

# Biotensegrity-Anatomy for the 21<sup>st</sup> Century Informing Yoga and Physiotherapy Concerning New Findings in Fascia Research



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## Abstract

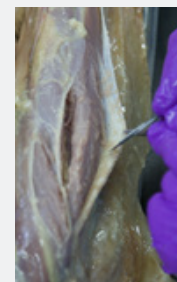
This short article addresses the question “is knowledge of human anatomy generally and fascia specifically, important to the Yoga teacher and physical therapist”. The science of human anatomy is changing. Anatomy has entered a new chapter in the understanding of human structure and form and this new vision entitled “Biotensegrity focused anatomy” is informing all disciplines of biomedicine, movement and manual therapies. The current multidisciplinary focus on fascial tissue is poised to have an impact on the work of surgeons, massage therapists, pain specialists, manual and movement therapists including Yoga teachers and practitioners worldwide. Therapeutic improvements in our patients and clients are better understood in the context of this oft forgotten human connective tissue matrix. Modern science may now be catching up with the natural and ancient wisdom of our unbroken, unified, ubiquitous fascial fabric that research is demonstrating may be the bridge between mind and body. Unique human dissections with a special focus on the fasciae are shedding new light, new explanations and new theories on the changing face of anatomy, biomechanics, pain, motion and e-motion.

## Fascia-the Highway to our Internal Self

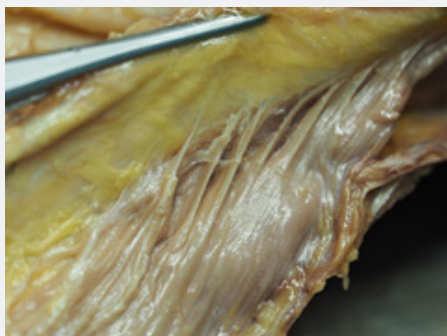
The word “Yoga” is rooted in the Sanskrit “yuj,” meaning “to join” or “to unite”. Essentially, yoga has come to describe a means of joining the mind and body. Yoga is an art and science embracing wholistic health related movement. Research coming from Biotensegrity focused dissection provides a unique educational experience whereby the Yoga practitioner or body worker can better appreciate the inner reality of our soft matter architecture. Through the study of anatomy via dissection it is appreciated that variation is the norm. No two bodies are the quite the same. No two patients/clients are the same. The cartoon-like images provided in anatomy textbooks showing the architecture of structures are a far remove from the reality that one witnesses in dissection. A false appreciation of our soft tissue architecture, due to the simplification of muscle fibers described without mention of their surroundings, investing fabric (the myofasciae) and its many roles based on its three-dimensional continuity, has promoted a misrepresentation of our connected self (Figure 1). In 1957 research by Stillwell [1] demonstrated the rich sensory innervation of fascia confirming ten times as many sensory receptors in the fascial tissues compared to muscles.

Research arising from a new approach to dissection influenced by the work of anatomist Jaap Van der Wal [2], as seen in (Figure 1 & 2) calls into question the long held traditional

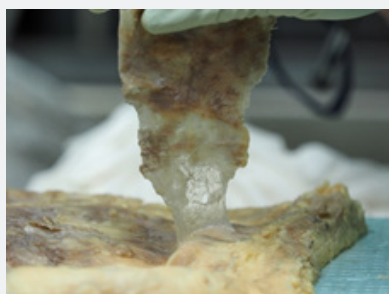
model of origins and insertions. The belief that one muscle is responsible for one specific action must now be erroneous. The flexors of the forearm are too numerous for all to attach to the medial epicondyle of humerus. The fascia provides the scaffolding for muscle attachments and force transmission. The myofascial system (if we can use such a term) provides a vast ocean within which the bones float. This ocean can be large or can trickle down to the smallest stream or brook. During a biotensegrity focused dissection the fascia can seem to vanish [3] as it becomes infinitely delicate (Figure 3) while in other locations fasciae merge to form a denser relationship eliminating glide such as seen on the palm of hand or the arcuate line which is a visible to invisible transition from thick to thin fascia [3].



