THE LIVING MATRIX: UNDERSTANDING FASCIA - PART 2
BY MICHAEL KERN B.C.S.T., D.O., A.B.D., N.D.

In the first part of this article Michael Kern explored some of the recent findings about fascia and how these resonate with traditional understandings outlined by Drs. Andrew Taylor Still, William Sutherland and others. Here he continues with a look at how fascia connects to the inside of cells, the discovery of abundant nerves within fascia and how Craniosacral Therapy can influence fascial function and whole body dynamics.

The internal matrix

Dr. James Oschman describes fascia as a central element within a “living matrix”, a material and energetic substrate that is involved in tissue organisation, communication and repair. The living matrix connects all functions in the body and can be compared to an operating system that connects all the functions of a computer, such as the keyboard, screen, modem, programmes, etc. (Oschman, 2008).

Within the living matrix, the meshwork in the extracellular matrix (ECM) actually extends to the inside of each cell through micro-filaments of the cytoplasm, reaching right into the cell nucleus (Oschman, 2008). This understanding extends the understanding of tensegrity to include the structures that are inside cells, which become part of a tensegrity network. It also means that every cell is in touch with every other cell in the body.

The bridge between the ECM and the cell cytoplasm is provided by receptors called *integrins*, located on cell membranes. According to Flores and Patel, “Integrins are the principal receptors used by animal cells to bind to the extracellular matrix … Integrins also function as signal transducers, activating various intracellular signalling pathways when activated by matrix binding. Integrins and conventional signalling receptors often cooperate to promote cell growth, cell survival, and cell proliferation.”

Transduction refers to the action of converting something (especially energy or a message) into another form. So, signal transduction from the outside to the inside of cells is carried out by integrins, which significantly can respond to mechanical cues. This means that cells communicate with other cells by pulling on each other’s membranes and distorting the cytoplasm. This process is called ‘mechano-transduction’.

Donald Ingber writes, “Mechano-transducers are molecules that change their chemical activity state when they are mechanically distorted, and thereby convert mechanical energy into biochemical energy … the function of virtually every molecule could potentially be altered by mechanical stress because all bioactive molecules move between extended and contracted forms … in the process of carrying out their biochemical activities” (Ingber D., 2005). According to Ingber, it is becoming increasingly clear that epigenetic factors, particularly mechanical and structural cues that influence cell behaviour, have a central role in our embryological development and tissue physiology (Ingber D., 2005).

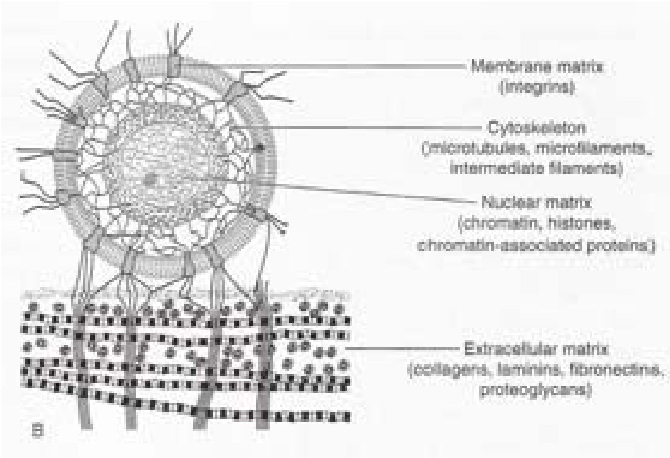

Figure 6: Integrins connect the cell cytoskeleton and nucleus to the connective tissue matrix. Image from J. Oschman (2000), Energy Medicine: The Scientific Basis

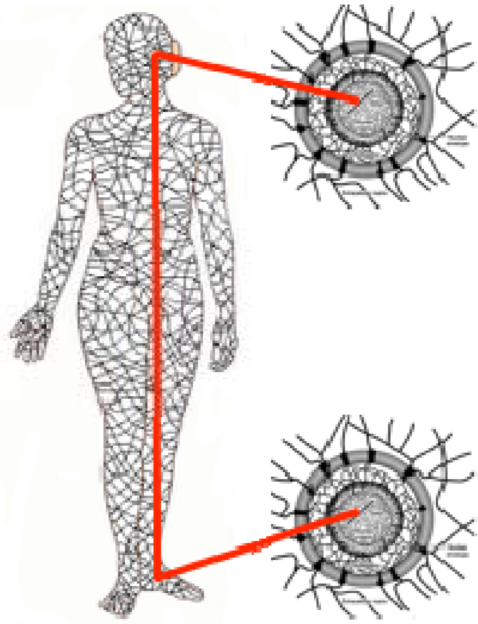

Figure 7: Links across cell surface and resonance allow for long-range interactions between cells, organs and throughout the body

Fascia as a communication system

Fascia can also be seen as an important communication system for the body (Oschman, 2012; Ho and Knight, 1998). According to Dr. Mae Wan Ho, the polarised nature of this 'liquid crystalline matrix' makes it highly responsive to electrical charge and able to carry impulses very fast. She suggests that impulses in the fascia are amplified via the action of proteins in the liquid crystal. The collagen fibres in fascia have been described as the conductor of electrons in the body, whilst the ground substance is the reservoir of electrons (Oschman, 2008). Also, due to the continuity of the extracellular matrix with the liquid crystalline cytoplasm in the interior of cells, everything in the body is in reciprocal communication.

