

Fascial Beings:

An Updated Model of the Human Body

David Noonan; BA, PTA

Abstract

Currently, the scientific model of the human body is one that reflects fragmentation; focusing on each system of the body. This study attempted to answer the question of whether the available research supported the proposed model of complete integration. The research quickly focused upon the connective tissue, or fascial, system of the human body. The current understanding of fascia is of a singular, inert tissue that serves the functions of covering, separating and supporting the various systems and organs of the human body. Conversely, research spanning six decades revealed a tissue that is singular, dynamic, adaptive and electrically active that connects every single structure within the human body to every other structure; down to the very cells themselves. Further, the fascial system serves as the connection point between the outside of the cell, via the ECM, and the internal cytoskeleton; which is partially responsible, through mechanotransduction, for internal cell processes. To answer the question of whether the proposed model of integration is supported, a primarily qualitative analysis of the research films of French hand and plastic surgeon, Dr. Jean-Claude Guimberteau was performed, which revealed a level of integration that contradicts the current model reflecting fragmentation. Concurrently, a qualitative analysis was performed of various fascial researchers that illustrates the effects that the fascial system has on the health and dysfunction of the human body. The results of this study reflected the title of this thesis; that we are all, indeed, “fascial beings”.

Chapter 1 - Introduction

The advent of scientific inquiry and the scientific method centuries ago armed humanity with a crucially important tool in the journey of learning about our environment, ourselves and our place within the cosmos. While philosophers and great thinkers have attempted to answer these questions throughout the ages, the discerning mind of science has given us the ability to go beyond armchair pontification or pure speculation. The ability of science to ask a question, gather evidence and see whether the question is supported or contradicted allows a gathering of knowledge that can be built upon to understand deeper and more fundamental phenomena. One of the greatest examples of this type of gathering and assimilation of knowledge is the scientific model. A scientific model is an approximation of reality that is constructed to serve as an experimentation and teaching tool for varied phenomena (Hewitt, 2006). Before we begin to investigate a more complicated scientific model such as the human body, we will familiarize the reader with a more well-known scientific model; that of the atom as conceived by famed physicist Niels Bohr, in an effort to make the concept of scientific modeling more understandable for the reader.

The atom, being the smallest piece of matter, is unobservable by the naked eye. With this, physics has long proved the existence of the atom, the properties of atoms and, within our previous century, the awesome and destructive ability to “split” said atom. One of the ways in which this has become possible is through the construction of scientific models. Niels Bohr took the current understanding of quantum theory, as postulated by luminaries such as Albert Einstein and Max Planck, and developed a scientific model of the atom, specifically, the motion of electrons as they orbit the nucleus; which assisted in explaining the emission of light that was observed from atoms when they were excited (Hewitt, 2006). As described previously, scientific models are approximations of the objects and systems they represent. As it was with Bohr’s

model of the atom; the oversimplified version of the atom with electrons orbiting a stationary nucleus, analogous to planets orbiting the sun, was added to with the discoveries made by Erwin Schrodinger. Schrodinger theorized what became known as the Schrodinger Wave Equation, wherein the position of an electron orbiting a nucleus can be in any position from near the center of the atom to a radial distance away. This alters Bohr's model to show that electrons exist in an amorphous cloud of possible locations (probability cloud) surrounding the nucleus (Hewitt, 2006).

This updating of Bohr's model of the atom by Schrodinger's probability cloud did not discredit Bohr's earlier work; rather, it added to and deepened our understanding of a natural phenomenon that had been observed. This is an important distinction that is often lost to people not familiar with basic scientific principles. Familiarizing ourselves with a concept known as the Correspondence Principle will assist in clarifying this seeming dichotomy between multiple theoretical models. The Correspondence Principle, as defined by Hewitt, is "the rule that a new theory must give the same results as the old theory where the old theory is known to be valid" (Hewitt, 2006, pg. 631).

It is with this understanding of scientific models that we begin to investigate the scientific model of the human body, which will be the focus of this study. Currently, our model of the human body revolves around the varied systems of the body; some examples being cardiovascular, neurological, muscular and skeletal. Centuries of research has uncovered the anatomy and physiology of these varied systems as they operate within the human body. While there exists an understanding of the totality of the human experience, many of these systems, in practice, are considered as if existing within partial vacuums; focusing on how one system works with another during certain activities. This can be seen in the way we categorize multiple

systems; cardiopulmonary, musculoskeletal, and neuromuscular, to name a few; as if these systems are independent of every other system of the body.

This separation of systems within the current model only exists due to the seeming separation within the body itself. This view, wherein the body is a collection of systems, rather than an integrated organism, can be seen in the way in which the body is often treated when dysfunction or injury occurs. Let us take the example of a complex diagnosis such as fibromyalgia to illustrate how this current model becomes insufficient. Fibromyalgia is a chronic disorder marked by diffuse pain throughout the body, increased tenderness at specific sites (trigger points) within certain muscle groups and is often accompanied by increased fatigue, sleeplessness and anxiety (Castro-Sanchez, et al, 2011). The traditional medical intervention for this condition, as detailed by the American College of Rheumatology, centers around medicating the symptomology utilizing a vast array of pharmaceuticals including duloxetine (Cymbalta), cyclobenzaprine (Flexeril), venlafaxine (Effexor) and opioid narcotics such as Tramadol (Crofford, 2015). A study published in the *Journal of Clinical Rheumatology* concludes that the treatment of fibromyalgia with Tramadol was effective over a six-week course (Russell et al, 2000). Unfortunately, fibromyalgia is a chronic condition; therefore, a six-week intervention can only hope to serve as a temporary measure. These medications are meant to effect certain systems of the body, namely the neurological system. This methodology reflects a model of the body as a collection of systems that can be individually affected; rather than our proposed newer model reflecting integration.

An understanding of the connective tissue system can serve as the missing link to this model of the body as a collection of parts and systems. Connective tissue, or fascia (pronounced fa-sha) is an uninterrupted tissue that weaves its way through the body – surrounding, interpenetrating and connecting every single system and structure, down to the cellular level

(Upledger and Vredevoogd, 1983). Additionally, the fascia is tasked with creating and maintaining the structure, balance and mobility of the human body as well as resisting the mechanical stresses placed upon it throughout our lifetime (Barnes, 2000). It is this often overlooked system of the body that we will focus our investigations upon in an effort to update the current scientific model of the human body.

