into pose
Pose at all costs	Poise relative to postural limit
Controlled breathing to manage and present the posture	Freedom to breathe and express the posture appropriately
Maximised reach	Elastic integrity

Direct proximal adjustment	Subtle distal implication
Macro-movement	Micro-movement
External correction	Internal containment
Conversion from weak to strong forms	Conversation in balancing form
Assertive or zealous encouragement to achieve the pose	Gracious invitation to touch and move beyond limits towards the pose
Demand the best	Reveal the best
Achieve the asana	Accumulate the ability to explore asana

Geodesic Geometry

> *"Nature always finds the most efficient way of doing things, and that includes geodesic geometry – the connection of points over the shortest distance, and the closest packing of objects together. Geodesic geometry provides the most economic utilization of space and materials and confers strength; it is at the heart of tensegrity with many easily-recognized examples in biology. In two-dimensions a circle encloses the largest area within the minimum boundary which makes it a minimal-energy structure."*[5]

If we imagine a "kinesphere", it is a changing outline around a participant, in any pose (i.e. changing from moment to moment, just as we do). It can incorporate all the so-called Anatomy Trains, a collective term including the entire "immediately-outside-and-around-them" layer. They are inside it, forming a tension–compression system that reflects the internal patterns that we cannot see. If we tension (stiffen or squeeze) the whole shape and then expand (stretch) to our own sense of our elastic limit in a subtle, pulsing movement, we can begin to animate a global feeling of overall balance-and-breathing. The longitudinal lines of the Anatomy Trains contour that overall balance; indeed Myers describes them as the geodesics of the architecture (see Ch. 12). Adjustment has more to do with choosing the optimum of a multitude of possibilities from within than placing the participant in a pose. This is an intuitive skill that develops with practice.

Subtle Touch Skills

There are many working possibilities from this point of view of adjustment. It is possible to use the Anatomy Trains examples in Chapter 12 to encourage balance between the bands (lines) as shown in detail in that chapter. This ensures that a posture is not performed for one side at the expense of the other. Once again, it is the material of many training hours; however, as a useful overview we will highlight the main themes (see Table 14.2).

> New word: nous
> "Nous" is not a new word but an old one. It comes from the philosophers of ancient Greece, where the principles of form and architecture and Sacred Geometry arose. Noesis is a word over which there is much discussion but it points towards "knowing" as a sense of awareness. Using your "nous" (pronounced in British English like "mouse"), in common parlance, refers to using your common sense: doing what makes sense rather than what you are told or what is easiest, without thinking. Another derivative of noesis is gnosis: the deep knowing of intuitive guidance. It refers to something that sometimes inspires us beyond our intellectual knowledge and leads us even if we "don't know why". It is a personal self-sensing "knowing" that could have a scientist drawn to a PhD project or an artist inspired to do a painting. It does not discriminate.

Adjustment invites the most subtle of touch skills. When we realise that we are touching an intelligent internal net (with an intelligent internal net), then any point will effectively communicate throughout *and*

between the system(s). Adjustment can harm or heal, impose or invite; the hands are used more as magnets than as hammers. Fingertips are eloquent tools and, depending to some extent upon the participant, suitable guidance might follow a “less is more” direction. Firm quiet hands give clear simple messages; kinaesthetic comments with signals designed to encourage self-organisation.

Inviting containment, steadiness and whole body participation from the ground to the extremes of the pose is a comment on integration rather than goal-seeking. The body usually loves finding balance within a smaller range, which can be gradually expanded.

Table. 14.2

Adjustment Theme	Overview
Ground control	Adjustment is based upon the ground print of the participant, using the hands to deepen their engagement with it
Spine design	Adjustment is focused on giving subtle feedback to the freedom of the primary and super curves of the spine
Counterbalance	Adjustment is placed in the opposite plane and direction to the movement
Expansive	Adjustment is based on a parallel movement that supports distal to the ground but expands the ground print (base of support) by replicating or increasing it
Restorative	Adjustment is minimal, but gives the limb back to the spine or supports the asana by resistance, the opposite of encouraging stretch. It restores the centre rather than encouraging movement away from it
Anatomy Trains in yoga	This is developed based upon the Anatomy Trains principles by Tom Myers: see Chapter 12 for how to work with them in motion to express volume. The adjustment is based on balancing or opposing bands (lines), encouraging the deep inner container to respond and hold its shape. See text for variety of possibilities

Ground Control

What is the participants’ relationship to the ground? By simply touching the part of their body engaging with the ground, you can facilitate a deepening sense of anchoring to the earth. (Fig. 14.6, Fig 14.7) Note the teacher is included in the new kinesphere they form together, so the emphasis goes beyond the local site of the touch cue to the whole ground print they form as combined.

Figures 14.6 and 14.7

The feet and the hands are all engaged with the ground in this pose. By emphasising that engagement with subtle touch, the posture is anchored and Alex can self-sense to naturally contain his fulfilment of the pose, down into and away from the ground, simultaneously.

Spine Design

Spine design is the spinal position pulled into a primary curve, or can the participant be brought into a less extreme version of the pose, that facilitates (or does not disturb) the secondary curves, or the ability to wave subtly through them, from toes to nose? (Can they breathe easily?) Hand placement is on the spine to give feedback, but the hand is used more like a magnet.

The purpose is to ensure participants are free to respond to the breath (Fig. 14.8). If they are pulled out of shape, more containment and less “pull” invites the limbs back to the spine. Stretching is the opposite requirement. If a student is unable to do this pose at first (easily seen in a forced primary curve or an unnatural breathing pattern) then, by these methods, it would be considered beyond that person on that occasion. A modification that supported their ability to honour the curves and breath (such as a chair, for example, to raise the hands above the ground) would be used and gradually lowered, to develop the pose over time without compromise to the spine (see Ch. 13, Posture Profiling).

Counterbalance

Counterbalance is the possibility of providing feedback to the opposite aspect of the movement. If the participant is working towards a back bend, an upward, extending motion, then feedback from a counterbalancing hand implying a downward flexion can provide the most useful reference. This can be applied from one side to the other, or as an impulse to rotation and counter-rotation. It can also be done by counterbalancing the whole posture. (Fig 14.9)

Figure 14.8

Alex is completely capable of getting his heels to the floor. However, tensioning through the back bands (see Ch. 12; Superficial Back Line in Tom Myers' Anatomy Trains) allows him to feel his way between stiffness and stretch, a scale along which he can self-adjust to honour his spinal curves. The adjusting hand enhances his sense of spinal freedom to breathe and wave through the natural spinal curves. The asana is dynamic, not static. The hand rests (on the spine at the back of the breath) to provide feedback. There is no pressure applied at all.

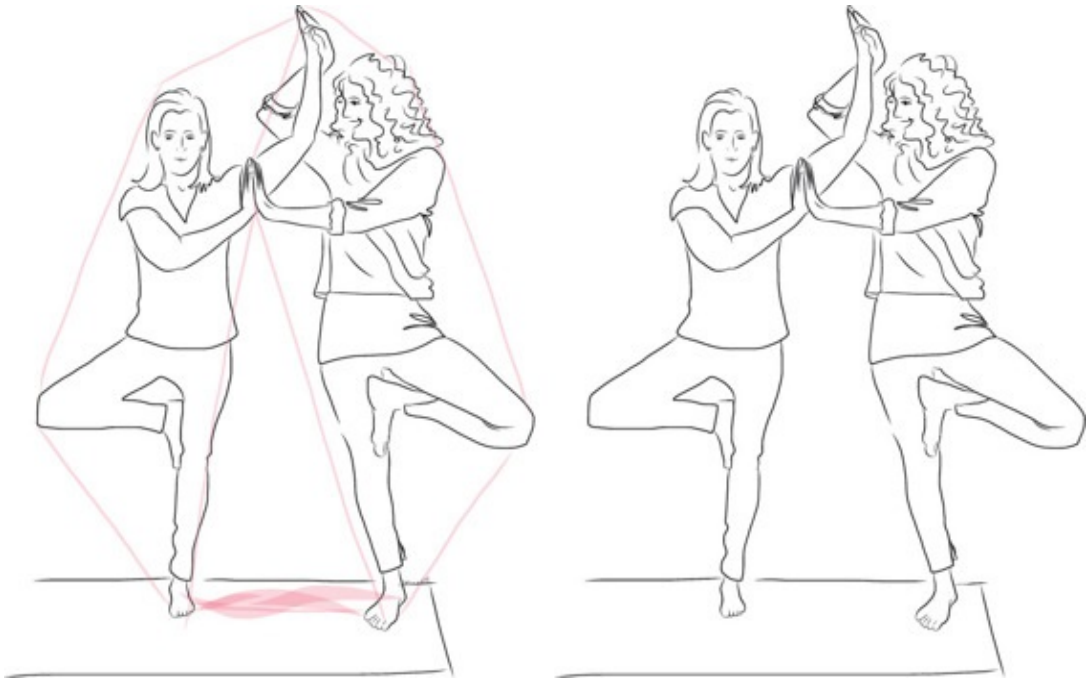


Figure 14.9

The facilitator, or teacher (right) is mirroring the pose. The adjustment provides the counterbalancing force for the participant to counter-move.

Expansive

This is where you provide a wider, broader or steadier base of support for the participant. You expand their ground print by standing relatively close to them but touching distal to the base of support that you emphasise. In a balancing pose, for example, you might provide a wide base and offer subtle support or feedback at the extreme of the balance. This may be standing aligned with them to the side (as if to expand their base of support widthways), while you are holding the extremities, to reassure their balance. Or you

can stand in front of or behind them, as if to enhance the length of their ground print (base of support), as, for example, in Figure 14.10.

Restorative

This is where you support a pose with minimal intervention, for the participant to use if they need to. An example of this would be standing beside someone in Warrior Pose and suggesting a lift to an arm or an alignment of the front knee, for instance, with the slightest of touches that the participant can use for resistance should they need to. (The lightest touch, however, creates one larger closed kinematic chain, at the point of contact, out of both bodies.) The invitation here is to limit the *range* and provide feedback. The other important feature of this kind of adjustment is the possibility of restoring a limb toward the spine, rather than stretching it away. It allows an exceptional sense of release to a straining participant. The invitation is to do less and breathe fully, exploring the pose by feeding back to the centre, rather than reaching from it, to their limits. The participant is invited to explore the in-between and develop their own sense of those limits, to eventually expand them in a very congruent and appropriate way for *them* (Fig. 14.11).

Figure 14.10

In this pose, the adjustment is *expansive* in the sense that it creates a broader ground print and supportive base – as if the participant has close access to four feet on the ground. The guiding hands are at the extremity of the upper hand and the apex of the shape made by the legs; as subtle support. The participant is not being pulled into shape, rather guided to find it.

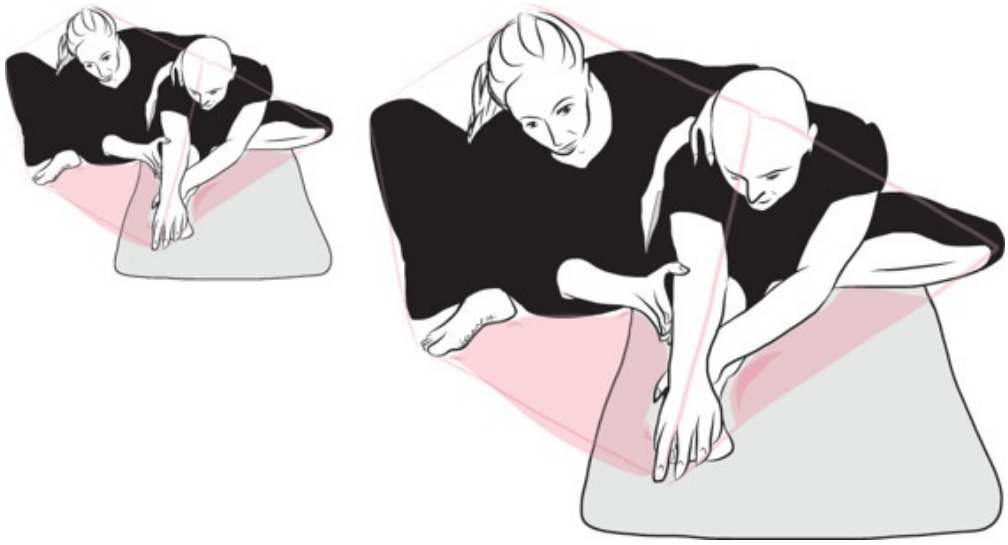


Figure 14.11

In this restorative approach, the arm is in fact being guided by the facilitator *back towards the spine*. Her hands are drawing towards each other, not pulling on the arm to stretch to the foot. (It is extremely difficult to show visually such subtleties of adjustment.) The result of this is that Alex can remain relaxed and fold forward incrementally to find what length comes naturally. It is *given* to the spine, rather than *taken* by pulling or stretching away from it.

Summary

These five adjustment parameters are amongst several that can be used appropriately, according to the pose and the participant. The common denominators of all of them are:

- Your balance and simplicity of position erring towards least intervention.
- Optimal choice or placement of your kinesphere and adjustment cue, for the pose according to balance and breath in both you and the student.
- Optimal self-regulation for the participant with neutral, rather than dominant or over-corrective sensory feedback.
- Self-sensing your own balance, prior to entering the participant's kinesphere.
- Using hands as magnets and as movement cues; sometimes the placement of the hand is almost to draw the tissue away from the direction of the movement, rather than push towards it. Invariably the gesture is without force.

We are fostering more refined understanding and transmission of movement forces, not forced movements. As such the language of adjustment is a softly spoken one and invites self-confidence to the practice.

Anatomy Trains in Yoga Guidelines

If we naturally follow through the idea that each of the lines designated by Anatomy Trains is a continuous line of pull, then their organisation can be usefully used as a more detailed guide. Using the *Anatomy Trains* book as reference for the longitudinal lines (see Ch. 12 for fast guide) we can usefully work with the following three main possibilities:

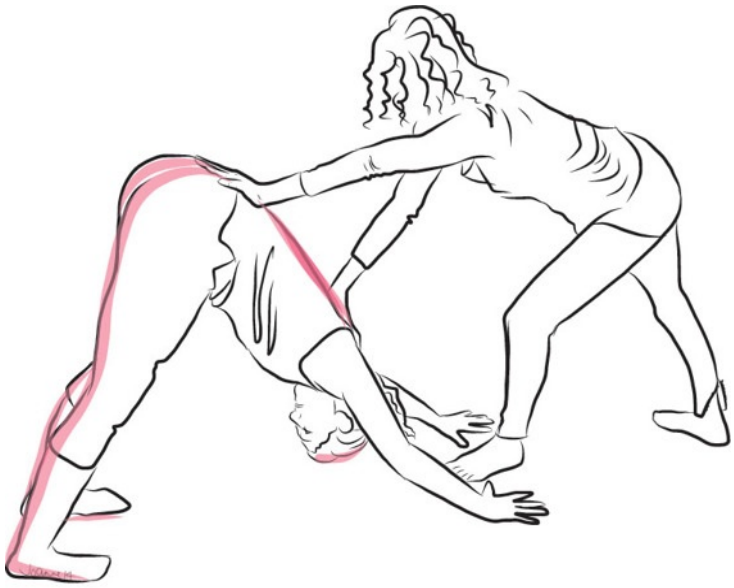


Figure 14.12

Example (1) of using a touch cue to adjust along the myofascial meridian or band being lengthened. In this instance, the facilitator is gently encouraging length in the back band (Myers' Superficial Back Line). As her body and the participant's form one whole shape, then the breath guides the response, via the ground, along that band (see Ch. 12).

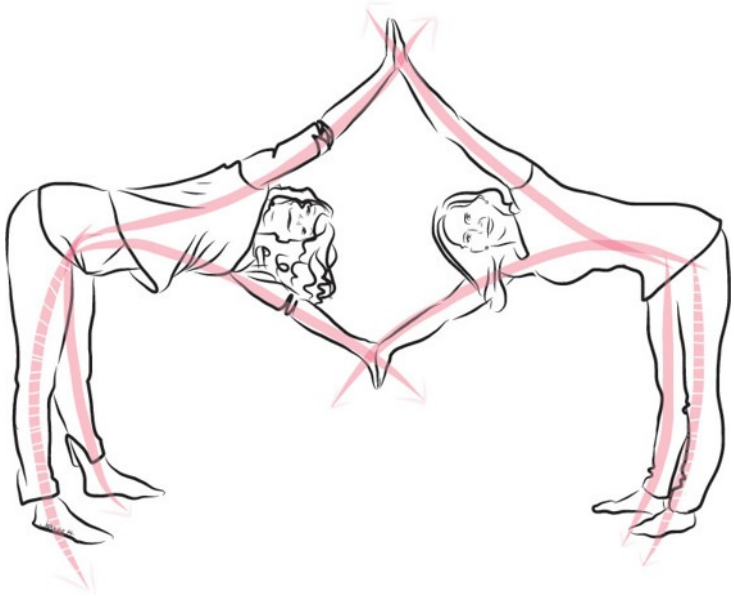


Figure 14.13

Example (2) of using a touch cue to adjust along the myofascial meridian or band being stiffened. In this instance, the facilitator is counterbalancing the stiffening required in the Front Functional Bands (Myers' Functional Lines). As her body and the participant's form one whole shape, then the breath guides the response, via the ground, along that band (see Ch. 12). The focus in a posture such as this, is to "hold" the balance with sufficient structural integrity to do the opposite of stretching and releasing. Although the hands are stretched out, the structure is maintained through appropriate tensioning.

- the Myofascial Meridian or Band being lengthened or stretched
- the Myofascial Meridian or Band being stiffened or squeezed
- both of the above in combination.

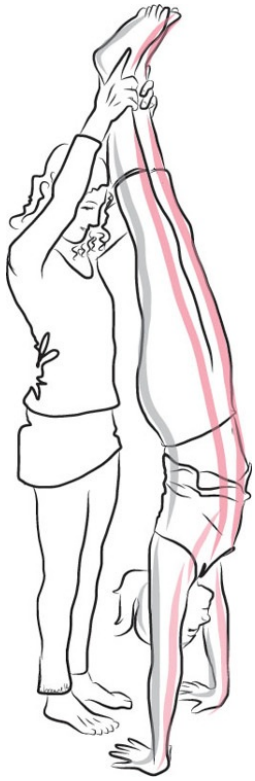


Figure 14.14
Example (3) of using a touch cue to adjust along both (all) of the myofascial meridians or bands being lengthened or stretched – and being tensioned and stiffened – at the same time. In this instance, the facilitator is gently encouraging a suitable combination of stiffness and stretch between the back and front bands. As they form one whole shape, then the breath guides the response, via the ground, between those bands (see Ch. 12).

If the fascia is in continuous communication, then these lines can be used with the basic principles outlined above. You can choose where to work, along a line, as its continuity can effectively allow the participant to respond throughout its length. It is an art and a skill, which can become effective at evoking optimum balance with least intervention (Figs 14.12–14.14).

Adjusting the Breath

There are many ways to "adjust" the breath. My preference is to use three key hand positions, illustrated here. The hands barely touch the body; they make just enough contact to feed back to the participant *the sense* of the movements of breathing. The participant can focus inwardly, to feel the breath *expand* the Deep Container (Myers' Deep Front Line, which is not a line, but very much experienced as a volume in this exercise.) The purpose is wide reaching and beneficial. It allows the student to "fill" their structure and experience the omnidirectional possibilities of breathing a little more fully. There is no force used; rather the hands are like magnets – encouraging all the principles in the table (Table 14.1) and three key "directions of breathing". The positions are shown below (Figs. 14.15 14.17).

The three positions encourage fuller breath in the lower ribs, front-to-back body and upper chest. The student is guided to gently expand the breath, from the breathing innersphere – inside out. (As distinct from activating muscles to force breathing action from the outside-in.)

Figure 14.15

Figure 14.16

Figure 14.17

Adjusting the breath

In Figure 14.15 the practitioner places fingertips on breast bone and spine to assist the sense of breathing them apart (inhale) and together (exhale) with the movement of the rib basket. In Figure 14.16 the practitioner places palms on the lower back ribs to assist the sense of expansion in the back and sides of the body. There is also elasticity and glide between the fascial layers as the “bucket-handle action” of the ribs becomes compliant with the movement of the rib basket. In Figure 14.17 the practitioner places palms on the shoulders to

discourage over-recruitment of shoulders in the upper rib basket and encourage glide of the shoulder blades over it (i.e. with her thumbs lightly placed on the shoulder blades). Bringing the breath into the upper part of the rib basket is encouraged here. (See Ch. 15 for detail.) Please note these exercises are brief and gentle. Forcing the breath can cause distress and stimulate over-breathing. These exercises are kinaesthetic reminders to encourage fuller use of the breathing volume. They can be done in class in pairs with the caveat of wise direction regarding dose and degree.

A Question of Ethics

Adjustment is necessarily part of an interpretive art. It is one of the many skills developed in yoga teaching. It is intimately related to the sensory faculties of the body, profoundly affecting them and affected by them. Effectiveness comes down to many aspects of integrity, whether in training, in teaching or transferring skills, on all levels. In Chapter 9, the sensory nature of all our organs was explored and yoga, given its approach, speaks eloquently in the language of our original heart-centred forming.

The most powerful question I have ever heard with regard to ethical practice around this point is "What is in your heart?". If you are intuitively intelligent enough to understand these movements and their integration, then you can use that same sense to know your own agenda. If it is not to adjust and assist your student to honestly optimise their own yoga practice for them, then what are you doing there? Intentional integrity and tensional integrity are the same.

FAQs

Let us consider the most frequently asked questions in adjustment, referencing the chapter.

How subtle a touch is needed?
We are not forcing movement so much as registering movement forces as an enhanced feedback system. The hands can be used as magnets, or subtle reminders of the ground, the centre, the spine or breath, etc. The least force can mean the most effective response in many cases.

Where should I touch, if the fascia is everywhere?
Using the categories of ground control, spine design, counterbalance, expansive and restorative, the purpose of a specific adjustment is toward optimum congruency for that participant in that pose and that point in time. As the fascia is everywhere, appropriate placement becomes specific to that occasion.

Are there key places that make a difference to every pose?
There are key meridians that are included in every pose, such as the Anatomy Trains lines, which wrap the body. The breath, the spine and the engagement with the ground arise as key places, common to all poses. However, as in (2), this is occasion-centred, rather than posture-centred, since the state, day and anatomy can all be variable.

Are there fundamental principles that we should adhere to?
Integrity, subtlety and remembering one's own kinespheric balance, before combining it with the person being adjusted. It is a conversation between two intelligent systems that become one in that moment of adjustment.

What is the point of adjustment; should we intervene at all?

It is to enhance practice for the person being taught and to develop their sense of their own containment and ability. If you cannot know you are doing that, then do not adjust.

If not posture-centric, then what guide or grid makes sense of poses?

See the details of kinesphere/innersphere and apply your heart-felt integrity and experience, from your own sense of balance. Using or applying such systems as Anatomy Trains can be a useful guide, particularly at the beginning while you develop your own confidence.

Does fascia affect the biomechanics of adjustment as well as moving?

We might say it is the *medium* of translation, transmission and transformation.

Notes

1. Thomas W. Myers, *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 2nd edition, Churchill Livingstone, Edinburgh, 2009.
2. Andrew T. Still, *Philosophy of Osteopathy*, A.T.Still, Kirksville, 1899.
3. Photographs used in the part opening pages are reproduced with kind permission from photographer: David Woolley, www.limitlesspictures.com. Models: Katie Courts and Samira Schmidli-McBriar. There are also some drawings of the same models and Alexander Filmer-Lorch used in this chapter and elsewhere in the book, reproduced with kind permission of the models.
4. Robert Schleip, "Fascial Plasticity: A New Neurobiological Explanation", parts 1 and 2, Journal of Bodywork and Movement Therapies 7(1): 11–19; 7(2): 104–116; 2003.
5. Graham Scarr, www.tensegrityinbiology.co.uk/, article: "Geodesic". See also: *Biotensegrity: The Structural Basis of Life*, Handspring Publishing Ltd., Pencaitland, 2014.

CHAPTER
15

The Elastic Breath

"There is an intimate connection between the breath, nerve currents and control of the inner prana or vital forces. Prana becomes visible on the physical plane as motion and action and on the mental plane as thought. Pranayama is the means by which a yogi tries to realise within his individual body the whole cosmic nature."[1]

Swami Sivananda

Pranayama

In the yoga classroom, we generally classify the breathing "techniques" as Pranayama practice. The word *prana* translates as "life force" and *ayama* means "extension or expansion". We could say it is the expansion of life force in the body.

When we become conscious of the breath it feels like an expansive *expression* of the life force: a deepening of presence and awareness.

Yoga is keenly focused on clearing the internal energy threads, pathways (nadis) and channels. This encourages the flow of prana, innate to our living form, optimising and balancing movement and stillness, inner and outer states. This encourages our self-regulatory functions, enabling us to vary appropriately between those states in healthy everyday performance.

In yoga we explore what Scaravelli calls "the force of anti-force",[2] the opposite of that *active* animation of prana, by exploring its full range, into active stillness. We can do this in more ways than one. We consciously explore the rate and range of our movements in the postures, expanding both, to accumulate a broader basis of elastic variability (see chart in Posture Profiling, Ch. 13). *Range* is explored by practising the postures while *rate* is explored by sequencing them. At the other end of that scale, variability is accommodated in *stillness*, by holding the postures and/or through meditation. Pranayama is also a key feature of self-regulation: you can gauge instantly, by the breath, how you are doing.

Simply pausing in your day (at your desk, in the shower, wherever works) once or twice a day to take a few breaths and be present to breathing as an expression of vitality contributes to expanding our awareness. Over time it enlarges the ability to gradually bring this fundamental bodily rhythm into consciousness (not thinking about it but being conscious of it, which is different). Try it right now. Breathe. Inhale and exhale, then let it go.

Pranayama is sometimes thought to mean “breath control”. The yogic path is considered to include the ways known as “yamas” and “niyamas” (personal ways or observances) followed by devotees of yoga. These are sometimes associated with “ways of controlling” the senses or the mind, for example. The word Pranayama, however, is not prana plus yama. It comes from prana plus ayama, so it invites us to extend our selves beyond the physical realm, to the benefits of expanding awareness. It does not actually mean imposing correct actions (i.e. breathing techniques) upon the body. Its true meaning invites us to expand into a fuller potential or possibility, rather than be constrained by a method of control. It can become a very simple and rewarding practice. We might hold it as “pre-position” rather than “im-position” as a valuable way to become familiar with being aware of where we are in space and how we are at the time *as a body*: a deepening of our proprioceptive sense, one moment at a time.

The ultimate expression of Pranayama is Vipassana. This is a state of complete stillness throughout the physical body. In this aspect of the training, the breath is passively observed, without identification with physical sensations or mental conversations. It is used to consciously bring our mental commentary, or “mind chatter” (chitta vritti), to stillness and silence. It is in essence a quiet place where the body simply breathes, sometimes called a state of “I am”. Here, there is nothing to do: to be is all.

Vipassana is something of a specialised skill, or at least a guided practice to start with, as it takes time to develop and accumulate. In everyday life, our breathing patterns are often so unnatural and disrupted that such practices are generally not advised until one has at least developed a clear foundation in the basics of practising observation of the breath. While breathing is a natural and requisite phenomenon, we do not always achieve an optimal breathing pattern. In yoga, as in some other fields, such as certain martial arts, for example, breathing is explored distinctly. Pranayama “techniques” have ancient origins, designed to accumulate range, variability, respiratory strength and resilience. The yogic sages understood balance and the benefits of natural compliance. A natural, compliant breathing rhythm is a fundamental expression of elastic integrity, from the heart. Both literally and symbolically, it can make an essential contribution to *happiness* or *joy (ananda)*.

The Power of Pause

One of the themes to emerge from our growing understanding of fascia is the power to be found in cumulative small and subtle strokes. Small impulses accumulate and, since we all breathe all the time, every day, there is a contribution to be made by simply pausing to observe breathing every now and again, purely for the sake of it. Yoga does not have to be just about the grand gesture of one or two hours on the mat. It can sneak into daily movement patterns and slowly bring about important beneficial habit changes. It is both deceptively simple and hugely valuable. The fascia will respond globally to even a tiny gesture of recognition.

Using yoga poses and meditation to develop the range and compliance of our breathing architecture inevitably impacts many more of our physiological systems than respiration. Just as sessions in the “sit-and-slouch” gym accumulate postural set (in joined up moments), so “pauses” can gradually bring us to being present for longer periods. Although our culture is naturally goal oriented, this is a mysterious basis upon which to practise yoga. It is, of course, possible to become competitive about achieving the postures, even with ourselves. (In fact, I have often seen people cross with themselves because they performed a posture better yesterday than they can achieve today.) It is, however, difficult to see how this mindset can be integrated into yoga, since yoga is about being present to presence itself. Just let your body *breathe you* for a minute and you will experience what I mean. Each practice is an opportunity for the body to inform the mind how it is at that point in time. It need not be remarkable.

"Although breathing is mainly an unconscious process, conscious control of it may be taken at any time. Consequently, it forms a bridge between the conscious and unconscious areas of the mind. Through the practice of Pranayama, the energy trapped in neurotic, unconscious mental patterns may be released for use in more creative and joyful activity"[3]

Just by pausing, we can take a moment and expand into it. We do not have to know anything about it to value it as a moment. It is fun in a yoga class to simply "press pause" and allow the group to observe wherever and however they are at that moment. No description or sharing is required, just the experience of observation for its own sake. That is the most profound basis of developing a yoga practice, in movement or meditation. The ability to catch ourselves (witness) and expand into being can take just as much conscious training as the twists and balances of the postures. You can call it Pranayama but actually it is a secret ingredient in enjoying life and seeing grace. It is there anyway, but we can forget that.

As we improve and expand our ability to regulate the usually involuntary aspects of our breathing functions, yoga can influence and improve various aspects of other physiological systems as a natural consequence. Eventually, in its more subtle forms, this yogic training is considered to provide access to higher states of consciousness than are ordinarily reached. Pranayama is a vehicle for this potential in all of us.

The Pranic Body

Yoga considers the body in very subtle ways, including our energetic field, or something that might relate to the "kinesphere" and "innersphere" we alluded to in earlier chapters. Compared to Western anatomy and physiology, it includes different aspects of our being and our functions in its distinctions. Considered to be the most vital process of the body, Pranayama influences and nourishes every part of us; however, it is understood as more than just functional breathing. It represents an essential aspect of our movement practice. Like the hub of a biotensegrity wheel, it gives us access to health in psyche and soma, in all directions.

Yogis believe that if Prana does not flow through the channels (the nadis, considered as threads or meridians throughout the body and limbs), or if it becomes blocked, it is a reason for disease or dysfunction. This is observed at the physical level of non-compliance in the tissues. In this case, rather than breathing with natural elastic integrity, the body recruits extra muscular effort to "fund" these otherwise natural rhythms when they are structurally or emotionally disturbed. It does this instinctively and it can directly link to the dis-ease and distress that ill health or injury can cause. Relentless or unresolved stress, poor diet, sedentary activities or overexertion and other features of a lifestyle that is not in balance can obstruct pranic flow and deplete vital energy. The practice of Pranayama is considered to be restorative and revitalising if the "pranas" can be brought into balance. However, this is not a set of "symptoms" for which a "pill" can be administered. It is more akin to a series of events or even feedback loops that seem stuck. Needless to say it is not an intellectual process of the reasoning mind. We have to participate in animating it consciously to begin.

Fascia responds to loading history; this is subtly accumulated in the motion of breathing just as it is in the movements of the postures. In animated real life, on the mat, we can effectively restore shallow or irregular breathing patterns. These develop for a variety of reasons but they can be managed and organised in a more healthy way so that they eventually allow the breath to respond in more instinctive and adaptable compliance, naturally expressive of elastic integrity. As teachers we can guide and

facilitate this process, but this is an area where forcefulness (self-imposed or otherwise) fails. The participant must want to participate. We are working to enhance and recognise (or even *reveal*) the most profound and subtle forces that are already there.