Dr. Zvi Karni, a professor of Biological Engineering in Israel, has also demonstrated that fascia is able to conduct electricity, so helping to transmit energy throughout the body and act as a carrier of information (Upledger and Vredevoogd, 1983). However, this conductivity is dependent on good hydration.

Herbert Frohlich (1968) and Fritz Popp (2003) demonstrated that living cells emit light (photons) across a wide variety of wavelengths and that this is an important way in which cells communicate with each other. According to Dr. Will Wilson, "In cancer the output of light is much reduced, thereby reducing the potential for cell-to-cell communication. Cancer cells act as if out of touch with the rest of the organism, proliferating uncontrollably. So, for cellular health it seems likely that a light-based communication system is needed" (Wilson, 1998). Dr. Sutherland talked about liquid light and the transmutation life's organising forces into the body, so perhaps he was describing from observation what science is now starting to explain.

A huge amount of information pours through the fascial matrix, which acts as an antenna picking up information from both inside and outside the body producing low-level subtle ‘whispers’ within the body physiology, many of which never reach the brain. Nerves just pick up stimuli at the tip of the iceberg, as they only get activated with certain strong stimuli (Oschman, 2008). If this is applied in clinical practice, it can indicate that gentler treatments can have a greater effect; less is more. Dr. Mae Wan Ho observes, “Coherent energy is stored everywhere within the system … Consequently any subtle influence arising anywhere within the system will propagate over the entire system and get amplified to global effects. In other words, the system, by virtue of being full of coherent energy everywhere, will be ultra-sensitive to very weak signals. This may be the basis of all forms of subtle energy medicine” (Ho, 1998).

The whole fascial matrix has been described as an information superhighway that has links to the nervous system, enabling inter-cellular signalling at a molecular level. Dr. Mae Wan Ho says, “Liquid crystallinity gives organisms their characteristic flexibility, exquisite sensitivity and responsiveness, and optimises the rapid noiseless intercommunication that enables the organism to function as a coherent coordinated whole” (Ho, 1998). The nervous system has traditionally been considered a high-speed communication system, but in comparison to the light-based communication within the fascial matrix, it is very sluggish! According to Dr. Mae Wan Ho, the body’s light-based communication system is primary, and the nervous system is actually designed to slow things down to regulate body functioning.

Remember that impulses can travel through the fascial network at high speed; probably at the speed of light. However, it is likely that contraction, loss of hydration and inertia of fascial tissues interferes with their capacity to conduct electricity (Upledger J. and Vredevoogd J., 1987) and with their ability to transmit light at a cellular level. This may be an important cause of a fragmentation of function between different parts of the body. Furthermore, as the extracellular matrix in fascia connects into the cytoskeleton of cells and in turn the cytoskeleton connects into the cell nucleus, any tension in fascia is now known to affect the expression of DNA in the nucleus. Working intelligently with the liquid-crystalline nature of the connective tissue matrix means much more than simply resolving muscular-skeletal strains; it is an opportunity to alter body physiology at a cellular and molecular level.

Fascia and the nervous system

In 1902 Dr. Andrew Still wrote, “No doubt nerves exist in the fascia” and suggested that fascia should be treated with the same degree of respect as if dealing with “the branch offices of the brain” (Still, 1902). In 1988 Dr. Jaap van der Wal reported in the presence of substantial nerve endings in the fascia of rats, but his finding was ignored for decades (van der Wal, 1988). However, in 2007, three teams from different countries independently confirmed findings of a rich presence of sensory nerves in fascial tissues (Findley T., Schleip R. (eds.), 2007).

The fascia surrounding nerve fascicles (the perineurium), the whole nerve and associated veins and arteries (the epineurium) plays an important role in pain regulation. Bove and Light (2008) conducted studies revealing nerve axons in the epineurium and perineurium that are consistent with nociceptive (pain) function.