To investigate this often misunderstood system of the human body and test whether it challenges our current models, a literature review will be conducted regarding the fascial system with the following questions as our guideposts:

- *What role does fascia play in the current paradigm and model of the human body?*
- *What are the properties of fascia that challenge this model?*

From this understanding of the fascial system, the research portion of this thesis will be focused upon these two questions:

- *Does the evidence support the proposed model, reflecting complete integration?*
- *Does the integration model affect our understanding of health and dysfunction?*

Currently, within the field of medicine and healthcare, fascia has been relegated to a minor role in terms of physiological functioning. A review of any basic college anatomy and physiology textbook attests to this fact, as fascia is often afforded a paragraph or two within the entire textbook. Additionally, cadaver labs within medical school and other allied health programs are often punctuated with the instruction to “scrape away all that unimportant tissue to get to the important stuff!” This is reflected in Figure 1.1, a common model used as a reference

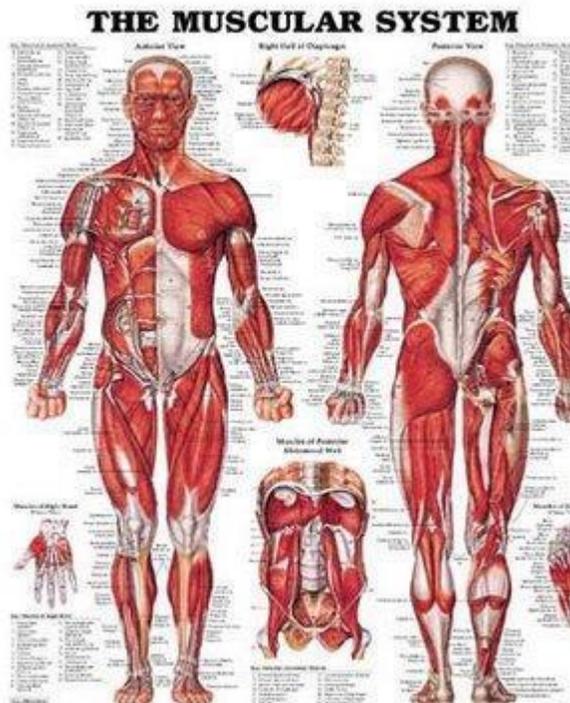


Figure 1.1 (Bachin, 1947) abdominal cavities, with no reference to it being part of the connective tissue of the muscular system. Finally, the authors separate the dural system, the covering of the brain and spinal cord, from the fascial system as well (2011).

within medical and allied health programs and the medical industry; modeling the muscular system with sparse areas covered by connective tissue.

Tortora and Derrickson's *Principles of Anatomy and Physiology 13th Edition* reflects this older perspective of fascia as being analogous to packing material. The text describes how the fascia is broken into superficial and deep layers that surround and separate the muscular system. Additionally, the authors separately discuss the viscera, the connective tissue that surrounds and separates the thoracic and

A review of the research performed over the last 50 years by varied researchers and the current explosion of new research via the International Fascia Research Congress contradicts this minor role and functioning of fascia within the human body as well as supporting the understanding that this one system serves as the connection for the entire organism. As a counterpoint to the former model of the muscular system with sparse covering; Figure 1.2 reveals how integrated the fascial system is with the muscular system in what Dr. Janet Travell termed the myofascial complex (Simons et al, 1999). This has led noted physical therapist and author John Barnes to remark that "there is no such thing as muscle" independent of the myofascial complex (Barnes, 1990, pg. 3). An understanding that every smaller section of muscle is covered and interpenetrated by the same singular piece of connective tissue is imperative when viewing this illustration.

Figure 1.2 (National Strength and Conditioning Association, 2008)

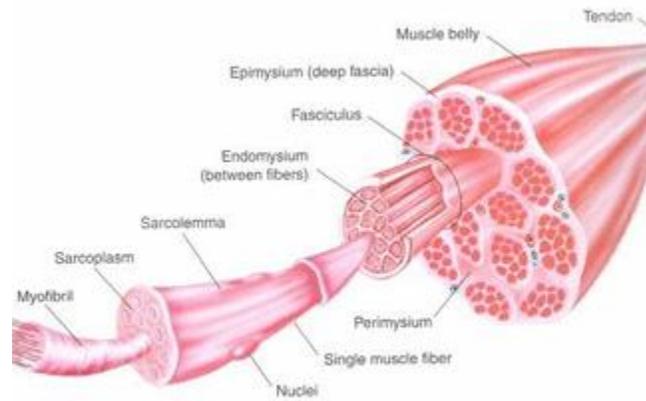


Figure 1: Muscle belly split into various component parts (from Essentials of Strength Training & Conditioning, National Strength & Conditioning Association)

Much of what we know clinically of the fascial system has come through the extensive clinical experience of bodyworkers, or those who treat the

body through their hands. This clinical evidence, often dismissed by detractors as anecdotal, has begun to gain the evidence-based foundation required within healthcare. A review of the available research on the fascial system will be our methodology within this study. Due to the comprehensive nature of the fascial system, we will be limited in acknowledging all of the aspects of health and proper physiological functioning that fascia provides; therefore, we will look to the properties of fascial tissue itself; occasionally relating these properties to the effects that can be viewed within human physiology, as we did earlier with our example of fibromyalgia.

We will now embark on our investigation of this little known and misunderstood system of the body known as the fascial system. As we uncover the complete integration that the fascial system creates within the human being, the reader will begin to realize that a complete re-imagining of the scientific model of human anatomy and physiology must take place. This newer model of the human body will follow the Correspondence Principle, allowing for the current knowledge that we have of human anatomy and physiology to remain verified, while changing the perspective upon which we view the human being; as a totality. As stated by the narrator in Dr. Jean-Claude Guimberteau's DVD entitled *Strolling under the Skin* (2005), "the human body is one and the same tissue that has differentiated over time but whose basic organization is stereotyped". Through viewing the current role that fascia performs in the current model, performing an examination of the research available on the fascial system and the noted

properties of fascial tissue that alter our current paradigm and model; we will begin to see that this statement by Dr. Guimberteau is truer than we realize; that we are all fascial beings.

Chapter 2 – Literature Review

As proposed in Chapter 1, this research paper is designed to reveal whether an update of our current scientific model of the human body is appropriate; from one of fragmentation to one reflecting integration. Our focus within this topic is the often misunderstood connective tissue, or fascial, system of the human body; and whether the available research supports or contradicts our main thesis. We shall begin by investigating the current understanding of the connective tissue system within the human body, as reflected by accepted texts and literature from the medical and allied health fields. Additionally, we will review the properties of fascia, as supported by research spanning over sixty years, which challenge this model.

An analysis of Tortora and Derrickson's *Principles of Anatomy and Physiology, 13th Edition*, reveals the accepted role that connective tissue plays in the human body within the current medical and allied health fields. As stated in Chapter One, our understanding of fascia is one of complete integration; as Dr. Upledger described it as a singular piece of tissue surrounding and interpenetrating every structure down to the very cells themselves. Conversely, Tortora and Derrickson (2011) relay information of connective tissue in a fragmented fashion, describing the tissue as it relates to specific systems. Fascia is described as the tissue that surrounds and protects the skeletal muscle tissue, separated into superficial and deep layers and forming the tendinous connections to the bones or the aponeurosis between muscles and miscellaneous structures. This is reflected in Figure 1.1 from Chapter 1. As reviewed previously, the fascial system includes the viscera and the dural system; which we shall now investigate through our anatomy text. When reviewing the thoracic and abdominal cavities, the authors describe the connective tissue coverings of the lungs (pleura), heart (pericardium) and the abdominopelvic cavity (peritoneum). Finally, the authors devote three more paragraphs to a description of the dural system, separated into the dura, arachnoid and pia maters (Tortora, Derrickson and Tortora, 2011). No reference could be found within the text reflecting the singular nature of these seemingly disparate tissues.