The Vital Energy of Breathing

Yoga considers the human framework to consist of (and operate in) more than one dimension, including the material body, the mental body, the vital energy body, the psychic body and the transcendental body.[4] This is a different vital anatomy based on living beings (as distinct from that inferred from the evidence of cadavers). It is not necessarily more right or wrong but it does lend itself to a more sophisticated possibility for how we are as humans.

These pranic bodies function together to form an integral whole. It is their mutual congruency that yoga seeks to reflect in our body. It is the vital energy body (Pranamaya Kosha) to which the main practices of Pranayama refer. These are known as the five Pranas (capital 'P') including: *prana*, *apana*, *samana*, *udana* and *vyana*. Between them they allow an interesting and subtle context for our balanced breathing patterns, distinct from classical texts on the anatomy of the breath. These qualitative distinctions are more recognisable in terms of our earliest expression of life, in embryogenesis (Ch. 5).

"The techniques of pranayama provide the method whereby the life force can be activated and regulated in order to go beyond one's normal boundaries or limitations and attain a higher state of vibratory energy and awareness"[5]

Prana (that is Prana with a capital "P") is all pervading life force. The five pranas (small "p") listed above are within the body and express Prana in relation to its location and its function. They are called the five vayus, or "inner winds". They imply direction; for example, apana is associated with the eliminative organs. The movement associated with it is through the skin, via the urogenital system (birth and excretion) and through the mouth (as exhalation or regurgitation). Within these classifications are five "sub-pranas" which include hiccoughing, sneezing, and so on. It is a different quality of classification that nevertheless accounts for all our bodily functions. As we would describe the weather in terms of perhaps a light breeze, or a strong wind, or a gale, the yogis use similar distinctions to denote different levels of energy and quality of energy flow or current.

The direction is relevant, as the flow of prana in the nadis (energy channels throughout the body) is considered paramount. When one of the pranas is "out" it throws the subtle and interrelated network out. This is expressed as "dis-ease" or imbalance in the body. When the flow, quality and direction of the pranas are appropriate, they are thought to express health and vitality. These are what we refer to as "autonomic" functions as when they function naturally and congruently they do so without us having to think about it – they are involuntary. The breath, however, is both involuntary and voluntary. Thus it can be considered as a portal to animating and even illuminating life force (Prana) within us.

prana refers, in this context, to the flow of energy governing the cavity of the thorax from the thoracic inlet to the diaphragm (pleural and pericardial cavities). It includes the heart and main organs of respiration together with the nerves and all the tissues that directly activate them. The fabric and forces that draw the breath into the body are included here. (The animation of the inhale and the mesodermal features of the embryonic forming).

apana refers to the flow of energy governing the cavity between the diaphragm and the pelvic floor (peritoneal cavity), including the large

intestine, kidneys and urogenital system. These animate the fabric and forces that fully release the breath out of the body. (Exhalation; relating to the endodermal layer in the embryo.)

samana is between the heart and the navel, activating the digestive system and associated with transformation (solar plexus and umbilicus; the original embryonic connection to the nutritive maternal source). Literally this is the transformation of food into nourishing nutrients. It can also symbolise the transformation of the conceptus to the embryo (of birth and expansion of consciousness).

udana refers to the neck and head, including the sensory platform (of eyes, ears, nose, tongue) harmonising the sensory tissues, skin, nerves and joints of the limbs and spine. It activates efficient, easy spinal posture and responsiveness to the outside world. It refers to and governs sensory awareness. We might consider it inclusive of, but not separate from, the original organisation of the ectodermal layer in the embryo.

vyana is everywhere in the body, regulating all movement and orchestrating the other pranas. It is described as their "reserve force". We might relate this to the role of mesenchyme in the embryo, being everywhere, and the extracellular matrix in the adult.

Each different style of yoga explores different ways of utilizing the breathing techniques. They are universal; however, they can be misused if knowledge is inadequate or sufficient attention is not paid to their subtleties and power. A yoga therapist or a Kundalini Master understands the nuanced qualities and abilities associated with the different techniques and the appropriate times for teaching and animating them in an individual. It is recommended that they should not be used without appropriate knowledge, guidance and respect.

Yoga breathing practices are designed to facilitate and enhance an optimal connection with this force. Our ability to naturally recognise and assimilate Prana is the literal expression of congruency in life as life force expressed in us. It is the union that the yogic journey explores. Breath is synonymous with spirit in many languages: "Allah" means the Great Breath; inspira (Spanish), inspirer (French) mean both inhale and inspire; in English "respiration" comes from "re-spiriting" or bringing spirit in, as inspiration implies illumination. We can be inspired by a new idea, a new pose or a new project. It is the spirit of life itself, expressed uniquely in each one of us, whatever path we take in life. We all breathe.

The general approach of becoming conscious of the breath, however, is a foundation in itself. What is offered here is a relatively simple way of considering the breath that can act as a starting point for all others. It can also travel, enhancing the most fundamental ways of bringing the breath into consciousness wherever you are. It permits and further improves elasticity and compliance, which can be defined in strict scientific terms as "stored energy capacity". Essentially, that energy is Prana.

Elastic Breath Cycle

Classical anatomy addresses individual breathing muscles, such as the diaphragm, the intercostals, the scalenes and so on, as separate entities. The body does not experience breathing in this way, however, although we are capable of focusing on a single area of the body at a time as an exercise. From a biotensegrity point of view, the connective tissues account for the geometry of our breathing architecture in 360 degrees. If we remember how the embryo forms the spine and the cavities, growing them around and down from folding them together and enfolding spaces to form the cavities (Ch. 5), then we might reasonably assume that the body does not separate its breathing muscles into categories either. Indeed, we know it does not function as individual muscles, but as motion. It breathes as a whole, amplifying the rhythm according to requirement, echoed throughout the force transmission system that is the fascial matrix. Levers are difficult to find in our breathing apparatus.

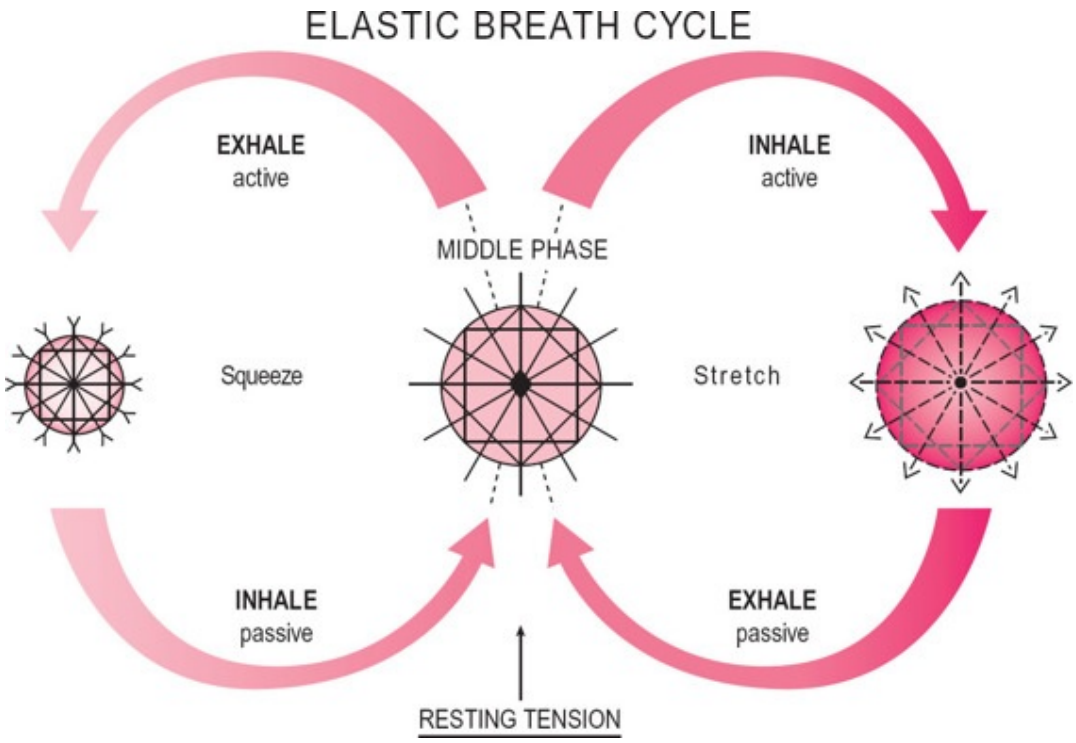


Figure 15.1

The elastic breath cycle elaborates the biotensegrity architecture of our fascial form in breathing. It works in practice as a simple foundation, recognising the middle phase as our relaxed state. ©The Art of Contemporary Yoga Ltd. and reproduced with their kind permission.

The multibar ball that we first examined in Chapter 7 is clearly representative of a breathing model in three-dimensional form. It demonstrates how the body seeks compliance, not permission, from each muscle group. An example of this type of multibar structure can be seen in Figures 15.2–15.5.

A great example of this is the Chinese Finger Puzzle (Fig. 15.6). The weave of our tissues around the thorax is formed in the embryonic pulses of our most primitive development (Ch. 5). The forming cavities work as a whole and in reciprocal responses between the diaphragms. Before we consider exercising the bandhas individually, there is value in recognising a model of how they work in a united rhythm as a completely enfolded form. The basis of the exercises associated with them is to improve elastic compliance throughout.

"In biotensegrity, the 'four-bar' is a 3-D vector equilibrium tensegrity icosahedron. It naturally oscillates. The rate can be changed by changing tension (tone) in the system. At any instant, there may be a phase change, and tension may become compression and vice versa. The models we make are only an instant in time and only exist in our imagination. Even when 'paused', movement is present at some scale." [6]

Figure 15.2-15.5

The first image shows the ball at its smallest, never reduced to zero, modelling the squeeze of the full or active exhalation represented by the

left hand side of Fig. 15.1. The second image shows the same structure towards the mid-point. It begins to represent the middle phase of the breath, which is neither stretched nor squeezed: our resting tension. This is the place of natural mobility rather than stability, poised for movement (we are at rest, with the lungs semi-inflated). This is approximating the middle phase in Figure 15.1. In the third image the ball is almost expanded, modelling the movement of the fuller inhalation. The last shows the ball fully expanded, modelling the movement of the full inhalation. Together these links enclose a space. If you were to add fabric and tension it, connected to and spaced by floating compression members, you would have something resembling the architecture of our torso responding in the range in which we breathe. (The bones do not touch each other, but "float" in the weave of the fascial matrix.)

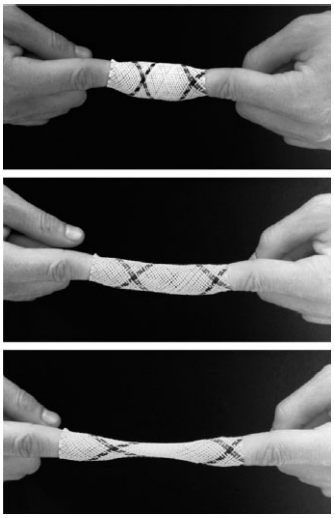


Figure 15.6
Chinese finger puzzle.

It is almost impossible to represent this in two dimensions but in your hands, by opening and closing (pulsing) the muli-bar structure illustrated above, you sense the rhythm of your pulse, the breath and the oscillation of the whole body as a part of the expression of elasticity. All the "linkage" points of this model conform to the geometries of a biotensegrity structure. The principles of biphasic movement and elasticity are held in the midpoint balance that represents our resting tension. This effectively means we balance and counterbalance every breath we take. We live in poised potential, balanced between extremes, breathing *from* the mid-point of the semi-tensioned elastic band in Chapter 8.[7]

When elasticity, or the range between stretch and squeeze, is compromised, it shows up immediately in the ability to vary the breath or adapt to the demands of speed to stillness (or not). This can be observed at both ends of the scale, for example by being out of breath a short time after beginning a Power Yoga class, or becoming restless when slowing down or preparing for meditation. Both represent a limitation in this range and variability. Both can be suitably trained to enhance our repertoire of breathing responses.

We can measure range easily by going to classes and finding out how long it takes us to reach a point where we can complete a whole class without being out of breath. If we can then follow such a class easily with a period of meditation, we can gauge that range and sense where we are in the journey towards mastery. (This is the same principle as that of Posture Profiling that we described in Ch. 13. We find the middle way and work from it.)

The fascial matrix responds to its loading history, so as long as we modify dose and degree (fairly easily detected by self-regulation) and practise with patience. It is remarkable how soon we develop range from speed to stillness. The breath is the perfect gauge because it cannot deceive us. We can either breathe easily or we cannot. It does not have to be complex. Do not force the breath: it will tell you where it is. It is almost like a sense, as much as a function.

Natural Breathing Rhythm

Many yogic breathing practices are designed to animate and strengthen different aspects of the breath. If we consider them from the perspective of biotensegrity, however, the fundamental theme of elasticity and compliance runs through them all.

In class, whatever the ability or age of the group, this one value (of elastic compliance) can provide powerful access to breathing well. The elastic breath cycle is designed as an exercise to be done consciously for a few minutes, at most twice a day. The breathing body is instinctive and it is not designed for us to think it through the day's activities. In healthy bodies we can, for the most part, sense our own breathing rhythm. We can quickly tell if our breathing rhythm is optimal and the message we should take from this is to try it, and if it works, keep it (by doing it again). Major Pranayama sessions can cause distress if people change their breathing patterns too rapidly or hold them to an imposed rhythm that does not suit their body. It is possible to over-breathe. *Start small*, from wherever the person is at the time.

Although it makes it harder to teach, we should be aware that breathing exercises are not about "controlling the body". This is a myth. They are intended to contain the body appropriately, or rather foster the body's ability to express that containment naturally. They can bring strength and resilience to the functional form. It becomes a resource to draw on when you are tired, or poorly, like a kind of reserve. It is not a religious set of instructions designed to bring enlightenment. If you pay enough time and attention to a process that is designed to be instinctive in your body, it will reward you with time in a different way. You might move with more agility and less effort; you might even find that spending some time becoming conscious of the breath gets you more quickly to wherever it is you are headed. You have been activating your breath since you were the size of an acorn. Your instinctive body already knows how to breathe. This work is to enhance that inner knowing(nous).

From the point of view of structural tensional integrity, there are three stages of the breathing cycle rather than two, from the full expansion (inhale), through the middle phase, to the full squeeze (exhale). In fact, in deeper study, there are considered to be five stages, to include the peak of the inhale and the peak of the exhale. These are valuable moments.

There is more to breathing than a two-phase inhale and exhale, although in smooth transition through the middle phase it can appear like that. The three phases subtly merge in smooth transition between the extremes of stretch and squeeze to form one whole cycle. However, we first need to identify them as distinct in order to define and recognise them. Our fascial form rests in tension, pre-stiffened, as the network of our matrix, at the middle phase (Ch. 8). This gives us the ability to expand globally and squeeze globally. The elastic breath cycle practises this and evokes the benefits of healthy respiration, including strength, variability, resilience and hydration. It supports our natural processes before we go on to do the more detailed and refined breathing practices of an advanced yoga programme.

This subtle and simple practice can, over time, lead to improved regulation of the breath and more refined and expansive utilisation of the full breathing capacity. This in turn, from the fascial perspective, balances the polarities of elasticity and stiffness. It can expand our sense of life force and our sense of being present in the body, which can have far reaching psychosomatic benefits.

"*So the physical and the breathing components are actually facilitating this central process, which is the meditative process. And the meditative process is not just a cognitive technique; you're actually changing brain function. When you change brain function you change brain physiology you change brain anatomy. Literally the brain is plastic, so as you do different tasks mentally, the brain will actually change in that direction, so this ends up being very profound. Even though many people are thinking 'well its just a mental game', but its actually changing brain structure and function.*"[8]

In essence these exercises are not designed to impose “right ways” of breathing on the body. Rather they train the breathing movements for enhanced compliance and expand the capacity to vary the breathing rate and elasticity naturally, to meet a fuller range of possibilities. They improve the natural function of our most primitive, original movement.

We know from Chapter 8 that elasticity is paramount to the health and variability of our architecture and its structural integrity. Perhaps this is why learning to generate the presence and stillness associated with Pranayama in each of the postures and extended into meditative practice can be so valuable in counterbalancing the events of everyday life.

Foundation Work

> As far as the anatomy is concerned, it raises interesting questions. If you accept biotensegrity as the basis of our architecture and include the fascial matrix as a body-wide tensional system that is literally everywhere, then what myofascia is not involved in breathing? The breath itself must be a primary signalling motion, communicated throughout the architecture; moment by moment and breath by breath. Whatever your beliefs, the idea of operating on more than one level of awareness is common sense in a way. Breath is universally accepted as a sign of life force. Placing value on elasticity (i.e. energy storage capacity) as an important feature of its architecture is a global gesture towards every local aspect of our vitality. You do not have to be a yogi to appreciate this notion (or to enjoy the benefits of breathing well and being able to respond accordingly to life’s circumstances).

The practice of some very simple exercises begins to develop awareness of this life-giving resource we happily ignore (because it generally works pretty well whether we think about it or not). It is important to do this foundation work before going on to more advanced practices; in this way changes can be naturally incorporated without any adverse or extreme reactions. Fascia responds to its loading history and it takes a long time to develop an inefficient pattern, so we have to be prepared for it to take a long time to incorporate a new, more efficient one. Breathing is a lifelong practice, so it is rewarding to take it slowly and almost imperceptibly through subtle layers of improvement, developing optimum patterns gradually and releasing optimal ones.

We seek the balance of *sthiram* and *sukham* (the steady and the sweet), to allow the influence of the breath to pervade the body without interruption or discomfort. It is communicating subtle awareness and appropriate attention through all our sensory communication system in subtle elastic balance. It takes time, but, gradually, we are able to find this steady place to sit in Vipassana more and more easily, and for longer periods of time. Adult humans breathe 21,600 times per day[9] and for many of us this breathing is local and shallow compared to our full capacity to bring life-giving oxygen into the body, for all its myriad functions, and allow waste gases to be efficiently released and recycled. We stay aware, however, of dose and degree. A theme in some of Sri Aurobindo’s writings[10] is that we should not use meditation as a “runway” to fly away from everyday life. This is a simple access to enhancing it.

Respiratory Tensional Integrity

The lungs rest semi-inflated, at about 50% full (or 50% empty, depending on your point of view). That is their resting tension: the pre-stiffened state of our resting architecture. Compliance relies on this feature for the ability to expand from it (towards fullness, exceeding 50%) and squeeze from it (towards emptiness, less than 50%).

The initial purpose of the breathing practices is to strengthen and enhance capacity of the lungs and surrounding tissues, relative to the individual. This can improve balance between the various related

systems of the body (all of which could be considered to benefit from efficiency of respiration). In tension–compression balance, this full range of capacity between full exhale and full inhale (between which extremes we find resting tension at the mid-point) could be considered as biotensegrity regulation of the whole breathing apparatus.

This is how tensional integrity can work in 360 degrees. If the spine is able to relax and restore its natural curvature, without undue strain (i.e. you can sit curved-upright in comfort), then it follows that the morphology of our integrated breathing apparatus is less compromised and more optimised (i.e. the primary curve of the ribs is in place and the secondary curves of the waist and neck allow for the exercises to be done in optimal positions for the head and tail). This is one of the reasons it is important to learn to sit well, so that breathing practice can be done without compromise to the elastic integrity of the spine and breathing motion, throughout the body. Using support to maintain ease in the spine is preferable to forcing "uprightness" for its own sake, with muscular effort. The reason for practising Pranayama in sitting is to work with attentiveness without falling asleep! (It is also recommended to practice Pranayama on an empty stomach so that the body is not preoccupied with digestion.) The practice itself can improve the ability to sit at ease. They are mutually beneficial.

Transitions become the key. After five rounds, rest and return to normal breathing. Over time, this exercise can be increased in small increments: more rounds and slightly greater range. It is designed to train elastic integrity and the meditative ability to observe the breath. It eventually becomes instinctive.

Elastic Breath Exercise

Find a comfortable seated position. (Initially it may be useful to work supine to establish the rhythm, or in a comfortable supportive chair or on cushions with the back supported by a wall.)

The active inhale Let the breath settle at the natural mid-point. Softly inhale, experiencing the breath through the nostrils and into the body with a feeling of expansion. Inhale as far as possible, with a sense of stretching the whole torso and all the details of the tissues between the ribs, under the arms, throughout the back, front and sides, the upper and lower parts of the body. Observe the "peak" of the inhale for a moment.

The passive exhale Let the breath release gradually and it will naturally find the mid-point of the breath as the exhale is releasing. The breathing action continues through this point. It does not stop there. (A shallow breathing pattern can be observed in people who inhale and exhale to and from this point only; they are using only the right side of the schema in Fig. 15.1.) The exercise asks us to continue through the middle phase, in smooth transition.

The active exhale As smoothly as possible, begin to activate and squeeze the exhale. The tissues that were stretched on the inhale are now being tightened and stiffened. Keep squeezing them until the whole torso is squeezed in, along the length of the spine. This is an active sense of drawing inward of the ribs and abdomen, tightening all the tissues of the body wall toward the spine. Observe the end-point of this active exhale when all the breath feels squeezed out of the body, without collapse. The torso is tensioned and stiffened by squeezing.

Passive inhale Let the breath release gradually and the body will naturally find the mid-point again, only this time it is a passive *inhale as release* (see Fig. 15.1). This is one whole breathing cycle. In smooth transition, it elaborates expansion and squeeze at both ends of the elasticity scale. A healthy body with a naturally compliant breathing pattern will do this anyway. A less compliant pattern can be observed using only one side of the chart. In either case, there is value in observing the breath and extending through the full cycle.

Repeat the exercise quietly, without overworking the breath, simply becoming aware of the torso's ability to expand globally and squeeze globally, through the "middle way" or mid-point of the resting tension. The lungs rest here at about 50% inflated when we are relaxed. Pause between cycles if required.

Transitions

There are many and various Pranayama techniques in yoga. Kapalabhati, for example (Skull Shining), animates the left side of the schema in Figure 15.1 and contributes powerfully to elastic integrity. The elastic breath exercise is not designed to replace established ancient and valuable yoga practices. It is merely offered as a relatively simple way to prepare for more advanced work with the yogic bandhas and traditional Pranayama techniques. "Skull Shining" is a metaphor for "polishing" the inner pathways; it is a cleansing breath. The cleansing practices are the Kriyas, designed to purify the body. In this case the Kapalabhati serves the central nerve

pathways, hence the reference to illuminating the being – making the skull shiny. (We engage a similar idea in phrases such as "her face lit up".) Indeed, after doing the Kriyas, people often do look shiny! They are lit up with the effect of the deeper benefits of yogic practice. It is advisable to be guided in these practices by an experienced teacher. Kriyas and Pranayama practices are not a list of techniques that can be simply taken off the Internet and applied without wisdom. Their benefits are many and varied, but (like everything) they work in an appropriate context.

The quality of the transitions in the Pranayama exercises, even at their most simple, is the essence of containment and the main focus of this exercise. Through mastering the quality of transitions, the flow of the breath can become rhythmical and harmonious at various rates. The stillness of meditation and the speed of a Vinyasa Flow class with the variations in between can all eventually be readily and instinctively accommodated without needing to overstrain the body.

At first, a novice in a Vinyasa Flow class might feel out of breath after only a short time; at the other extreme, they might become a little agitated and restless after a relatively short time in seated meditation. As the body responds to these cumulative loading patterns (i.e. training and practice), this gradual progress can optimise experience of both these extremes. Just as we get stronger and more contained through training in a sport, so, too, can the body learn the micro-movements of breathing for added compliance and enhanced variability. The same method – accumulating a pattern through repetition – is used for both.

By reinforcing the natural elasticity of breathing compliance the quality of rebound of elastic energy storage eventually renders these movements relatively effortless. While the breathing becomes more efficient and acquires more range, so the elastic balance of the tissues improves and demands less metabolically expensive muscular effort and holds more natural spring. It happens on every scale because a yoga practice pays such specific attention to breathing for its own sake. It is capable of endorsing the benefits of breath containment, and just by carrying out a small practice on a regular basis, in appropriate dose and degree, the tissues of your whole fascial matrix can become cumulatively more responsive.

Paradoxical Breathing

Paradoxical breathing is both common and quite complex; however, it is worth mentioning so that it can at least be recognised. This type of breathing is often associated with trauma and specific pathologies. It involves reverse responses internally to the natural motion and pressure balances between the body cavities in the normal, healthy breath cycle. In practice, the movement of breath behaves as paradoxical to the pressure response of stretch and squeeze. It can be in evidence without specific pathologies, and is often part of a picture that includes fatigue.

Note to teachers In my experience when working with clients therapeutically, many people can generally experience the first part of the cycle (active inhale and passive exhale: right side of the chart in Fig. 15.1) as their whole range of breathing. Once they become aware of the active exhale, they are able to extend the breathing cycle *through the middle, using both sides of the chart.* The chart provides a means to visualise this subtle transition (like a Möbius strip). It is a morphology that can, at first, be very small and gradually expand as the capacity improves. A Möbius is the name given to a shape, like a figure-of-eight, with a particular quality. If you take a strip of paper and join the two ends to form a circle, but add a twist to the paper first, it forms a Möbius strip in which the outside becomes the inside; they unite as the one form. If you trace the outside of the shape with your finger you will find yourself on the inside (and vice versa), as you go around it. It becomes a useful metaphor/visualisation in this practice.

This type of breathing is most readily demonstrated in supine or seated position, in abdominal breathing. The participant breathing paradoxically will tend to squeeze the abdomen back towards the

spine on the inhalation and stretch (or push it out) on the exhalation. This is a counter-instinctive pressure response, most clearly understood through demonstration and most easily adjusted the same way. It is a complex phenomenon, because it can involve accumulated compensatory patterns between the thorax and abdomen. However, if it is detected soon and the participant can recognise it before it creates chronic patterns, it can be a rewarding relief that restores balance.

Correct Breathing?

In yoga classrooms, depending on which "school" you go to, there is discussion about how we should breathe and whether poses should be activated on the inhale or the exhale. In some schools the instruction is to rest on the inhalation and act (i.e. do the pose) on the exhalation. Other schools equate back bend (extension) with the inhalation and forward bend (flexion) with the exhalation. In these cases, the body is encouraged to act (do the pose) on the inhalation and release the movement on the exhalation.

Exercise for Paradoxical Breathing Pattern

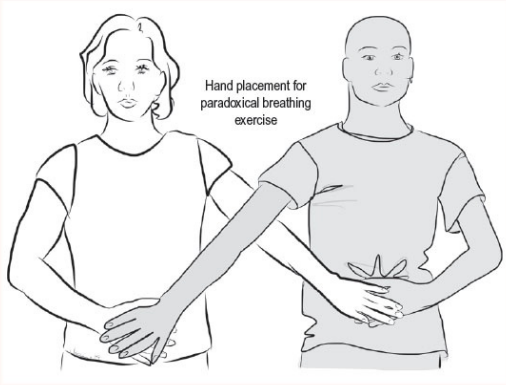


Figure 15.7
Both practitioner and participant have one hand on their own abdomen, the other over the other person's hand. Reproduced with kind permission from Art of Contemporary Yoga Ltd.

Sit beside the participant, each in a comfortable chair, or if on the floor, with backs against the wall. This way you both feel relaxed and supported. Sit on the sitting bones so that the spine is upright. Place your (outermost) hand on your abdomen while the participant places their (outermost) hand on theirs. Invite them to place their other hand over yours, while you place yours over theirs (Fig. 15.7).
You breathe gently in and out, slightly exaggerating the expansion of the inhalation and the release and squeeze of the exhalation. You invite the participant to follow you and do the same. The hands act as guides, slightly emphasising the appropriate direction of the abdominal movement. If the participant is paradoxically breathing there will, at first, be resistance under your hand and they will feel the difference in your breathing movement. In my experience, this works very quickly to re-educate the system kinaesthetically as it does not impose but invites reorganisation through the felt, proprioceptive senses. It may help to work with eyes closed or it may be preferable to allow the client to see the movement. This is a matter of personal judgement for the practitioner. In any case, it can guide the participant back to a more optimal pattern.
After a short while, the participant is then invited to place their own hands over each other and work alone, using the hands to assist with slight pressure on the belly on the exhale, while expanding the breath into the hands on the inhale. Abdominal breathing is recommended in supine or supported seated pose, so that internal structural support is not compromised. This teaches the participant to become self-regulating.
If left in a paradoxical pattern, the breath often influences posture, inviting a more "collapsed" appearance with the exhalation and an effortful "lift" of the upper body on the inhalation. It can be very relieving to rectify this pattern.

The psychosomatic aspect and associations of the breath and breathing patterns is a domain of therapeutic practice about which a great deal has been written and researched. This is not a comment on correct or incorrect breathing. In my

experience, assisting a participant in managing their breathing, especially if they have fallen into a default pattern of breathing paradoxically, can have far-reaching benefits for their sense of well-being. It is wise to begin slowly and the above exercise is designed only to suggest one possibility. It is not a definitive method, as this must be left to the practitioners and their individual relationships with their clients and students. Please also note that in certain states, over-focusing on the breath can bring a student into distress and might not be advisable. This does not replace medical advice.

Personally, I think there is a great deal to be said for considering the body actively able to self-regulate and manage the appropriate breathing for the task. I feel far more concern when the breath is being held, when it is not rhythmical, or when it is forced. This can imply a participant is straining or forcing a posture, which defeats the purpose. While education and re-education (from patterns that are disadvantageous) is valuable, there is also a cost to over-management of our natural breathing patterns. From a global point of view, elasticity and variability are paramount. They tend to be naturally self-regulating. After all, we have been breathing successfully as a species for millennia.

The structural integration classroom, dedicated as it is to optimum fascial organisation, is home to many a conversation with regard to optimal breathing patterns. The yoga class can be very interesting when breathing is taught using counts for retention, for example. I have seen some people thrive, while others become distressed by the same count. Breathing is very closely associated with emotional expression and instinctive responses, which we cannot always account for. It is worth approaching it gently, with huge respect for individuality. Building a repertoire of breathing exercises can fundamentally assist participants of all ages to find balance and integration naturally. Starting gently and gradually progressing from the foundation exercises above can readily accomplish this. Understanding the elastic breath cycle as an expression of the architecture can be very helpful.

Guided Breathing

In Chapter 13 on Adjustment, we considered subtle touch cues that invite an omnidirectional breath and encourage a fuller range for the breathing capacity. I prefer to err on the side of non-intervention, as for me there is a huge difference between conscious breathing and self-conscious breathing patterns. The latter are useful as education tools but, where there is no pathology to remedy, once a natural unselfconscious pattern is restored it can be left to the instincts of the individual.

Meditative Breathing

Once the foundations of breathing techniques are established, there are various specific practices (particularly for meditation purposes) that are designed to gradually refine Pranayama in the individual. We eventually develop the ability to be still and observe the body from the quiet and calm perspective of the witness. Using various breathing techniques can improve refinement and the ability to move and balance energy within the body. This is at levels that might not be immediately available to us before developing a practice in Pranayama. Like any other practice, once it becomes instinctive we do not have to think about it.

Here, we see and discover the three aspects referred to at the beginning. Biotensegrity architecture is a tension–compression force including three states. Notwithstanding the fact that it is based on triangulation, as we have said, there is tension, there is compression and there is tension–compression: the neutral state of the combination. In yoga, this neutrality is symbolised in Shushumna, the third channel that resides with Ida (feminine) and Pingala (masculine). However, it arises spontaneously and it cannot be animated

unless there is balance between the polar forces. Meditation is designed to enhance the possibility of that balance.

Once we have established balance in the fascial architecture of the breathing form, it becomes a resource. This can then evolve into practices such as meditation (Part 3) that can take us beyond the animation of the physical body to the illumination of the more subtle bodies (*koshas)* that yoga also respects.

