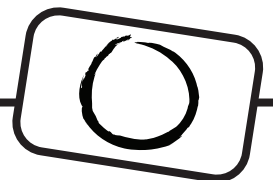
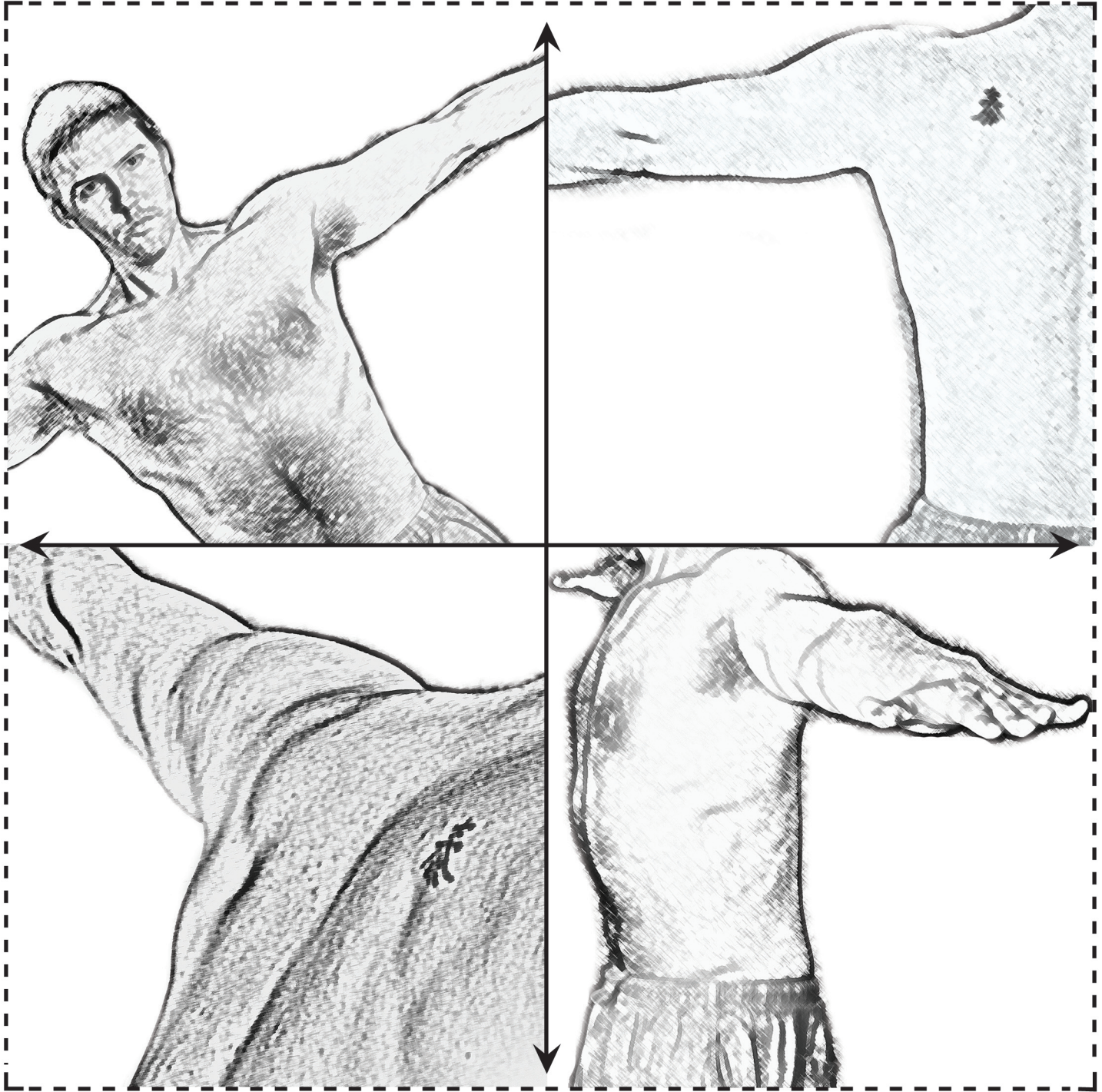


Biotensegrity and Musculoskeletal Traction
in Hatha Yoga Posture Practice



A New Hypothesis

In recent years a new and potentially revolutionary hypothesis has come to the fore regarding the structural organization of living systems. This hypothesis asserts that principles governing what are called tensegrity structures are the same principles that underlie the complex organization of biological systems.