An article written for the *International Journal of Therapeutic Massage and Bodywork* by noted fascial researchers Dr. Helene Langevin and Dr. Peter Huijing relays some of the similar issues when discussing fascia. In *Communicating about Fascia: History, Pitfalls and Recommendations*, the author's state that a current understanding of fascia should include twelve specific terms that describe the same tissue, yet reflect the difference in their specific anatomy and physiology. These terms include: dense connective tissue, areolar connective tissue, superficial and deep fascia, intermuscular septa, interosseal membrane, periost, neurovascular tract, epimysium, perimysium, endomysium and aponeuroses (Huijing and Langevin, 2009).

Before moving forward in our review of the research pertaining to fascia and connective tissue, an understanding of the elements that create the tissue we know as fascia will assist the reader as we delve deeper into the topic. According to physical therapist and author of *Myofascial Release: The Search for Excellence*, John Barnes; all connective tissue is made of the same three elements: the tough, fibrous protein collagen, the elastic glycoprotein elastin and a polysaccharide gelatinous material containing hyaluronic acid and proteoglycans called the ground substance. Further, according to Barnes (1990), the differences observed in connective tissues can be found in the percentages of collagen and elastin found in Langevin's twelve types mentioned earlier. For instance, the elasticity required for skin and arteries requires a different mixture of these proteins than do the tendons and the excessive tensile forces required of those structures. Connecting all of these fibers of collagen and elastin together is the polysaccharide gel complex known as ground substance, sometimes referred to as the extracellular matrix (ECM), which accounts for all material outside of the cell walls (Myers, 2014). *Grays's Anatomy 38th Edition* describes the ECM as the sum total of all insoluble protein fibrils and soluble materials which allow the ability of the ground substance to bind to water. Further, the ECM assists in handling the mechanical stresses placed on the body while maintaining an extracellular environment which allows for proper cell absorption and diffusion (Gray, Williams and Bannister, 1995).

As stated within Chapter One, the comprehensive nature of the fascial system defies the ability of this one thesis to investigate every aspect. With this said and with our understanding of the general components of connective tissue, we shall review some specific properties and characteristics of this system of the body that challenge the current model. These properties and characteristics will be:

- *The fascial systems function as support and mobility within the body*
- *The phenomenon of mechanotransduction*
- *The bioelectric properties of fascia, including piezoelectricity*
- *The phenomenon of phase transition within the ground substance*

Support and Mobility

As described by Upledger and Vredevoogd (1983), the connective tissue system is a singular piece of tissue that weaves its way through the body, surrounding, protecting and interpenetrating every single structure of the human body, down to the very cells themselves. Additionally, Barnes states that if every structure were removed throughout the human body aside from the fascial system, the shape of the human body would remain the same (Barnes, 1990). A paper published in *Spine: State of the Art Reviews* by Dr. Stephen Levin (1995) illustrates how this comprehensiveness of the fascial system, soft tissue in his words, creates the dynamic support structure required for bipedal locomotion and dynamic stability. Within this article, Dr. Levin explains that the post-and-beam model of the skeletal system as support does not allow for anything to occur outside the center of gravity; as the shearing force would be too extreme and would require increasing rigidity, similar to that seen in skyscrapers. Additionally, Levin states that the concept of the musculoskeletal system as an advanced lever and pulley system does not account for the abilities of the human body. His example being that a load of 200 kg located 40 cm from a fulcrum would require 1600 kg to lift. He explains that most weightlifters could easily lift 200 kg, yet the erector spinae muscles located along the vertebral column can only generate

between 200 and 400 kg of force. This would cause the muscles to tear prior to lifting this weight, which does not coincide with the evidence.

To account for this discrepancy, Levin introduces the concept of biotensegrity, a biological model of the concept of tensegrity as originally conceived by architect Buckminster Fuller. Tensegrity refers to a truss-type structure wherein the structural integrity of the system is maintained through a level of tension within the components of the system (Myers, 2014). This concept of constant tension outside of muscular forces brings us to our next property of fascial tissue: the ability of fascia to contract. In a paper presented at the 6th Annual Interdisciplinary World Congress on Low Back and Pelvic Pain; the authors stated that, as opposed to the current model that fascia is a passive transmitter of force throughout the body, myofibroblasts were found within fascial tissue. This presence of these contractile cells allow the fascial tissue to be a contractile organ, with the largest clusters being found in the fascia lata (along the thigh), plantar fascia (bottom of foot) and lumbar fascia (low back). This contractile aspect of fascial tissue can change in minutes to hours, or remain even longer when seen clinically as contractures, with the resultant histological remodeling (Schleip, Klingler and Lehmann-Horn, 2007).

Mechanotransduction

Mechanotransduction is the term used to refer to the phenomena of mechanical signals outside and inside the cellular environment that are translated into biochemical signals within the cell. This phenomenon is coming under more intense scrutiny due to the influence that these mechanical signals have upon tissue structure and function, especially with the etiology of disease (Ingber, 2006). Mechanotransduction comes into our investigation of fascial tissue due to the extracellular matrix. Ingber's article lists the ECM as one of the elements responsible for mechanotransduction. An additional article by Alenghat and Ingber points to the link between the ECM and the cytoskeleton, the structural component of the cell, as the link between the

external and internal cellular environment that allows for the translation of mechanical signals into biochemical processes (2002). This discussion regarding the connection point between the ECM and the cytoskeleton is brought into clearer focus by Thomas Myer's book, *Anatomy Trains* (2014), wherein the author explains that the "cell-as-a-balloon-full-of-Jell-O" model, populated by floating organelles, currently accepted by biologists, is insufficient. The cytoskeleton is analogous to the musculoskeletal system of the body; including contractile fibers within the cytoskeleton.

Bioelectrical Properties

A review of the varied connective tissue structures and functions compiled by Dr. Janowski-Bell, assistant professor of biology at Victoria College, supports the current model of connective tissue within modern medicine. While reviewing the different types of connective tissue, the professor consistently relates the functions of the tissue as support structure, protection and the smooth connections between bones within the joints (www2.victoriacollege.edu, 2015). A discovery made by Nobel recipient Dr. Szent-Gyorgi adds a significant function to the fascial system. In a presentation to the University of Szeged in Hungary, Szent-Gyorgi postulated that, due to the structure and chemical composition of the proteins within connective tissue, the fascial system could act as a crystal and be a conductor of electricity (Szent-Gyorgi, 1941). Following this lecture, Dr. Szent-Gyorgi along with Peter Gascoyne and Ronald Pethig (1981), verified through experimentation that the proteins found in collagen, when attached to water molecules, allow the connective tissue to become a semiconductor. Semiconductors, as the name implies, are materials that lie between the spectrum of electrically conductive materials such as copper and insulating materials such as wood. Semiconductors are the materials that make modern technology possible in the form of cellphones, computers and the like (Oschman, 2009).

Following along with this discovery that the fascial system is arranged in a crystal-type lattice formation leads to our next bioelectric property of fascia – piezoelectricity. A piezoelectric material is any material that when subjected to mechanical stresses or pressure, creates an electric charge (fasciacongress.org, 2015). As demonstrated by Shamos and Lavine (1967), the piezoelectric effect can be found in any biologic tissue that has collagen structured in a similar orientation. Additionally, the authors postulate that piezoelectricity may be an inherent property of all living tissue. Placing these bioelectric properties of fascial tissue back into the whole picture brings forth new hypotheses regarding the function of the connective tissue system. A paper published in the *Journal of Medical Hypotheses* posits that the electrical and mechanosensitive properties of the fascial system could possibly serve as a “whole body communication system” (Langevin, 2006).