Notes

1. Swami Sivananda, *The Science of Pranayama*, Divine Life Society, Tehri-Garhwal, Uttar Pradesh, Himalayas, India. First published in 1935. The online (2000) edition is freely available at http://www.dlshq.org/.
2. Vanda Scaravelli, *Awakening the Spine*, 2nd edition, Pinter and Martin, London, 2012.
3. The Bihar School of Yoga.
4. The Bihar School of Yoga. The teachings of Swami Satanyanda.
5. The Bihar School of Yoga.
6. Stephen Levin, personal communication, 2013.
7. As noted previously, weaving is considered by Kenneth Snelson to be the "Mother of Tensegrity" (http://www.kennethsnelson.net/icons/struc.htm). This is a stunning article on how weaving can bring us to tensegrity architecture.
8. Sat Bir Singh Khalsa, Assistant Professor of Medicine, Harvard Medical School, interview for www.yogaintheshadows.com.
9. Sawmi Satyananda Saraswati, Bihar School of Yoga.
10. Sri Aurobindo (1872–1950). See, for example, the list of his writings in Wikipedia (http://en.wikipedia.org/wiki/Sri_Aurobindo#Writings).

CHAPTER
16

Yoga for the Fascial Body: A Simple Practice

Prior to everything, asana is spoken of as the first part of hatha yoga. Having done asana, one attains steadiness of body and mind, freedom from disease and lightness of the limbs.[1]

Hatha Yoga Pradipika (1:17)

Sthiram, Sukham, Asanam

Several years ago I read a New York Times article about investment in sports shoe technology. A doctor (and keen marathon runner) mapped the rise in shoe technology against injuries in elite athletes: injuries were not reduced. He proposed the foot mediates an intelligent listening to the ground, feeding-back to the body about the terrain. Wrapped in "smart" shoes, the feet and legs send/receive inappropriate signals. The journalist, Chris McDougall, later wrote Born to Run. There is controversy about barefoot versus "shod" running. Research[3] suggests preference and training win over either: it depends what you are used to (congruent with the idea that fascia responds to our loading history). James Oschmann,[4] recommends walking on dew-soaked grass for a few minutes a day to animate the feet. Introducing people to their toes through yoga can improve balance and movement and all sorts of disabilities (See Fig.16.19).

"Sthiram" means steady and "sukham" means sweet. "Asanam" refers to a position or posture that is both steady (firm, strong) and comfortable. In a way it echoes the simplicity Vitruvius bestowed upon architecture: "firmitas, utilitas, venustas", making something strong, fit for purpose and beautiful (see Ch. 2). We are, of course, referring here to our natural physical architecture rather than to the built structures of Vitruvius. The postures presented in this chapter under the heading Foundation Series are designed to naturally clear the energy channels and psychic centres. From the point of view of the fascia, they perfectly confirm the kind of practice that honours individual form and promotes elasticity and hydration. One purpose is to enhance proprioceptive and interoceptive awareness.

By focusing on the relationship of any posture to the ground, to start with, we naturally deploy our biotensegrity architecture to fulfil our multidimensional promise. The practice is an exploration of that. First and foremost is the technique of bringing ourselves "down to earth", and back to being in our bodies. Then we use our awareness and attention to develop our relationship to it in the simplest of ways.

The feet become our "ears to the ground" and since they have such a constant role in so many of the things we seek to do, there is a value in taking special care of them. These techniques are presented as a class. However, feel free to select what works. You will see exceptional results from 10–15 minutes at the beginning of any session spent on releasing and easing extraneous tension in the feet. They respond with enthusiasm by anticipating our responses to the ground and becoming more intelligent and aware. (See Fig.16.19 for specific techniques.) This foundation series is designed as a useful basic practice

though even very advanced yogis and yoginis have used it when they are travelling or working under pressure, with no time for a fuller practice. It is also extremely valuable after illness or injury, when the body is under stress. It allows for a deep strengthening and calming of the system. Counterintuitively perhaps, it can help to facilitate strength and speed on a demanding schedule and restores performance.

Foundation Series

Participants have been able gradually to introduce the very subtle movements involved, even after surgeries or during pregnancy, under careful supervision. In this way, over a suitable period of time (which is unique to every case), they have been able to restore the valuable range of movement optimally available to them. It is advised that in all such cases, an individual seek the guidance of a trained yoga teacher or yoga therapist, as a book cannot provide the watchful eye of an experienced witness. As a teacher, you are encouraged to practise and modify these foundational asanas to suit your own programme.

These asanas are used to prepare or relax the body and might be done just once per week to give the body permission to simply explore where it is and enjoy your undivided attention. I have used these asanas with people of various ages over long periods of time, at weekly intervals. The intention is to promote fascial glide and sensory refinement through the longitudinal aspects of myofascial continuities, with particular focus on the limbs. All the practices throughout this series are designed to release the fascial layers in the torso and axial body.

Fascia Muktasana for the Torso, Neck and Head

All the movements in the Foundation Practice are designed for freeing the fascia of the torso and body. At the same time, they facilitate the breathing so the whole body is benefiting from the practice, with gentle attention to the breath. The series presented later, in Chapter 17, invites more subtle movements for all the main joints to free the energy pathways or channels of the subtle body.

	Basic class with variations	Notes
1	Back to Earth (A and B)	Finding the ground
2	Filling the Space	Listening to the breath
3	Little Boat	Freeing the breath
4	Spinal Twist (A and B)	Two parts, including release
5	The Wave (A and B)	Two variations
6	Stretch-and-squeeze	The elastic body
7	Fascia Muktasana	Using myofascial meridians
8	Ears to the Ground	12 Toe and foot exercises
9	Honouring the Curves (A and B)	Three variations
10	Simple Standing Rotation	Gentle rotation and counter-rotation
11	Sun Salutation of your choice	See Chapter 20
12	Pranayama and Shivasana	See Chapter 15

1A Back to Earth

PURPOSE: The purpose of this is to kinaesthetically note the primary curves (touching the ground) and

the secondary curves (not touching the ground) and bring the body into relaxed, but attentive stillness. It allows for life to be left outside the door and gentle attention to return inward for the period of the practice.

SUPPORT: There are schools of thought that place a support under the back of the head. This may be helpful in some cases; however, it is often even more valuable to support the back of the neck and allow the head to return to a more optimal position. A rolled blanket is ideal as it provides a minimal lift, but allows the neck to relax and begin to accommodate a more optimal posture. A small folded towel in the back of the waist can also assist in bringing a participant to a "felt" sense of their natural spinal curvatures.

TIMING: This position can be maintained for 2–12 minutes, with the caveat that at any time a participant can hug the knees to relieve any strain felt at the back of the waist. Its value is in slowing down the racing mind and bringing the attention back to the body.

- Lie on the back, feet hip-width apart, toes slightly turned in.
- Let the knees softly rest together allowing the body to rest down.
- Slide the shoulder blades downwards and slightly together.
- Allow the toe tips, ball of the foot and heel to soften down.
- Allow the pelvis, ribes, shoulders and head to feel the floor.
- Note that which is touching the floor and that which is not.
- Let the breath become relaxed and even.

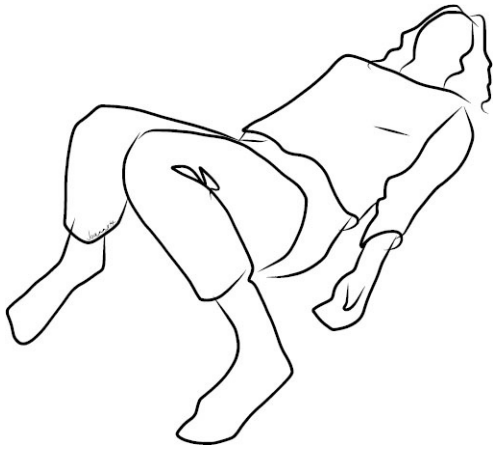


Figure 16.1

1B Back to Earth; Finding the Curves *(as per Ch. 11)*

PURPOSE: The purpose of this is to sense the primary and secondary curves of the back body from the crown of the head to the soles of the feet, including the heel, arch, ball of foot, spaces between the ball of the foot and the toe tips and the ends of the toes. We follow the "wave" of the curves using the ground as a reference for the whole length of the body – primary curves touch the floor, secondary do not. (The notion

of pressing the back of the waist or the neck into the floor is actively avoided: a straight spine is not an integrated one.)

SUPPORT: This comes from the ground and is aided by the hands initially supporting the subtle and natural curve at the back of the waist.

TIMING: This can be at the discretion of a teacher, as a finishing pose, a starting pose, or a resting pose. If it is to specifically encourage primary and secondary curve recognition it can be used as a repeated reference.

- Place hands (palms down) under mid back, middle fingers touching (See Fig.16. 2b).
- Slide the shoulder blades together and down, resting into the floor.
- Feel the primary curves: head, shoulders, hips, heels, toes (Fig. 16.2a).
- The primary curves touch the floor.
- Now feel the secondary curves: neck, waist, back of legs and foot arch.
- Release the hands if preferred and sense the curves as a wave.
- Take attention to the sides and front of the body relative to the back.

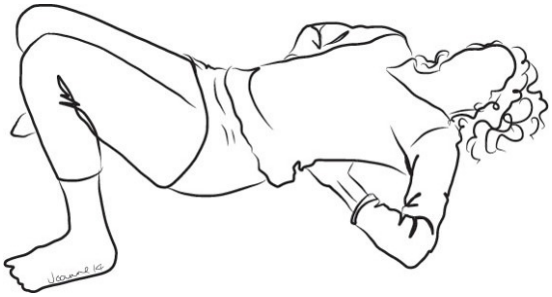


Figure 16.2a

Figure 16.2b

2 Filling the Space

PURPOSE: The purpose of this is to deepen the sense of elasticity that the breath can optimise. It is not to force the breath or induce fast or heavy breathing. Rather it is to familiarise the body with the sense of

its biotensegrity architecture: inhaling fully to expand to the point of resistance, exhaling fully to squeeze to the tensional limit. In each case, the release returns the torso to its natural resting tensional integrity. This exercise can be repeated 2–12 times without force (and resting between cycles). It is a preparation to invite tone to the torso as an overall value in any movement. It is enhanced by the specific breathing exercises in Pranayama practice; however, this is designed as an introduction.

SUPPORT: As for 1. Another benefit of this is to invite participants to feel the back and the front of the body, and fill into the sides so that they experience their three-dimensional "support" of their own boundaries. The floor becomes an important resource and a feedback system as awareness is encouraged by "pushing the floor away" during the full inhale and surrendering to it during the exhale. It becomes an enquiry as to how that changes on the extra exhale and release during the three phases of the elastic breath cycle. Do not force or induce over-breathing.

TIMING: As below. At any time a participant can hug the knees to relieve any strain felt at the back of the body. This is usually done as part of the "back to earth" rest, once attention becomes inwardly focused.

- Allow the tongue to rest softly on the roof of the mouth.
- Breathe through the nose, inhaling and exhaling evenly.
- Gradually feel the inhale expand the torso, following it.
- At first let the exhale go and rest at active the end of the exhale.
- Then explore the "extra exhale" squeezing the whole torso.
- Let that go and experience the inhale to release it.
- Explore this several times without force to become familiar.

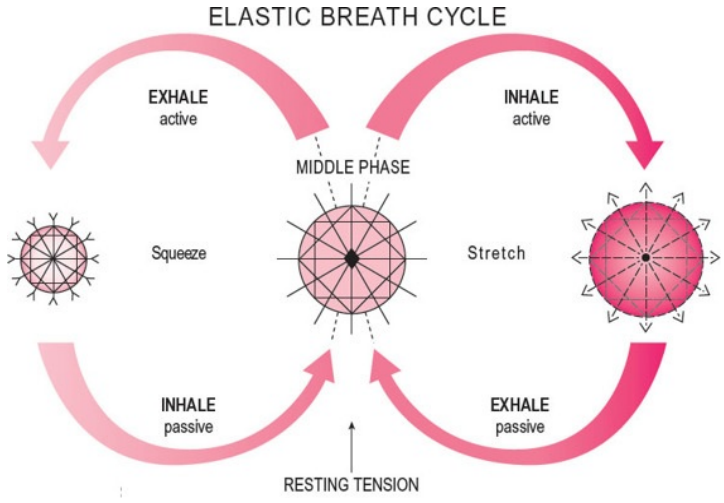


Figure 16.3

3 Little Boat Variation (Pasva Pavana Muktasana)

PURPOSE: The purpose of this is to gently allow the spine to find its rotational ability, with the shoulder girdle and pelvic girdle working in opposite directions. This should not be forced. It is a small movement

allowing the spine to find its natural rotation, gently and cumulatively through the length of the spine. It is essential that this is done in a small and comfortable range, without force, as the breathing continues. Ideally the breath is inhaled at centre and exhaled toward the twist but this will become natural if the posture is not forced and allowed to find an instinctive rhythm. There is also a lovely bonus in "massaging" the long myofascial continuities of the erector spinae along their length on the floor. Fluidity of movement is more valuable than range in this asana.

SUPPORT: As for 1, although by this time participants often feel they need less support after the work of the first two parts of this preparatory sequence. The movement can be a micro-movement, so such a small range will not disturb the support under neck, head or lumbar spine.

TIMING: This postural twist can be explored for 1–3 minutes, as preparation for the fuller twist to follow. It is designed to relieve tension and improve range in a subtle way and at a natural speed.

- With an extra exhale to support the lumbar spine, squeeze and press into one foot to send the other knee to the chest.
- Wrap the hands around the folded knee and on the next exhale draw the other knee to the chest, releasing the lumbar spine.
- Re-establish the soft curves of the back body, hugging the knees.
- Begin to rock the knees gently from side to side (a small range).
- Softly add the head to the movement in the opposite direction.

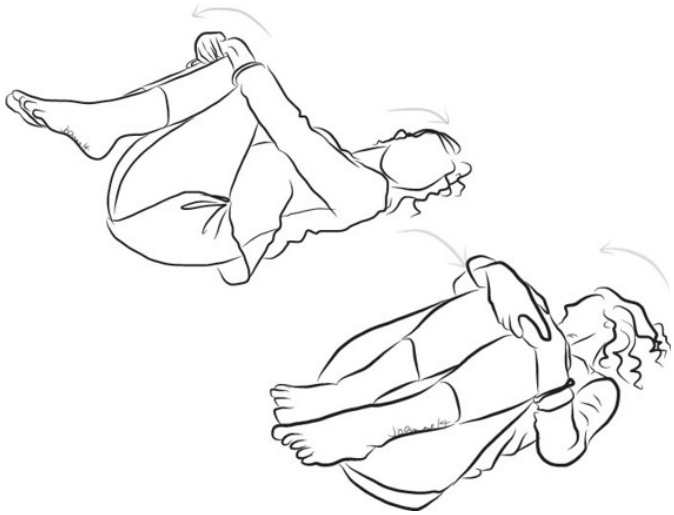


Figure 16.4

4A Lying Spinal Twist (Supta Matsyendrasana)

PURPOSE: The purpose of this is to gently deepen the spinal twist that number 3 prepared for. The invitation is to release into this posture as an opportunity to "unwind" the spine, using the breath to explore the spaces between the ribs, the "corners" of the lungs and sense the breathing in the neck, abdomen and diaphragm. A lovely cue is to imagine the right dome of the diaphragm as the wing of a dove (I do not know where this inspired idea first originated but it was not mine). The image of a dove opening one wing to let the sunlight (of the breath) through its feathers and allow that to release and open the

breath is delightful. The weight of the pelvis and shoulder girdle will naturally facilitate the twist. DO NOT FORCE.

SUPPORT: Blocks can be placed on either side of the body to ensure the twist is within natural range. It is very common for the number of blocks to be reduced within a few weeks of practice if the participant honours their comfort zone and does not force the twist. Sometimes a block or towel between the knees is more comfortable. The angle of the knee can be adjusted for comfort too. Focus is “through” the spinal length of cumulative rotation evenly along the spine. There is no need for forced twist at the waist or neck. This can be detrimental and at the expense of subtle unwinding.

TIMING: This postural twist can be explored for a few breathing cycles. It is used to find the relaxed unwinding, not to be pushed into achieving a twist. The next pose is coming out of this posture safely, via the breath.

- Find the centre position (see Fig. 16.6) and take the right arm out to the side.
- Place the right palm on the ground, anchoring the pose.
- Inhale and do nothing, sensing the right arm moving downward.
- Exhale the knees towards the left, continuing the extra exhale.
- Rest both knees on blocks or the ground, as comfortable.
- When ready, gently turn the head to look along the right arm.
- Relax the body and explore the right side of the breath.

Figure 16.5

4B Releasing Lying Spinal Twist (Supta Matsyendrasana)

PURPOSE: The purpose of this is to gently return the body, without putting pressure on the lumbar spine. It also increases the proprioceptive sense of awareness regarding the distinct difference between left and right sides after doing the pose to one side. There is usually a sense of more openness, or that one side of the body is “lower” than the other. The pose also facilitates the fascial release and awareness of the breath and allows the tissues to be gently stretched and opened in a non-invasive but attentive way. The one rule of this posture is DO NOT FORCE. The range of motion will accumulate gradually over time and the benefits of increased breathing capacity will be naturally incorporated.

SUPPORT: As 4A.

TIMING: The rest between twisting from one side to the other is a matter of personal judgement. Usually a few breathing cycles while the participant appreciates the difference between left and right is sufficient to experience the value of this pose.

- Breathe in, do nothing. On the exhale return the head to centre.
- Breathe in, do nothing. On the extra exhale, squeeze and bring the upper knee back to the chest and allow the lower knee (closest to the floor) to follow.
- It is very common to experience a distinct difference between one side and the other.
- Having consciously noted that difference, repeat 4A to other side.
- Hug the knees and listen to the sense in the back of the body.

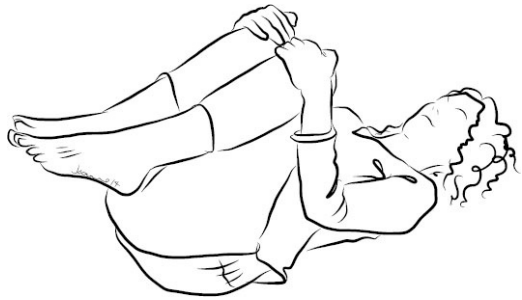


Figure 16.6

5A The Wave

PURPOSE: The purpose of this is to bring conscious kinaesthetic awareness to the spine in all its detail and synchronise breath and wave. To begin with there is often a feeling of sections of the spine moving together; however, this will foster micro-movements that eventually build a much more sensitive response, gently moving each vertebra and allowing the spaces between them to free up and bring more suppleness to the whole spine. The keynote of this posture is patience and allowing the spine to respond to the feet going down. One begins to surrender to the sense of a wave from coccyx to crown. It is a powerful preparation for shoulder stand but should not be forced at the neck. No tension is needed in the back of the body, as this is an exercise in less recruitment, not more. The buttocks do not need to tense to "push" the pelvis up. It is designed to encourage the wave of release through the spinal architecture, safely supported by the ground, as a response to the feet going down into it. One seeks fluid movement quality rather than height or force. A variation of this can be taken to the wall (5B).

SUPPORT: Ideally no support is required, as this posture need not be taken beyond a small sacral tilt if the participant cannot easily lift the weight of the pelvis. No force is needed. The purpose is to find or reveal the natural wave, not perform a lift. Eventually it finds a breathing rhythm: breath and wave work together in synchronicity. This is the purpose of this practice.

TIMING: This wave can be done for several cycles up and down the spine.

- Return the feet to the floor so that they are parallel, knees bent.
- Find the ground and press the footprint down to move the sacrum.

- Explore and experience the subtle activation of this relationship.
- As the feet press the floor, the sacrum softly rolls back and forth.
- With legs and feet parallel, we explore this “down to roll up”.
- One vertebra at a time, peeling the spine off the floor.
- Returning one vertebra at a time to the starting position.

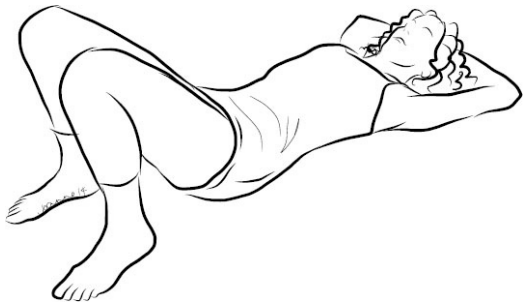


Figure 16.7

5B The Wave Inverted

PURPOSE: The purpose of this is to bring conscious kinaesthetic awareness to the spine in all its detail and to introduce inversion. For older participants inversion may not be suitable. However, using the wall allows any fear to diminish and increases confidence with a sense of the benefits of inverted poses. It also facilitates the lift of the pelvis. It can be easier to encourage an articulate spine from this starting position. Again, this will foster micro-movements that eventually build a much more sensitive response. Each vertebra is gently moved, allowing the spaces between them to free up and bring more suppleness to the whole spine. The keynote of this posture is patience and allowing the spine to respond to the feet pressing the wall. One begins to surrender to the sense of a wave from coccyx to crown. It is also a powerful preparation for shoulder stand but should not be forced at the neck. No tension is needed in the back of the body, as this is an exercise in less recruitment, not more. The buttocks do not need to tense to “push” the pelvis up. It is designed to encourage the wave of release through the spinal architecture, safely supported by the feet against the wall. One seeks quality of wave rather than height.

SUPPORT: As for 5A.

TIMING: This wave can be done for several cycles up and down the spine.

- Press the feet to the wall so that they are parallel, knees bent.
- Find the wall and press the footprint into it to move the sacrum.
- Explore and experience the subtle activation of this relationship.
- As the feet press the wall, the sacrum softly rolls back and forth.
- With legs and feet parallel, we explore this “press away to roll up”.
- One vertebra at a time, peeling the spine off the floor.

- Returning one vertebra at a time to the starting position.

Figure 16.8

6 Simultaneous Stretch-and-squeeze

PURPOSE: The purpose of this is to bring the value of an actively loaded stretch to the whole body after having been on the floor for 12–20 minutes altogether. It primes the body and invites participants to remember how easy and how important it is to stretch-and-squeeze (i.e. yawn and stretch) after the tissues have been resting. Personally, I believe the minimum daily practice of spending a couple of minutes, even in bed, simply stretching and yawning and waking the body up (like most self-respecting animals) is a most valuable and forgotten resource. It serves the tissues but primarily it serves us to be conscious of them as we transition from sleep and rest to motion. Long periods of sitting in cars, not to mention at desks, are usefully countered with short yawning stretches.

SUPPORT: Rolling onto the right side of the body and using the hands to push up from the ground protects the spine as it rises to a sitting position. For some older participants, it is useful to go round onto all fours to bring themselves up without strain.

TIMING: Enjoying the experience of moving from supine to sitting in a different place mentally and physically, having paid attention to the body for a quarter to half an hour, encourages presence.

- Return to the mat and simply yawn and stretch.
- Yawning in class tends to be catching, so set up a wave!
- Encourage natural stretches one side then the other.
- Then opposite hands to feet, then same side.
- Gentle long arch and curls, feeling into the corners of the body.
- Reaching into the fingers and the toes, as they lengthen away.
- Roll onto the right side to push up into sitting.

Figure 16.9

7A Fascia Muktasana (LEGS)

PURPOSE: The purpose is to bring more detailed awareness to the longitudinal meridians in the lower limbs and free the gliding capacity of the fascial layers and tissues. It is important to practice this gently, with the sense of a yawning stretch, while remaining within personal elastic limits. Done with supervision, to avoid over-straining, this is the most valuable "flossing the tissues" experience. It frees the fascia, layer by layer, according to how it is in the individual. An excellent cue is to ensure the felt sense of pushing floor and ceiling apart (keeping the hip on the floor), so that the knee is not hyperextended and the spinal curves are not pulled. It is not about stretching the whole leg and folding it back to the head. For people who can do that easily, the task calls for more tensioning of the tissue, to experience the glide between the layers. For those who feel shortness (which they may well describe as stiffness) or adhesion, it is important to do this slowly and inquisitively to find glide and length through the lower limbs, without forceful pulling on any meridian at the expense of any other.

It is also essential to pause, both knees bent, before doing the other side, to appreciate the difference resulting from freeing the fascia. Great benefits are reported from doing this for every age group, and it has been successfully used in rehab, as it can also be done sitting up. (See **SUPPORT**.)

SUPPORT: In standard practice, the ground and the other bent leg, with foot well placed on the floor, will provide the base of support. The fingers interlocked around the back of the leg prevent over-effort in the leg. It is an exploration of tissue glide rather than an exercise in strength or reach. Range expands as the layers free themselves. In seated versions, the leg must be fully supported, folding at the hip joint, and the back upright and supported if necessary (use a block to ensure comfort in sitting upright and have the back against a wall if that encourages an easy, seated pose).

TIMING: 1–3 minutes for each variation, taken relatively gently, will pay dividends, with pauses and releases as required throughout.

- Lie on your back (see 9A, Honouring the curves).
- Press the left foot down into the ground to raise right knee to chest.
- Interlock the fingers behind the right knee and dorsiflex the foot.
- Relaxing back into the ground, press the foot towards the ceiling.
- Imagine pushing the ceiling away from the floor with the foot and …
- Simultaneously press the floor away from the ceiling with the hip.

- This naturally opens the back of the knee, keeping foot flexed.
- Gradually reach the foot to the ceiling and towards the face.
- You will feel the Superficial Back Line (Ch 12) gliding (or not) through the back of the leg as you straighten it.
- Release the foot, with a soft bend at the knee, and repeat gently.

Figure 16.10

- Then point the foot (plantarflex) strongly towards the ceiling.
- Gradually reach the foot to the ceiling and towards the face.
- You will feel the Superficial Front Line (Ch 12) gliding (or not) through the front of the leg.
- Release the foot, with a soft bend at the knee, and repeat gently.
- Then flex the foot and invert it (face inward), reaching to ceiling.
- Take the foot across the midline of the body with a straight leg.
- You will feel the Lateral Front Line (Ch 12) gliding (or not) along the side of the leg.
- Release the foot, with a soft bend at the knee, and repeat gently.
- Then flex the foot and evert it (face outward), reaching to ceiling.
- You will feel the Deep Front Line (Ch 12) gliding deep to the core leg as you reach up.
- Take the inner ankle bone (medial malleolus) across the midline.
- Keeping the leg as straight as possible and towards the face.
- You will feel the longitudinal “pull” of the deep leg compartment.
- Release foot, with a soft bend at the knee, and repeat gently.
- Hug the knee to the chest, stretch the other leg away and then …
- Return both legs to the starting position observing the difference from one side to the other.
- Then repeat to other side.

Figure 16.11

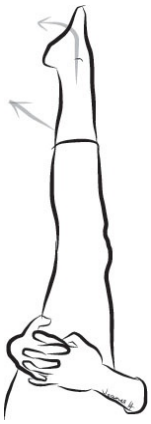


Figure 16.12

Figure 16.13

Figure 16.14

7B Fascia Muktasana (ARMS)

PURPOSE: To release and explore the limits of the Front Arm Lines, both Superficial Front Arm Lines and Deep. This facilitates glide and mobility of the shoulder joint as well as releasing common holding patterns from seated postures and activities such as driving and working at a computer.

SUPPORT: In standing practice, Tadasana supports this pose. If done in sitting (on a stool with no back) be sure to be up on the sitting bones.

TIMING: 1–10 repetitions for each variation, taken relatively gently, will pay dividends, with pauses and releases as required throughout.

- Sit comfortably in an upright posture with space around you, or …
- Stand in Tadasana, with feet hip-width apart.
- Take the arms out to the sides at shoulder height, palms down (Fig 16.15).
- Gradually rotate the hands behind (Fig 16.16), leading with the thumbs.
- Keeping the length from hand to hand across the torso, as you rotate.
- Gently allow the thumbs to lead the breast bone up into an arch.
- Hold the elastic limit of the rotation and gradually reverse (Fig 16.17).
- Leading with the little finger, reverse by turning the hands forward.
- Maintaining the length from hand to hand across the torso, rotate.
- Allow the back to round slightly.
- Feel the rotation of the hands curl the spine.
- Release the hands down by the sides and find centre in Tadasana.
- Stand in Tadasana with feet hip-width apart (Fig. 16.18A).
- Clasp hands behind you at sacrum and interlock the fingers, forefingers together.
- Rest the hands on the sacrum, so that the elbows are bent.
- Inhale gently and do nothing, relaxing the arms and shoulders.
- With the exhale (Fig. 16.18B), begin to point downward over the sacrum and …
- Squeeze the wrists, elbows and shoulder blades together.
- Squeeze the breath, pressing the feet down and crown upwards.
- Release the breath with the arms and relax back to start position.
- Repeat as required (working up to 10).
- Variation on this includes folding at the hip in forward bend.
- Allowing the long arm position to continue to arc over the head.
- This is quite advanced so please move arms forward without force.

- Let the arms drop back before unrolling the body back to standing (Tadasana).

Figure 16.15
Start position.

Figure 16.16

Figure 16.17

Figure 16.18A
Inhale

Figure 16.18B
Exhale

8 Ears to the Ground

PURPOSE: The purpose is to bring more detailed awareness to the feet and enhance proprioception and "ground control". The feet are our ears to the ground. The more detailed and "literate" they become, the more articulately they respond. We will go on to explore using the feet to guide us in activating the myofascial meridians. This preparation is valuable for gradually improving co-ordination of the toes and physical literacy in the feet. A 10 minute weekly practice of these exercises transforms the ability to do them over 3–12 months. They seem to provide a disproportionate confidence in the body, compared to the apparently small scale of the achievement. Since the feet have to "understand us" all day long, this offers an opportunity to encourage them to be more refined and detailed in their feedback signals to the rest of the body. I am convinced it prevents falling and, when a fall is inevitable, it seems to encourage bounce! Try balancing and rocking on the feet in standing before you do the other side. The difference is obvious and palpable between the two feet before/after.

SUPPORT: Ideally this is done barefoot.

TIMING: This can be done 5–10 times for each exercise.

- Use a block under the sitting bones to ensure comfort in sitting upright.
- Alternatively have the back against a wall to encourage an easy seated pose.
- Sit up on sitting bones, avoiding slump.
- Massage one foot in a seated position, including the whole foot and ankle.
- Place the fingers of the opposite hand between the toes and hold.

- Place one foot on the floor speading the toes (A).
- You can hug the knee for comfort as you “talk to your toes”.
- Lift and lower the big toe on its own, move side to side (B).
- Place the big and little toe down and lift/lower middle three (C).
- Raise all five toes up (D), lowering just the big and little toe alone.
- Attempt to move the second, third, fourth toes on their own (E).
- Drum the toes, seeking to lower them one at a time to the floor.
- Repeat on the other side.

Figure 16.19

9A Honouring the Curves: Tadasana

PURPOSE: The purpose of this is to rediscover the sense of the primary and secondary curves in standing, to develop the self-sensing of a long torso, able to create space throughout its length. It also honours the subtle postural changes of the breath (Ch.14) and permits the confluence of breath and bones in their soft tissue architecture. It becomes relaxed and beautiful, without stiffness or discomfort. It takes practice but is worth exploring for the sensory refinement that naturally accumulates as the extra exhale is explored and released.

SUPPORT: This comes from the ground; the feet are consciously pressing into it but attentively, rather than forcefully. It is very rewarding, with practice, as the body quietly finds confidence and restfulness without strain, revealing its tensional integrity in this natural and easy pose that actually is not so natural or easy at first.

TIMING: This can be at the discretion of a teacher but 1–2 minutes may feel a lot initially. Ensure participants are not over-breathing. This is a subtle animation of the previous asana and is, in some practices, considered to be an advanced pose. Stillness in standing takes practice. If it is to specifically encourage primary and secondary curve recognition it can be used as a repeated reference.