If this is true, then it is true of the macro (as seen in Tom Myers' Anatomy Trains) as well as the micro (as seen in Donald Ingber's work). As the old saying goes, "It's turtles all the way down."¹ Living systems are, in this paradigm, nested tensegrities, and in the words of Tom Flemons, "a discontinuity in a structure marks the boundary or interface between separate tensegrities. Also, molecules within cells within tissues within organs within bodies, and bodies within environments are all synergistically linked tensegrities in a hierarchical cascade from the smallest wholes to the largest."² Donald Ingber, M.D., a leading researcher at Boston Children's Hospital further notes that use of the tensegrity "architectural system for structural organization provides a mechanism to physically integrate part and whole."³

That said, my purpose here is not to advance the hypothesis that the structural and mathematical principles of tensegrity structures in actuality underlie the design and organization of living systems such as the human organism. This is frankly beyond the scope of my education and my experience. Furthermore, I feel the work that has been done to this point by experts in medicine, architecture, and mathematics, points us definitively enough in this direction to begin to explore the idea of the human body as a matrix of tensegrity structures, which can be primed for optimum efficiency through the development of what I call *musculoskeletal traction* by way of hatha yoga posture practice.

The Principles of Tensegrity

Tensegrity, as defined by Buckminster Fuller, "is an invention: it is a contraction of tensional integrity. Tensegrity describes a structural relationship principle in which structural shape is guaranteed by the finitely closed, comprehensively continuous, tensional behaviors of the system and not by the discontinuous and exclusively local compressional member behaviors."⁴ A tensegrity system is self-contained, non-redundant, and is composed of discontinuous compression struts that are suspended in a web of tension lines so as to create efficient, mobile stability for the entire system.

Tension exists in these structures in three essential forms:

- 1 - that which is prestressed in the materials, or built into the system from the start
- 2 - that which is then added by gravity pulling on the weight of the structure
- 3 - that which is further added by moving one of the compression struts, or by pinching one of the tension lines

In architecture, these structures know only what we know. We build into them the necessary

tension to hold themselves up. We hope that we calculate properly the tensile strength needed to hold up the weight of the structure as it sits still and as it moves.

The same cannot be said of human bodies. As we will see, there are more factors involved when applying these principles to biological systems. Much of what we know of this application, we owe to orthopedic surgeon, Stephen Levin, who coined the word biotensegrity.⁵

The classical idea of the human body as a machine made of levers and pulleys that are controlled at isolated points by the contraction of relatively discontinuous muscle groups is outdated. As such, let us move forward under the assumption that tensegrity is, in the words of Tom Flemons, "a map of the nature of structure. If tensegrity is seen not so much as a building system as it is a description of the most efficient way that all form is organized, in terms of most economical use of energy and material, then we would expect parsimonious nature to utilize this principle universally."⁶

Floating Bones

Early in my teaching and visualization of hatha yoga posture practice, I frequently employed the metaphor of feeling as though one's bones were floating like fish, suspended weightlessly within the ocean of his/her myofascial tissue. This is nothing more than an early and somewhat naïve visualization of the principles of biotensegrity in action. When you are perfectly balanced in a given pose, when all the right muscles, tendons, ligaments, and fascia are working with your structure in the field of gravity such that the perfect Asana for your body in that moment manifests itself, there is a degree of effortlessness that naturally arises. You forget about the different, apparently opposing structures of your body, and your form becomes one. This is the feeling of complete tensional integrity as the opposing forces of tension and compression reach equilibrium within the tensegrity system of the human body.

Many experienced yoga practitioners will know this feeling of virtual weightlessness. In contrast, many more people will probably be familiar with the times when tensional integrity is not balanced, when your bones do not feel like they're floating, and when it's just plain hard work to make anything happen.