Phase Transition

Phase transition, alternately referred to as phase change, is the phenomenon where a material undergoes a change from one phase of matter (solid, liquid or gas) to another. The example often used of is that of water changing from ice (solid) to liquid water and, finally, to water vapor (Chang, 2010). As described earlier, the ground substance of the fascial system is gelatinous (liquid phase) by nature, allowing for proper support, protection, mobility and mechanotransduction. Fascia, when injured and beginning the inflammatory response, reorganizes along the new lines of tension that are the result of the insult or injury to the body from varied causal factors. The tissue becomes dehydrated during this inflammatory process with a resultant solidification (phase transition) of the ground substance (Barnes, 2000). Additionally, according to Barnes, in Dr. Carol Davis’ book *Complementary Therapies in Rehabilitation*, the pressures and stretches utilized with the manual therapy approach known as Myofascial Release

allow for the piezoelectric phenomenon to occur with a resultant phase transition in the ground substance of the fascial tissue from solidified back to gelatinous (Davis, 2009).

Conclusion

Our main line of inquiry into the question of whether the current systems model of the human body is incomplete continues. We have begun our investigation into the often misunderstood and discarded fascial system as our avenue through which to update the current model of fragmentation into one reflecting integration. We have illustrated the current understanding of the connective tissues of the body through anatomy and physiology texts. Additionally, we have reviewed research and literature spanning six decades that reveals the complete integration as well as additional properties of the fascial system. In our next chapter, we will begin to investigate the ramifications of this research and continue to test our hypothesis; is there an updated model of the human body that reveals that we are fascial beings?

Chapter 3 – Research Design and Methodology

The General Perspective

The question of whether the current scientific model of the human body is insufficient and requires an updated perspective, with which we may improve our understanding of human anatomy and physiology, was introduced in Chapter 1. The main crux of this argument for an updated model has focused on the misunderstood, and largely ignored, system of connective tissue that has been termed the fascial system. An analysis of the current paradigm of the human body, specifically the accepted anatomy and physiology of the fascial system, was conducted. Following this, a review of available research spanning six decades was performed; with portions of the reviewed information challenging the current model of fragmentation and relegation of the fascial tissue to the role of packing material. Conversely, the research conducted revealed a tissue that was global in nature and possessed properties and characteristics far beyond what is currently accepted within the medical and allied health fields.

The Research Context

This dichotomy between the accepted form and function of the fascia and the verified properties and characteristics of the fascial system leads to several important questions which this research study will attempt to uncover. A primarily qualitative research perspective will be employed. The primary question posed in the beginning of the discussion remains solvent:

- *Does the evidence support the proposed model, reflecting complete integration?*

As the modeling of the human body exists to assist our understanding of anatomy and physiology; any update to this model must include changes to our understanding of the body's form and function. Therefore, the following question shall also be investigated:

- *Does the integration model affect our understanding of health and dysfunction in the human body?*

Research that spans six decades has challenged the current paradigm that the connective tissue of the body, the fascial system, is nothing more than a type of packing material that covers structures and creates separation within the human body. To answer why this research has been largely ignored within the medical and allied health fields is beyond the scope of this research study. What can be understood is how this new information changes the model of the human body as it pertains to its anatomy and physiology. This thesis has been titled “Fascial Beings”; a title that implies the complete integration of the human body via the fascial system. This study will attempt to answer the question of whether there exists any separation between all of the myriad systems of the human body.

Procedures Used

Does the evidence support the proposed model reflecting integration?

Building upon the information discussed in Chapter 2, a qualitative analysis of the research of French plastic surgeon Dr. Jean-Claude Guimberteau was conducted. Dr. Guimberteau (2005) is the first researcher to record the fascial system in vivo; which led to the publishing of the findings in his book and DVD, *Strolling under the Skin* as well as the follow-up films, *Muscle Attitudes*, *Interior Architectures* and *The Skin Excursion*. Dr. Guimberteau’s filming of the living fascial system has lent landmark audiovisual support to the understanding of this important tissue. The filming of living fascia lends support to the concept of the complete integration of the human body via the fascial system.

How does this affect the functioning of the human body in health and dysfunction?

Any updating of the model of the human body will lead to a discussion of how the information will affect the functioning of the body in both health and disease. Covering every effect of the fascia on the anatomy and physiology of the human body is beyond the scope of this thesis. Concurrently, a

quantitative analysis of new research into varied physiological effects of the fascial tissue will be conducted, built into the framework of properties covered in Chapter 2; namely: support and mobility, mechanotransduction, bioelectric properties and phase transition; as they relate to health and disease. A document study was conducted of the research database of the International Fascia Research Congress, spanning their 2009-2012 annual conferences. An internet search of peer-reviewed journals, papers and presentations was conducted, in tandem, to provide further data for our study.

Data Analysis and Summary

A qualitative analysis of the works of Dr. Guimberteau will add to the understanding of the global nature of the fascial system that remains our primary hypothesis. Building upon this model, a qualitative analysis of the International Fascia Research Congress' database, along with peer-reviewed journal articles, papers and presentations by pioneers in the field of fascial research, will serve to relate the ramifications of the proposed model on the health and disease processes in humans. To continue within the framework that has been constructed by this thesis, the data collected will be categorized under the properties and characteristics of fascia related in Chapter 2: support and mobility, mechanotransduction, bioelectric properties and phase transition. Taken together, this analysis should serve to support the proposed updating of the scientific model of the human body.

Chapter 4 – Research Findings

This thesis has been focused upon the question of whether the scientific model of the human body, a systems approach, has become insufficient and requires updating. The main focus of this research has been on the fascial system of the human body, supporting the integrated model that was proposed in Chapter 1. A thorough literature review provided information not only on the current understanding of fascial tissue (covering and support), but also uncovered properties and characteristics of fascial tissue that began to challenge the current understanding of this system of the body. As stated in Chapter 3, the analysis of the research relating to the sub-question of how the integration model affects our understanding of health and dysfunction, in an effort to convey the information to the reader, will be ordered within the categories presented in the literature review of Chapter 2: support and mobility, mechanotransduction, bioelectric properties and phase transition.

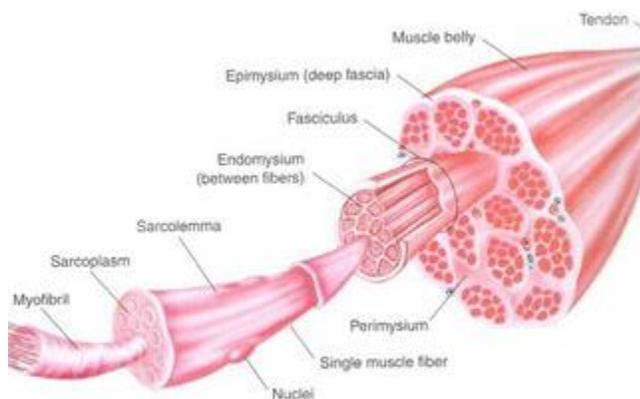
Does the evidence support the proposed model, reflecting complete integration?