- Stand in Tadasana, with feet hip-width apart and activated.
- Spread into the toes and find the ground through the foot.
- Find the sense of going down (via feet) to go up (via crown).
- Imagine the pelvis as a tilted heart shape, slightly anterior (Fig. 16.20).
- Imagine the first ribs as a tilted heart shape, (see image).
- Align the centres of the two heart shapes, over each other.
- Sense the curves as a wave from ground to crown and breathe.
- The inhale expands, the exhale waves and lengthens the torso.
- The “heart-shapes” stay over each other, their centres aligned.

Figure 16.20

This is less fanciful than it might first appear. If you look at a classroom skeleton, the pelvic ring and the first ribs appear as tilted heart-shapes if you stand in front of them. This cue is very easy for participants to follow and even inexperienced members of class can bring about a lovely and easy-to-remember poise in upright posture; standing or sitting.

9B Honouring the Curves: From the Diaphragm

PURPOSE: The purpose of this is to become conscious of the breathing, integrated psoas and diaphragm relationship. It also honours the lumbar curve and allows the somatic sense of the breathing movement to filter through the pelvis. This should not be forced. Again, these are micro-movements to encourage elasticity. The sensation is to allow natural elasticity at the hip to be revealed, gently observing the swing and breathing rhythmically.

SUPPORT: This comes from the ground under the standing foot (a block) and the hand on the wall or bar, resting gently so the body does not activate balancing as such. This is not a leg raising or swinging exercise. It is a subtle observation of how we breathe down into the legs, via the lumbar spine, and experience the spine with their movements.

TIMING: This can be done for a minute or two and repeated, but is not advised for long periods on each side as it can, at first, feel unbalanced before both sides are animated.

CONTRAINDICATIONS: Participants should try this only after 9A, especially if they are sedentary or experiencing lumbar pain. It can help to relieve it; however, the return to standing must be cautious and attentive.

- Stand on a block, one foot centred, with a hand on the wall.
- Find an easy Tadasana, on the standing foot, knee “unlocked”.
- Allow the other foot to hang off the block.
- The hanging foot often begins to swing very slightly.
- Feel the swing, the wave of the breath, and allow the foot to hang.
- Gradually find the sense that the foot hangs from the diaphragm.
- The swing is small, effortless, feeling the curves through the spine.
- Take attention to the length of the torso, subtle micro-movement.
- Release gently, standing down from the block to feel the two sides.
- Repeat to other side, preparing attentively and using the wall.

Figure 16.21

10 Simple Standing Rotation

PURPOSE: The purpose is to guide the body gradually into rotation to give the spine kinaesthetic information as to its rotational, elastic limits. Do not force any twist. Remain clear where the ground is and have the sense of rotating in a spiral to facilitate smooth gliding rotations throughout. Gradually, over time, this facility accumulates in the spine, without force and without compromising the natural lumbar and cervical curves. The effort is in fluid slide rather than range.

SUPPORT: This comes from the feet. The back of a chair can be used, releasing the leading hand (i.e. to the side or direction of the rotation) as the twist is completed and bringing it back to the chair by return and changing sides.

TIMING: Three repetitions or rounds, with a few seconds holding (as above) can be built to more with longer holds. However, the point is to free and release the spine.

- Stand in Tadasana, preparing to rotate up and down the joints as follows:
- Gently turn only the ankles over the foot, to the right …
- Then the knee over the ankles, the hip over the knee …
- Then the ribs over the hips, the shoulders over the ribs …
- Then the chin over the shoulders, cheek bones over chin, eyes over cheeks.
- Look around behind you, softening the stance, feet planted, and keep the breath even and soft.
- Hold for 30–90 seconds, relaxing.
- Return through the joints in reverse order; that is, eyes to centre …
- Then cheeks, then chin, then shoulders, then ribs, then hips …
- Then knees, then ankles over feet and back into Tadasana.
- Rest in Tadasana and repeat joint by joint to the other side.

Figure 16.22

Figure 16.23

11 Sun Salutation *(see Ch. 20)*

PURPOSE: The purpose is to integrate all the different practices into a conscious sequence, with fluid transitions and integrated breathing movements. The body stays in communication with the ground and naturally responds to it. Speed accumulates; however, quality of movement through transition is paramount and will soon become more elegant as the body moves from contained relaxed structural integrity.

SUPPORT: This comes from the relationship that develops with the ground, through the hands and feet in all the postures of the sun salutation. It also becomes part of our torso strength and containment, as the breath is followed with fluid grace. Music can be very helpful to find the natural rhythm and help the body to drop into its instinctive movement.

TIMING: One or two rounds of Sun Salutation (Surya Namaskara) after a long practice can be very rewarding. Over time this can be built up; however, supervision is advised if any difficulty is experienced. Sun Salutation (Surya Namaskara) is a gift, rather than a challenge. It can bring energy to the awakened tissues and benefits from conscious preparation.

- Choose your own favourite Sun Salutation or use the one detailed in Chapter 20.
- Stand comfortably at the front of the mat.
- Carry out your favourite Sun Salutation (Surya Namaskara).
- Experience the congruent flow of the breathing and also …
- The contained wave of the spine, from ground to crown.
- This is an opportunity to gently put all the above into practice.
- You can slowly increase the number of moves incorporated and the number of repetitions.
- Chapter 20 includes a Posture Mandala of this part of the practice.

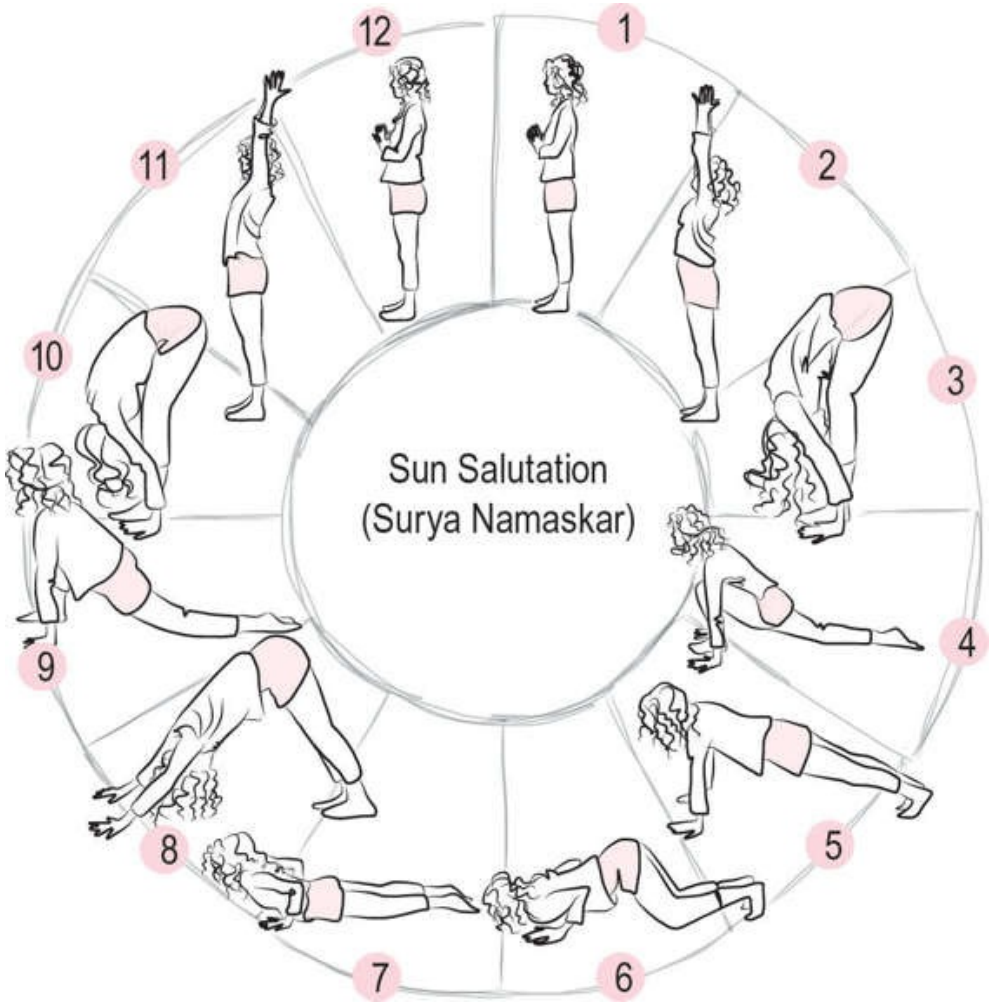


Figure 16.24

12 Pranayama and Shivasana *(see Ch. 18 for further meditation)*

PURPOSE: The purpose is to begin the practice of stillness and contemplation as a preparation for meditation. It is partly to allow the body to simply "be": focusing the mind on moving the breath in subtle ways, while relaxing in a clear still position that eventually becomes effortless.

SUPPORT: This comes from the base position, the cross-legged pose or the block/cushion and/or the wall if it is used. Be sure to stay up on sitting bones, or even use a chair to start with, until the body is used to stillness. Meditation is not necessarily easy, however simple it may look. The body responds to loading patterns and it takes time to accumulate attentive stillness in a balanced body. That is the point.

TIMING: To begin with, this can be done for 3–5 minutes, building slowly. Supple joints and improved comfort in sitting are two of the many benefits of this deceptively simple series.

- Sit comfortably on your sitting bones, with legs crossed.
- Use a block for added comfort or lean against the wall, upright.
- Close the eyes and let the tongue rest on the roof of the mouth.
- Inhale and exhale through the nose, breathing gently, no force.
- Feel the coolness of the inhale at the tip of the nostrils.

- Invite the breath in and up via the crown to the 12-finger point (Fig. 16.25).
- Hold the inhale for a moment, then allow the exhale to drop down.
- The sense is that the exhale drops down the front of the spine to the ground, below the sitting bones, spreading down/out as roots.
- Invite a quiet pause at the end of the exhale, squeeze the breath.
- Release the breath (inhale) and continue smoothly through inhale.
- Allow this to travel upward, through the crown to the 12-finger point and repeat.
- Pause for easy breathing at any point.
- Ensure that the eyes remain still, quietly closed, without following breath.

Figure 16.25

Shivasana

Figure 16.26

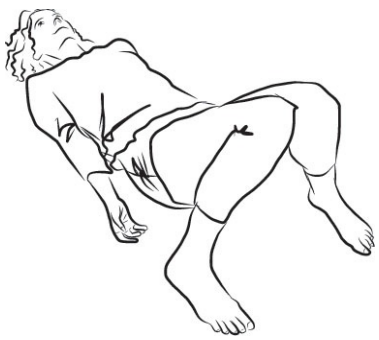


Figure 16.27

Figure 16.28

Figure 16.29

Figure 16.30

Ensuring the body will remain warm, lie down for Shivasana (Options Figs.16.26 16.29).
If the back is at all uncomfortable after a class, a participant may prefer to return to the start position, with knees bent and softly resting on each other, or placing a cushion under the knees if they are lying supine. Otherwise side lying, with a small pillow at the head may be preferable. If a participant has to leave a class early, it is recommended that they take a 3–5 minute rest such as this before going, rather than skipping this important stage of assimilation of the practice. A brief period of sitting up quietly to re-orientate after Shivasana is also recommended.

Please note, this sequence is part of a Restorative Yoga class and has been used thus for many years for people ranging in age from 8 to 84 years, including participants who are pregnant and others with a variety of conditions. However, there is a clear caveat that anyone suffering from disc herniation should not do the spinal twists. In all cases, any injury is specifically supervised and this sequence, like any other, does not replace the medical advice of a doctor or suitably qualified practitioner.

Notes

1. *Hatha Yoga Pradipika (1:17)*
2. Serge Gracovetsky's spinal engine theory (see Ch. 7, notes and suggestions for further reading).
3. B.M. Nigg, "The Role of Impact Forces and Foot Pronation: A New Paradigm", Clinical Journal of Sport Medicine 11(1):2–9; 2001. Human Performance Laboratory, Faculty of Kinesiology, University of Calgary, Alberta, Canada.
4. James Oschman, private conversation 2011 and part of his workshop presentations. For further information see: James L. Oschman, "Fascia as a Body-wide Communication System", Ch. 2.5 in Robert Schleip, Thomas W. Findley, Leon Chaitow and Peter A. Huijing, *Fascia: The Tensional Network of the Human Body*, Churchill Livingstone/Elsevier, Edinburgh, 2012.

PART THREE

Illuminating intuitive awareness: integrating the new paradigm

CHAPTER
17

Freeing the Fascia from Within

"True yoga is not just doing a posture as dictated by outside robotic influences, but more an observation from within at what happens in the body along the journey … No matter how still we think we are there is always a tiny movement somewhere inside, visible only to us, I think it is called life … Just become quiet enough in the thinking brain to observe movement that is happening in the physical body. Relaxing – truly relaxing is becoming quiet, watching the pattern of the breathing and keeping your attention there until the pattern of the breathing takes over and governs the movement within. This is where the stillness in yoga comes from, not doing a movement but observing the movement that happens with the breath … In the hustle and bustle of everyday life we don't have time to observe this deep movement, we're doing not being. It's like abseiling down the thread of breath."[1]

Patricia Mary Sparrow (12 March 1935 – 13 April 2006)

We can begin to "abseil down the thread of the breath" once we feel at ease enough to observe it and be present to it. This chapter is focused on the more subtle practices of yoga and seeks to provide a practice that can:

- free the internal channels of the subtle body, symbolised by the chakras (see Ch. 20)
- free the fascia of the joints to allow the subtle energies to flow more fluently and the tissue to glide and hydrate
- facilitate our sensory refinement through micro-movements and attention to the breath at the same time.

The term Pawanmuktasana means "freeing the winds".[2] It refers to the vayus (winds) or pranas of the subtle body defined in Chapter 15. These form part of the practice of Pranayama and here they unite with the movements until the rhythm of the breath takes over. The actual techniques facilitate several things at once.

Foundation	Practice

1	Toes
2	Ankles A
3	Ankles B
4	Ankles C
5	Knees A
6	Knees B
7	Knees C
8	Knees D
9	Hips A
10	Hips B
11	Pelvis and Spine
12	Fingers
13	Wrist A
14	Wrist B
15	Elbow A
16	Elbow B
17	Shoulder A
18	Shoulder B
19	Arm Reach
20	Neck and Head A
21	Neck and Head B
22	Neck and Head C
23	Neck and Head D
24	Shivasana

The gentle rotations, flexions and extensions through the joints free the fascia in every direction, without straining. When these movements are united with the breath, the respiratory rhythm can take over and we begin to be present to the motion. There is also a sense of stillness in those parts that are not moving. The exercise is to divide our attention between the part of the body that is moving (see sequence below) and the remainder, which is still. Eventually the breath unites both parts. Once that happens – when we arrive at this sense of "abseiling down the thread of the breath" – something else begins to occur. It is as if our vitality, the essence of the being, is nourished.

By doing Pawanmuktasana regularly, the stillness of awareness and the dynamic balance of our attention are trained simultaneously. Each movement calls for attention divided between, on the one hand, the joint being gently and rhythmically released and simultaneously, on the other, the steadiness of the rest of the body to quietly support it. It is the physical practice in present time, bringing together all the polarities we have referred to throughout the book. We are becoming the witness; observing and facilitating *sthiram* and *sukham* together in present time: awareness and breath. Just breathe and be aware in rhythm with the ten movements in each set. (Unity is the theme behind this practice and also behind the number ten, as we will see in Ch. 20.)

Resting tension, or elastic integrity, is naturally fostered by this first Pawanmuktasana series. Whatever one's age or level of skill, the result seems to be the same: a gradual improvement in seated and standing posture and in the ability to integrate the movements with the breath and develop a self-practice with ease. It is as if the fascia is freed from within, which is exactly the purpose of this subtle practice.

As participants become adept, the rhythmical breathing and movements begin to resonate in unison expressing exactly what yoga means. It is a deceptively simple and humble practice. It takes courage to bring the mind to calm and continue doing it on a regular basis. It is designed to draw the attention away

from thinking and conceptualising and gradually invite the space (literally and symbolically) of our inner sense to develop.

We begin to find the *spaces between* our thoughts by transitioning along the breath and focusing gently on this, in rhythmical listening. If the mind wanders, as it is inclined sometimes to do, as soon as this is noticed, simply and gently return the attention to the breathing movements. Over time, the mental commentary switches off sooner and the body more readily becomes a quiet reflection of the being. Then we have choice as to how we can be, still or in motion, at will.

The Practice

There is no fanfare or celebration with this quiet approach. We are building a bridge between active postures and at the same time feeding the suppleness and self-containment needed to sit in meditative stillness, which we will explore next. This happens as a result of the fascial matrix working in all its many aspects. It takes us towards attaining the natural ability to self-regulate and enjoy moving, breathing and stillness with quiet integrity, as appropriate. Perhaps there is a clear correlation between the micro-movements of the body and the subtle awareness of the being? Yoga practice suggests this, and since the fascia is our largest sensory organ, it would naturally benefit from the soothing focus of these rhythmical movements. They begin to resonate in their own way, with the subtle rhythm of the compliant breath.

This series has been devised partly as a result of working with the foundation postures described in Chapter 15 and partly also using adaptations from the Bihar School of Yoga[3] series (Pawanmuktasana Foundation).[4] It has been taught to a variety of age groups and, once individuals can overcome the mind-chat and surrender to the rhythmical movements, natural comfort in sitting seems to be the most common experience.

This practice also demonstrates therapeutic value for a multitude of problems involving the shoulders, hips, neck and so on, by integrating parts of the body that have become isolated through pain or injury. At first there may be a slight “pins and needles” sensation from leaning back on the heels of the hands; if this happens release the hands regularly and gently shake them out or rub them together, resting as frequently as needed. Also sit comfortably on a cushion, supporting the back of the knees if necessary, until the ability to sit becomes more established. It takes time but it is worth accumulating this quality of stillness in our loading history. The spine responds well and seems to be able gradually to enjoy sitting naturally and expressing its curved design in easy breathing. It is a subtle practice and, if the fascia responds to micro-movements in its loading history, this series optimises their benefits gradually and efficiently from the inside out.

Participants report an inner sense of calm and a greater ease or cumulative comfort with various functions, from breathing and digestion to movement and sleeping. It is an excellent preparation for meditation.

Foundation Practice (Pawanmuktasana)

(Adapted from the teachings of Swami Satyananda Saraswati, Bihar School)[5]

This foundation practice is recommended to begin with to bring any student into a place of self-awareness while reaping the benefits of strengthening the body. Regular resting periods between the postures are advised, sitting in the base position, observing the breath and pausing as necessary. It is also ideal as part of the preparation for (though not immediately before!) peak performance activities (such as

sports or events like going on stage, for example) and after illness, particularly stress or tiredness. It is suitable for all age groups and all levels.

1 Toes

PURPOSE: The purpose is to bring more detailed awareness to the feet and free the joints of the lower limb. Have the arms straight but relaxed behind you and rest back supported by them. Remain long in the torso so the breath is clear and you can engage through the inhale and extra-exhale cycle as you curl and flex the toes.

SUPPORT: This comes from the base position, particularly the hands. At first there can be mild pins and needles in the hands. If so, release them periodically and rest between the rounds. With regular practice, they will easily support you.

TIMING: To begin with this can be done 5 times with focus on the feet and 5 times more integrating the breath. As the choreography of the Foundation Practice becomes familiar, you can go straight to the integrated breathing and increase the number of rounds to 15. The point is not to rush through and beat the clock. It is to experience the body freeing each joint and strengthening as it does so. Supple joints and improved comfort in sitting are two of the many benefits of this deceptively simple series.

Figure 17.1A
Base position.

- Sit comfortably on your sitting bones, hands behind you, as shown (Fig.17.1A).
- Have the heels resting a little more than hip-width apart.
- Dorsiflex the feet so they are at right-angles to the ground.
- Focus on the toes and simply dorsiflex them together towards you.
- Then plantarflex them away from you, by curling them down.
- Isolate the movement to the toes only, if you can, for 5 rounds (Fig.17.1B).
- Then add the breath, inhaling the toes up, exhaling toe curls.
- Do this in sequence with the breath for 5 rounds, working up to 10.

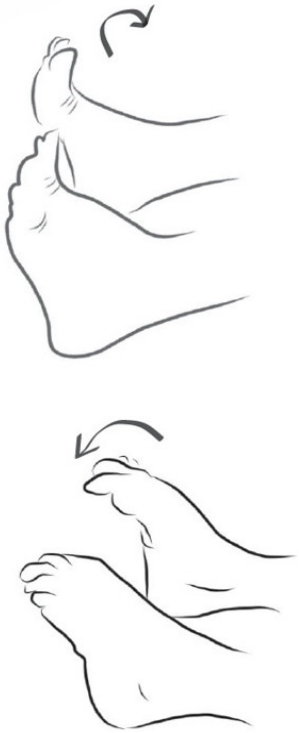


Figure 17.1B
Exercise

2 Ankles A

PURPOSE: The purpose is to bring more detailed awareness to the ankles and free the joints of the lower limb. Have the arms straight yet relaxed behind you. Rest back supported but long in the torso so the breath is clear and you can engage through the inhale and extra-exhale cycle as you move the ankle joint.

SUPPORT: This comes from the base position, particularly the hands. At first there can be mild pins and needles in the hands. If so, release them periodically and rest between the rounds. In time, with regular practice, they will easily support you.

TIMING: To begin with this can be done 5 times with focus on the feet and 5 times more integrating the breath.

- Sit comfortably on your sitting bones, hands behind you.
- Have the heels resting a little more than hip-width apart.
- Dorsiflex the feet lengthening into the heel opening the back knee.
- Then point the toes in plantarflexion.
- Isolate the movement to the ankles only if you can, for 5 rounds.
- Then add the breath, inhaling in dorsiflexion, exhaling as you point.
- Do this in sequence with the breath for 5 rounds, working up to 10.

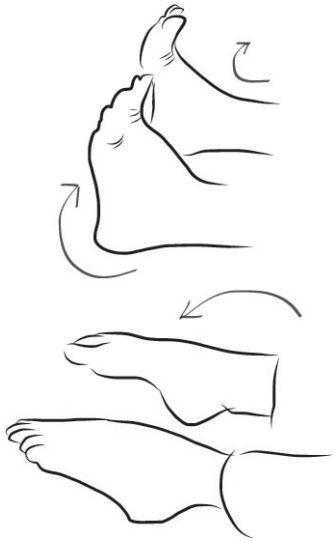


Figure 17.2A and B

3 Ankles B

PURPOSE: The purpose is to bring more detailed awareness to the ankles and calves and free the joints of the lower limbs. Have the arms straight yet relaxed behind you. Rest back supported but long in the torso so the breath is clear and you can engage through the inhale and extra-exhale cycle as you circle the ankles and explore smooth movements. The key to this is finding smooth even movements throughout the range, rather than jerky, clicky motions. It takes practice.

SUPPORT: This comes from the base position, particularly the hands.

TIMING: To begin with this can be done 5 times with focus on the ankles and 5 times more integrating the breath for each round. Eventually 10 times with the breath is sufficient. It is an excellent practice for strengthening ankles while maintaining suppleness.

- Sit comfortably on your sitting bones, hands behind you.
- Have the heels resting a little more than hip-width apart.
- Circle both ankles clockwise for a complete round.
- Circle both ankles anti-clockwise for a complete round.
- Circle both ankles away from centre, for a complete round.
- Circle both ankles towards the centre, for a complete round.
- Isolate the movement to the ankles only if you can, each 5 rounds.
- Then add the breath, inhaling the upper half, exhaling the lower.
- Do this in sequence with the breath for 5 rounds, working up to 10.

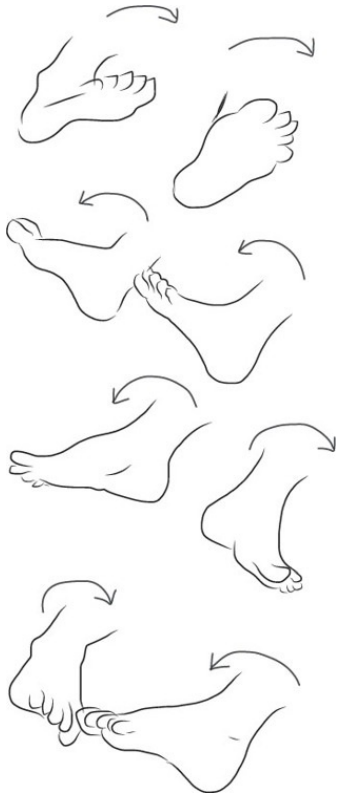


Figure 17.3

4 Ankles C

PURPOSE: The purpose is to passively encourage a meditative sitting position and free the joints of the lower limb. Have the right hand support the ankle and remain tall. Stay long in the torso so the breath is clear and you can engage through the inhale and extra-exhale cycle as you make the circling movements with the leg in this position.

SUPPORT: Support the ankle with the same hand and work gently but firmly with the opposite hand, encouraging range of motion without force. Support is in the torso now, so ensure you are sitting upright. (Use a block if it helps, preferably a low one to avoid hyper-extending the knee of the outstretched leg.)

TIMING: To begin with this can be done 5 times with focus on the circling motion and 5 times more integrating the breath. Later you can do 10 with the breath only.

- Sit comfortably on your sitting bones, or use a block to sit up.
- Take your right foot and cross it over your left thigh.
- Place your left fingers between your toes, or hold the foot.
- Gently circle the ankle, using the hands and relaxing the foot.
- Then circle the other way.
- Isolate the movement to the ankle only if you can, for 5 rounds.
- Then add the breath, inhaling the upper circle, exhaling lower.
- Do this in sequence with the breath for 5 rounds, working up to 10.

- Repeat to other side.

Figure 17.4

5 Knees A

PURPOSE: The purpose is to strengthen the upper leg and ensure support around the knee joint. Have the arms straight but relaxed behind you and rest back supported by them. Stay long in the torso so the breath is clear and you can engage through the inhale and extra-exhale cycle as you squeeze the knees.

SUPPORT: This comes from the base position, particularly the hands (Fig.17.1A).

TIMING: To begin with this can be done 5 times with focus on the feet and 5 times more integrating the breath. Eventually 10 with the breathing cycle is sufficient within the series.

- Sit comfortably on your sitting bones, hands behind in basic pose.
- Have the heels resting a little more than hip-width apart.
- Squeeze the knee caps up, so that the front of the leg engages.
- Hold the squeeze for a count of 5.
- Then release.
- Isolate the movement to the knees only if you can, for 5 rounds.
- Then add the breath, inhaling and holding the breath on squeeze.
- Do this in sequence with the breath for 5 rounds, working to 10.

Figure 17.5

6 Knees B

PURPOSE: The purpose is to strengthen the legs and abdomen, integrating the breathing pattern. Eventually this pose can be done with both legs at the same time, finding "Boat Pose" (Navasana), but this should not be attempted until there is established strength and this version is easy. Please note contraindication (below).

SUPPORT: This comes from the extended leg and the sitting bones and, eventually, from accumulated abdominal integrity. The arms are quite strong in this pose and should not be pulled into a slouched position.

TIMING: To begin with this can be done 5 times with focus on the straight leg and strong arms and 5 times more integrating the breath. The extra exhale is designed to help stabilise the lumbar spine and strengthens it by doing so.

CONTRAINDICATION: The advanced version of this practice with both legs is not recommended for people with weak abdominal muscles, lower back issues, high blood pressure or heart conditions. Over time, this sequence can strengthen the lumbar spine and abdominals but it is strongly advised that it is only attempted on one side at first and with few repetitions until strength is established.

- Sit comfortably on your sitting bones, hands round one thigh.
- Bend this knee, with foot flat to the floor, other leg flat and long.
- Straighten the leg out in front of you, holding it up with the hands.
- Focus on knee joint and hamstrings as you bend the leg to release.
- Isolate the movement to the knee and leg if you can, for 5 rounds.
- Add the breath, inhaling the foot down, exhaling it straight up.
- Do this in sequence with the breath for 5 rounds, working to 10.
- Change sides and do the other leg.

Figure 17.6

7 Knees C

PURPOSE: The purpose is to strengthen the tissues around the knee joint and assist its support structures, as it bears a great deal of weight and organisation. “These asanas rejuvenate the joint by activating the healing energies”, according to the Bihar School.

SUPPORT: This comes from the straight (other) leg and the hands. Use them around the leg you are working with, to “hold” the torso straight. You can interlock the fingers, or cross the arms holding the elbows. The focus is on glide rather than range.

TIMING: To begin with with this can be done 5 times clockwise focusing on the quality of the circular motion, and 5 times more integrating the breath. Then increase to 10 when you feel confident and the knee strengthens. Please avoid this practice unless specifically supervised if you have knee issues.

Figure 17.7

- Sit comfortably on your sitting bones, holding one leg up with the hands. (Fig.17.7).
- Describe a gentle circle with the foot without strain.
- Don’t force the knee. This is designed to encourage movement.
- Focus on the circles, seeking to straighten the leg at the top.

- The upper leg and torso should remain still, the circles smooth.
- Isolate the movement, if you can, for 5 rounds each direction.
- Then add the breath, inhaling the upper half, exhaling lower.
- Do this in sequence with the breath for 5 rounds, working up to 10.

8 Knees D

PURPOSE: The purpose is to facilitate comfortable sitting positions, cross-legged for example, with freedom between the knee and the hip joint. After performing this exercise, take care to straighten the leg partially with the hands, bend it back to a folded position (heel at the groin if possible) and then straighten it out completely to ensure the knee joint is aligned correctly.

SUPPORT: This comes from the (other) straightened leg and sitting up on the sitting bones, without slumping in the spine.

TIMING: To begin with this can be done 5 times, with focus on the knee and hip relationship, while integrating the breath. Once strengthened and adaptable, this posture can be extended to add small pulses at the bent knee and an increased range at the "opened" hip joint. 10–20 pulses (not forced and not as strong as bounces) are sufficient to encourage the hip to release, if it can do so without strain.

Figure 17.8

- Sit comfortably on your sitting bones, one foot on thigh, as shown (Fig.17.8).
- Breathe in gently and lift this knee to the chest.
- Exhale and gently press it away from the body towards the floor.
- The torso remains still and no force should be used.
- The same-side hand does the work rather than the leg – it is passive.
- Do this in sequence with the breath for 5 rounds, working up to 10.
- Gently straighten the leg then place heel against the inner thigh.

- Then lay the leg out straight and lengthen fully, to align the knee.

9 Hips A

PURPOSE: The purpose is to bring more detailed awareness to the leg joints and free the hip. As the knee and hip become supple, you can rest the ankle on the opposite leg and circle the knee with the hands. Stay long in the torso, so the breath is clear and you can engage through the inhale and extra-exhale cycle as you rotate at the hip.

SUPPORT: This comes from the base position and the hands/arms holding the rotating leg.

TIMING: To begin with, this can be done 5 times with focus on the hip circles then 5 times more integrating the breath, working up to 10.

- Sit comfortably on your sitting bones, folding one leg.
- Hold the outside of that knee, cradled in the same side arm.
- Cradle the ankle joint in the other arm as above.
- Use the arms rather than the leg, which remains passive.
- Circle at the hip joint clockwise, then anticlockwise, 5 times.
- Isolate the movement at the hip if you can, for these 5 rounds.
- Then add the breath, inhaling the upper circle, exhaling lower.
- Do this in sequence with the breath for 5 rounds, working up to 10.
- Repeat on the other side.

Figure 17.9

10 Hips B (Fig. 17.10)

PURPOSE: The purpose is to prepare the body for seated postures and relieve tension in the groin from long hours of sitting, standing or walking. These postures can relieve tiredness after long hours on your feet at work.

SUPPORT: This comes from the base position, which gradually becomes optimal as the heels move closer to the pelvis. Be sure to sit up (using a block if necessary) and place the heels together in front of

you where they are comfortable. As more range is introduced at the hip joint, they can come closer to the body.

TIMING: This must be done without force, always respecting the knees and hips and not pressing on them too hard. It is to invite and encourage a subtle impulse rather than a bouncing force. 30 times is a sufficient maximum.