**Figure 1:** A view of the muscle fiber and its surrounding fascial fabric (Image Sharkey, J. 2018).



**Figure 2:** Muscle fibers in series continuity with fascia (Image: Sharkey, J. 2018).



**Figure 3:** Fascia morphologically changes dense to thin, coarse to delicate (Image: Sharkey, J. 2018).



**Figure 4a&b :** Nature's laws lead to spirals and patterns repeated at many scales and in all species (Image: Sharkey, J. 2018).

These myofascial laminae vary in thickness and thinness dictated by the tensional forces acting upon them and they are intimately connected with these forces working against gravity to produce or reduce movement. Inventor, artist, sculptor, theorist, mathematician and naturalist Leonardo Da Vinci was fascinated with the form of spirals (found everywhere in nature) evidenced by his further fascination with the movement of water. Leonardo devoted a significant portion of his life to understanding the phenomena of nature, the natural laws and the cosmos (Figure 4a & 4b).

This led Leonardo to write, but never complete, treatises on anatomy including humans, animals, plants and trees. Da Vinci's use of the Divine proportion or golden mean is evident in many of his completed and uncompleted works. Leonardo's Vitruvian Man, was constructed based on the golden ratio (or divine

proportion) and like all things science based even Da Vinci's work can be improved upon as evidenced in (Figure 5) depicting a more wholistic and complete representation of Da Vinci's Vitruvian Man a concept by clinical anatomist and surgeon Dr. Niall Galloway.



**Figure 5:** Addition to Leonardo da Vinci's Vitruvian Man by Dr. Niall Galloway (Sharkey, J. 2018).

Developing a deeper appreciation and understanding of the helical nature of human anatomy through dissection is now further supported by modern day imaging techniques including ultrasound, MRI, and tensor magnetic resonance linking morphology and function to the true nature of our structure. New imaging techniques allow us to see what is not always possible to visualize immediately with the naked eye. We know bacteria exist however we cannot see them with the naked eyes. The same can be said for the most delicate of fascial laminae visible only (initially) by modern day imaging technology. Understanding fascial planes leads to less invasive medical and surgical clinical procedures. This results in faster recovery and retained functionality. With appropriate knowledge of fascia the Yoga teacher can also play an important role in pre and post operative care of patients ensuring a return to normal functionality and pain free movement (Figure 6).



**Figure 6:** (Image: Sharkey, J. 2018).

Debate continues among the recognised international committees responsible for defining fascia. (Figure 6) provides a staircase visual representation showing the skin, as surface, with the next morphological change at the depth of the superficial adipose tissue containing fat lobules and strong retinacula (or skin ligaments) connecting the deep fascia to the undersurface

of the integument. The deep fascia surrounds and penetrates the muscle, nerves, blood vessels and eventually ligaments. Therapists can appreciate how forces generated by the muscle fibers act upon the fascial system tensioning the bones to move while stiffening joints and specific myokinetic chains [4]. Importantly biotensegrity focused dissection demonstrates how the myofascia provides structural integrity effecting blood supply and venous return and neural entrapment. Dense fibrotic fascia stifles the gliding relationships of superficial to deeper structures resulting in tethered tissues and, possibly, pain. Currently many hold the opinion that wrist pain (carpal tunnel syndrome) often involving numbness, tingling, weakness, pain and other problems in your hand are exclusively because of pressure on the median nerve in the wrist at the carpal tunnel. The reality is that the nerve can be compromised anywhere along its length due to fascial insults. While it is important to move the wrist it is vital to move the entire upper limb in connection with the body as a whole. Cutting the transverse carpal ligament does not address the underlying cause of the problem and should represent the choice of last resort.