To answer this question, research performed by Dr. Jean-Claude Guimberteau was relied upon heavily. Dr. Guimberteau, a specialist in reconstructive surgery, specifically the hand; uncovered findings that support the model of integration proposed within this study. He is the co-founder and former director of the Aquitany Hand Institute from 1987-2011. Additionally, he was the director of research at French Society of Plastic, Reconstructive and Aesthetic Surgery as well as a member of the French Hand Society and the French Society of Plastic and Reconstructive Surgery. Dr. Guimberteau has become a pioneer in hand surgery, developing a new technique for repairing flexor tendons, using vascularized island transfers and he was the first to perform vascularized allotransplants of a flexor tendon in 1991. Much of his current research lies in exploring and defining the movement of tissues beneath the skin, using intraoperative endoscopic visualization of living tissue. As a director and producer of many videos on living matter, he has developed a new concept on living tissues and proposed a new paradigm for the development of biological structure in man (www.guimberteau-jc-md.com, 2015).

The biggest difference in Dr. Guimberteau’s work, as opposed to all others within the field of fascial research, was this filming of the fascial system in vivo; to assist in educating the medical and scientific communities as well as the general public. This audiovisual representation was recorded within several DVD releases: *Strolling under the Skin*, *Muscle Attitudes*, *The Skin Excursion* and *Interior Architectures*. To organize the mass of information that these films uncover, an analysis of them was performed, with this study presenting the relevant portions of the data in a hierarchal fashion; from the skin down into the deeper layers of the body.

In *The Skin Excursion*, Dr. Guimberteau (2010) investigated the dermis and epidermis, showing that both layers are completely interdependent, with no sign of separation. Further, there were no specific “layers”, or stratification, within the dermis and epidermis. The narrator within *Interior Architectures* continues to illustrate this interdependence by stating “underneath the dermis is a highly mobile network of tissue filling every available space. The show is total... encompassing the muscles, skin and fat” (Interior Architectures, 2012). Traveling deeper into the body via *Muscle Attitudes*, Dr. Guimberteau reveals in vivo observation of the myofascial complex as postulated by Travell, Upledger and Barnes, all discussed within Chapters 1 and 2. To review, Figure 4.1, shown below, models the myofascial complex, with each succeeding layer encapsulated by fascia:

Leaving the dermal layer, the narrator states that the fibers of the epimysium (outermost layer of



muscle) continue unabated from the surface of the skin. Further, the epimysium “enters, leaves, mixes with and combines with fibers in the perimysium”, creating the striated separation observable in muscle tissue. Finally, the film states that “Everything is connected. There is no

Figure 1: Muscle belly split into various component parts (from Essentials of Strength Training & Conditioning, National Strength & Conditioning Association)

break in continuity of living matter. There are no sheets of tissue, layers or sub-layers arising from nowhere” (Muscle Attitudes, 2010).

It is in *Strolling under the Skin* that Dr. Guimberteau (2005) introduces a scientific model of this continuum of fascial tissue that was reviewed in *Interior Architectures* and *Muscle Attitudes*. This model, termed the Multimicrovacuolar Collagenic Dynamic Absorbing System (MCDAS), is pictured below in Figure 4.2:

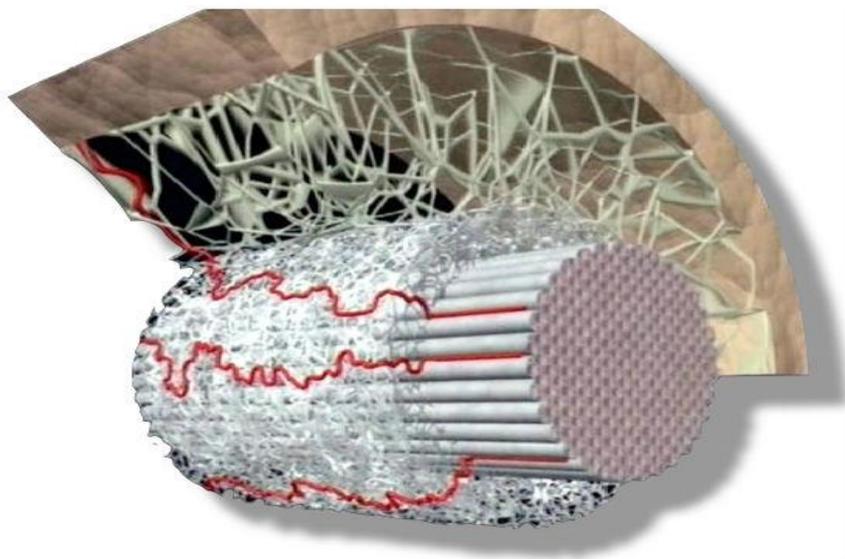


Figure 4.2 (Strolling under the Skin, 2005)

This model illustrates the continuum of fascial tissue that extends from the dermis down through the muscle and encapsulates the nerves and blood vessels that surround a tendon; in this case, the wrist and hand. To explain the MCDAS, Guimberteau states that “electron microscopy revealed the collagenous fibers comprising millions of tiny vacuoles that formed a continuous network that was organized fractally” (Strolling under the skin, 2005) which reflects the multimicrovacuolar portion. The collagenic and dynamic aspects refer to the collagen fibers that were revealed to possess the capacity to distend, retract and reorganize their arrangement spatially. As the narrator states within the film, “There was a continuity between the sheets and the tendons despite the distension created with flexion...

simplistic mechanistic actions could no longer account for this phenomena” (Strolling under the skin, 2005).

The fact of complete integration is reiterated over and over again within all of Dr. Guimberteau’s research. Several of the more poignant statements are listed here:

- *“The observation in vivo required the existence of a tissue continuum, rather than layers of sliding structures.”*
- *“Not only could the tendons move independently of each other through this sliding system, but organs could do the same, so the system was common to the whole organism.”*
- *“This tissue anchors the muscles and tendons and could be their main constituent material.”*
- *“The tissue continuum is total, the marriage homogeneous and the arrangement completely fractal.”*
- *“The human body would seem to be one and the same tissue that has differentiated over time but whose basic organization is stereotyped.”*

(Strolling under the skin, 2005)

Does the integration model affect our understanding of health and dysfunction?

Dr. Guimberteau’s research and observation of the fascial system in vivo lends support to the integration model that has been proposed by this thesis. With this integration model, the second question posed of how it may affect our understanding of health and dysfunction within the human body becomes evident; as we are no longer dealing with independent systems. As stated earlier, in an effort to allow the information to flow for the reader; the studies that have been analyzed will be organized under the characteristics of fascial tissue discussed in Chapter 2: support and mobility, mechanotransduction, bioelectric properties and phase transition.