CONTRAINDICATION: This posture is not recommended for anyone with sacral issues and/or sciatica.

- Sit comfortably on your sitting bones; place the feet together.
- Hold both feet in the hands, pressing the heels together.
- The heels should be as close to the perineum as possible.
- Relax the inner thigh muscles completely.
- Hook the fingers around the big toe to seal the posture.
- Gently raise and lower the knees 20–30 times, breathing normally.
- Gently press the knees down 20–30 times if you are comfortable.

Figure 17.10

11 Pelvis and Spine

PURPOSE: The purpose is to feel the ground in the seated position and invite a rotation from it, without force. It can be nice to fold forward over the legs after this and rest for a minute or two, if that is comforting.

SUPPORT: This comes from the base cross-legged position. It is used to engage downwards and experience the upward sense of rotation. No force is required. It is an enquiry to ask how the spine is right now and encourage the optimal and natural lumbar curve in sitting.

TIMING: To begin with this can be done 5 times to each side, working up to 10.

- Sit comfortably with legs lightly crossed on the floor.
- Find the sitting bones and use the legs to sit up “tall”.
- Inhale and do nothing. On the exhale, rotate the torso to the right.
- Gently continue until the head is looking over the right shoulder.
- Inhale as you come back to centre, then exhale the other way, till head is looking over left shoulder.
- Do not force this rotation. It is an enquiry not a challenge.
- Cross the legs the other way and repeat to each side.
- Do this in sequence with the breath for 5 rounds, working up to 10.

Figure 17.11

12 Hand A: Stretch and Squeeze

PURPOSE: The hands are considered to be on the heart line, growing from the embryonic torso to wrap around it. This opens the energy meridians through the arm and thorax and it is surprisingly demanding. To add a variation to this asana, it can be done with the arms out to the side at shoulder level.

SUPPORT: This comes from the base position, particularly cross-legged. It is important to be comfortable sitting upright, so that the heart is open. If the arms tire quickly at first, rest them beside or behind you between practices.

TIMING: To begin with this can be done 5 times with focus on the hands and 5 times more integrating the breath. Work up to 10.

- Sit on your sitting bones, in base position or cross-legged.
- Use a block if preferred, to rest comfortably.
- Reach the hands out in front of you as shown (shoulder level).
- Stretch the hand and fingers apart, palms facing (Fig.17.12).

- Then squeeze the hand into a fist, thumb inside the fingers.
- This is slow and deliberate but strong, for 5 rounds.
- Then add the breath, inhaling the hand open, exhaling closed.
- Do this in sequence with the breath for 5 rounds, working up to 10.

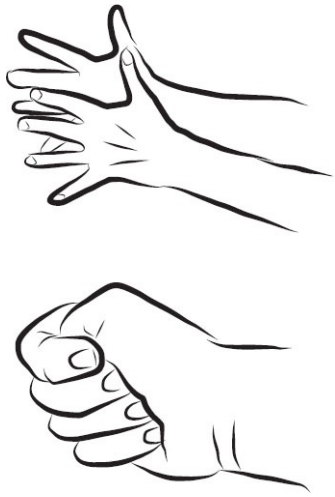


Figure 17.12

13 Wrist A

PURPOSE: The hands are considered to be on the heart line, growing from the embryonic torso to wrap around it. This opens the energy meridians through the arm and thorax and it is surprisingly demanding. To add a variation to this asana, it can be done with the arms out to the side at shoulder level. It is designed to facilitate glide at the wrists and strengthen the arms.

SUPPORT: This comes from the base position, particularly cross-legged. It is important to be comfortable sitting upright, so that the heart is open. If the arms tire quickly at first, rest them beside or behind you between practices.

TIMING: To begin with, this can be done 5 times with focus on the hands and 5 times more integrating the breath. Work up to 10.

- Sit on your sitting bones, in base position or cross-legged.
- Use a block if preferred, to rest comfortably.
- Reach the hands out in front of you as shown (shoulder level).
- Keep the palms open and fingers straight and touching each other throughout the practice.
- Press the hands up (as if against a wall) then point fingers down (Fig.17.13).
- Elbows are straight and so are the hands. Do this for 5 rounds.
- Then add the breath, inhaling the hand up, exhaling down.
- Do this in sequence with the breath for 5 rounds, working up to 10.

Figure 17.13

14 Wrist B

PURPOSE: The hands are considered to be on the heart line, growing from the embryonic torso to wrap around it. This opens the energy meridians through the arm and thorax and it is surprisingly demanding. It helps considerably if you have spent a long day at the keyboard, or working with the hands, as it relieves unnecessary tension and encourages gliding and hydration in the wrist joint.

SUPPORT: This comes from the base position, particularly cross-legged. It is important to be comfortable sitting upright, so that the heart is open. You can use the arm you are not practising with to support you from behind if it is easier. If the arm tires quickly at first, rest it beside or behind you between practices.

TIMING: To begin with, this can be done 5 times in each direction focusing on the hand and 5 times more integrating the breath. Work up to 10 for each hand.

- Sit on your sitting bones, in base position or cross-legged.
- Use a block if preferred to rest comfortably.
- Reach one hand out in front of you as shown (shoulder level).
- With a soft fist, thumb inside, rotate at the wrist clockwise.
- Reverse the rotation (anticlockwise) keeping wrist facing down.
- The arm should be still and the circles as large as possible.
- Then add the breath, inhaling the fist up, exhaling down.
- Do this in sequence with the breath for 5 rounds, working up to 10.
- Repeat with other hand. (Movement is isolated to the wrist joint if possible.)

Figure 17.14

15 Elbow A: Flex and Extend

PURPOSE: The hands are considered to be on the heart line, growing from the embryonic torso to wrap the arms around it. This opens the energy meridians through the arm and thorax and it is surprisingly demanding.

SUPPORT: This comes from the base position, particularly cross-legged. It is important to be comfortable sitting upright, so that the heart is open. If the arms tire quickly at first, rest them beside or behind you between exercises.

TIMING: To begin with, this can be done 5 times with the focus on the hands and 5 times more integrating the breath. Work up to 10.

- Sit on your sitting bones, in base position or cross-legged.
- Use a block, if preferred, to rest comfortably.
- Reach the hands out in front of you as shown (shoulder level).
- With palms facing up, bend the elbow to touch the shoulder.
- Then straighten the arms again, maintaining shoulder height.
- This is slow and deliberate but strong. Do this for 5 rounds.
- Then add the breath, inhaling the arms open, exhaling flexed.
- Do this in sequence with the breath for 5 rounds, working up to 10.
- Repeat the whole sequence, starting with arms to the side.

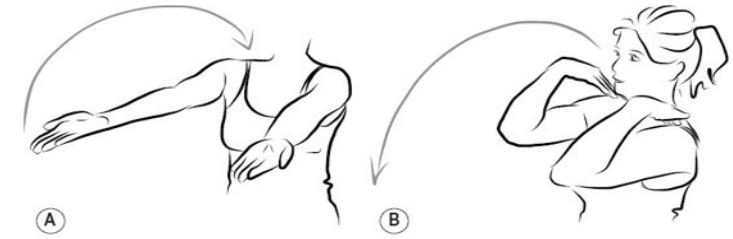


Figure 17.15

16 Elbow B: Rotation

PURPOSE: The hands are considered to be on the heart line, growing from the embryonic torso to wrap the arms around it. This opens the energy meridians through the arm and thorax and it is surprisingly demanding.

SUPPORT: With the other hand at the elbow joint, supporting the working arm to keep it steady throughout the practice, encouraging smooth circular movements.

TIMING: To begin with this can be done 5 times, with focus on the smooth movement of the elbow, and then 5 times more integrating the breath. Work up to 10.

- Sit on your sitting bones, in base position or cross-legged.
- Use a block, if preferred, to rest comfortably.
- Reach one arm out in front of you as shown (shoulder level).
- Support this arm, just above the elbow with the other hand.
- Bend the arm at the elbow, rotating the joint clockwise.
- The arm remains steady, hand brushing the shoulder.
- Do this for 5 rounds.
- Then add the breath, inhaling the arms up, exhaling down.
- Do this in sequence with the breath for 5 rounds, working up to 10.
- Repeat the smooth circling in an anticlockwise direction.
- Repeat the whole sequence with the other arm.

Figure 17.16

17 Shoulder A: Rotation

PURPOSE: The shoulder joints receive great benefit from this practice to relieve strain patterns from carrying bags, lifting, or sitting in relatively sedentary positions for work. This sequence can relieve the strain of driving and a variety of activities involving arm work.

SUPPORT: To begin with, the other arm can support the working arm. Once sitting up is comfortable and sustainable, both arms can practise together. The point is to encourage smooth circular movements through the full range so that the shoulder girdle can rest comfortably over the thorax and movement is isolated to the shoulder joint.

TIMING: To begin with, these can be done 5 times with focus on the smooth movement at the shoulder, then 5 times more integrating the breath. Work up to 10.

- Sit on your sitting bones, in base position or cross-legged.
- Use a block, if preferred, to rest comfortably.
- Reach one elbow out to the side, same hand on shoulder.
- Rotate this elbow in a large circle clockwise, smoothly, 5 rounds.
- Repeat in an anticlockwise direction, 5 rounds.
- Then add the breath, inhaling the arms up, exhaling down. circles.
- This whole sequence can then be repeated with both arms.
- Left arm on left shoulder and right arm on right shoulder.

Figure 17.17

18 Shoulder B: Squeeze Forward and Back

PURPOSE: As in the Shoulder A exercise, the shoulder joints receive great benefit from this practice to relieve strain patterns from carrying bags, lifting, or sitting in relatively sedentary positions for work. It

also helps to open the front of the body after long periods of sitting at a desk, at a computer or in a car, for example. This sequence can relieve the strain of driving and a variety of activities involving arm work and can be readily incorporated during work, as a brief interlude to prevent strain patterns.

SUPPORT: Both arms work together to sense balance of range between left and right. Ensure the spine does not fold forward when the elbows are drawn towards each other in front of the body.

- Sit on your sitting bones, in base position or cross-legged.
- Use a block, if preferred, to rest comfortably.
- Reach each elbow out to the side, same hand on shoulder.
- Keep both elbows at shoulder height.
- Squeeze elbows together at the front, pause, then to the side.
- Take elbows in a smooth movement as if to meet at the back.
- Then add the breath, inhale elbows forward, exhaling back.
- Forward and back is one round; repeat 10 rounds.
- Maintain shoulder height for the elbows and pause as required.

Figure 17.18

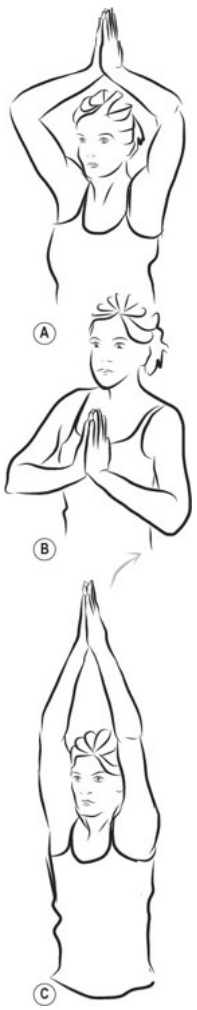
19 Arm Reach

PURPOSE: The hands are considered to be on the heart line, growing from the embryonic torso to wrap the arms around it. This opens the energy meridians through the arm and thorax and it is surprisingly demanding. It ensures a full range of motion is encouraged at the shoulder.

SUPPORT: This comes from the base of the pose. It is recommended that if you are in a cross-legged position, you change the favoured side regularly throughout the practice.

TIMING: To begin with, this can be done 5 times with focus on the smooth movement of the hands up and down, then 5 times more integrating the breath. Work up to 10.

- Sit on your sitting bones, in base position or cross-legged.
- Use a block, if preferred, to rest comfortably.
- Place the hands together in prayer and reach them over the head.
- Bend the elbows softly until the heels of the hands touch the head.
- Lengthen the hands up, to position C, then return to A.
- The hands stay in line over the crown, 5 rounds.
- Then add the breath, exhaling the hands up, inhaling them down.
- Do this in sequence with the breath for 5 rounds, working up to 10.
- There is a slight feeling of lift and extension through the spine.
- Hands remain palm to palm throughout. Rest in B as required.



Figures 17.19A and B

20 Neck and Head A

PURPOSE: The purpose is to relieve tension and free the tissues of the neck. All nerves connecting the different organs and limbs pass through the neck and the myofascial layers and organisation can hold extra tension and be over-recruited by disorganised posture. These asanas are designed to free their mobility;

however, they must not be forced. There are delicate structures in the neck and subtle mobility and sensory refinement is sought rather than length or range for the sake of it.

SUPPORT: This comes from the base position, particularly the hands. Be sure to use the hands for support if necessary. Otherwise sit up “tall” as the first secondary curve is essential to the natural efficacy of these movements.

TIMING: To begin with, this can be done 5 times with focus on integrating the breath and sensing balance. Work up to 10 rounds.

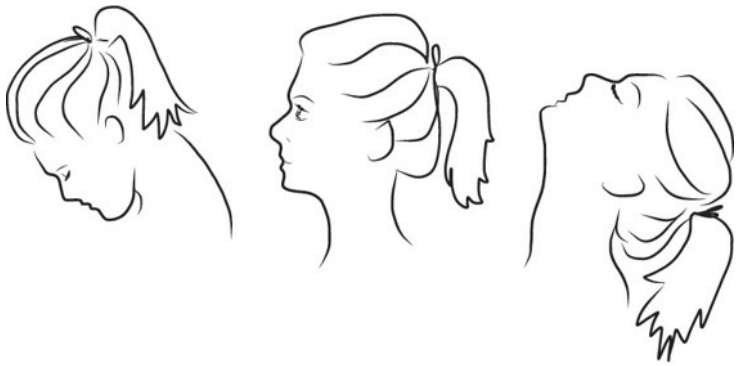


Figure 17.20

- Sit comfortably on your sitting bones, hands behind you as shown.
- You can sit cross-legged if you prefer. Close the eyes.
- Exhale, taking the chin down to the chest, lengthening the neck.
- Inhale as you take the head up and backwards as far as is comfortable.
- Repeat 5 times and work up to 10; however, do not strain or force.
- Please note the contraindications for the neck/head practices (below).

CONTRAINDICATIONS FOR ALL NECK AND HEAD MOVEMENTS:
These movements should not be performed by elderly people and those suffering from low or high blood pressure, vertigo or extreme cervical spine conditions, such as herniation or spondylosis. (NB: Cervical spondylosis patients must avoid forward bending of the neck.)

21 Neck and Head B

PURPOSE: The purpose is to relieve tension and free the tissues of the neck. All nerves connecting the different organs and limbs pass through the neck and the myofascial layers and organisation can hold extra tension and be over-recruited by disorganised posture. These asanas are designed to free their mobility; however, they must not be forced. There are delicate structures in the neck and subtle mobility and sensory refinement is sought rather than length or range for the sake of it.

SUPPORT: This comes from the base position, particularly the hands. Be sure to use the hands for support if necessary. Otherwise sit up “tall” as the natural spinal curves are essential to the efficacy of

these movements.

TIMING: To begin with, this can be done 5 times with focus on integrating the breath and sensing balance and symmetry. Work up to 10 rounds.

- Sit comfortably on your sitting bones, hands behind you, as shown.
- You can sit cross-legged if you prefer. Close the eyes.
- Inhale in centre position, then exhale taking right ear to shoulder.
- Inhale back to centre, exhale left ear to left shoulder.
- Repeat 5 times; work up to 10. Do not strain or force.
- It is not necessary to get the ear to the shoulder.
- Please note the contraindications of the neck/head practices (Ex 20) and caution (below).

Figure 17.21

CAUTION:
If there are any neck injuries or disc herniation, then all neck movements should be done under supervision or with the advice of a doctor or physiotherapist. Where improved mobility is sought, these movements should be modified and minimised to micro-movements, gradually increased as range is improved.

22 Neck and Head C

PURPOSE: The purpose is to relieve tension and free the tissues of the neck. All nerves connecting the different organs and limbs pass through the neck and the myofascial layers and organisation can hold extra tension and be over-recruited by disorganised posture. These asanas are designed to free their mobility; however, they must not be forced. There are delicate structures in the neck and subtle mobility and sensory refinement is sought rather than length or range for the sake of it.

SUPPORT: This comes from the base position, particularly the hands. Be sure to use the hands for support if necessary. Otherwise sit up “tall” as the natural spinal curves are essential to the efficacy of these movements.

TIMING: To begin with, this can be done 5 times with focus on integrating the breath and sensing

balance and symmetry. Work up to 10 rounds.

CONTRAINDICATIONS: See Ex 20 and 21.

- Sit comfortably on your sitting bones, hands behind you, as shown.
- You can sit cross-legged if you prefer. Close the eyes.
- Inhale in centre, then exhale turning head over right shoulder.
- Inhale back to centre, exhale the head over the left shoulder.
- Repeat 5 times, work up to 10. Do not strain or force.
- It is not necessary to get the chin over the shoulder, keep head level.
- Please note the contraindications for the neck/head practices (p. •••).

Figure 17.22

23 Neck and Head D

PURPOSE: The purpose is to relieve tension and free the tissues of the neck. All nerves connecting the different organs and limbs pass through the neck and the myofascial layers and organisation can hold extra tension and be over-recruited by disorganised posture. These asanas are designed to free their mobility; however, they must not be forced. There are delicate structures in the neck and subtle mobility and sensory refinement is sought rather than length or range for the sake of it.

SUPPORT: This comes from the base position, particularly the hands. Be sure to use the hands for support if necessary. Otherwise sit up "tall" as the natural spinal curves are essential to the efficacy of these movements.

TIMING: To begin with, this can be done 5 times with focus on integrating the breath and sensing balance and symmetry. Experience the sensations of the head and neck and keep the eyes still, even though they are closed. (They do not need to move up and down with the head). Work up to 10 rounds.

CONTRAINDICATIONS: See Ex 20 and 21.

- Sit comfortably on your sitting bones, hands behind you, as shown.
- You can sit cross-legged if you prefer. Close the eyes.
- Roll the head on the neck in a soft clockwise direction.

- Reverse the roll in the other direction, inhaling the head up.
- Exhale as the head rolls down, going back the way you came.
- Repeat 5 times; work up to 10. Do not strain or force.
- It is not necessary to pull on the neck. Keep it relaxed.
- Please note the contraindications of the neck/head practices.

Figure 17.23

24 Shivasana

PURPOSE: The purpose is to relax and let the tissues organise themselves, after having been invited to consciously move and hold a variety of positions. Pawanmuktasana allows the energy channels to open and flow. If this is done for the first time, there may be disturbance where tissue is being revitalised, the bodily fluids are reorganised and extraneous tension is released. Ensure that you drink plenty of water and take 2–5 minutes to rest the body in this pose.

SUPPORT: As above, ensure that you are comfortable. If there is any possibility of becoming cold after the practice, you are advised to ensure you have a light blanket over you during the rest period.

TIMING: This is arguably the most important part of the practice. If participants ever have to leave a class early, it is recommended that they stop 5 minutes before they leave to ensure some time in Shivasana before they return to the demands of everyday life. Opening the channels without giving the body time to assimilate and absorb can leave the body feeling unprepared and vulnerable, which depletes the rich benefits of this practice.

- Lie down comfortably on your mat.
- Ideally Shivasana includes the whole body resting supine.
- If it is more comfortable, either bend the knees. (see Ch.16 Ex12)
- Or place a cushion or rolled up mat under the knees.
- Alternatively, lie on your side with a rolled towel, blanket or pillow.
- The posture is designed to allow the body to completely relax.
- Allow the breath to “breathe you” without force or effort.
- Rest while the postures integrate and the body assimilates.

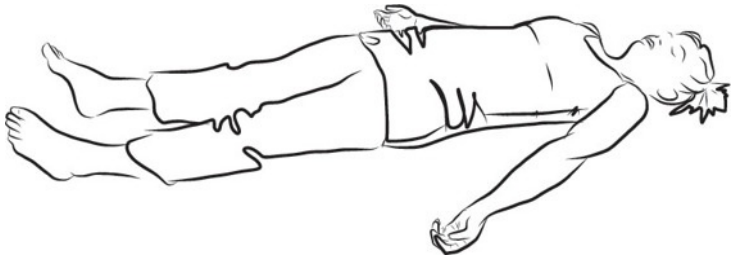


Figure 17.24

Postscript

This series is designed to bring the body into comfort in stillness. The mind eventually lets go and allows us to enter the "zone": a kind of timelessness, absorbed in the rhythm of uniting breath and motion. This practice may be used as preparation for the short meditation in Chapter 18.

Notes

1. From the personal diaries of Patricia Mary Sparrow (12 March 1935 – 13 April 2006), one of my most loved yoga teachers. Used with the kind permission of Stephanie Sparrow.
2. In Sanskrit, pawan means wind; mukta is to liberate, free, or release.
3. The Bihar School of Yoga was founded by Swami Satyananda Saraswati in 1964; http://www.biharyoga.net/bihar-school-of-yoga/about-bsy/.
4. Swami Satyanada Saraswati, *Asana Pranayama Mudra Bandha*, Yoga Publications Trust, Bihar, India.
5. See notes 3 and 4.

CHAPTER
18

The Inner Sense of the Fascia

"We create and respond irresistibly to circles, cylinders and spheres because we recognise ourselves in them. The message of the shape bypasses our conscious mental circuitry and speaks directly to the quiet intelligence of our deepest being. The circle is a reflection of the worlds - and our own – deep perfection, unity, design excellence, wholeness, and divine nature."[1]

Michael S. Schneider

In the practice of yoga postures we explore movement. We change the shapes we can make with the body and outwardly express and evolve the range and balances of the forms we can contain. In the practice of yoga meditation we explore stillness, the unchanging sense of being that is inwardly expressed and formless. The invitation is to expand consciousness through containment. We draw a symbolic circle around ourselves and practise what is called involution, just for a while.

The fascia responds to our past loading history. It is also our organ of organisation in present time, reacting to where and how we are in space at any moment in time. This chapter is where we pause to reflect that accumulation of gestures, by being consciously inactive. Of course, it could be argued that we are gesturing by sitting still. However, the purpose of the previous chapter was to make stillness available in a way that is comfortable and allows us simply to relax, without collapsing. From a fascial point of view it involves suitable stiffness for us to hold still comfortably and sufficient softness for us to be at ease for a period of time, relatively motionless. It is allowing the inward motion and motility of the body to slow down, consciously. Eventually, we can come to a state where the mind is quiet and reflective, where there is little or no sense of discomfort in the body, and we can be with our form, in time and space, as it is. The matrix becomes aware of itself, being.

Uniting both the inner and the outer practice of yoga is the breath, expressed by the shape and rhythmical pattern of life-force in our form. Fascia both connects and separates the forms it produces (or unites as a whole). Indeed, yoga and fascia have very close correlations with unity itself. (This is why fascial anatomy makes so much more sense of yoga than some of the classical theories of anatomy which often exclude the fascia.)

At this level of yoga practice we seek to transcend the intellect and theoretical conceptualising. We look to the symbolic realm in which the language of yoga begins to flourish. While we can scientifically quantify the results of meditation from brain scans, we can become its beneficiary only by participating and "realising" them for ourselves. No one can do this for us, and, arguably, we cannot teach it

authentically to others unless we know it from our own experience. It simply will not make sense. The fascial matrix is now considered to be our largest sensory organ. It is possible that we make sense of it on this symbolic level by simply becoming more aware of it.

Inner Presence

Finding the depths of our inner world, from deeper within it, is the purpose of meditative practice. It offers a profound stillness as the natural counterbalance to activity and motion. Tension and compression forces combine to create multiple forms together, in biotensegrity architecture. Silence can counterbalance sound here, uniting the active and the passive elements within us. Something else can occur, when the apparent and the inapparent unite to form a transparency. It is something we can see through, rather than something we can see.

After all the striving for evolution, we surrender to something. We reflect our selves, or within our selves; whichever form we personally take. Through this portal, we can begin to practice involution, a deepening sense or our inner universe. It is not an intellectual exercise. It is designed to train us into becoming more aware of mind, of body and of being. They arise in balance: mind and body become quiet and still. Being, the immeasurable and qualitative essence of us, is nourished by our presence. We witness the witness witnessing here. We see ourselves at pause, listening to the listening nature of our sensory form. It may be smelling a rose, reading the pattern in a leaf or seeing a spider's web as morning sunlight lends its radiant illumination to the magic of the design. It is whatever it is, as it is.

A Simple Meditation

The meditation practice that follows is called Self-Centring Meditation. It is not an invitation to sit down and write a mental diary about each feeling, thought and nuance in a self-centred commentary. That is the mind working. This is something else. It is a way of drawing a circle around you and being in it. Nothing more, nothing less. Nothing happens. That is the point.

This part of the practice is neither easy nor immediately obvious to the mind. Do it once or twice a day for a month and see what happens, and what has happened. In this way you can come to know what is *involved*. If you find that you enjoy your teaching more or recognise colour with increased intensity, then *that* is what happened. You may simply find yourself listening to someone *as presence*. This can be about deliberate non-motion – biomotional stillness.

> In yoga, "the point" is the bindu, the dot at the centre of the circle. You become the centre of this particular circle, drawn by you at this point in time … a circle in which to be still.

This is the gift of the present, which we will explore in the next chapter as the basis of generating "the Field" Rumi refers to "out beyond ideas of right doings and wrong doings". This is the Grace Field of a new beginning you create every time you choose to teach a class. You literally create it and we will look at how we do that symbolically *in advance* in the next chapter. First, however, we can work on our selves in preparation for working with others, from experience.

Meditation

This meditation has been written especially for this book, by Alexander Filmer-Lorch and is reproduced with his kind permission from his school Inside Meditation.[2] The meditation exercise is detailed below with sketches to assist visualisation in the absence of a teacher. They are not a definitive protocol but a pictorial sense of how the instructions might be usefully interpreted. The invitation is to go within and quietly discover what unfolds for the individual meditating and, indeed, the individual meditations. They accumulate with regular practice, once or twice every day. It is a gentle loading history for the fascia!

The Meditation

Sit up comfortably either in a chair (with your spine supported) or with your back against a wall, on a cushion. Legs are crossed or out in front of you, whatever is comfortable, with the spine as upright as possible, but not rigidly held. Close your eyes and allow the breath to settle into a natural easy rhythm. Place the tongue softly on the roof of the mouth and allow the breath to come in and go out through the nose.

Whilst keeping your eyes soft, bring your attention to the tip of your nose, noticing the sensation of the breath, slightly cooler as it draws into the body. Become aware of the rising and falling away of your breath, without imposing anything on your breathing. Whilst your eyes disengage, rest in your awareness. Be with the appearing screen in front of you. Allow your attention to rest behind your eyes. (In the meditation ensure the eyes do not move up and down with the directions for the breath; it can give you a headache.)

Your attention follows your most gentle inhalation through the very tip of the nose up to the crown of the head. It is held inside the crown, rather than going beyond (Fig. 18.1).

Figure 18.1

Pause briefly at the crown, for only a second, within the space at the top of the inhalation.

Very gently allow the exhalation all the way down through the body, channelled along the spine, in a downward direction. Your attention moves down, with the breath to your coccyx (Fig. 18.2).

Pause briefly at the coccyx, for only a second, within the space at the end of the exhalation.

Then, with the next inhalation, the attention moves gently up along the back of the inner body to the level

of the third eye. Breath and attention move together, looping forward from the back of the body to the third eye (Fig. 18.3). This moves in a continuous loop (without a pause) as a subtle transition to the next (see Fig. 18.4).

Continue the loop to exhale down the front into the solar plexus completing the loop. Pause at the solar plexus, ready for the next inhalation with the addition of a mantra (Fig. 18.4).

Inhale mentally saying the word “I” during the inhalation, allowing the solar plexus and then the whole body to fill and expand whilst feeling the resonance and reverberation of the silent sound of “I” (Fig. 18.5) as you draw it in.

Let go into the exhalation by mentally saying “AM” (Fig. 18.6).

Feel and merge with the formless state of “AM” during the pause after the exhalation. Rest there momentarily; notice the pause.

Return to the beginning and repeat the whole process for seven repetitions (Fig 18.7).

(The sketch in Fig. 18.7 is an impression of a shape. It may feel quite different for each individual and each meditation. It is here as a guide to the general shape of the energy pattern to begin.)

Figure 18.2

Figure 18.3

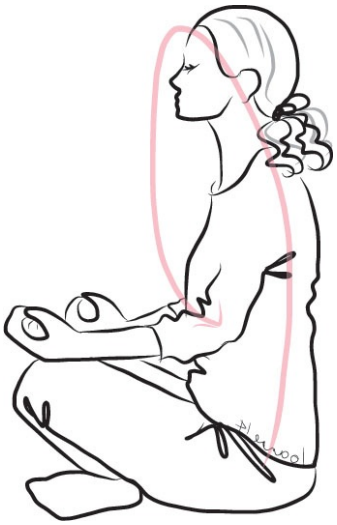


Figure 18.4

Figure 18.5

Figure 18.6

Figure 18.7
Seven rounds.

Back to you

The "I" can disappear and the sound of "AM" resonates to a place we cannot describe. There are various translations of the poems of Wittgenstein but this is one of my favourites.

"Whereof one cannot speak, thereof one must remain silent"[3]

Welcome yourself to the Field where sound and silence unite, becoming one and the same. *Ananda* (en-joy), also means "your bliss".

The Purpose of Yoga

"Yoga arose at the beginning of human civilization when humankind first realised their spiritual potential and began to evolve techniques to develop it. The yogic science was slowly developed by ancient sages all over the world."[4]

You can read many books but you can never experience the personal value of a yoga practice and meditation unless you animate it and take it on in present time *by participation*. The invitation of many yoga schools is to go beyond that experience, or more accurately *through it*, to find an ability to *generate* presence and Grace and compassion.

There really is a Field beyond ideas of right doings and wrong doings. It is here, now. This is it. It is a deepening of our sense of our selves, with nothing added. The fascial matrix, as one of the largest sensory organs of the body, is invited to simply sense the body for the sake of it; back to itself as the witness. It is a kind of self-sensing stillness. When this accumulates in the body, it can provide a metaphysical space, a reserve in which we can see clearly and more directly. This can facilitate *foreseeing* when it provides a neutral context from which to perceive.

The use of chanting and mantras is designed to assist the process of becoming still. In this practice we simply witness it. We use the mantra to attract our attention and develop the ability to observe what happens. Awareness can then expand. If we can acquire something of this quality of stillness, we expand our ability to sense subtle changes and possibly anticipate them.

The Tree of Life

There is an interesting correlate here in the Yogic Sutras. Sanskrit is a language of the Wisdom Traditions. It contains alphanumeric correspondences which means the sounds of the language each have a numeric value. They relate to musical scales and geometric patterns, also reflected in the chakras (see Ch. 21). Yogic wisdom was handed down through word of mouth, in verse form, as in the Sutras of Patanjali, for example. Sutra means thread. (This is the origin of the word sutures as used in surgery and medical practice, when joining things together. Sutures are also the name of the intricate thread-like patterns of the bones of the skull formation.) The verses of the Sutras were pearls of wisdom, joined or threaded together. However, in the reciting, the pauses between the sounds were considered to be as important as the words themselves; as in the playing of a musical piece. They form sound waves with specific resonances. The unifying of the sound and the silences gave rise to the triunity, or triune harmony, of their combined effect.

Meditation does not always have to be about sitting in a room with incense and cushions or perfectly placed candles, waiting for the "right time" for silence, as beneficial as that might be. It can become another thing on your list of "things to do", putting you under even more pressure, which defeats the object somewhat. One of the most valuable resources is to develop the ability to create a "circle" around you – elaborate your own kinesphere – and silently withdraw into it. There is barely a gesture to be seen; it is more of a demeanour; a quiet, temporary shift in focus. A few moments, taken from within and behind the bustle of every day life, can become juicy minutes of restoration.