Subsequent studies using in-vitro electrical and chemical nerve stimulation have demonstrated that stimulation of local nociceptive receptors of the perineurium and/or epineurium can evoke nerve inflammation. This indicates that irritation of perineural fascial tissues can trigger local nerve inflammation and pain. Evidence indicates that chronic low back pain may actually emanate from fascia, rather than bone, cartilage, or musculature. Subsequent work has also implicated lumbar fascia as well as peri-spinal ligaments as common culprits of low back pain. Thomas and Robet (2009) found corroborating histological evidence indicating that low back pain may be due to inflammation in the lumbar fasciae. Indeed, the magnitude of low back pain frequently does not correlate with the degree of vertebral or disc degeneration, as damage in these tissues indicated in X-ray or MRI findings is not an accurate barometer of pain.

Richly innervated tissue

Fascia is now considered to be the most richly innervated tissue in the body, with a very high density of sensory nerves. It has been estimated that fascia contains over 250 million sensory receptors (Schleip, 2021). These sensory nerves include a high percentage of proprioceptors that help our nervous systems orient to our surroundings. Fascia also contains a large amount of interoceptive sensory nerve endings that are involved in our ability to sense internal states of the body.

With regard to the sheer quantity and richness of nerve endings, this network can match our sense of sight, not to mention hearing or any of our other normally considered sensory organs (Schleip, 2015). The fascial web is also our largest sensory organ in terms of overall surface area. Robert Schleip (2003) concludes,

> "*Our richest and largest sensory system is not the eyes, ears, skin, or vestibular system but is in fact our muscles with their related fascia. Our nervous system receives its greatest amount of sensory input from our myofascial tissues. Yet the majority of these sensory neurones are so small that until recently little has been known about them*."

Mechanoreceptors

There are key mechanoreceptors within the fascia, as well as in subcutaneous tissue, membranes and tendons. These are:

- Golgi receptors - found in deep fascia, ligaments and myo-tendinous junctions. These are involved in proprioception and respond to only deeper pressures and strong stretches.
- Pacini receptors - found in myo-tendinous junctions, deep joint capsules, spinal ligaments and surrounding muscular tissues. These are also involved in proprioception. They respond to sudden pressures and rhythmic movements such as shaking and rocking.
- Ruffini receptors - found in the skin, dural membranes, ligaments and joint capsules. These are also involved in proprioception, and they respond to slowly-applied pressures and stretching. They are able to create a global relaxation response by decreasing sympathetic tone in the body. Ruffinis also change local fluid dynamics and aid tissue metabolism.

- Interstitial receptors - these are widespread and the most abundant receptors found in fascia. They are located almost everywhere in the body, even inside bones, with a high density found in the outer periosteal layers of bones. Some of these receptors are high-threshold, but about 50% are low-threshold fibres that respond to very light touch and subtle stimulation (Wilks J. and Knight I., 2014). Furthermore, many receptors of interstitial nerves are responsive to more than one kind of stimulation (Schleip, 2015). Robert Schleip and his team have also established that the innumerable small-calibre nerves abundantly found in fascia that were previously thought of solely as pain fibres (nociceptors), are in fact interstitial mechanoreceptors with a much wider function.

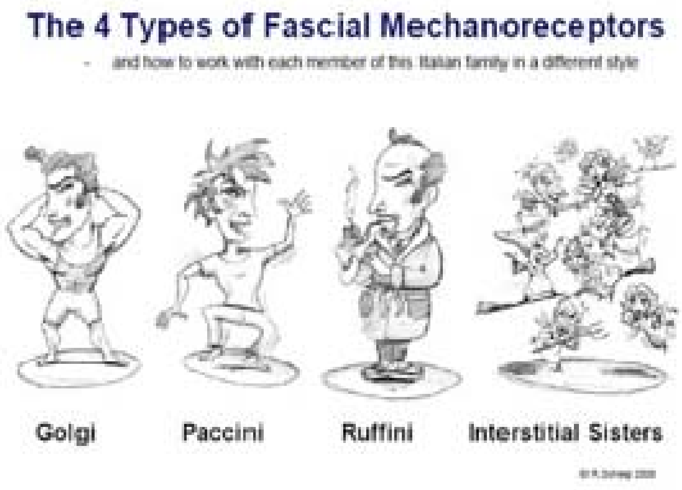

Figure 8: The "Italian brothers and interstitial sisters": mechanoreceptors in fascia – cartoon by R. Schleip

When stimulated, interstitial receptors increase vagal tone and consequently decrease sympathetic nervous system activity to promote relaxation (Schleip, 2003). Interstitial receptor stimulation leads to a change in heart rate, blood pressure and lung respiration. Some interstitial receptors are also involved with thermo-reception and can help regulate blood flow to muscles by monitoring muscular activity to the sympathetic nervous system (Schleip, 2015). Schleip reports, "It seems that a major function of this intricate network of interstitial tissue receptors is to tune the nervous system's regulation of blood flow to local demands, and this is done via very close connections with the autonomic nervous system" (Schleip, 2003).