Support and Mobility

The analysis of Dr. Guimberteau's work reveals the importance that the fascial system has on the support of the human body; as the research reveals "Not only could the tendons move independently of each other through this sliding system, but organs could do the same, *so the system was common to the whole organism* (emphasis mine)" (Strolling under the skin, 2005). Additionally, Dr. Guimberteau's work fundamentally changes the current model of motion that relates the mobility of the human body to a complex pulley and lever system that we term the musculoskeletal system. To reiterate, "There was a continuity between the sheets and the tendons despite the distension created with flexion... simplistic mechanistic actions could no longer account for this phenomena" (Strolling under the skin, 2005).

An article published in the *International Journal of Therapeutic Massage and Bodywork* states that "We find that muscles hardly ever transmit their full force directly via tendons into the skeleton, as is usually suggested by our textbook drawings. Rather, they distribute a large portion of their contractile forces onto fascial sheets". Additionally, the author concludes that no muscles work independent of each other, nor are they independent functional units (Findley, 2011, pg. 2). A review of Dr. Stephen Levin's work with Biotensegrity from Chapter 2 also reiterates the importance of the fascial system in creating dynamic stability (Levin, 1995).

Mechanotransduction

A study published in *Nature* reveals a correlation between the stiffness, or viscosity, of the ECM and an increase in the incidence of breast cancer. The researchers found that increased stiffness produced malignant phenotypes in epithelial mammary cells (Chaudhuri et al, 2014). Along with this, researchers at the University of California – Berkeley presented their findings at the annual meeting of the American Society for Cell Biology in San Francisco in 2012. The researchers stated that mechanical pressures on the cell reversed malignancy compared to malignant cells not placed under mechanical pressure. Further research by teams at UC Berkeley have revealed similar results, with researchers showing that malignant

cells can be guided back towards healthy patterns with the right signaling via mechanical pressures (Yang, 2015).

Dr. Findley's article published in the *International Journal of Therapeutic Massage and Bodywork* states, in regards to the cellular effects and responses to therapies aimed at the fascial system, that "connective tissue actively regulates matrix tension in response to stretch as a normal, dynamic physiological process. Understanding how cells respond to forces can lead to potential new treatments and refinements on existing ones." In addition, "the slightest touch on a cell surface with a micropipette caused the nucleus to immediately expand and begin DNA transcription" as discovered by Dr. Donald Ingber (Findley, 2011, pg. 2).

Bioelectric Properties

In an article published in *Techniques in Orthopedics*, Osteopathic physician, Dr. Judith O'Connell describes the effects of the piezoelectric phenomenon on somatic dysfunction. Dr. O'Connell states that the piezoelectric phenomenon occurring through the compression or distraction of the fascial system "triggers a cascade of cellular, biomechanical, neural and extracellular events as the body adapts to external stress" which can serve to create somatic dysfunction; manifesting as tenderness in soft tissue, asymmetry in structure and dysfunctional movement patterns. Additionally, these same piezoelectric characteristics of the collagen within fascia can be harnessed to relieve somatic dysfunction (O'Connell, 2003).

Piezoelectricity, according to noted physical therapist and author, John Barnes, is capable of converting the mechanical pressure applied by a skilled bodyworker into a bioelectric flow that enhances the healing process through a phase change in the ground substance of the fascial tissue (Barnes, 1996). Fascial researcher, Robert Schleip, has offered an alternative hypothesis in terms of piezoelectricity and fascial tissue. Schleip states that the change within soft tissue tone and texture cannot be completely explained through piezoelectricity and the "sol to gel" model; offering, instead, a model that reveals the

complete integration of the fascial system with the autonomic nervous system and the regulatory organs contained therein, such as Golgi tendon organs, Golgi receptors and Ruffini corpuscles (Schleip, 2003). A review of the article by Dr. Helene Langevin, presented in Chapter 2, will serve to remind the reader that the bioelectric properties of the fascial system could serve as a body-wide communications array that acts in conjunction with the accepted role of the nervous system (Langevin, 2006).

Phase Transition

An interview was conducted in conjunction with this research with Dr. Carol Davis of the University Of Miami Miller School Of Medicine. Dr. Davis discussed the phenomenon of phase transition within the ground substance in reference to manual therapy, specifically Myofascial Release; and the effects this could have upon somatic dysfunction. Dr. Davis referenced the phenomenon of thixotropy in regards to the ground substance of the ECM, and how this phase transition within the ECM can be attained through activation of the piezoelectric effect (Davis, 2015). Thixotropy is the phenomenon wherein certain gel-like fluids, including colloidal fluids like the ECM, will undergo phase transition when stressed for a long enough duration (Barnes, 1997).

Summary

This research study has concerned itself with the main question of whether the current scientific model of the human body, a systems approach reflecting fragmentation, has become insufficient for explaining physiological processes; or, rather, if the proposed model of integration throughout the human body is supported by the evidence. As the model of the human body serves to assist in explaining anatomy, physiology and possible dysfunction, the main question led to the sub-question of how this proposed model affects our understanding of health and disease within the human organism.

An analysis of the collected findings of Dr. Jean-Claude Guimberteau served as the main research supporting the proposed model of integration. As stated within *Muscle Attitudes* (2010), “Everything is connected. There is no break in continuity of living matter. There are no sheets of tissue, layers or sub-

layers arising from nowhere”. Concurrently with these findings, Dr. Guimberteau states within *Strolling under the Skin* that the tissue that comprises the MCDAS not only serves as the anchor for all muscles and tendons, but could also be the material from which these systems arise. Going further, Guimberteau states that “the human body would seem to be one and the same tissue that has differentiated over time but whose basic organization is stereotyped” (*Strolling under the skin*, 2005).

Answering the sub-question of how this integration affects the understanding of health and dysfunction was achieved through a review of relevant studies and literature organized under the properties and characteristics of fascia as discussed in Chapter 2: support and mobility, mechanotransduction, bioelectric properties and phase transition. Guimberteau’s work was reviewed again as it related to the subject of support and mobility. Further studies from Findley and Levin were analyzed in addition to these findings. Several studies were discussed in regards to the effects of mechanotransduction to disease (specifically, cancer) as well as further information from pioneers in the field, Dr. Thomas Findley and Dr. Donald Ingber.

The concept of piezoelectricity was investigated through articles published by Dr. Judith O’Connell and Myofascial Release authority, John Barnes. A secondary hypothesis to the bioelectric properties of fascia was introduced through the work of Robert Schleip; revealing the complete integration of the fascial system with the autonomic nervous system. Reference to the earlier article by Dr. Helene Langevin, wherein she hypothesizes the fascial system as a communications array for the entire organism, was included. Finally, a statement from University of Miami Miller School of Medicine Professor, Dr. Carol Davis, relayed the link between manual therapy, piezoelectricity and phase transition within fascia.