A delightful way to animate this stillness is to "think tree" (Fig 18.8). There is, of course, no need to actually be in Tree Pose to do this! Simply find somewhere to be still and let your feet root down into the earth and the rest of you occupy the space you are in; sensing your crown up towards the sky. Breathing softly, the way you do, literally *taking time* to be present to it is a valuable way to deepen the pauses. They tend to accumulate and contribute something subtle and valuable, beyond the tiny amount of time they take.

Figure 18.8

This sketch was done from the session in which Katie and Samira modelled inside the tubes as a way of presenting a tension network, albeit around the body. They were playing with Tree Pose (Vrksasana) and experiencing the quiet inner poise afforded by the extra sense of the net that the tubes gave them. Bringing that attention into the fascia that already ensheaths us is the purpose of this light-hearted exercise.

In Chapter 21 we will consider in more depth the symbolic aspect of the geometries we incorporate; presented in all their polyhedral chaos by the fascia. In the next chapter, we will experiment with an exercise that generates the witness state in a very rewarding and light-hearted way. It also fosters a creative approach to designing a class and can be fun to participate in. Meditation can appear to be quite a serious undertaking. In fact, once understood and appreciated as a kind of personal *reward* or "playful pause" to season your day, it is like giving the body time to smile back.

Notes

1. Michael S. Schneider, *A Beginner's Guide to Constructing the Universe: The Mathematical Archetypes of Nature, Art, and Science*, HarperCollins, New York, 1994.
2. Alexander Filmer-Lorch, www.insidemeditation.co.uk; Alexander Filmer-Lorch, *Inside Meditation: In Search of the Unchanging Nature Within*. Matador, Kibworth Beauchamp, 2012.
3. Wittgenstein from *Tractatus Logico-Philosophicus*, proposition 7.
4. The Bihar School of Yoga was founded by Swami Satyananda Saraswati in 1964; http://www.biharyoga.net/bihar-school-of-yoga/about-bsy/.

CHAPTER
19

Presence and Pre-sense of the Fascia

Closing all the body doors, confine your mind within the heart, retain the breath within the head, on yogic concentration start[1]
Bhagavad Gita

The fascia is omnipresent in the body. We have learned through the research into this "fascia-nating fabric"[2] that the design of our sensory selves is organised for listening more than doing (Ch. 9). We might say we are made of a listening tissue. At the level of social interaction, and certainly teaching, tuning in and listening can be richly rewarding.

The fascial system is, among other things, an intelligent means to sense where we are in space at that time. Speaking in a fascial dialect of body language, is it possible to expand our ability to listen kinaesthetically just by being still? Can we go beyond that too, to a place of intuitive sense? We might call it "pre-sensing" but it has little to do with "seeing into the future". Rather it seems to reside as a deepening of our ability to be aware and expand *into* the moment, rather than forward from it (Fig. 19.1).

Three Aspects of the Breath

One of the fastest ways to bring ourselves into a state of presence and awareness is by giving our attention to the breath. Simply stop and notice your breathing, without imposing on it at all. It shifts moods and changes pace within a few moments.

In Chapter 14, we explored the *elasticity* of the breath as a simple way of nourishing the natural breathing rhythm. It provides a bridge to this next level of practice in more ways than one. We can approach working with the breath on three levels, just as we have approached the three parts of this book: intellectually, in physical practice and towards deepening awareness. We could say that the first is what we learn, the second is what we find out and the third is what we do not know. It is in the immeasurable domain of being (Fig. 19.2). The ancient yogis had a profound understanding of these different levels and the subtle qualities they possess.

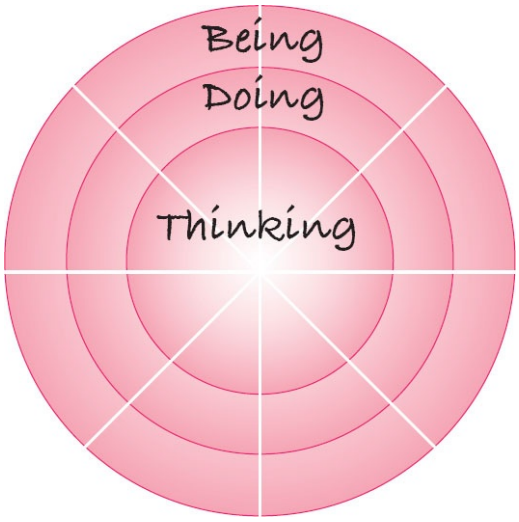


Figure 19.1

Thinking is contained in doing, which is contained in being. Meditation practice includes the whole circle, becoming conscious of each layer and their interfaces.

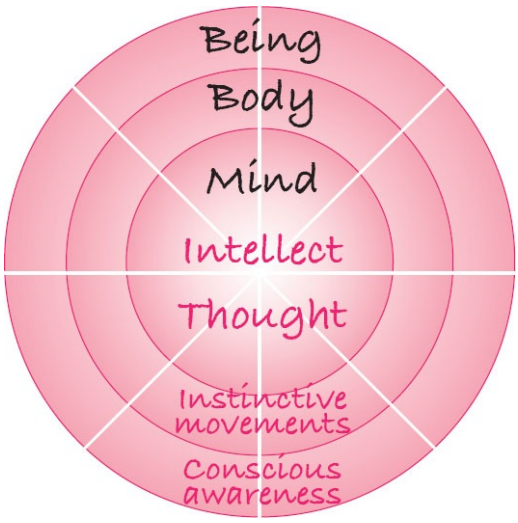


Figure 19.2

The Breath as Three Kinds of Knowledge

In the breath example, the first (inner) ring is the intellectual aspect of our understanding. It includes the chemistry, physics and biology of breathing. At this level we think it through. We activate the mind and learn about compliance, function and suitable ways to foster it in the fascial matrix. From a yogic point of view we can go further into the study of the subtle energies such as the pranas and vayus, gathering information to broaden our understanding of how fascial anatomy and yoga practice can benefit each other in practical and subtle ways (see Ch. 15). This relates to the past as we gather information and it becomes a part of our personal learning: our own historical database. We build upon it to become suitably qualified, expanding our learning as we go. We build the inner archives and their loading history by the physical process of learning. We think intently and attentively at this level.

In the second aspect (the middle ring), we put the books aside. We animate the information and data in present time. We do this by practising it and/or teaching it. We can bring our attention to our own breath, to see how it moves us and how we can move it. However, even when we are not focusing on it directly, it works instinctively. Thus the information we acquired at the first level can be a means to explore at this second level. It accumulates into patterns. We can reflect upon and explore these patterns in ourselves and

expand that enquiry with our students. At this second level, we work with integrating breath and movement so fluently (on the mat) that they become instinctively congruent. We do not have to think about it. In a movement field, drawing from that physical experience, *we become our own resource through the experiential knowledg*e from which to teach. The inner ring is absorbed and we evolve to teach *from both*. Mind and body express their understanding in present time. (It is more than information at this level. It is *incorporated* into knowledge.)

In the third aspect (the outer ring), the practice can be taken to a deeper level. Here we can become quiet or still. It is less about either thinking or doing. At this level we focus inwardly, in periods of reflection or meditation, to feed the source of our ideas and inspiration, without necessarily knowing exactly what they will become. We pause. We can go within or beyond the techniques of *Pranayama* to being (and be-coming) the beneficiary. This is the benefit of expanding our awareness. This level – even harder to describe – is a deepening of the presence. It is hallmarked by the quietness of the conceptualising mind. It includes and transcends it. This is not a seeking of silence. It comes when the "seeking" stops. It is within the presence: a concentration of the source of *being*, when we have paused "doing" for a while. In this place of reflection the breath is exactly the way the breath is, at the time. This is the state of presence.

Tissue Time Frames

Certain schools of ancient yogic philosophy believed that these three levels of awareness operate at three very different speeds. Thinking is the slowest, animated instinctive movement is considerably faster, and faster still is what we will refer to as intuitive awareness. This level has a sense of timelessness. It can bring us to a place of highly creative inspiration. One purpose of practising all aspects of yoga is to bring all these different centres, or aspects of us, into congruent balance. We do not have to think about them; they become more of a facility that we can call upon, consciously.

> Yoga refers to *samadhi*, the ultimate state of union that meditation is considered to assist us in reaching, if that is the goal. It is a state of being at one with the Divine force of life itself, no longer knowing our selves as separate from that original state of wholeness. It is considered to be the original state from which we emerged. Linda d'Antal[3] has an interesting way of interpreting this: *Sama* means same, *Dhi* comes from *Dhiyana;* meaning concentration and meditation. In this sense, concentration does not only refer to the focus of attention on an object. It also includes the concentration (as distinct from the dilution) of a substance into its purest essence. This is something about alchemy, in the symbolic sense of transformation. It refers to the pure essence of (the) being. In this way a broader or more subtle interpretation of *samadhi* is the one (same) concentrated essence. It symbolises the wholeness of the being and the collective union of the one and all at the same time, within us: animated by the essential living force. It is the elixir we call vitality. Perhaps meditation is no more than allowing ourselves to remember our essence, or replenish it, without thinking, by just being present. Could it be that the presence itself concentrates the essence? Or even that it allows the concentrated essence to diffuse out into our awareness?

We each have a tendency to favour one particular aspect, whether intellectual learning, kinaesthetic learning or the intuitive approach. No aspect is better than any other. The purpose of this work is to find balance and access between all of them, through learning, through practising and moving, and through pausing to acknowledge and assimilate the knowledge that is accumulating in the tissues of our body and being. This last part requires something beyond reasoning – which is where meditative or reflective practices facilitate our awareness. One cannot do it like mixing ingredients for a recipe, but by practising in the kitchen it becomes possible intuitively to create something delicious – eventually working without the recipe book.

We can learn all the names of all the parts of the body and speak "fluent anatomy". This would be an

anaesthetic, intellectual approach. The individual named parts could all be cut out of a cadaver, or found in a body, but the relationships between them and their context might be lost. In the domain of instinctive movement, on the other hand, we would find out through experience which parts relate to each other and rapidly respond and explore through trial and error, action and animation. Kinaesthetically we build a history of practice, training through training in present time. We might not all have the identical anatomy, but we may all find a way of animating the movements. At the third level we have an inexplicable ability to sense so fast it can seem to occur in advance. Indeed, this aspect accounts for anticipatory awareness. It is so rapid it feels like foresight.

This state of presence (which could be described as joined up pauses really) is the place from which the sense of "pre-sense" can be developed. It is the blank page upon which true creativity can occur: where inspiration comes in and can be recognised. We sense it.

The Blank Page

We first create the blank page (meditation) inside, in order to acquire the ability to find stillness. One purpose of the meditative part of yoga is to train ourselves, at least for brief periods, in stillness as actively as we do in motion. It might seem counterintuitive. When we are busy, the last thing we want to do is slow down. However, it seems to pay a different kind of dividend. It allows the inspiration to come to us or become visible, audible or tangible (however it comes to you). If we are preoccupied with thinking and achieving and worrying, it is difficult to see inspiration when it does come in: the "page" is too cluttered. Or if we are busy, we do not take time to be still. We can miss it.

The result of it is that creativity can seem to take less time to learn; in other words, it animates what we are doing. We find ourselves increasingly able to design, from within a class. Confidence and self-esteem can grow and we work with precision and appropriately, from experience. Indeed, we can begin to trust something beyond our selves and our knowledge; something unmeasurable. We become able to witness our selves creating.

We "re-present" a class, in present time for our students. We become the source that is their resource, while they learn. It is possible to work very intuitively (and rapidly) at this level. This practice naturally invites concentration (as in a more concentrated essence).

The Art of Not Knowing

There is a lovely art exercise that is a practical study for recognising (and fostering) the Witness and deepening this sense of being present, when the mind is quiet. It illustrates these three levels very clearly. It is a lively challenge and great fun to do; only don't take it too seriously!

Betty Edwards wrote a book called *Drawing on the Right Side of the Brain*.[4] It facilitates the ability to witness yourself seeing and translating the outside world, through your vision. At the same time, it allows you to recognise the voice of the mind (chitta vritti) *as distinct*. The drawings become a reference for change and progress.

One of the exercises in the book is to place a paper and pencil in your usual dominant hand and draw your non-dominant hand. The key is to turn away from the drawing, so that you cannot see the page (Edwards calls it contour drawing). You then watch the resting hand very attentively and draw it, without looking away from it. Keep your eyes on the hand you are drawing at least 90% of the time. Focus is

almost entirely on the hand being drawn. Your movements (with the pencil) then have to translate directly from eyes to drawing hand, *without seeing or commentating on* how you are "doing" it. We do not realise how much our thinking and beliefs influence our actions. In this exercise you bypass the critical mental commentary and simply follow what is there. (It can feel very frustrating at first, so be patient with yourself.) You begin to *look* really intently. However, the ability to do that comes after at least two extraordinary things occur:

- The mind can become bored, agitated, grumpy with anything from needing to move, needing the bathroom, getting a headache, remembering something essential or any other trick for getting out of the situation. If you can, simply let the commentary run. It can be anything from "this is ridiculous, I can't do it anyway" to "this is a complete waste of time". Notice, thank the commentating mind for sharing, and carry on drawing.
- Over time, if you simply observe the commentary and practise the drawing anyway, the excuses the mind comes up with get better – and so do the drawings! Something takes place for which your mind has no specific explanation.

What occurs is an *emerging ability*. Usually, the mind eventually just takes a break and leaves you to enter the "zone". We do not have any adequate words for this place. Time literally takes on a whole different demeanour. You can "come round" from a drawing with no concept at all of time passing in the usual way. (Once the mind gets fed up with ticking off minutes.)

The metaphor for taking our "beginner's mindset" to the mat is obvious. The illumination of abilities beyond your (mind's) belief system is of huge value (Figs 19.3 and 19.4).

This practice is a training in deepening presence and designed to facilitate awareness *for the sake of it*. The consequence is various for different people; in teaching yoga it is invaluable.

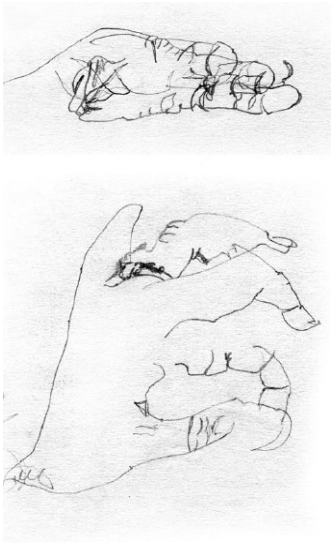


Figure 19.3
First attempts at contour drawing.

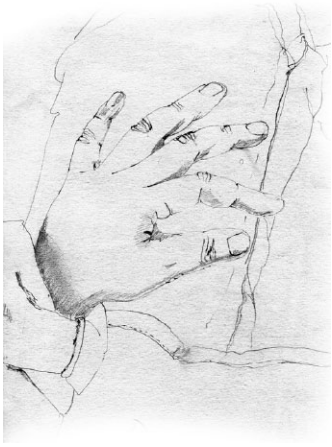


Figure 19.4
Contour drawing after 3 months of practice.

"while in samadhi, yogis and yoginis experience a powerful alteration in their sense of both time and space. I believe this is due to radical shifts in brain function (meditative states greatly increase alpha and/or theta activity). In these relaxed brain states, time seems more fluid and space often takes on strange attributes …What might last an hour in linear time may be experienced as lasting for eons or for just a moment."[5]

In essence, the power to generate presence is the ability to witness oneself witnessing. It is essentially uneventful and it takes honest and simple training to "be still", just as it takes honest and simple training to learn "to do" yoga. Sitting, standing or walking in meditation (or self-observation) is part of such a practice. It might just be a balance that brings a sense of quiet and ease to whatever you are doing at the time. It might be nothing more than a suppleness of spirit to match the same biomotional agility in the body.

Time

Let us divide our experiences into three domains of time (Fig. 19.5). Rather than past, present and future, we can put them into past, present and pre-sent – where what has not happened yet can occur as if given to us, or created *in advance*. It is something we consciously anticipate. We can design a class, then re-create it or "re-present" it, in the actual classroom. This could be referred to as "designing the future *from the future*", which, in a way, is what we do when we prepare a class beforehand. We are just adding the sense here that it has already happened and *come from* that, as we describe it to ourselves and choose what we will teach (or will have taught, if we imagine having done it, just for this exercise). Deepak Chopra refers to "waking up the wizard that is deep to all of us". He presents this way of working *from the future* symbolically and delightfully in his book *The Return of Merlin*. The principle of designing the future by creating it from the power of your present imagination is a metaphor throughout the book:

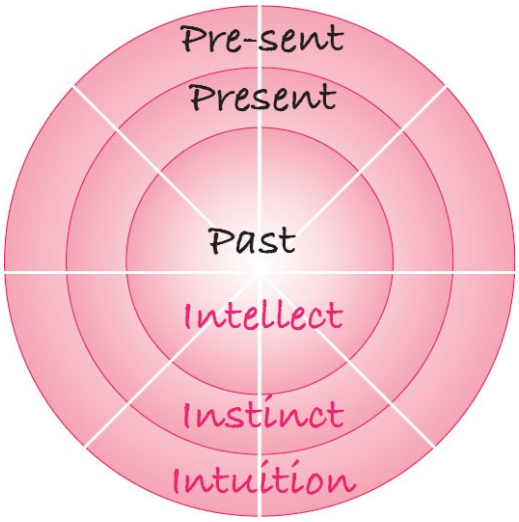


Figure 19.5
This is a useful way to present the different aspects or levels of learning, contained within each other. They correlate to different time frames.

"This is the wizard's secret: the spirit is never overshadowed by the form or the phenomenon. The wizard knows that to be truly alive, she must die to the past in every moment. To be alive now is to be dead to the past. To be alive now is to have life-centred, present-moment awareness. If you have your attention on what is, see its fullness in every moment, you will discover the dance of the divine in every leaf, in every petal, in every blade of grass, in every rainbow, in every rushing stream, in every breath of every living being."[6]

Anticipation

The past is a useful resource, an archive. Regular practice in meditation seems to enhance our natural ability to leave it there and draw on it when we need to. That enables us to be more present to what and where is right now. It can accumulate grace and responsiveness, while deepening our listening faculties in whichever situation we are in. Can it possibly enhance the vitality of the entire fascial matrix as if by *listening to it?* We actually *do not think* so much but *act* more congruently and intuitively, trusting the inner voice of intuition more. In yogic terms this would imply balance between the pranas. In experience of teaching, it can translate to a keener sense of what is happening in the classroom and an appropriate and swift ability to adjust and manage a group. We go beyond simply giving instruction and become free to participate *and* have access to this third domain of *anticipation.* This is essentially the intuitive "pre-sense" we are referring to. Just as anyone who can sign their name, according to Betty Edwards, can learn to draw, so might the intuitive ability to "pre-sense" be honed as a skill.

The vital experience of anticipation is one of *pre-empting* the *potential* future as a deepening of the presence, occurring from within it. It may be less of an esoteric notion and more what our fascial tissues are doing anyway. It is the basis of adjustments when we become instinctive in our practice: subtle interventions that can sometimes alleviate potential issues before they become a problem. We do not necessarily need to think about them, yet we are very attentive and conscious about making accurate, subtle suggestions. It is awareness, from presence, in action; a kinaesthetic conversation wherein the tissues speak directly and intuitively to each other in their astute sensory language.

"Intuition is neither the ability to engage prophecy, nor a means of avoiding financial loss or painful relationships. It is actually the ability to use energy data to make decisions in the immediate moment. I

firmly believe that intuitive or symbolic sight is not a gift but a skill – a skill based in self-esteem."[7]

Intuition

Caroline Myss (the source of the quotation above) refers to this domain of intuition as moving at a rate so fast it lives in our experience in "still-spin". Myss, a medical intuitive who has been tested under medical research parameters, claims we all have these powers. As we develop our instinctive skills of presence, something becomes available in the realm of teaching movement and practising manual therapy. This "something" is not entirely answered in books on anatomy or psychology. It lives in the stories of what happens in practice and how we (and our students, clients and colleagues) experience it.

"Intuition" is a subject that can often be associated with a sort of mystical ability to read into the future and see things for which there is little evidence in the physical world. However – and this is important in understanding fascia – it is a different *rate* of knowing rather than necessarily a special knowledge gifted only to the chosen few. The fascial matrix proprioceptively anticipates all the time. Far from needing special powers, these are specialisations of your body's powers of recognition and distinction. Your body builds up its movement repertoire in time. It constantly anticipates with such ease that you do not even think about it, unless the sense of anticipation "makes a mistake". In a yoga sequence, for example, the movements are completions (of the previous move) and preparations (of the next in the sequence), all at the same time. This proprioceptive ability occurs at a considerably faster rate than thinking.

Proprioception seems to embrace more subtle distinctions, that we can incorporate through the sensitivity of our systems, crafting their art. Our art is yoga and it speaks to the value of practising whichever aspect of it that you wish to teach and develop in yourself and your students.

As yoga teachers, we live in the domain of the body moving (assuming you practise what you teach). We become profoundly familiar with the nuances of form and subtle gesture. So much so that after decades we develop a certain mastery that allows us to intuit more easily. Since the fascial system is a communicating and signalling network, perhaps we are highlighting the more subtle and articulate forms of that communication. Perhaps our tissues are "speaking directly" to someone else's, living matrix to living matrix, via our ability to sense beyond the purely physical and measurable.

This intuition seems to arrive in advance, a kind of "nous"; it is the intuitive recognition of a potential. It is has a different quality to "knowing". It is merely a possibility, a "light bulb moment". When enough of these moments join up, there is a certain illumination that seems to come with confidence or enhance self-esteem. One can begin to trust oneself to know the accurate thing to do at the time.

Learning from Teaching

Teaching the postures includes far more than learning them. Part of the task is organising them, creating class plans, inviting students, being on time, making sure of the details and dramas that inevitably go along with the actual process of getting yourself in front of the room. To do that with participants to teach is (in a way) an act of creation, of going from nothing to something. As we become more agile and adept at creating the still, blank canvas, so it seems we can become more creative with the classes we have not taught yet and crafting the confidence to re-create them.

Being present, while it starts with being able to reflect and meditate, goes way beyond your own meditative practice. It includes the participants inside the circle you create called "the yoga class". You become a resource on many levels, so a practice for yourself that enhances your well-being and your

calmness so that you enjoy it seems an invaluable tool. This is about feeding the source: the source of life force (Prana) and the source that you are in life.

Pranayama means expansion of life force, which might also be associated with expanding our sense of happiness, community and relatedness. Yoga practice at this level works quite simply: a few minutes every day simply being with (and awake to) that life force (consciously doing nothing, essentially). If the fascia is our tissue of relatedness, our inner matrix connecting our wholeness with the parts of us on every scale, then can loading stillness and quiet reflection into its history, accumulate calm? Or even vitality? (As a counterbalance to movement, that is, not as a replacement!)

Pre-sense within Presence

The fastest way to access presence *as a sense* is through the body. Asking a class participant to follow their breath, or making a subtle adjustment, brings the sensory awareness immediately into present time. Practising this *entering into present time* is like joining up numerous moments in repetition.

Joining up moments in repetition is essentially what we did in order to learn the yoga poses and sequences. It is much the same process for learning meditation and practising stillness. By connecting many moments of present awareness, we can join them up in meditation and become still, more readily.

From this place, we can create class plans, by designing them in advance on the blank canvas of our listening, our presence. Recreation is the basis of having fun. This is where we create and recreate the potential for enjoyment: the active en-*joy*-ment (*ananda*) of working congruently, inviting our class participants to do the same. This is something more than writing a list of postures on the way to teaching a class. It is a conscious act of creating a field, one that can contain the ideas of "right doings and wrong doings" and work beyond them. It can make for some fascinating classes and is an interesting domain to teach from.

In the next chapter, we will consider some class plans from this creative place. We become the intuitive creative force, literally and symbolically drawing the circle for others to stand in.

Notes

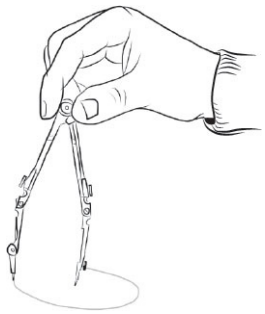
1. Ch. 8, *The Bhagavad Gita, A Verse Translation*, by Geoffrey Parrinder, Oneworld, London, 1996.
2. Robert Schleip signs his emails "fascianatedly yours"; Andry Vleeming refers to people in the field as "Affascianados", others prefer "Fascianistas".
3. Linda d'Antal, www.treehousestudio.co.uk; Vinyasa Flow Yoga; Advanced Yoga Teacher, Head of Yoga Faculty at the Art of Contemporary Yoga Ltd.
4. The first edition was published in 1979 and it is still in print. Betty Edwards, *Drawing on the Right Side of the Brain: A Course in Enhancing Creativity and Artistic Confidence*, 4th edition. New York: Penguin Books, 2012.
5. *The Magdalen Manuscript*, by Tom Kenyon and Judi Sion: www.tomkenyon.com.
6. Deepak Chopra, *The Return of Merlin*, Century London, London, 1995.
7. Caroline Myss, PhD, Medical Intuitive. Caroline Myss, *Why People Don't Heal And How They Can*, Bantam Books, London, 1998. For further information see www.myss.com or wikipedia.org/wiki/Caroline_Myss

CHAPTER
20

Posture Mandalas

"I saw that everything, all paths I had been following, all steps I had taken, were leading back to a single point – namely, to the mid-point. It became increasingly plain to me that the mandala is the centre. It is the exponent of all paths. It is the path to the centre, to individuation. I knew that in finding the mandala as an expression of the self I had attained what was for me the ultimate."[1]

C. G. Jung



A circle to symbolise a Field of Grace within which to create a class.[2]

Once we have experienced the meditation practice and begun to tune in to the ability to create a blank page, we recapitulate the symbolic cycle of creativity. This chapter is designed to simply convey this to you to animate for yourself. The idea behind the Posture Mandalas is primarily the preparation, in advance, of a Grace Field in which to teach. It is also a field *from which* to teach and into which you can welcome your participants. It forms a kind of connective tissue framework for the relationships you choose to present in real time, between postures. It is the field: your field to work from in your way.

The Circle

Drawing a circle is symbolic of an act of creation from which the hidden geometries of life can all be found. The ancient yogis profoundly understood these forms in nature and included their resonance in many aspects of the deeper yogic teachings. In Chapter 21 we will consider the chakras and the relationship of the geometries they represent to biotensegrity and our fascial architecture.

This field is symbolised in the act of drawing the circle (see drawing in margin). This can become a ritual in itself. It is just a quiet conversation between you and your own intuitive awareness, prepared in advance. The pair of compasses are used symbolically. One leg represents the positive, or active force (*Pingala*) and the other leg represents the negative or passive force (*Ida*). The opening of the pair of

compasses forms a ray of light, the Sun (*Pingala*) and the Moon (*Ida*). The point represents stillness while the pencil is the dynamic element, describing the “whole”. When you remove the compass point it leaves the mark in the centre, in yogic terms the *bindu*. It is the dot, another tiny circle within the circle, representing the one and the all at the same time (Fig. 20.1).

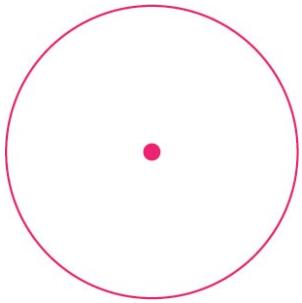


Figure 20.1

The circle contains (encircles) the emptiness, the “no-thing” that zero represents. At the same time as containing the emptiness, with the boundary of the circumference the circle also represents “something”, emergent from the dot, becoming the line, to join and form into a circle. We will see in the next chapter that the symbol of “one” is the Monad: a circle with a dot in it. Together the line enclosing the space it contains forms this symbol of the field that contains the opposites and presents them as united.

The mandala is then made by making another circle around the first one and dividing the circles into upper and lower halves horizontally. The outer circle is divided into 12 equal sections, six above and six below (Fig 20.2).

The Class Plan

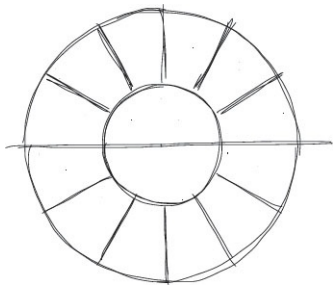


Figure 20.2
Above the line will be the poses and below the line the counter-poses.

The simple premise behind these Posture Mandalas is pose and counter-pose, with two poses per direction of movement. It means that a series of postures in a class assure that the fascial matrix of the body enjoys different ranges of motion, in forward and back bending (flexion/extension), side bending (lateral flexion) and twists (rotation/counter-rotation). It is also versatile enough that these can be designed with postures of different levels.

In the centre you place the key or main pose you intend to teach, with its counter-pose underneath. We will use the example of Dog Pose (*Adho Mukha Svanasana*). In the top six segments we will choose two poses that emphasise each of the movement directions. Then a corresponding counter-pose will be placed in the opposite segment of the lower half of the circle (Fig. 20.3).

Presenting a Balanced Class

This format invites a class design that honours overall equilibrium of the fascial body. It ensures that there is balance and variability of forces and directions of movement activated in a lesson, through the choice of postures. This is a common basis of any teacher training, although prior to a fuller understanding of myofascial anatomy in practice, priority is often given to the type of yoga rather than the type of individuals undertaking it.

Those forms of yoga that are biased to a particular repetitive sequence, emphasising one direction, can build strength and ability at first. However, from a myofascial point of view this can eventually become a repetitive strain pattern if it is repeated over a period of time without suitable counterbalance. By gradually introducing a counterbalancing sequence, over a suitable period, the practice can be modified. If it is interspersed with all movement directions, in such a way that it is naturally balancing the tissue loading, such strain can be avoided. Balance and counterbalance, including the three directions, better ensures variety and elastic integrity within the level or ability of the participants or class being taught.

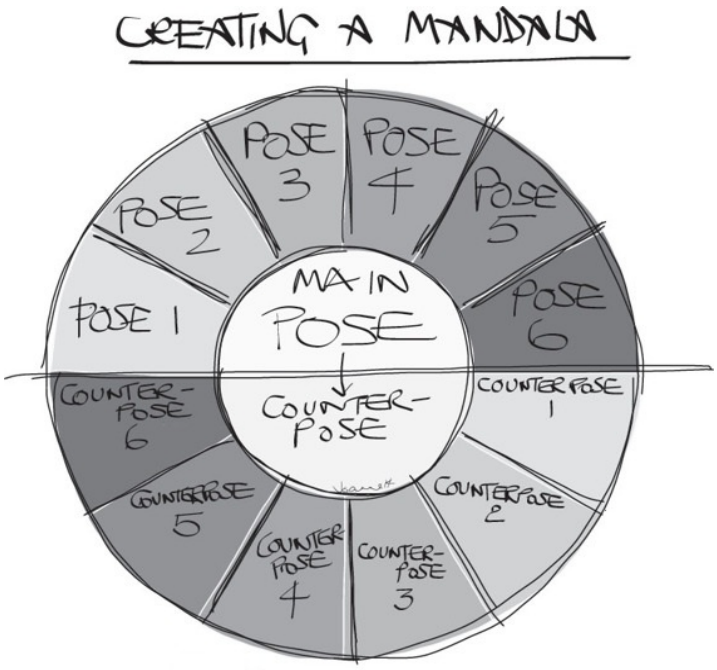


Figure 20.3

The Posture Mandala; this type of Posture Mandala has poses in the top half and counter-poses in the lower half. It is like a visual table of poses. This particular one is not presented as a sequence, but rather a visual teaching aid, to ensure that postures chosen for a suggested class plan are balanced overall. The elements include forward and back bend, side bend and twisting; each with pose and counter-pose.