### Biotensegrity Focused Dissection

Anatomists feed on technicalities and on detail. The traditional method of teaching anatomy via dissection to undergraduate medical students is one that is uniform and systematic. The student of medical anatomy removes the skin and associated fascia to get a “better look” at the vessels, nerves, and organs that are essential to locate. This approach requires removing the associated fascia, even scrapping it away, and placing an emphasis of “where” as the focus of the dissection. “Where” is the superior mesenteric artery, “where” is the coeliac trunk, “where” is Dandy’s vein? While this knowledge is essential for surgeons in training it unfortunately can take focus away from the associated fabric that unites and supports these structures, the very tissue removed, the fascia.

Fascia is not a new topic, an original work published in 1923 by Dr. John D. Goodman M.D. clearly states “I am by no means anxious to claim great merit for proving the continuity of fascia.....I do expect thanks of anatomists and physiologists for having pointed out the mode in which the capsular ligaments are made up from the coverings of the muscles and thus rendering their natural conditions more intelligible and opening the way to new views of their possible situations resulting from disease or accident”.

Fascia of the Pectoralis major muscle (Figure 7) is a resolutely attached tissue connecting the underlying muscle by means of intramuscular septa originating within the muscle emerging to embrace and separate the muscular fibers. Van der Wal argues, that “an architectural description of the muscular and connective tissues organized in series to enable the transmission of forces over a joint or multiple joint is more appropriate when compared to the classical concept of “passive” force-guiding structures, such as ligaments organized in parallel, to actively force-transmitting structures such as muscles with tendons”.



**Figure 7:** Superficial fascia of the anterior chest wall with deep adipose tissue removed exposing the fascia profundus overlying the Pectoralis major (Image: Sharkey, J. 2018).

### Dissection Room to Yoga Practice

If one intends to become a car mechanic can the mechanic be truly informed without getting under the hood and deconstructing the engine? The topic of continuity, layers, stretching, fascia release techniques, friction, gliding, sliding, connections, disconnections, compartments, spaces, and movement are put into perspective by this dissection approach. This new paradigm suggests that our current model of anatomy falls short of reality. A new theory needs to be challenged and tested, rebutted and ridiculed. If the new model or hypothesis cannot stand up to scrutiny and provide undisputable answers and better explanations, it does not deserve recognition. While still in the stages of organic evolution, Biotensegrity focused dissection has passed much rigorous scrutiny with flying colors. In contrast, the old biomechanical model of levers, joints and laws developed from observation made in the sixteenth century by pantheons of great scientific minds, scientists and mathematicians of antiquity including Galileo Galilei (1564-1642), and René Descartes (1596-1650) have come up short in providing adequate explanations of living mechanics. Considering the body exclusively as tissues and bones does not do justice to the wondrously complex and miraculous construct that makes us human beings [5].

The study of anatomy has led to a reductionist view of what is ultimately a global or holistic organism. Historically, anatomical study concentrated on specialties, a focus on specific processes or applications. Anatomists viewed their role as the scientific discipline that investigates the structure of the body including the form of structures, microscopic organisation and the process by which they develop [6]. Biotensegrity, similar to Yoga, promotes a language of “Whole” (a global view) while recognizing that a language of “parts” can be helpful, even necessary, at times. When discussing Biotensegrity-Anatomy for the 21st Century, classical anatomy provides a foundation upon which we can discuss the part and then place it in the context of the whole. The language of Biotensegrity is tension and compression with continuity. The premise of Biotensegrity is non-linear continuous matter that is self-generated, self-organizing, self-stressing, hierarchical, load

distributing and low energy consuming [7]. There are no shear moments, no bending moments, no levers and no joints. This new vision will have significant impact on clinical practice for all Yoga teachers moving from a one muscle does one movement model to Yoga based full body kinetic chain movement.

“Every one of us is, in the cosmic perspective, precious. If a human disagrees with you, let him live. In a hundred billion galaxies, you will not find another.”– Carl Sagan

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