So where is the discrepancy? It seems the answer lies in the tension present in the structure. As discussed earlier, tensegrity structures are all prestressed under a baseline tension level to maintain structure. This pretensioning varies in degrees based generally on the weight and reach of the structure(s) involved.

As we look at the human organism in more detail, we find more facets to this baseline tension level. Neuromuscular phenomena like residual muscle tension and sensory motor amnesia will alter the tension present within the system. For example, a baby's body is

prestressed at birth with the proper draw to hold his/her bones together within the virtually weightless playground of the mother's womb. As this child becomes acquainted with the field of gravity, with crawling, with walking, his/her body will accumulate more tension in order to maintain balance during these activities. This is all well and good. It is, in point of fact, quite necessary, as a total lack of tension would mean complete collapse.

The problem arises when this child sustains an injury or grows to be a computer programmer and his/her posture becomes distorted. At this point, tension in certain parts of the body are elevated beyond the necessary levels in order to compensate for these distortions. Those unnecessary tensions then become habitual. They eventually cause the fascial net surrounding the entire system to get very thick and dense, further creating undue tension beyond the baseline created first by the prestress inherently needed to hold the body together, then by the weight of the body in gravity, and finally by the range of motion utilized.

This heightened tension will have the effect of creating structural misalignments and inefficiencies of movement in even the simplest of positions. The resulting decrease in functionality will in turn create all sorts of problems for any human being

Musculoskeletal Traction

Our brains constantly calculate the necessary tension for maintaining balance within the field of gravity. Without this, our bones and cartilage would do little to hold us up, so obviously this is desirable. When we crank up this level of tension beyond the optimal with problems like obesity, residual muscle tension, and sensory motor amnesia, we are only making our lives more and more difficult. We are making *musculoskeletal traction* that much more difficult to gain.

Musculoskeletal traction refers to the degree to which you can consciously control the level of tension in your myofascial network and strike that balance of tension and compression, thus creating the "floating bones" sensation. Your ability to control and manipulate your soft tissues as they support the compression struts of your bones correlates directly to your ability to be comfortable and stable throughout your daily activities. This stability does involve certain proprioceptive senses and reflexes that normally happen without conscious impetus. However, access to a large degree of *musculoskeletal traction* can allow you to control and hone these normally self-regulated senses as well.

The use of the word "traction" here may seem a bit vague. It should not be confused with traction as a treatment modality in modern medicine. I do believe, however, it is apropos in this case for several reasons.

Firstly, this is how I intuit what is happening in my yoga posture practice. That is to say that the concept I am trying to articulate feels like the development of traction throughout my musculoskeletal system. Secondly, traction can mean "the act of drawing or pulling." This

begins with general muscle tone – the baseline prestresses needed to support your weight – and your ability to control the amount and location of this drawing or pulling beyond the necessary baseline is what I am calling *musculoskeletal traction*.

A final application might be related to traction as “adhesive friction,” or “the friction between a body and the surface on which it moves.” This might be inaccurate in terms of tensegrity systems, but it seems like what Godfrey Devereux talks about in his book *Dynamic Yoga*. He talks of engaging the muscles at their origin and insertion, effectively sucking muscle to bone. If this is in any way physiologically accurate, greater *musculoskeletal traction* implies a better grip on the structure. This undoubtedly translates to more confident and sophisticated movement.

Musculoskeletal Traction and Posture Practice

I have people who are new to yoga tell me all the time that they feel like they've worked muscles they never knew they had, or that they are sore in places they've never been sore before, after their first couple of yoga sessions. This sensation illustrates how good yoga posture practice can be for the development of *musculoskeletal traction*. Furthermore, it demonstrates a key element of *musculoskeletal traction* I have called localized draw. This term refers to the use of tension in tissues directly connected to the structures you are attempting to move or hold up. This is the opposite of distant draw, which emphasizes the use of large, superficial muscles, often stretched across multiple joints to move or hold up structures to which they aren't directly attached.