Please note that a balanced practice includes all three "planes of movement" discussed in Chapter 7. Forward and back bending movements are just one direction, a counterbalance to each other. I have seen several cases of individuals doing regular sessions *of the same repetitive sequence* of the same yoga series, biased towards forward folding (flexion) only, for months and even years. They cannot understand the pain they experience despite their consistent practice ("I do my practice religiously every day"). They assume their discipline and the design of the class will help them "because it's yoga". The body is designed to move in a variety of planes, however, and its basic blueprint includes forward bend counterbalanced by back bend, side bend countered from the other side, and rotation (without force) also counterbalanced from above and below. There are subtle expressions of these main planes of course, and yoga invariably looks to do postures to each side. Restricting the body to hours of heavily biased movements prioritising one direction (e.g. forward bend – flexion only) can and does accumulate in the fascial tissues as a repetitive strain pattern. A balanced practice is considered to include balance between the main three planes, within appropriate structural limits for the individual.

Posture Mandalas

Primarily these are a way of planning a class list in a visual format that can be read instantly, at the speed of a class. It offers a well considered and recognisable template for you to develop.

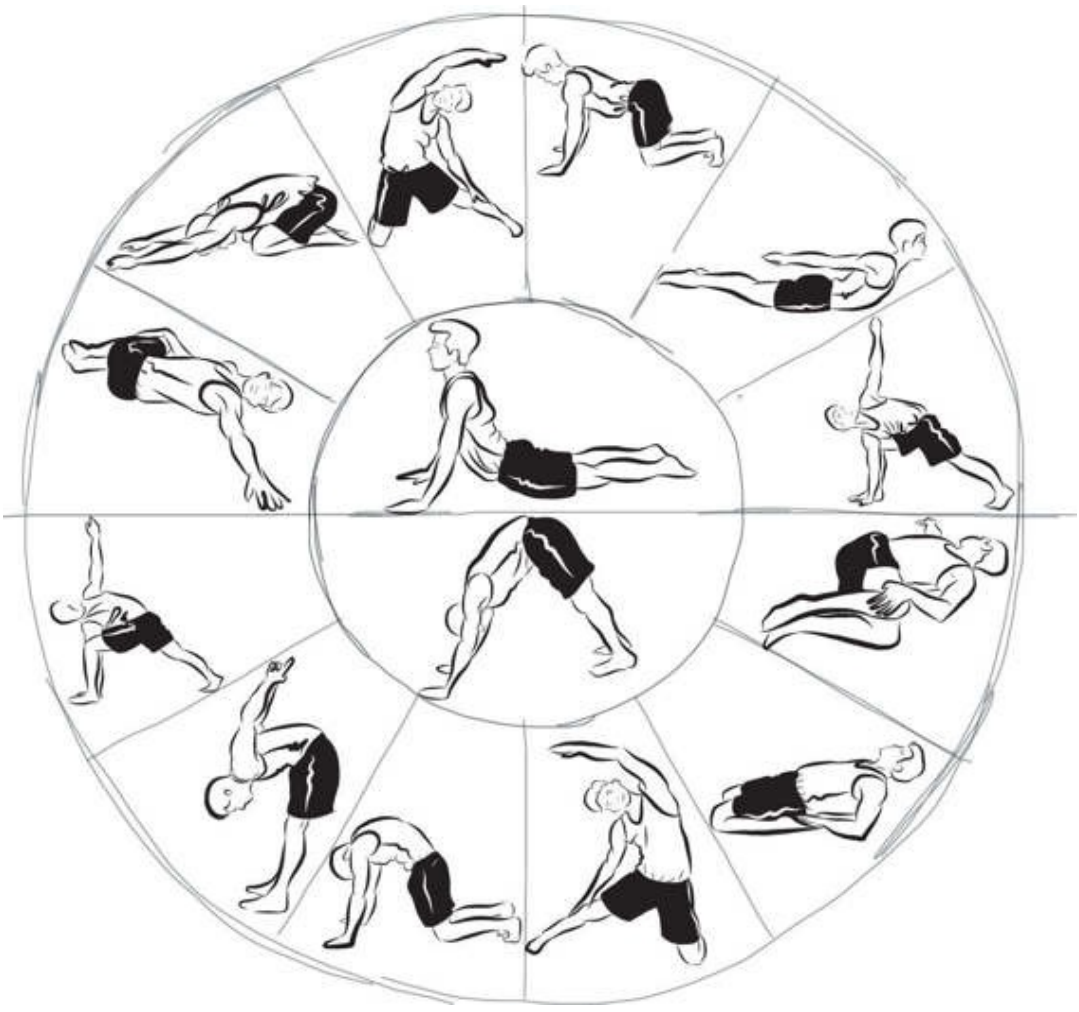
What follows are three simple examples of this type of mandala, rather than prescriptions (Figs 20.4–20.6). The idea is to adapt them for your own style of yoga. This format encourages you to base the postures of a given class around an optimal design for tensional balance. As a teaching tool, they simply allow a creative class plan to be structured, saved and built into a portfolio as your experience and range of teaching develops or accumulates. It is really designed to encourage creativity and a balance of asana, adapted to work in a class, a workshop or over a term. They provide instant visual organisation, rather than a list in a notebook.

The idea of first drawing a circle is also a very practical way of working with the postures (in any order) to ensure a rounded, variable training programme per class, per term or per event. (It is scale free!)

The purpose of doing these is to create a clear and accessible way to:

- design a balanced class/lesson/personal practice to optimise fascial form overall
- ensure balance between the asanas chosen for either a general group or an individual
- contain a theme that can be carried through for an individual by session, or series of sessions (such as a term or course of work)
- retain a useful at-a-glance record of class plans and progress
- create a circle from your own intention, in advance, like the Grace Field that Rumi speaks of (see the opening of Ch. 1).

These are three basic class plans (Fig.20.4, 20.5 and 20.6). The idea is themed around a main asana (pose) to base the class upon, such as Dog Pose (*Adho Mukha Svanasana*). In this example, (Fig.20.4)



Face Up Dog (*Urdhva Muhka Svanasana*) and Face Down Dog (*Adho Mukha Svanasana*) or Cobra Pose (*Bhujangasana*) could be used. They are placed at the centre of the mandala, one designating the main pose and the other the main counter-pose. The other poses chosen are put in for their value in contributing to the main pose and finding a suitable balance for the level of the class. The leading six postures are placed in the upper half, one in each of the six segments, and their respective counter-poses are placed in the lower half, in their opposite segment. Here the main poses are a Forward Bend and a Back Bend, so the other postures included are two twists, two more forward/back bends and one side bending pose. The aim is to provide range of motion for the limbs (note the different arm positions and leg positions) as well as the spine.

Figure 20.5

Being creative does not necessarily require that your mandalas have to have perfectly drawn figures in them. Stick men (Fig.20.5) and words will do. All the examples are designed to demonstrate this idea in different ways.

Mandalas do not have to have “goal oriented” postures in the centre. In this one, (Fig.20.6) the theme is one of resting the spine. The class plan animates it in balance and on the ground, while the main feature of this class would be the comfort of rest and restoration. It could equally be done by swapping Lord of the Dance to either side, for example, with the prone and supine postures in the main centre.

Figure 20.6

Mandala Flows

In a Vinyasa Flow-based class, for example, or any sequencing programme, the postures can be presented as part of a flowing sequence. In this case, the same mandala can be used – but the postures work “around the clock” from one to the next (Fig. 20.7).

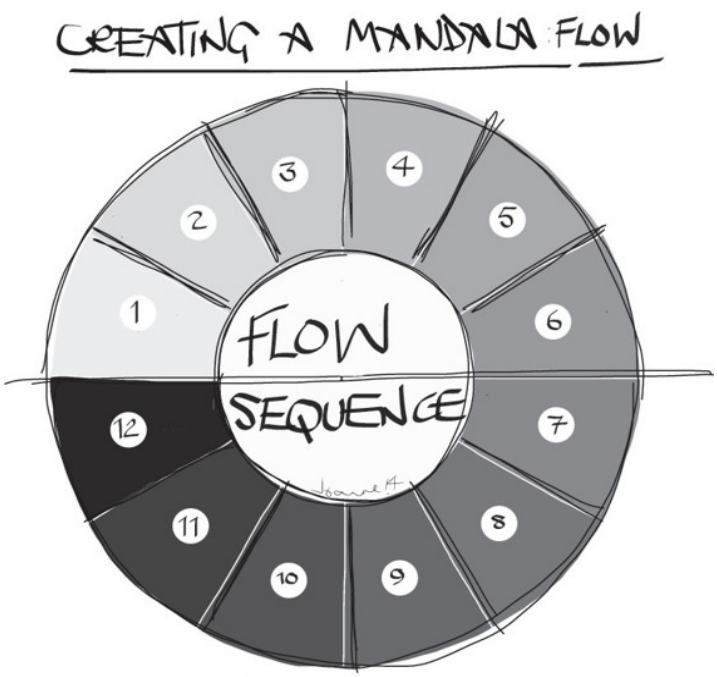


Figure 20.7
In a flow sequence, the numbers can start where you choose; it is a matter of personal preference. Some people prefer the numbering to follow a clock.

If you are teaching sequential classes, you may choose to design one biased to one movement plane, counterbalanced by another whole mandala biased to a different movement plane. This is based on common sense and the idea that the body responds well to range and variety as well as being trained by repetition. As ever, it is our task to find balance between these aspects of learning. It is for you to "pitch" the mandalas to the age, range, ability and scope of your particular practice and style of teaching. They can be used one-to-one to develop a particular participant, or for a class or group.

A well-known example of a flowing mandala sequence is the Sun Salutation (Surya Namaskar) (Fig.20.8).

Posture Mandalas are an art form in their own right. They can be developed into class plans, workshop plans and term plans (see www.aocy.org for more detailed examples). In the meantime, it is highly recommended that you take the time to draw the circles, make your own templates and design your own class mandalas. Apart from being fun, they are a wonderful resource in their own right.

Figure 20.8
This sequence follows the numbering of a clock face. Sun Salutation (*Surya Namaskar*) Flow Mandala.

The mandalas are designed to bring you "present to" the class you intend to create, in advance of it *being present-ed*. It occurs in the domain of intuitive listening to the group, as an act of anticipational pre-sense. It can free you to be present to the participants as well as creative about what you will teach them. The mandalas can become a portfolio of your creative ideas. The circle symbolises that act of creation...

Notes

1. C. G. Jung: The Red Book of Carl Jung: http://www.loc.gov/exhibits/red-book-of-carl-jung/the-red-book-and-beyond.html
2. Image by Martin Gordon (www.mothcreative.co.uk)

CHAPTER
21

Archetypal Geometries

"Unity always preserves the identity of all it encounters. We might say that 'one' waits quietly within each form without stirring, motionless, never mingling yet supporting all. The Monad is the universe's common denominator. The ancient Gnostics called it the 'silence force.' The universe was carved of this primeval silence. Everything strives in one way or another toward unity."[1]

Michael S. Schneider

Any number divided by or multiplied by one, preserves its identity and wholeness. If we go back to considering ancient wisdom in the history of anatomy (Ch. 2), we can view it in a slightly different light. When it comes to understanding yoga at a symbolic and archetypal level, beyond the postures and general practices, we can perhaps begin to see how yoga and fascia provide fascinating pathways towards the unity everything strives for. The common denominator of both is the geometry of form.

Geometry has profound significance in the study of the fascial matrix. If we could consider geometry as a kind of structural code of nature, it suggests the formulae of forming that biotensegrity is beginning to reveal. As we explore we discover that each number we use (from 0 to 9) has a symbolic role and an archetypal character, as well as its mathematical meaning.[2]

It is possible that the ancients understood mysteries that the study of fascia is providing new access to, for long before yoga came to the West, the patterns used to symbolise the chakras, for example, were schematised in the architectural designs of sacred sites.[3] While modern technology is supporting our efforts to see new things, it may simply be allowing us to explore *new ways* of seeing things, perhaps reuniting us with mysteries that our ancestors understood before the advent of technology. (Indeed they are at the source of the mathematical origins of that technology.)

Back to the Renaissance

Alongside the other discoveries made at the time of the Renaissance in Europe came the discovery (for Europeans) of civilisations to the east and west, as Christopher Columbus set sail to India and discovered the Americas. The first European to reach the Indian subcontinent was Vasco da Gama, a Portuguese sailor whose journey prescribed the first trading lines – the earliest "connective tissue" pathways between the East and West. Alongside the exotic spices and silks they found in the rich and colourful

markets of India, da Gama and the early travellers to India brought back the concept of zero. For it was in these markets that the ancient sages had devised the numeric system of symbols we use today (Fig. 21.1).

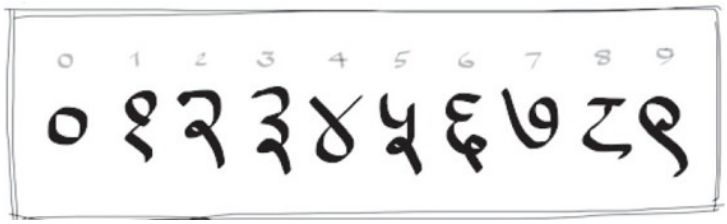


Figure 21.1
The Sanskrit numerals.

Zero: Entering Nothing

Zero in Sanskrit: *sunya-m* "empty place, desert, naught".

This concept provided numerical *relationships* in a way that had not been considered in the West. Zero as a concept gave rise to new possibilities of understanding. This is exactly where the concept of neutral, referred to throughout this work, resides. The opposites can be united, through zero: plus and minus live either side of it. Together, all three permit paradox but also unite to give each other their relative meaning.

–1 0 +1

Figure 21.2
The dot in the decimal system recapitulates the placement either side of zero (i.e. showing whether it is a negative or a positive number) by showing if it is a so-called whole number or a fraction. It is a scaleable whole system.

"But the next step, the true miracle moment, is to realize that that 'symbol for nothing' that you're using is not just a place-holder, but an actual number: that 'empty' and 'nothing' are one. The null number is as real as '5' and '2,002' – that's when the door blows open and the light blazes forth and numbers come alive. Without that, there's no modern mathematics, no algebra, no modern science. And as far as we know, that has only happened once in human history, somewhere in India, in the intellectual flowering under the Gupta Dynasty, about the 6th century C.E. There was no 'miracle moment,' of course. It was a long, slow process."[4]

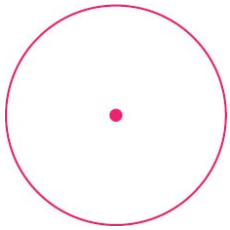


Figure 21.3
The Monad.[29]

Negative and positive can only be known mathematically in the context of the existence of zero between them (Fig. 21.2). Plus one and minus one are so because they sit either side of this "non-thing": neither one nor the other. We call it "nought". It was considered to be "naught". Yoga begins and ends with the circle, the symbol of zero which *at the same time* represents oneness. It is an aspect of every kind of

practice. The symbol for zero is a circle. The symbol for "one" is the Monad (Fig. 21.3). It is a circle, with a dot at the centre. The wonderful saying so often heard in Asia, "same-same but different", applies perfectly here. It is a conundrum that yoga embraces; the one and the all ultimately being (becoming) the same.

The Unifying Principle of Zero

In the Roman system of numerals, the number and the number of digits have to be translated, added and subtracted. Letters stand for numbers and the placement of a letter (or letters) before or after another indicates whether it should be added or subtracted from the main number (letter). Thus, for example, IV (4) is V (5) minus I (1) (5 – 1 = 4); VI (6) is V (5) plus I (1) (5 + 1 = 6). In the same way, IX is 9, XI is 11, XII is 12, XIII is 13, and so on. One has to count in order to count. Additional letters are added as the numbers increase (L is 50, C is 100, D is 500, M is 1000). There is no zero in Roman numerals.

During the Renaissance, these Indian symbols came to replace the Roman numerals that were in common usage at the time. The logic of the Roman system was not as elegant and scaleable as the Vedic numerals. It did not include the symbol or the *concept* of zero.

"The Vedic mathematicians had developed the decimal system of tens, hundreds, thousands, etc. where the remainder from one column of numbers is carried over to the next … it has been said that the introduction of zero, or sunya as the Indians called it, in an operational sense as a definite part of a number system, marks one of the most important developments in the entire history of mathematics. The earliest preserved examples of the number system which is still in use today are found on several stone columns erected in India by King Ashoka in about 250 B.C.E.[5] *Similar inscriptions are found in caves near Poona (100 B.C.E.) and Nasik (200 C.E.)*[6] *These earliest Indian numerals appear in a script called brahmi."*[7]

It is apparent from further studies by David Osborn, the writer of the article quoted from above, that the need for numeric reference, the discovery of algebra and so on, developed in India from the culture honouring its spirituality, rather than simply studying mathematical logic for its own sake. By following the phases of the moon, for example, or cycles in nature, the sages could ensure appropriate timing of ritual and rite in the context of their religious culture. Numbers formed part of their devotional expression and poetry. They did not segregate that knowledge and apply one (mathematics) to the other (things to measure) as if the practice of mathematics was separate from the context of nature and devotion to her forms. It was considered part of the means by which those forms express themselves – or we might say, by which Nature expresses them. Body, mind and spirit were not relegated to separate domains; nor were mathematics, physics and biology separated. The vision remained whole, seeking explanations of differentiations in scale rather than between the components. These ancient sages placed the boundaries in very different ways.

"*After 700 C.E. another notation, called by the name Indian numerals, which is said to have evolved from the brahmi numerals, assumed common usage, spreading to Arabia and from there around the world. When Arabic numerals (the name they had then become known by) came into common use throughout the Arabian empire, which extended from India to Spain, Europeans called them 'Arabic notations,' because they received them from the Arabians. However, the Arabians themselves called them 'Indian figures' (Al-Arqan-Al-Hindu) and mathematics itself was called 'the Indian art' (hindisat)."*[8]

In alphanumeric correspondences a difference of one is allowed. The Greek word "Monad" adds up to 361, symbolising the number of degrees in a circle. One particular Sanskrit verse[10] has a numeric value of 0.31 415926535897932384626433832792. That is p (pi), divided by 10, to 32 decimal places. It is unlikely to be pure coincidence that pi is the number derived from dividing the circumference of any circle by its diameter. It is an infinite number. The poem is a prayer to the Divine.

In Indian numerals only ten figures were required in a pattern based on *numeric* archetypes that repeat themselves in a decimal logic. These archetypes incorporate the universal basis of nature's forms, presented in all her geometric mystery. The different numeric values and geometries are found in flowers, plants, snowflakes, trees, growth patterns, features and faces of fish, animals and humans. The patterns of leaves, insects, atoms, molecular arrangements and planetary orbit patterns contain these archetypal designs. Spirals and chirals, forms of wood, flows of water and the structure of crystals all present the variations on a theme represented by each of the different numbers. Everywhere from the cosmos to the microcosmos and back again, these shapes conform to the formulae found in symbolic mathematics. The archetypal one and zero (1,0) brought about what we call the decimal system and the binary system of computer coding that modern technology is founded upon.

"To ancient mathematical philosophers, the circle symbolised the number one. They knew it as the source of all subsequent shapes, the womb in which all geometric patterns develop. The Greek term for the principles represented by the circle was Monad, from the root menien, 'to be stable', and monas, or 'Oneness' … they noted that unity exists in all things yet remains inapparent."[9]

Literal and Symbolic Beginnings

This principle is important to understand in order to appreciate the metaphysical aspects of yoga and recognise how this notion of unity gives it such a significant relationship with the fascia, from the moment of our conception. It lives in the geometry of our form, which is the basis of the biotensegrity model. It is no coincidence that embryologically, we begin as one conceptus, represented by the Monad (Fig. 21.3). The fascial matrix arises from the "middle layer" which emerges from within the one conceptus, symbolised by the circle (representing the sphere *it is originally*: containing the nucleus – *bindu* – that subdivides to become a tiny part of every part; every single cell in our body derives from this original "Monad"). The actual forming principles of the embryo, from a mystical point of view, conform to the concept zero provides. It is recapitulated throughout the developmental process. The zero, or null point of axis in three dimensions, is where the notochord is shown (see Ch. 5 and Fig. 5.10) in cross-section at every stage (Fig. 21.4). There are three states required for the two to exist, or know themselves as distinct. We can only distinguish muscles from bones *because of the connecting tissues differentiating them*. It is the context for both of them, yet it is neither of them, at the same time. The third aspect connects and unites the other two, coexisting as one whole when they arise together in triune harmony. The same can be said of the mesoderm. From this symbolic point of view, it arises from the "no-thing" between the upper and lower layers of the bilaminar embryonic disc growing away from each other: the space between them. Mystically, it is not a layer, rather a field of "middleness", the essence of which is the in-between, distinguishing and connecting the other layers (Jaap van der Wal, to respect that, refers to it as "the Meso"[11]). This is what Chapter 14 points to in considering adjustment as a moment of balance between two separate kinespheres (practitioner and participant) joining and creating one balanced shape; it is triune harmony. They connect the "no-thing" between them and form one whole, greater than the sum

of the parts. That is practitioner + participant = their combination. Biotensegrity offers the same opportunity to unify tension and compression into a third facility, resulting *from their combination.*

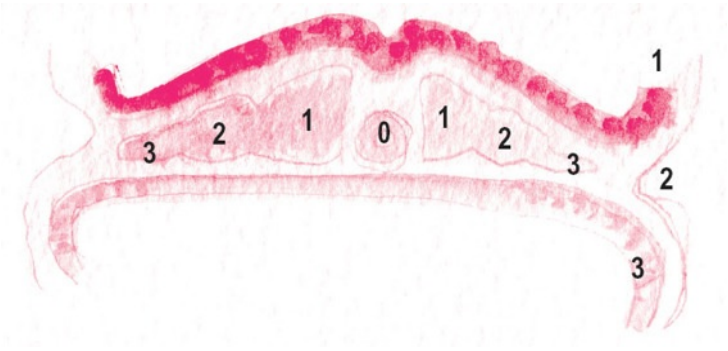


Figure 21.4

This is a sketch, reflecting the symbolic mathematical arrangement, deep to the geometry of embryonic forming. It is taken from Figure 5.10, showing the embryological annotation represented here in the upper (ectodermal) layer, the lower (endodermal) layer and the middle (mesodermal) layer. That middle layer then subdivides three times either side of the "null point" or central axis, notochord, which prescribes the neural tube above it.

Archetypal Numbering

Sanskrit was the "higher form" of the Vedic language of India.

"Although Vedic mathematicians are known primarily for their computational genius in arithmetic and algebra, the basis and inspiration for the whole of Indian mathematics is geometry. Evidence of geometrical drawing instruments from as early as 2500 B.C.E. has been found in the Indus Valley.[12] *The beginnings of algebra can be traced to the constructional geometry of the Vedic priests, which are preserved in the Shulba Sutras."*[13]

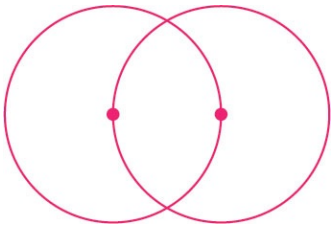


Figure 21.5

The Dyad. There are now three shapes: one, another as a reflection of itself and the Mandorla (almond shape) between them.[29]

In his excellent book on the archetypes of numbers, Michael Schneider elaborates on the symbolic and archetypal significance of numbers in every aspect of our lives.[14] He refers to numbers and shapes as the universal language of nature and art.

One (the Monad) (Fig. 21.3) and Two (the Dyad) (Fig. 21.5) are considered to be the parents of all numbers. Three (the Triad) unifies them and is their first offspring, the eldest of the subsequent six numeric "siblings" that, between them, give rise to the many. The Triad also brings us to "triune harmony", a theme common to many deities and religious cultures (see below and Fig. 21.8).

Four takes us from area to volume: "*three points define a flat surface, but it takes a fourth to define depth*". The tetrahedron is a volume in space (one of the Platonic Volumes or Solids) that has four identical sides. It provides the four aspects of triangulation that allow us to make biotensegrity masts.

To get to Five, "*beyond the Monad's point, the Dyad's line, the Triad's surface and Tetrad's three-dimensional volume*", the Pentad represents "*the introduction of life itself*".[15] This shape completes the set of the Five Platonic Solids (Fig. 21.6), all drawings of which are derived from the original Monad. Their geometries are deep to the study of motion, when tensegrity structures are being designed.

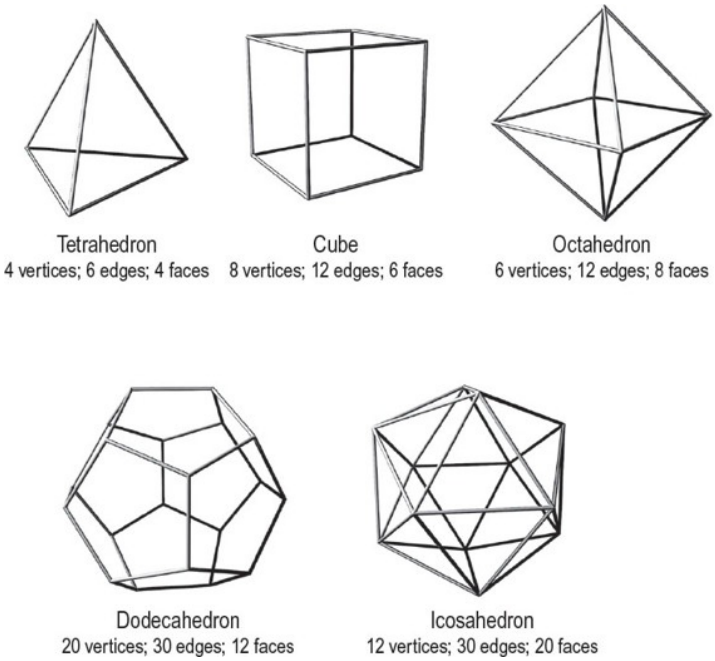
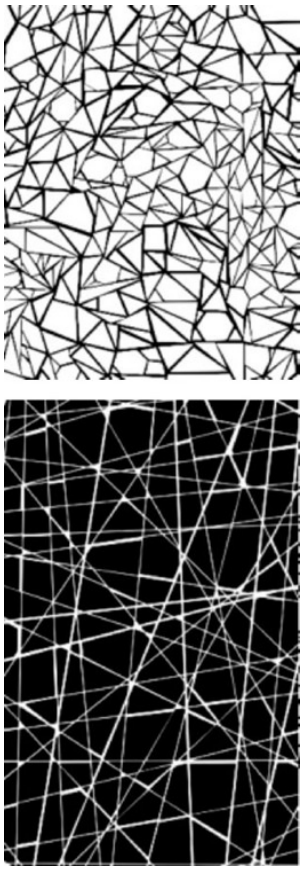


Figure 21.6
The five Platonic Solids.[29]

There are an infinite number of *irregular* polyhedrons in nature, beautifully depicted, for example, in Jean-Claude Guimberteau's "polyhedral chaos" of the pattern on the skin (see below) and the patterns of the fascia under the skin (see below), seen through an endoscopic lens. There are, however, only five *regular* polyhedrons, known collectively as the Five Platonic Solids or Volumes. Others can be derived from these. These form the foundation of questions being explored through biotensegrity architecture, although it is not limited to them.



The images are inspired by the patterns of the skin above and the fascia under the skin; © Victoria Dokas (www.ariadne-creative.com).

Representing 2 × 3, the Hexad holds the secrets of structure, function and order in the shape of the hexagon, which we saw in Chapter 3 as the basic shape of the endomysium. Double triune harmony gives these three assets to the archetype of "six-ness". The hexagonal shape interlocks exactly and so has stability such as is seen in a honeycomb, for example (which is formed by the bees' bodies moving through it). This is a tessellated pattern (where the sides of each shape fit each other). The endomysium is at the microscopic level of close fitting structures within the body: the closely organised fibrils and fibres of the muscle bodies within their myofascial matrix. Forms organise in these patterns and according to Stephen Levin, account for the organisation of our internal world of colloids and emulsions.

The archetype of seven, we learn, is a particular number that does *not* fit with its siblings. It can only be approximated with the geometer's tools (of a pencil and a pair of compasses). Familiar as the number of notes in a scale and days in the week, the Seventh Day is famous as one of rest – different from the others. It has unique numeric properties. The ancient philosophers considered there to be only seven numbers, since one, two and ten were the source, or result, of the others. As such, it has a unique place in the system: "*Seven represents a complete yet ongoing process, a periodic rhythm of internal relationships*":[16]

"use a calculator to divide the 360 degrees by each of the values one through ten. While every one of the ten, except seven, divides 360 without remainder, only the seven-sided polygon presents an endless decimal and an unmeasurable, elusive angle from its center to its corners."[17]

Could it be that part of the difficulty in reducing biomechanics down to the properties of the more regular geometric patterns, is that some of them do not fit? Does that question biotensegrity, or the logic through which we seek to explore it, to explain our structure?

Eight (from the Sanskrit *o-cata-srah* meaning "twice four") gives us the Octad, which is about polarity

and pulsing cycles (see Ch. 15). The number itself reveals its cyclic nature; it is represented as the Möbius: the continuous nature of the birth–life–death–birth cycle inherent to yogic philosophy.

"*Composed of three trinities (9 = 3 × 3), the number nine represents the principles of the sacred Triad taken to their utmost expression*".[18] Such patterns as the magic square (Fig. 21.7) help lend Nine its mystical sense of completion that is, the symbol of new beginnings. It gives rise to patterns unique unto itself.

4	9	2
3	5	7
8	1	6

Figure 21.7

In a magic square all lines and diagonals add up to 15 in all directions; each square within the square containing a unique digit. Nine, in Sanskrit is nava, and was part of the glyphs for the sunrise and the new moon, representing a new cycle. Thereafter is the One and the Zero creating the next whole cycle in a decimal numeric system.

Stepping into Ten represents a recapitulation of the whole. It holds within itself the parents of numbers (zero, one, and is the first having two digits) and their seven children (three though nine). Expressing the properties of all numbers, Ten represents a whole greater than the sum of its parts, beyond the number itself.

One of the difficulties in reconciling symbolic mathematics, is that the first three digits are zero, one and two (not one, two and three). One and two are considered to be the parents of subsequent numbers, so three is the first born (and the fourth digit). Symbolically, everything is contained by the wholeness of the next level in the holarchy.[19]

From Circles

Every time we draw a circle, we invite these archetypal patterns into our awareness. It is an invocation of creating wholeness. In itself the action of drawing the circle contains the balance of opposites: the stillness of the point (the bindu) and the dynamic movement of the pencil drawing the circumference. That first circle is whole and complete; however, in order to "see" or "know" itself, it has to create "other than" itself.

In order to create a second circle, we keep the compasses exactly as they were, to preserve the exact radius and reverse how we hold them. By placing the point (stillness) of the compass anywhere upon the (dynamic) circumference of the first circle, without changing the radius, we reverse the positions of the two legs and draw an exact reflection (Fig. 21.8). In yoga this is the illusion of Maya. This symbolises the reflection that can only be formed accurately in the presence of itself. (Mirror images are always reversed.) Its circumference passes through the centre point (*bindu*) of the first one. Thus the first circle

has been precisely imitated; it forms the imitation, the illusion of "other" as a mirror image of itself. However, this is to provide the coordinates for three: the triune harmony the two give birth to or cause to arise.

