BIOTENSEGRITY: THE STRUCTURAL BASIS OF LIFE

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The ability of the human body to function in the way that it does and repair itself when things go awry has been a constant source of wonder for millennia, and an incalculable number of different therapeutic interventions have been devised to assist these processes.

Some require many years of study, while others are more intuitive and rely on the practitioner's sense of touch to read what is going on inside, with both approaches providing useful information that empowers what we do in treatment; but there is a caveat.

No matter how we got to where we are now, at some point in our lives we have all been taught that the body operates like a machine. Where the spinal column acts like a pile of bricks and keeps us upright, the muscles simply pull on the bones and cause movement, and the visceral power-houses keep us alive; but things are not that simple.

The Conundrum

Anatomy (https://www.massagemag.com/brick-by-brick-this-is-how-your-knowledge-of-pathology-movement-anatomy-medication-improves-your-massage-124727/) textbooks have always classified structures according to the thinking of the day and sought to understand their functions with the latest technologies, but established conventions have allowed many inconsistencies to survive long past their sell-by dates.

The relegation of the fascia (https://www.massagemag.com/our-understanding-of-fascia-from-packing-material-to-central-role-121748/) and other connective tissues to mere supportive roles; the persistence of a contrived lever/joint system that loads destructive stresses on tissues that would be unable to withstand them; and the dominance of anatomical and biomechanical dogmas that have remained essentially unchanged since the seventeenth century, are significant examples, but things have moved on.

In order to properly understand health, dysfunction and disease we must first examine how the body is organized—the architecture of the system and the way that it operates—and that means starting at the beginning.

Biotensegrity is increasingly recognized as a more thorough explanation of the mechanics of motion. It examines the basic physics of natural forms through their underlying geometry and shows how even the most complicated organism can be better understood through the simplest of models. Where complex living structures are the result of interactions between some basic principles of self-organization, and that these apply to everything from the smallest of molecules to the whole body. Tensegrity demonstrates the natural balance of forces, the dynamic tension network, and an integrated movement system that is applicable to all living things.

What is Tensegrity?

The term *tensegrity* is a contraction of the words *tension* and *integrity* and was coined by the designer and thinker Buckminster Fuller, (https://www.bfi.org/) but it was his student, the sculptor Kenneth Snelson who created the structure that inspired the concept. Tensegrity models are surprisingly strong and light in weight for their size, and they become even stronger and stiffer when loaded. They consist of a set of compression struts that are suspended or appear to float within a tensioned network of cables, with both coupled into a self-stressed mechanical unit that can change shape with the minimum of effort and remain completely stable throughout.

Tensegrity reduces structure to its simplest form, with the forces of tension and compression efficiently separated into different components and made visible through the cables and struts, because as Snelson emphasized: tensegrity structures are the physical representations of the invisible forces that hold them together; just like anatomy!

Structure and Energy

This inseparable link between structure and energy (invisible forces) is crucially important to understanding the value of tensegrity models to the human body because they are both governed by the same fundamental principles. However, before racing ahead, we must be careful with our comparisons and resist over-simplifying the anatomy. Even though it might seem easy to compare the tension cables and compression struts with muscles and bones, respectively, such a simple analogy can be misleading if taken on its own.

One of the characteristics of life is structural and functional interdependency between multiple parts at multiple size-scales, from molecules upwards, which means that we can no longer take anatomy at face value but must also appreciate how it is organized; and that means more than just textbook detail—we want to make it real.

As an orthopedic surgeon in the 1970s, Stephen Levin observed things at the operating table that were at odds with conventional biomechanical theory and set out to find a more satisfactory explanation. Starting with the study of creatures that stretched these theories to the limit, he discovered that tensegrity provided a more thorough assessment of biological motion at every level and that it is compatible with the basic laws of nature, eventually introducing the term biotensegrity to distinguish this new concept from man-made contrivances that follow a different set of rules.

Therapeutics

Mechanical continuity is intrinsic to the biotensegrity concept and underlies a motion system that easily adapts to ever-changing conditions, but it also implies that some aberrant mechanical signal has the potential to compromise it. A genetic mutation that leads to changes in the configuration of a particular molecule can alter its relationship with others and lead to dysfunction.