Robert Schleip notes that slow and gentle contacts generally stimulate an increase in the parasympathetic nervous system with an increase in vagal tone, thus facilitating the calming of emotional states (Schleip, 2003). This type of contact activates the anterior lobe of the hypothalamus and has the effect of lowering muscle tonus throughout the body, producing cortical and endocrinal changes that are associated with deep and healthy relaxation (Ernst Gellhorn, 1967). Therefore, any practice that influences the fascia can also influence the autonomic nervous system.

Interstitial receptors can function as both mechanoreceptors (responding to mechanical tension and/or pressure) and pain receptors. In the presence of pain, their sensitivity changes so that normal physiological pressures can lead to strong and chronic firing of these receptors. This explains why pain often exists without any mechanical irritation of nervous structures, as was frequently assumed by the nerve root-compression model (Chaitow and DeLany, 2000, quoted in Schleip, 2003).

Fascia plays a big role in delayed muscle soreness after exercise. If over-sensitised, the interstitial receptors can be involved in states of chronic pain and sensitivity. These painful symptoms can result even though there is no mechanical irritation of nerves (Liptan, 2010). Chronic inflammation can be one cause leading to this hyper-sensitivity of nociceptors. Treatments that employ a soft touch and that do not consequently elicit a pain response can help to break these cycles of pain and inflammation.

The interstitial nerves in fascia also serve an interoceptive function. This provides the brain with information about the internal condition of the body, such as warmth, nausea, hunger, soreness, effort, heaviness or lightness, as well as a sense of belonging or alienation regarding specific body regions (Craig, 2002).

CLINICAL APPLICATIONS: FASCIAL FUNCTION

"I know of no part of the body that equals the fascia as a hunting ground."
- Dr. A.T. Still

Inertial fulcra are places in the body that contain unresolved trapped forces leading to a contraction in tissues and a densification and stasis in fluids. They may result from a range of unresolved experiences such as physical trauma, emotional stress and toxicity. These conditioned patterns can distort the fluid/tissue matrix and affect its numerous functions. During palpation these patterns of stress or strain may be felt as a drag or pull through your hands, organised around an inertial fulcrum. Or, they may be experienced as disturbances in the natural primary respiratory motion of fluid and potency which have to move around these places of contraction or compression. They are distortions within the unified function of tissues, fluid and potency and can act as a primary pre-cursor to the development of symptoms and pathologies.

In Craniosacral Biodynamics a 'holistic shift' is described as a state of settling and availability, in which the client is sufficiently safe and resourced so that they are able to stop managing or controlling what's going on during a session. It can be facilitated by the practitioner sitting back with an orientation to the whole field of tissues, fluid and potency, and not following the first patterns that show themselves, but waiting for a letting-go and settling. It marks a physiological shift from a sense of fragmentation and conditioned motion patterns to wholeness and connection to resources. It is the gateway to deeper therapeutic processes, in which a resolution of the underlying forces that organise an unresolved pattern can more easily occur.

If the practitioner can support the client to settle into a holistic shift, an automatic shifting of potency can begin to move towards the inertial fulcrum that's ready to be worked with. Biodynamic Craniosacral Therapy (BCST) treatment skills, such as synchronising to expressions of primary respiratory motion, accessing states of balance and/or employing augmentation skills, can be used to re-orient the pattern imprinted in the fascia to our underlying blueprint of health and wholeness.

The light touch used in BCST, appropriately synchronised to the needs of the patient, may have the following effects:

- Increase the expression of potency through the fascial matrix

- Re-establish a connection with the wider matrix of health (primary respiration)
- Support the hydration of myofascia
- Stimulate mechanoreceptors in fascia (particularly some interstitial receptors and possibly Ruffinis)
- Increase vagal tone and lower the stress response
- Stimulate efficient blood supply
- Help to re-establish fascial contractility and recoil
- Reduce pain and inflammation
- Facilitate greater interoceptive awareness (awareness of the body's internal state)
- Facilitate greater proprioceptive awareness (awareness of the body's position, movement and orientation)
- Facilitate greater coordination of movement within the body
- Improve organ function
- Assist with local and global cellular function
- Facilitate light-based, piezo-electric and electrical communication throughout the body.

Michael Kern will be teaching 'The Living Matrix', a four-seminar for all Craniosacral Therapists and Cranial Osteopaths from September 21st-24th 2023 in Berlin. This practical and stimulating seminar will explore many of the ideas explored in this article and equip practitioners with a range of Biodynamic Craniosacral Therapy skills to work with the fascial network. For further details and bookings, please contact:
Weg Der Mitte,
Ahornstr. 18,
D-14163 Berlin-Zehlendorf,
Germany
Email: berlin@ wegdermitte.de
Tel: +49-30-813 10 40
Website: https://www.wegdermitte.de/cst-living-matrix

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