Chapter 5 – Summary and Discussion

Introduction

As we understand a scientific model to be an approximation of reality that exists to serve as a tool for experimentation and teaching (Hewitt, 2006), this research project began with a singular thesis query: is the current scientific model of the human body insufficient and does it require updating? Concurrently, the Correspondence Principle was reviewed, revealing that any update to an existing model must give the same results to the previous theory where the previous theory has been verified (Hewitt, 2006). The current model, as evidenced by standard practices within the medical and allied health fields, focuses upon the systems of the body and how they act independently or with adjacent systems. This can be seen in the way that they are often described in practice: cardiopulmonary, musculoskeletal and neuromuscular, to name a few. This conception of the human body as a collection of systems can often lead practitioners to attempt to treat the systems of the body independently of others, as was evidenced with our review of the standard treatment protocol for the chronic disease of fibromyalgia (Crofford, 2015). The introduction of the connective tissue, or fascial, system of the human body served as the “missing link” to this seeming separation within the body and quickly became the focus of the research. It is an accepted anatomical fact that the fascial system is an uninterrupted tissue that weaves its way through the body covering, interpenetrating, supporting and separating the differing systems of the body (Upledger and Vredevoogd, 1983; Simons et al, 1999). It was the function and role of the fascial system and how that supports or contradicts the concept of integration that became the focus of this study. The literature review was centered on the following questions:

- *What role does fascia play in the current paradigm and model of the human body?*

While reviewing the available literature on the fascial system; research, spanning six decades, was uncovered that began to challenge the current model of the physiology and role of fascia within the human body. This literature review led to the following question:

- *What are the properties of fascia that challenge the current model?*

This information was included in four separate categories: support and mobility, mechanotransduction, bioelectric properties and phase change. Utilizing the information uncovered with these questions, a qualitative research study was conducted to support or contradict the main query of our thesis:

- *Does the evidence support the proposed model, reflecting complete integration?*

As this field of study lies within the bailiwick of the biological, medical and allied health sciences, any proposed update to the modeling of the human body would necessitate a change in perspective to the understanding of health and dysfunction. A qualitative study was conducted to answer the following:

- *Does the integration model affect our understanding of health and dysfunction?*

A literature review was conducted to assess the current model of the fascial system. To assess the current understanding of fascia, Tortora and Derrickson's *Principles of Anatomy and Physiology 13th Edition* and reference materials from the Biology Department of Victoria College were analyzed. The text describes the connective tissue only as it relates to specific systems: the superficial and deep fascia being the covering of the muscles and the material that creates the ligaments and tendons of the body. Within the thoracic and abdominal cavities, the viscera is discussed: the covering of the lungs (pleura), the heart (pericardium) and the abdominopelvic cavity (peritoneum). Finally, the covering of the brain and spinal cord (meninges) was discussed, yet no mention of the interconnectedness of the fascia was found (Tortora, Derrickson and Tortora, 2011). Concurrently, the reference materials from Victoria

College (www2.victoriacollege.edu, 2015) supported this anatomical and physiological role of the fascial system as being analogous to packing material. All anatomy texts concur on one fact; the make-up of fascial tissue. Fascia is composed of three materials – collagen, the fibrous strands; elastin, the stretchy component and a gelatinous ground substance that connects everything – oftentimes referred to as the extracellular matrix, or ECM (Barnes, 1990; Gray, Williams and Bannister, 1995; Myers, 2014).

Further research and review led to the discovery of additional physiological properties of fascial tissue that were not reflected in the anatomic texts and course materials for biology departments. Biomechanically, the fascial system, being the singular piece of tissue that connects the entire organism, was revealed to operate as a truss, or guy wires, for the rest of the body. It is the fascial system, through biotensegrity, that allows the dynamic support and mobility that is required for even the most basic movements performed by the human body (Levin, 1995). Additionally, it has been discovered that fascial tissue has contractile properties, similar to that found in smooth muscle (Schleip, Klingler and Lehmann-Horn, 2007); which adds to the ability of fascial tissue to create support and mobility.

Mechanotransduction is the phenomenon wherein mechanical pressures outside and inside the cell are translated into biochemical signals. Research, primarily by Dr. Donald Ingber, has shown the ECM as the juncture point of the cell wall – thereby, vitally important to proper cellular functioning; as well as the cytoskeleton of the cell being a micro-fascial system (Ingber, 2006). In terms of bioelectricity, there are two distinct properties found with fascial tissue. One, discovered by Nobel recipient Dr. Szent-Gyorgi, is the ability of collagen to act as a semiconductor, thereby allowing electrical signals to pass through the web of the fascial system (Szent-Gyorgi, 1941; Gascoyne, Pethig and Szent-Gyorgi, 1981). The second is the property of piezoelectricity, which is the phenomenon of pressure creating an electrical charge within piezoelectric materials – in this case, fascia (Shamos and Lavine, 1967). Finally, the concept of phase transition. Phase transition is the change of materials from one state to another (i.e. ice to water). The ECM has been found to be able to undergo phase transition, through the phenomenon of

thixotropy, changing from a gelatinous state to a more solidified state (Davis, 2015, 2009; Barnes, 1997). This is commonly attributed to the inflammatory process following trauma (Barnes, 2000).

Statement of the Problem

To reiterate, this thesis began with a singular query: is the current model of the human body, reflecting fragmentation, insufficient; and does that require an update to a model that reflects integration? Further, does the current evidence support this proposed integration model? The literature review conducted revealed a tissue that weaves its way through the body covering, interpenetrating and supporting every single structure of the human body; down to the cells themselves. This was reflected in anatomical textbooks and course materials as an inert tissue whose main role was that of covering and separating structures; akin to packing material. Conversely, over six decades of research revealed a tissue that is not only uninterrupted, but electrically active, contractile, intricately associated with movement of the body, capable of dynamically altering its viscosity and partially responsible for cell structure as well as biochemical signals within the cells. This dichotomy of information was brought into the research portion of the thesis that asked the questions:

- *Does the evidence support the proposed model, reflecting complete integration?*
- *Does the integration model affect our understanding of health and dysfunction?*

Review of Methodology

For the research portion of the thesis, a qualitative analysis of research was conducted to support or contradict the proposed integration model. The research analyzed for the main question came, primarily, from the findings of French hand and plastic surgeon, Dr. Jean-Claude Guimberteau. Dr. Guimberteau's research was compiled in several DVD film releases; *Strolling under the Skin* (2005), *Muscle Attitudes* (2010), *The Skin Excursion* (2011) and *Interior Architectures* (2012). To answer the sub-question of how the integration model affects the current understanding of health and dysfunction, a

qualitative analysis was conducted of studies published by various fascial researchers. The available research was categorized similarly to the organization found in Chapter 2: support and mobility, mechanotransduction, bioelectric properties and phase transition.

Summary of Results

Does the evidence support the proposed model, reflecting integration?

To answer this question, the research performed by Dr. Jean-Claude Guimberteau was relied upon heavily. The biggest difference in Dr. Guimberteau's work, as opposed to all others within the field of fascial research, was his filming of the fascial system in vivo; to assist in educating the medical and scientific communities as well as the general public. This audiovisual representation was recorded within several DVD releases: *Strolling under the Skin*, *Muscle Attitudes*, *The Skin Excursion* and *Interior Architectures*. To organize the mass of information that these films uncover, an analysis of them was performed, with this study presenting the relevant portions of the data in a hierarchal fashion; from the skin down into the deeper layers of the body.