Developmental abnormalities, postural misuse, and injury will also cause changes in the local dynamic balance and influence the behavior of tissues some distance away, thus potentially jeopardizing normal functionality as they adapt to a different structural arrangement. Even the effect of an acute muscle contracture is often clear to see as the body contorts itself into a position that minimizes the local stress but changes the bigger picture, at least temporarily.

A Change in Perception

However, while an appreciation of the fascial network in relation to health and disease has been an integral part of certain manual therapies for more than a century, the concept of biotensegrity has been around for a much shorter time, and orthodox views of anatomy and biomechanics have been slow in catching up. Even though it is frequently mentioned in the literature, the precise value of biotensegrity to clinical practice is often misunderstood. Is it simply a footnote to technique or does it go beyond theory; and is it possible to see, feel, or influence it?

A Shift in Balance

In order to answer these questions we must first take a step back from our instinctive response to disease, at least for a moment, and reconsider what is meant by terms such as dysfunction, injury, and illness. These words can be quite misleading because they evoke images of harm, damage, abnormality, and pathology and imply that something must be wrong and that it needs fixing.

Living tissues, however, operate in exactly the same way in a healthy body as a dysfunctioning one, in the sense that the underlying physiological processes always follow the same principles and are constrained by the same rules of self-organization. Even though homeostasis is built into the system, a change in the balance of forces in one region can shift it away from its normal operating parameters, with the tissues now acting within a different set of constraints and displaying a different pattern of behavior.

However, it is us who really make the value judgement about health and disease, not the biology. Whether we have a cut finger, chronic arthritic joint or invasive cancer, the body always responds in the most energy-efficient (and only) ways that it can, and the same fundamental principles of biotensegrity always apply.

So, while it is the responsibility of the practitioner to understand the client's problem, it is equally important to recognize that treatment is about initiating changes, and then allowing the body's inherent self-organizing mechanisms to respond to this as it moves towards a different state of health. The resolution of a local condition can then require a whole-body approach to treating it, or vice versa, particularly if tissues some distance away have become chronically adapted to changes in the structural balance, and an understanding of biotensegrity provides the rationale for this.

The Biotensegrity Concept

Biotensegrity describes a relationship between every part of an organism and the mechanical system that integrates them into a complete functional unit. It examines morphological complexity through the geometry of its architecture and appreciates this as a simple and energy-efficient arrangement that has refined itself over hundreds of millions of years. A constantly evolving system that enables each part to move with the minimum of effort and powers the dynamism that we recognize as life.

Biotensegrity is thus not really about treatment, techniques or fixing problems but a different way to understand what is going on inside the body. Time spent with the stick-and-string tensegrity models shows how every part of the structure is integrated into a complete functioning unit, and that its fluid-like dynamics are remarkably similar to those observed in normal living tissues. They demonstrate the point of balanced tissue tension that is observable in practice, and show how disturbances due to posture (https://www.massagemag.com/make-posture-awareness-part-of-your-self-care-31416/), trauma, and pathology might alter this, with the entire system functioning in synchrony and the body operating in the most energy-efficient ways that it can at each moment.

Models have always played an important part in clinical practice and provide the practitioner with a conceptual tool that can be used in both diagnostic and therapeutic reasoning. Tensegrity models reveal the invisible forces that are active within them, the geometric organization that underlies all living structures and the functional mechanics that emerges from within it. Treatment is then more than just changing tissue tensions or improving mobility but a process that alters the tissue geometry, changes the architecture, and allows the body's self-organizing ability to move towards a better state of health.

Basic Science

All models are representations of a more complex reality, and their acceptance is not dependent on the piecemeal accumulation of scientific data but because they describe the dynamic behavior of the human body better than any other. The biotensegrity concept reduces the architecture of anatomy to its simplest form and is based on fundamental physical principles rather than artificially contrived ones – thus making it part of basic science—and an understanding of that should underpin what every clinician does!

The value of biotensegrity is not that it changes a particular mode of treatment but that it provides a better means to visualize the workings of the body in the light of new understandings about functional anatomy—a rational approach to biomechanics.

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