There is no doubt that the use of the larger, superficial muscles has numerous benefits. They should be developed for a greater sense of synergy, of overall strength, and for improved fat-burning during normal daily activity. However, we should not replace wholesale the use of deeper muscle tissue, more localized muscle tissue, with the brute force of the major muscle groups. Yoga posture practice is so great for this because it asks you specifically to employ localized draw. If you're using the bandhas effectively, as described in the first Brickhouse Bodymind Blueprint, and you're spreading that dynamic throughout your structure, you are developing *musculoskeletal traction* and utilizing localized draw.

When my teacher was working with me on my headstand practice, he used to say “the feet hold the feet up, the legs hold the legs up, the hips hold the hips up, and the chest holds the chest up.” This is the efficiency of localized draw. You are not asking one large set of muscles to do all the work until it collapses, which is the paradigm of conventional weight lifting. Localized draw via the development of *musculoskeletal traction* in yoga posture practice spreads the effort more evenly across more lines of tension, making your movement and posture more efficient, and uncovering more of your innate physical flow.

Through this process, we can awaken a sort of cellular, or somatic intelligence. In posture practice, we consciously connect with as much of the soft tissues as we can, gently and

deliberately bringing the tension lines in our bodies above the baseline of normal muscle tone. This generates heat and dissolves unnecessary residual tension, breaks up areas of density, and restores neuromuscular connections.

Conclusions

Quite simply, the various asanas in hatha yoga posture practice, particularly those that are more remedial, are the most complete preparation for the rigors of life. The acts of standing, lunging, bending, reaching, twisting, and squatting are the stuff of life in terms of human movement. When we work with the postures and the movements between them judiciously, we can undo the evils of residual muscle tension, sensory motor amnesia, and myofascial density discussed earlier. As a result, we reduce the amount of unnecessary tension present in the soft tissues of the body, we gradually increase the range of motion available to our joints, and our autonomy within our own bodies grows along with our *musculoskeletal traction*.

Think of your body as a computer. Your central nervous system (CNS) is your CPU. As you grow and learn to walk and do things, you begin to store movement patterns in your random access memory (RAM). If you sustain an injury, or if you are largely inactive and spend long hours sitting, you start to avoid certain movement patterns because they have become uncomfortable, or at least unfamiliar. Your software starts to rewrite itself. You begin to drop once-comfortable movement patterns from your RAM. Then, when you are called upon to perform these actions in your life, they become exceedingly difficult, and can result in further injury.

A regular hatha yoga posture practice begins the recovery of those movement patterns dropped from RAM. It is never too late to begin this process as the human body is a remarkably adaptable system. To this end the judicious development of *musculoskeletal traction* through the hatha yoga posture practice can be the key to returning the comfortable ease of physical flow many of us remember from youth to our adult lives.

REFERENCES

- 1 - Wikipedia, http://en.wikipedia.org/wiki/Turtles_all_the_way_down
- 2 - Flemons, Tom, "The Geometry of Anatomy - the Bones of Tensegrity," http://www.intensiondesigns.com/itd-biotensegrity/biotensegrity/papers/geometry_of_anatomy.html
- 3 - Ingber, Donald, "Tensegrity and Mechanotransduction," *The Journal of Bodywork and Movement Therapies*, Vol. 12, Issue 3, pp 198-200, Elsevier 2008
- 4 - Fuller, R. Buckminster, 1975, *Synergetics*, Macmillan, pp 372
- 5 - Levin, Stephen, M.D., <http://biotensegrity.com>
- 6 - Flemons, Tom, *Obid*.

Acknowledgements and Copyright Mumbo Jumbo

None of these concepts is new. The material here is only unique in its presentation. So the language used (except where quotations are made), the graphic presentation, and the phrase Brickhouse Bodymind are the sole intellectual property of Philip Walter and Brickhouse Bodymind Integral Fitness Solutions. That said, please feel free to reproduce this document in its entirety or quote any part of it, so long as you give credit where credit is due.

I must thank Dr. Steve Levin for conversing with me briefly and helping me clarify a few things based on his pioneering work in the field of biotensegrity.

Special thanks also goes to my wife, Amy, for letting me obsess over the creation of this document in lieu of spending a little extra time with her. I love you so very much.

©2008, Philip Walter