The Skin Excursion (2011) focused upon, as the name of the film implies, the dermis and epidermis. Dr. Guimberteau's research revealed no separation between the layers, and further, no specific layers, or stratification, to speak of. *Interior Architectures* (2012) took this investigation deeper, revealing this same tissue that was observed in *The Skin Excursion*, was completely integrated to the muscles, skin and fat. The research further revealed no separation between the epimysium, perimysium and endomysium of the muscles of the body (*Muscle Attitudes*, 2010). It is within *Strolling under the Skin* that Dr. Guimberteau (2005) states some of the most illuminating observations of the fascial system:

- “*The observation in vivo required the existence of a tissue continuum, rather than layers of sliding structures.*”

- “Not only could the tendons move independently of each other through this sliding system, but organs could do the same, so the system was common to the whole organism.”
- “This tissue anchors the muscles and tendons and could be their main constituent material.”
- “The tissue continuum is total, the marriage homogeneous and the arrangement completely fractal.”
- “The human body would seem to be one and the same tissue that has differentiated over time but whose basic organization is stereotyped.”

Does the integration model affect our understanding of health and dysfunction?

A qualitative analysis of current research into the effects that fascial system has upon health and dysfunction within the human body was conducted. For the readers’ sake, the information was ordered under the categories set in the literature review: support and mobility, mechanotransduction, bioelectric properties and phase transition.

Support and Mobility

Dr. Guimberteau’s research was revisited, as his findings on the continuity of the fascial system and how it alters our understanding of movement and support. Additionally, Dr. Stephen Levin’s work on biotensegrity was reiterated, as it explains the importance of the soft tissue structures to dynamic support and movement. Finally, an article by Dr. Thomas Findley in the *International Journal of Therapeutic Massage and Bodywork* revealed that it is not the musculoskeletal system but, rather, the fascial system that allows the transmitting of forces throughout the human body (Findley, 2011).

Mechanotransduction

A study published in *Nature* reveals a correlation between the stiffness, or viscosity, of the ECM and an increase in the incidence of breast cancer. The researchers found that increased stiffness produced malignant phenotypes in epithelial mammary cells (Chaudhuri et al, 2014). Along with this, researchers

at the University of California – Berkeley presented their findings at the annual meeting of the American Society for Cell Biology in San Francisco in 2012. The researchers stated that mechanical pressures on the cell reversed malignancy compared to malignant cells not placed under mechanical pressure. Further research by teams at UC Berkeley have revealed similar results, with researchers showing that malignant cells can be guided back towards healthy patterns with the right signaling via mechanical pressures (Yang, 2015). Additionally, a study by Dr. Findley supported the research findings of Dr. Ingber, showing that “the slightest touch on a cell surface with a micropipette caused the nucleus to immediately expand and begin DNA transcription” (Findley, 2011, pg. 2).

Bioelectric Properties

Several articles relayed the importance of the piezoelectric phenomenon to the ability of manual therapy to elicit changes in myofascial tonicity to treat somatic dysfunction (O’Connell, 2003; Barnes, 1996). Dr. Langevin’s (2006) article published in *Medical Hypotheses* states that the fascial system, due to its bioelectric properties, could well serve as a vast communications array throughout the body; similarly to the way the nervous system is currently understood.

Phase Transition

An interview with Dr. Carol Davis of the University of Miami, Miller School of Medicine revealed the capacity, and importance, of phase transition within the ECM. Dr. Davis referenced the phenomenon of thixotropy within the ground substance of the fascial system; which is accessed via the sustained pressures and stretches of Myofascial Release. This time-dependent shear of the ground substance activates the piezoelectric effect, leading to the thixotropic phase transition of the ECM (Davis, 2015)

Relationship of Research to the Field and Discussion of Results

From the analysis of the relevant research, our main thesis question proposing the integration model of the human body was supported. For centuries, the understanding of the human body came from cadaver dissection. This observational research was vitally important to building the current model of the human body, as it allowed anatomists to begin to discern, in a scientific manner, the structure and function of the body. Unfortunately, these cadaver dissections were done on tissue that was dehydrated; therefore, the information discovered was misleading. As theorized by Szent-Gyorgi (1941) and validated by Gascoyne, Pethig and Szent-Gyorgi (1981), the addition of water to this global tissue creates an electrically active system that connects every cell to every other cell via the ECM (Gray, Williams and Bannister 1995). This complete connectedness throughout the human body was visually presented through the research of Dr. Jean-Claude Guimberteau. As stated in *Strolling under the Skin* (2005), “everything is connected. There is no break in the continuity of living matter”. Referring back to our discussion of scientific modeling in Chapter 1, with the model of the atom; if a phenomena is observable and measurable, it must be accepted within the model, in accord with the Correspondence Principle. The complete continuity of this tissue, while accepted as fact for centuries, must be understood from a larger perspective; science and medicine can no longer relegate the fascial system to the role of packing material.

New research being performed by pioneers in the field have begun to link this understanding of the fascial system to how it relates to health and dysfunction within the human body. Through this research, it has been shown that the fascial system is deeply integrated within every system of the body and impacts every single system from the macro level (support and mobility) to the micro level (mechanotransduction). The viscosity of the ECM, through the phenomenon of phase transition (Davis, 2011), has been shown to directly affect the biochemical signals produced within each cell (Ingber, 2006), even to the point of DNA transcription (Findley, 2011) and the incidence and remission of cancer

(Chaudhuri et al, 2014; Yang, 2015). This directly effects the fields of oncology and genetics dramatically. Further, it has been shown by several researchers and clinicians that the fascial system can be accessed via manual therapy approaches and techniques to treat somatic dysfunction (Barnes, 1990, 1996, 2000; Schleip, 2003; O'Connell, 2003; Davis, 2015).

Conclusion

This thesis has been titled "*Fascial Beings: An Updated Model of the Human Body*". This title set the stage for the main avenue of inquiry for this thesis: is the current model of the human body, reflecting fragmentation, insufficient? Concurrently, does the preponderance of evidence support an updating of this model to one reflecting integration? The focus of this question came to rest upon the often misunderstood system of the body known as the fascial system. The review of available literature revealed agreement within the textbooks and resource materials for anatomy and physiology students of the current model of the fascial system; reflecting a system that was singular, inert and served the role of separating, covering and supporting the varied systems of the body. Further investigation led to the discovery of characteristics and properties of fascia that challenged this current model. Research spanning over six decades revealed a tissue that was not only singular, but electrically active, dynamic, responsible for the majority of support and movement available within the human body and partially responsible for the proper physiological functioning of every cell. Further research must be done to answer the question of how this dichotomy of information exists and why medical and allied health programs teach an erroneous view of the only system of the body that connects every other system.

While there has been an understanding of the global nature of the fascial system via cadaver dissection, and a theoretical understanding of the properties and characteristics of fascial tissue; the filming of the fascial system, in vivo, by Dr. Guimberteau has provided a link between the two. His filming of the fascial system has supported the integration model that has been proposed by this author. Further research, as reviewed within this study, reveal the importance of the fascial system to the health

as well as dysfunction of the human body. Future researchers would be well advised to familiarize themselves with the enormous amount of research spanning six decades that challenge some of the basic assumptions of the anatomy and physiology of the human body. Just as Bohr's model of the atom was updated to Schrodinger's; so too, must the current model of fragmented systems be updated to the concept proposed of integration. As stated by Guimberteau (2005) in *Strolling under the Skin*, "The human body would seem to be one and the same tissue that has differentiated over time but whose basic organization is stereotyped." Or, stated more poetically, that we are all fascial beings.

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