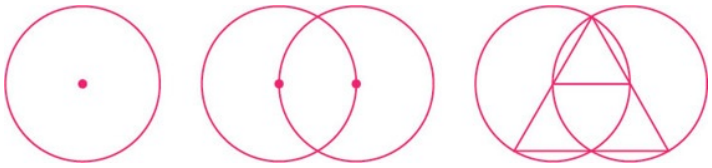


Figure 21.8
From the birth of the line, this constructs the triangle, which symbolises area or surface.[29]

Every biotensegrity model represents a close-packing arrangement of spherical shapes. The "joints" represent the centre points of the overlapping spheres. Imagine a crate of oranges; if you somehow photographed it transparently and turned it into a 2-D diagram, you would get overlapping circles. They can close pack such that each layer sits in the gaps of the layer beneath. Or they can pack by sitting one on top of the other, depending on the boundaries containing them. If you drew lines from centre point to centre point and then "disappeared" the oranges; you would have a geometrical drawing modelled by one kind of biotensegrity mast. Our cells are soft biological versions of these moment-by-moment, movement-by-movement geometries-in-motion. They also contain the fluid flows in which they reside. The fascia forms the substrate in which the close-packing arrangements are organised and organise these transitions. It is profoundly interrelated. We organise in nonlinear ways, motioning through combinations of these various subtle and constantly changing geometric patterns. Each shift in the close-packing arrangement represents what is called a "phase transition". It has far reaching geometrical significance on every scale of our inner and outer worlds. That is the structure of our chemistry, our biology and our movement mathematics. It is the structure of our structure and its implications are both universal and ancient, even if they appear new to us, now that we are seeing this fabric of the "in-between".

The two circles form an opening between them: the possibility of a third entity. It gives birth, geometrically, to the (coordinates of the) line and provides the pathway, or access, to the third aspect. (These are precisely symbolic of the forming principles of the layers in the embryonic process of gastrulation.) The ectoderm and the endoderm move away from each other as the space between them becomes the third layer. It emerges from them.

The third shape that the two circles create, sometimes called the Vesica Piscis (pronounced Pie-Sis), is fundamental in many shapes of our physical forms (mouth, eyes, etc.) It is the "almond-shape" or Mandorla. This pattern of circles repeated is the basis of the Flower of Life symbol (Fig. 21.9), within which can be found the Tree of Life (Fig. 21.10), which has profound significance for our form. It maps the geometries from which we are formed; the close-packing arrangements of our cells. Originally these are the organisation of the earliest divisions of the conceptus that represent the blastocyst (see Ch. 5).

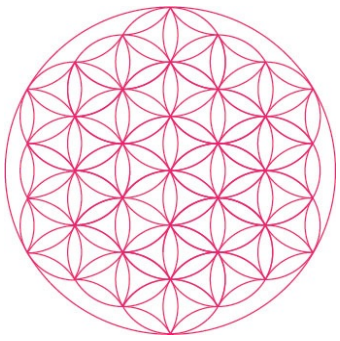


Figure 21.9
Flower of Life.[29]

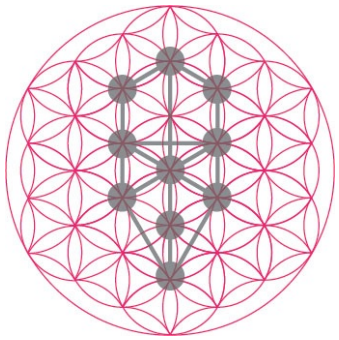


Figure 21.10

Tree of Life symbol in the Kabbalah. Many different traditions and ancient theologies contained and presented knowledge in these geometries through art and symbols.[29]

In Sacred Geometry the Flower of Life, originating in Ancient Egypt,[20] denotes the containment of all geometries, arising from repeated overlapping circles of the same size. The Seed of Life (in two dimensions) and the Egg of Life (in three dimensions) (Fig. 21.11) are the forms representing the pre-embryonic stage of cleavage, at the third division, in the human embryo. They are also the basis of close-packing arrangements of our cells in microscopic organisation of the soft tissues.[21]

These geometries all have deep significance in various theologies. They are fundamental to the architecture of the earliest cathedrals and sacred sites. They are fundamental to the patterns of how every cell in our body is "close packed". They are fundamental to the Golden Ratio, or Divine Proportion which all bodies naturally manifest and conform to, in terms of shape and structure. We are the principles of nature's close-packing geometries, walking around.

Once we have drawn two circles, identical to each other, we can join the points and form a cross. From there we have the coordinates to create surface (Fig. 21.12).

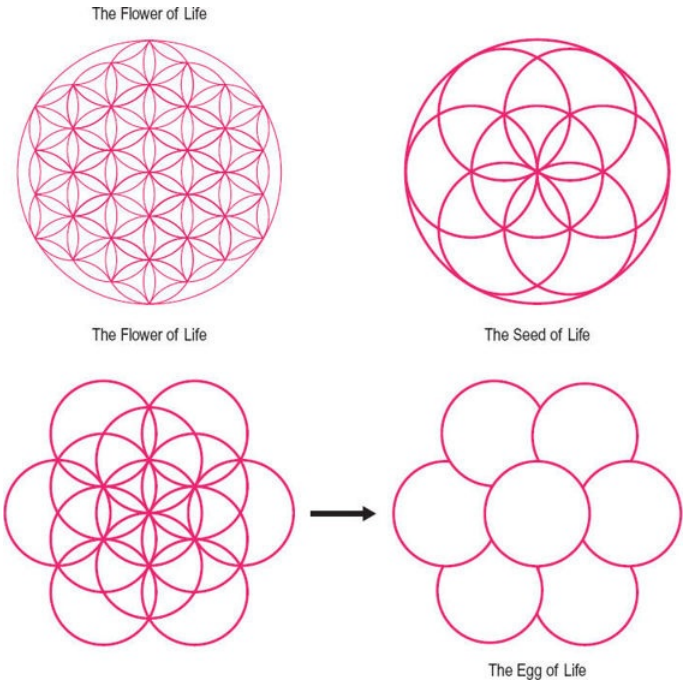


Figure 21.11

The flower, the seed and the egg of life.[29]

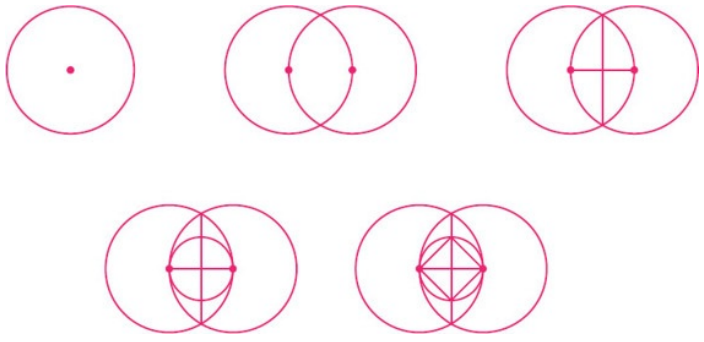


Figure 21.12
From the birth of the line, this constructs the triangle, which symbolises area or surface.[29]

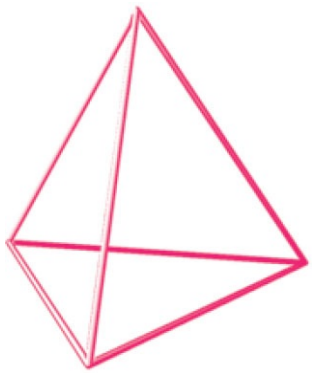


Figure 21.13
Triangles joined form the tetrahedron. [29]

When the two lines are drawn, they provide the possibility of opposite directions. However, they coexist, arising from the same situation or opening (the Vesica Piscis representing a portal). Symbolically this is the domain of paradox, the gateway to the next level. These symbolic polarities, represented by the two lines, invite us to unite them by appreciating their differences. Vertical and horizontal can be woven together as if they are different things, such as warp and weft. When these two aspects become unified, they combine to form material and surface. Their combination, working together *as opposites,* permits the possibility of something far beyond the sum of their parts. Weaving, according to Kenneth Snelson, is the mother of tensegrity.[22] Thus we secure two-dimensionality from which to explore three; by joining three flat triangles, a fourth arises from the space they leave contained (Fig. 21.13). (Note that this gives rise to a four-sided shape; each number contains the potential for the next and is held within it; siblings in the family arising from the original parent numbers.)

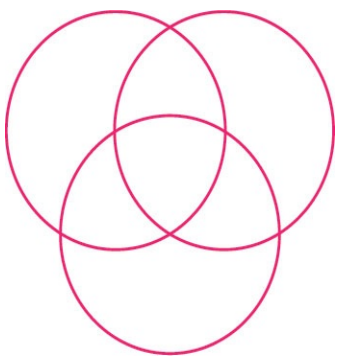


Figure 21.14
Three overlapping circles reunite to create triunity. Each can know itself and be conscious of others.[29]

The archetype of the parent numbers, one and two, gives birth to the third form, considered to re-

establish the harmony of unity. Combined, two produces three, the essence of creation. The third form can then unite the two. As we draw the third circle, each individual has access to a reflection of themselves. Between them, acting together they can create "three-ness" and transcend the illusion of Maya (separateness or duality). This is known as Triune Harmony or Triunity (Fig. 21.14). There are many literal examples in our bodies, such as the triple helix of the collagen fibres. This archetypal three-ness is the basis of the field Rumi refers to "out beyond ideas of right doings and wrong doings". In other words, the duality is united and transcended by the field containing both; the harmony in which they enter four dimensions.

Triunity is very familiar as a significant concept from many religions, for example a triple deity, or triple function of a deity. In this context it is representative of three levels of awareness that allow us *to experience unity*. At this level, mathematics and mythology are symbolic and meaningful. Every number has its own innate geometries and they all have correlates in our energy matrix, which we will see through the "windows" of the chakras as we examine their archetypal geometries, below.

Expanding Awareness

This geometry is symbolic of our approach to meditation. It is a part of the purpose. We sit, literally *in reflection*, allowing the illusion of duality to dissolve as we learn to observe ourselves witnessing *from the place of the witness*. We sit still and quiet while the things concerning us, the considerations and judgments and opinions, good and bad, valuable and costly, right and wrong, *can be the way they are*. We simply observe them *coexisting* in the circle of silence we create. From that (third) place of observation we become united with our original being. It is always present. We arise from it, or we self-assemble it. So meditation can be seen as a way of temporarily returning to, or remembering the source. It is not complex. It is already listening. We reflect, in order to move through something already deep within us, to the "silence force": the One. Caroline Myss describes the mind as "an inadequate tool" in this domain of awareness.[23] That does not mean it cannot participate or learn. It just means the logic might require a certain expansion beyond the limits of its usual reasoning, to one that can contain that reasoning.

The fascia begins as a dot (fibroblast) which exudes a thread (spiral) which unites with two other threads to become a collagen fibril (line). These three can then weave themselves (in complementary directions) into fabric (surface) and form shapes (volume) in biotensegral organisation. It gets more complex and detailed but if every number is seen as an archetypal possibility of geometric forms, at every one there is a correlated aspect of the fascia.

It is in our ability to draw a circle around ourselves or around others, to create the opportunity of community. Even art and science meet here, in the spiral forms, the shapes of sound waves, light waves and what Mae-Wan Ho[24] calls "quantum coherence", which is a scientific expression for wholeness.

Fascia, for its wholeness and active unifying, represents our unity. Symbolically it embellishes the purpose of yoga, allowing our anatomy to make sense to us on every level: literal, symbolic and universal. By working with the chakras as symbols of each level of our awareness at ever more refined frequencies, we can evolve the being and the way it contains the body and mind.

Geometry could be considered the language of form, spoken in shapes and profoundly organised relationships. Fascia is our Organ of Form. It expresses itself through geometry – as geometry is fundamental to its every formation. Therein lies the segue that biotensegrity seeks to model in three dimensions. They become four-dimensional if you add the time element that these moments of movements are captured in.

We can only examine them as models caught in suspended animation. We might not be able to explain them in literal mathematics, any more than we can reason them into submission with intellectual logic.

Archetypal Geometries of the Chakras

"though we are discussing the subtle body, nadis, samskaras, chakras and the like, as if they are concrete things, we must always be mindful of the fact that this is the result of our language and not their subtle, symbolic true nature. No matter how beautiful or seemingly complete a description you may find in any ancient or modern text, it will always be incomplete … the seeker must always maintain the finest levels of discrimination to properly understand the boundaries between domains."[25]

This, in a way, returns us to where we started. Fascia seems to be about the study of the "boundaries between domains": literally, symbolically and archetypally. In Chapter 2 we suggested that the kinaesthetic realm was lost sight of in early Western scientific reasoning. In the East, the sensory aspect of the kinaesthetic was left intact, if only because there was no definite separation of mind, body and being as there was in the West. They were distinguished but they were not dissected or treated as being anything other than whole parts of the one whole being.

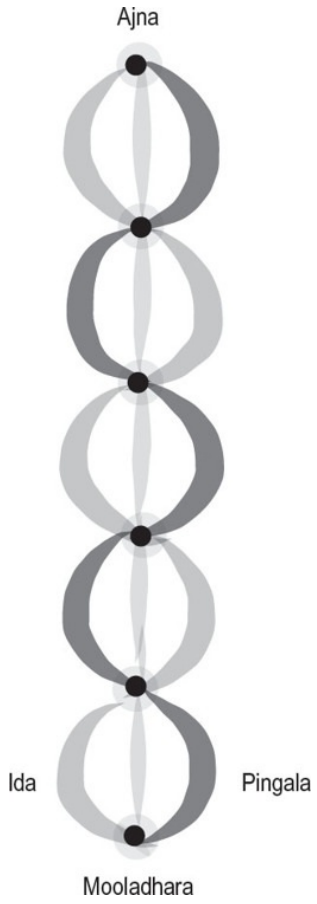


Figure 21.15
The nadis (meaning current, or flow as in Wind Current) are said to be visible to someone with psychic vision. The Bihar School describes them as "blueprints for physical manifestation". They are considered to be everywhere in the body (72,000 in the psychic body).

The ancient yogic history may not have engaged in the anatomical journey of discovery of Western science, examining the finest details of separate muscles or individual cell tissues in human bodies. However, it did study and describe the most sophisticated detail of the patterns in nature that were

common to celestial bodies, human bodies and the bodies of many living phenomena *and how they relate* in a continuum. In many Eastern cultures, the history behind yoga is a different *kind* of story to that of the Western study of human beings and human bodies. It has included the aspect of the *subtle energy body* which is understood in yogic philosophy to form channels, or threads, through which the pranic (life) forces flow.

These flowing currents are brought into balance by the practice of Pawan Muktasana (see Ch. 17). It is designed to "free the inner winds", meaning the flows through these main subtle energy pathways. They are called *nadis* (flow or current) and can be related to nerve currents or energy flows, just as we would refer to wind currents and electrical currents, meaning exactly that; energy flows.

The three most significant of these nadis, the main ones centring around the spine, are Ida, Pingala and Shushumna, spiralling along the length of the spinal axis (echoing the triple helical pattern of the fascia in Ch. 10) (Fig. 21.15). Closely related to the crossing points of these subtle energy channels (or nadis), is located a chakra (meaning wheel or circle). If we think in terms of currents, then each chakra might be understood as a whirlpool or vortex of pranic energy. They are considered to be like an energetic interface, or databank, between the life force and the subtle body animating us and managing the flow of that force. Each chakra is considered to represent what we would call a "psychosomatic" (literally meaning soul-in-the-body) aspect of us and has a particular set of characteristics and a Sanskrit name (Table 21.1). It also represents a geometric pattern; a symbolic quality portrayed in many subtle ways in the letters used, the sounds made by intoning them and the coordinates each chakra represents in the body.

Sanskrit, the higher form of the Vedic language, is known as a "language in the Wisdom Tradition". In this extremely sophisticated means of expression, each letter in each name has a numeric value, like ancient Greek and Hebrew (known as alphanumeric correspondences). Those correspondences are resonance fields; they represent far more subtle meanings than their spelling appears to denote. Their sounds have specific musical connotations and they unite many aspects of our lives that we might consider separate.

Table 21.1

No.	Theme	Name	Symbol		Yantra	Location	Meaning
9	The Horizon looking out beyond number; new beginnings				Grace Divinity	12-finger point, above the crown	
8	Octad – infinite compassion and continuous cycles	Sahasrara		A shining lotus of 1000 petals	Supreme knowledge or consciousness	Crown of the head	One thousand
7	Septad – approximation	Bindu		A tiny crescent moon on a dark night sky	Awareness	Top of the back of the head	Point or drop
6	Hexad – the cube – structure, function and order – the double triad	Ajna		A silver lotus with two petals; represents the sun (Pingala, positive or active) and the moon (Ida, negative or passive)	Subtle Mind; knowledge and intuition converge: these two pranic flows converge at this chakra with Shushumna, the spiritual force (neutral)	Mid-brain, behind the space between the eyebrows	Also known as the Third Eye; jnana chakshu (the eye of wisdom). Ajna means command; guidance from the higher self or the guide comes through here
5	Pentad – the Pentagonal Geometries; all five regular forms – new life	Vishuddi		A violet lotus with 16 petals	A white circle, the Ether Element	At the back of the neck, behind the throat	Shuddi – purification. It is enhanced by "vi"; a deepening of discernment
4	Tetrad – tetrahedron and Star Tetrahedron – Gaia Metria; when two tetrahedrons (four-sided) combine	Anahata		A blue lotus with 12 petals	A hexagon, formed by two interlacing triangles; the Air Element	In the spine behind the sternum, level with the heart	"Unstruck"; it refers to the soundless sound from which sound manifests
3	The Triad – Trinity or Triune Harmony	Manipura		A bright yellow lotus with 10 petals.	A Red Triangle; the Fire Element	In the spine behind the navel	Mani – gem and pura – city; "City of Jewels"
2	The Dyad – Mandorla or Vesica Piscis – the illusion of Maya	Swadhistana		A crimson lotus with six petals	A White Crescent Moon; the Water Element	Two-fingers width above Mooladhara; the coccyx	"One's own abode"
1	The Monad – circle containing the bindu	Mooladhara		A deep red lotus with four petals	Yellow Square; the Earth Element	The perineum in the male and the cervix in the female	Mool – root, adhara – place. The Root Centre

The use of specific sounds of words to describe postures – and mantras to use in meditation – was not arbitrary. They denote forms and particular ways in which the sound waves resonate with certain geometric patterns or subtle energies. As we have mentioned, even the numeric values of the verses through which the teachings were presented hold significant shapes, just as the energy pattern of a light wave or a sound wave (or a heel strike pulse; see Ch. 7 and the work of Serge Gracovetsky) resonates. Indeed when we begin to look a little closer at the symbol associated with each of the chakras, it reveals its geometry.

Each chakra represents a particular geometry and geometric configuration and place in the body (Fig. 21.16). Once we begin to explore the hidden geometry of all life, we discover that the chakras incorporate specific aspects of it; the numbers, letters, sounds and images presenting them all correspond and the mysteries of the energy system are encoded by that geometry. The patterns on our skin, the polyhedral chaos of the fascial matrix seen under endoscopic magnification – all adhere to the laws of Gaia Mater. *Geometry names* the field of knowledge that deals with spatial relationships (Greek: *geo*, meaning earth and *metria*, meaning measure). Gaia is the Greek Earth Goddess and the origin of the word *metria* is shared with *mater* (mother). The word "geometry" incorporates the symbolic meaning *the measure of Mother Earth*.

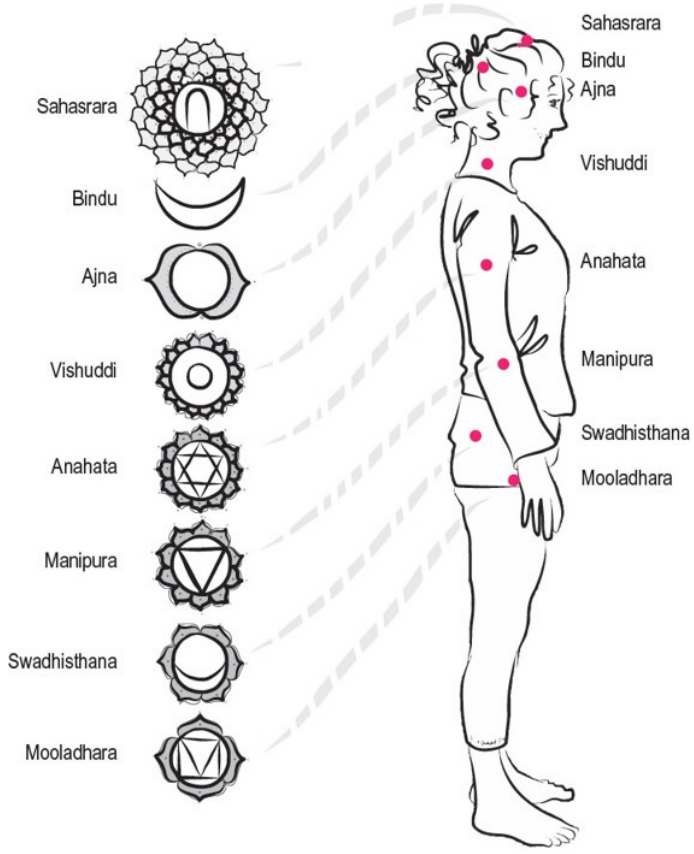


Figure 21.16
The chakra system.

We are just beginning to understand the geometry of our structure, through learning about biotensegrity architectures. The hidden geometry in every form we know is found on various levels and in all natural forms, be it the chemical structure of an element, the crystalline form of inert rocks, the organisation of petals and leaves on a flower or weed, the dimensions of a snow flake or the structure in fluid arrangements of everything from water to chocolate.

Chakras as Levels or Frequencies

In ancient India, each letter/number had a resonance field, so each chakra had a series of subtle annotations including its specific name, an image (*yantra*, meaning sacred journey, represented by a mandala) and a sound (*mantra*, meaning sacred sound, represented by a Sanskrit term, designed to be chanted). Each term also has numeric value indicating a specific type of geometry associated with that value. This geometry gave rise to the particular forms and shapes assigned to the chakra. Indeed, they each have a corresponding symbol and colour. Bearing in mind the exquisite precision of this metaphysical annotation, the wholeness of each chakra is embodied in the repeated image of the lotus flower. The number of petals at each level has significant links with the "*bija mantras*" (seed sounds) of the Sanskrit alphabet. Like the rules of biotensegrity, nothing is redundant and each part is self-contained yet remains an intimate part of the whole. The detail is traceable at every scale and it is universal and intimate at the same time. Besides the yantra and the mantra, the movements (tantra) were the physical manifestations of those references in the body. Regardless of what we have come to make them mean, they were originally designed as a triune harmony.

At a literal level this is the gross and the subtle, the form and the formless: visible and invisible aspects that unite. When they are in balance, a third state arises, which we are referring to as neutral (as

we have throughout this book). In yogic wisdom this third aspect is symbolised in Shushumna: the spontaneous release of energy flowing through a distinct energy channel. This is thought to be at the spinal cord, possibly relating to the original axis defined by the notochord in the embryonic structure.

Shushumna is considered to arise spontaneously as an expression of unity between the other two principal forces. Thus, together, they can be referred to as "tri-unity" or "triune wholeness". Ida represents the Moon (negative, passive) and Pingala represents the Sun (positive, active). Shushumna represents the "zero", the "non-thing" between them that, in triune harmony, allows them all to be.

We could consider that a location of the chakra on the spine is its "apparent" manifestation. The energy of that centre, or its frequency, is inapparent. Together, however, the chakras themselves provide the *transparency*: the third uniting aspect that allows us a particular view to see through, that is congruent with its colour, sound and symbolism. It also incorporates its subtle relationships to the other chakras.

Opposing Directions

The whole subtle energy system of the body was thought to include more and more subtle or refined frequencies working up the spine, from the first base or Root Chakra (Mooladhara) to the Crown (Sahasrara), upward to the energy centre beyond it. In the other direction, working down the spine, energy becomes more dense and is considered to materialise and manifest from the collective consciousness (above) to the individual (downward through to the earth). Divine Inspiration is said to move down from the crown and is then "made real" in the community in the metaphorical sense of "giving birth" to an emerging idea, once it has sufficient gravitas to be manifest.[26]

Throughout this book we have alluded to the unity arising from a third state; the combination of apparently paradoxical ideas creating a third aspect once they can be combined. The ability to move the energy up and down the body is realised as the free flow of the inner winds, or currents (see Chs 15 and 17). Polarities become paired attributes when their sum is united. Moving energy up and down the body allows for circulatory pathways to remain free and flowing. This is part of the physical and meditational practices of yoga. The directions, or symbolic polarities, unite to become a realm, or field, of neutral possibility combining all possibilities.

The notion that we work up from the ground and back down to it is recapitulated in all yogic practices. This is in the physical act of balancing in the postures, upright and inverted. In meditation, it is to counterbalance movement itself. If everyday life is mainly about our outward focus and evolution of our abilities, then meditation could be framed as our opportunity to focus inwardly for the involution of our potentials. We foster balance and counterbalance on every level, by incorporating both.

No	Name	Symbol	Chakra Energies At Each Level of Being A Person (Example: from 1 - 9)
9			Universal Grace; beyond archetypal patterns, this level denotes the realm of pure consciousness from which we emerge, to which we return.
8	Sahasrara		Personae; the eighth chakra denotes the archetypal world of the collective consciousness. Here all manner of personae are present to us as universal archetypes: rich in symbolic patterns we all recognise.
7	Bindu		Transpersonal; the seventh chakra denotes the connection with grace or spirit such as it is for you; respresenting your own intimate connection with the divine forces that transcends the personal realm; thereby being transpersonal.
6	Ajna		Impersonal; the sixth chakra is symbolic of our knowledge; the intelligence and wisdom we gather from the world around us and our knowing and understanding. If it comes from the heart it can become compassionate knowledge, however, it is not so much "ours" as it is impersonal and shared.
5	Vishuddi		Personality; the fifth chakra is symbolic of our ability to express ourselves, from the heart We "find our voice" as the channel from the heart through the throat chakra to speak directly from it. It is also the central chakra; heart-centred self-expression.
4	Anahata		Inter-personal: the fourth chakra (the heart), symbolising the ability to be in a relationship as a whole and complete person, with another whole and complete person; both self-contained and free to choose. (100 + 100 = 200% here)
3	Manipura		Personal; this is the third chakra (of self-esteem), symbolising the state of individuation. Our sense of who we are becomes personal to each of us.
2	Swadhistana		Co-personal; this the second chakra, symbolising the state of recognition "other than me"; when we become aware of our sibling or parents as separate from us – yet we still depend upon them entirely; we are co-dependent in relationships at this level. (50 + 50 = 100% here)
1	Mooladhara		Pre-personal; this is the first chakra, symbolising the state of entering the world at the level of our tribe. It is "pre-personal" in the sense that we are part of the collective we are born into.

In meditation we sometimes begin by focusing on a dot: the centre (or bindu) of the circle. If, for example, that dot is visualised as a stone dropping into a pool of still water, it ripples outward in concentric rings. The stone represents our focused attention and these rings symbolise the larger circles of our expanded awareness. We learn to generate the "witness" in order to see ourselves seeing the stone and the circles. We explore our own triune harmony through participating in witnessing ourselves witnessing.

An example of the chakra system, representing the different levels of awareness, is found in recognising the different ways we consider what is personal. Figure 21.17 represents a **person**. We could say that the levels of the chakras as an energy system reflect different aspects of *being a person* at each level. Working up from the root chakra in this example (presented in reverse order): (See Table 21.2 above).

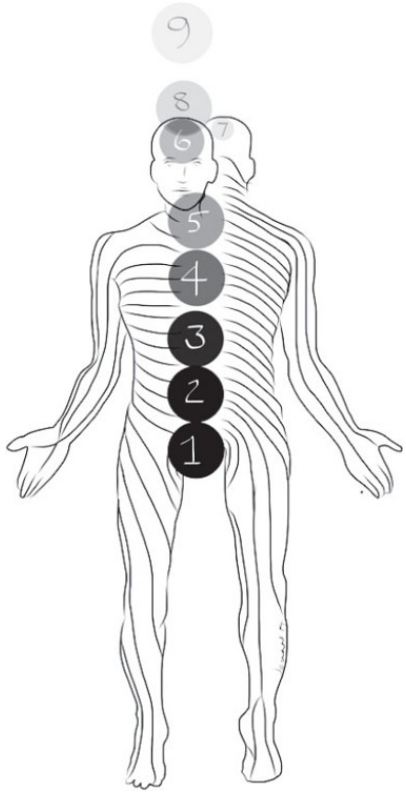


Figure 21.17

The chakras are presented here in relationship to the dermatomes – a purely speculative correlate on the part of the author. The *bindu* (see Fig. 21.16), shown here on back view, is not included in the main chakras in some references, as it is in the Bihar School of Yoga. This is offered as a way of considering the chakras in a contemporary context.

Symbols of the Chakras

In the system of the chakras, these numeric archetypes are symbolised by levels in the body in relation to the spine. They further correlate to specific levels of awareness on the journey of the self towards so-called enlightenment. That is, the journey from the first chakra (earth) to the highest chakra (heaven) symbolises a journey from denser, earthly levels through the colour spectrum, the musical scales and their related numeric archetypes, to the light (full spectrum) beyond the crown. In *Sacred Contracts*, Caroline Myss[27] suggests that our individual power is expressed in the ability to bring an idea or inspiration back down through these distinct levels of awareness into manifestation, formed in a particular shape that conforms to everyday life and can be birthed into it. The cycle begins again, on every level and in every aspect. Perhaps every time we teach a class, we are in fact “giving birth to” an idea. We bring it down from inspiration to manifestation through a process of transformation. Then we give it away, to have a life of its own in the community.

Thus these geometries can be considered to express different qualities found in our form, correlated directly to our physical well-being and our metaphysical way of being. They relate to the geometry associated with each number. They unite the principles of energy in motion, the vibrations of sound waves and light waves and the geometries of nature’s forms. They are not literal, dissectible structures, any more than thoughts or emotions are. Sanskrit, as we have noted, was a language in the Wisdom Tradition. It was the refinement of sounds, expressed by priests, versed in its nuances and very precise expressions of subtle feelings, qualities and metaphysical states. It took lifetimes to learn, experience and teach this work. The flowing of these subtle energies was considered paramount to the ability to be at ease with

one's self (as distinct from *dis*-eased). The idea is far from new but it might be made more accessible by restoring the sense of unity between body, mind and being, and understanding the matrix between them.

Perhaps understanding the fascia will unite not only the different aspects of science, such as psychology and physiology, affected by the paradigm shift it is causing, but also the rift between science and art. It invites a pathway – or perhaps a connective tissue network – between mathematics and music, movement and form, anatomy and yoga. (We might hear the echo of "firmitas, utilitas, venustas" from Vitruvius in Ch. 2.)

Hidden Geometry

"The beauty expressed by a flower's hidden geometry is as necessary to the world as its reproductive function is to the plant. How fascinating, though, that their beauty is communicated not by the plant, but by us. It is we who respond to its beauty. It is humanity that has always embedded this geometry in the world's greatest works of sacred art and architecture, simply because we resonate with these hidden patterns. We, too, are made up of them and, thus, we contain the universe that contains us. Or, as the traditional philosophy for which Keith speaks would phrase it, we are each a microcosm of the macrocosm."[28]

The world that contains us and the world that we contain expresses the idea of the microcosm in the macrocosm. Understanding the fascia from a view of multiplying up to connect and unite, rather than cutting apart to dissect and divide, is an invitation towards recognising the experience of *unifying*, as we said at the beginning. That is, unifying mind with body and being, not just unifying the parts of us to become one body. It goes further, to suggest the community (common-unity) of beings together in a universal whole. For the ancient yogis, the metaphysical and the physical are parts of each other. They coexist to form a wholeness, within one another. This is the principle of the embryonic development and the idea introduced in Chapter 4 of a holarchy. A "holarchic structure" is one in which each part is whole and complete, as well as being a part of another (whole and complete) part or wholeness. It drives the mind in circles until it is experienced. Then we can simply recognise it.

We are perhaps beginning to move from the two-dimensional world of the "musculoskeletal" system to a three-dimensional world of the body, where the connectivity is honoured and wholeness and relationships feature (and even take precedence) in the story. This is a cultural leap of faith. It takes us by the hand into that field in which the thing that makes us all the same is also what makes us all unique, yet makes us all the same, continuously, like a circle within a circle: the endless cycle of a continuum. Perhaps the greatest gift of yoga is zero; the circle with nothing in it; the symbol of where we begin. From here the only thing to do is create a way – your way, unique in all its glorious forms. *Enjoy the field!*

Notes

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