Fascia and Osteopathy –

a perfect marriage of body structure and treatment techniques to facilitate the healing progress in a variety of conditions in dogs

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Introduction:

Fascia is an intricate network of soft tissue which like an intimate web connects to bones, muscles, tendons, ligaments, organs, blood vessels and nerve cells throughout the body. As such, it lends itself to the idea of osteopathy of treating the whole body rather than individual regions, conditions or diseases. Thus, promoting self-healing with respect to all bodily structures being as equally important to function harmoniously with each other in order to create homeostasis.

Pioneer of osteopathy, Dr. Andrew Still, was fascinated by this structure as his studies and explorations in the late 1800's gave evidence of how fascia contributes to health and healing. His teachings included four principles that all showcase the significance of fascia as a connective tissue system:

1) The body functioning as a total biologic unit
2) The body possessing self-healing and self-regulatory mechanisms
3) Structure and function are inter-related
4) Abnormal pressure in one part of the body produces abnormal pressures and strains upon other parts of the body (Still, 1899)

The importance of fascia in a medical sense wasn't elaborated on until 2007, when the first international "Fascia Research Conference", held in Boston (USA) investigated the basic science and clinical implications not only for conventional but also for complementary health care such as osteopathic medicine, edited by Thomas Findley and Robert Schleip.

Over the next three congresses, Findley went on to gather scientific research about fascia and in 2013 published a paper together with Shawala which explored the links to and relevance of Still's findings: while modern medical professionals confirmed that fascia penetrates, supports and innervates surrounding organs, muscles, bones and nerve fibers (Langevin and Huijing, 2009), it was Still's hypothesis that fascia is also involved in fluid flow that gave the breakthrough of recogising the significance of fascia. This proves that it assists in lymphatic circulation, the nourishment of all cells in the body, waste transfer, respiration and cardiovascular stability.

Therefore, the health of fascia is vital for organism's growth and support and the interruption or dysfunction of fascia contributes to disease and cancer (Still, 1899)

What is fascia?

With its origin in Latin meaning "band" (Oxford Learner's Dictionary), it is described as a collagenous fibre network connecting to all aspects of the body. This includes metabolic and immune systems due to its cellular make-up of fibrocytes and myofibroblasts and relates to blood supply, fluid drainage and innervations and therefore can be regarded as the largest organ in the body.

Fibrocytes or fibroblasts are the main component of fascia. They have fusiform cell shapes when they are found in mature connective tissue in a non-transformed condition. However, they change into a stellate configuration when they need to "grow" either from an immature state or during the phase of healing. This is called an epithelial -mesenchymal transformation

and is crucial in wound healing or tissue regeneration. Due to their long wave-like dendrites they take on in this shape, fibrocytes are able to attach efficiently to other tissue cells such as collagen fibres, plasma cells, fat cells, blood vessels, smooth muscle cells, elastic fibres and lymphocytes that are all critical in the process of tissue repair. (Seffinger, 2018). This allows the fibroblasts to receive tensional changes from adjacent structures and therefore gives them the ability to monitor mechanoreception and chemoreception. Fibroblasts detect and respond to mechanical stressors e.g. when calcium increases in a skeletal muscle due to contraction which suggests that "tissue contraction and relaxation may result in a dynamic, body-wide pattern of cellular activity" throughout the fascia (Langevin et al, 2009).

Myofibroblasts are cells that derive from fibroblasts due to tissue trauma. One of their functions is to assist in wound healing and tissue repair after an injury occurs. This is very valuable in the short term. Increased interstitial flow within the traumatised area facilitates the conversion of fibroblasts into myofibroblasts as well as collagen production. However, if this activation of myofibroblasts becomes a prolonged state of tissue healing due to re-injury, lack of nutrients, decreased lymph flow, etc. fibrosis is the result due to the excessive amount of fibrous collagen bundles.

Amongst others, fascia also contains a high amount of water, collagen and elastic fibres. The responsibility of the latter two is to provide the toughness for tissue connectivity as well as the gel-like cushioning to protect the cells and fibres. Collagen has the ability to transmit electrical signals throughout the body and these depend on external factors such as touch while elastic fibres give the fascia network the resilience to bounce back after being stretched (Seffinger, 2018).

Even though fascia attaches to muscles, ligaments, tendons, aponeuroses and organs, it is distinguishable from other soft tissues by its histological composition mainly of the above as well as the fact that fascia is arranged in irregular fibres unlike the parallel fibre bundles in other body tissues such as muscle fibres (Gray, H., 2013)

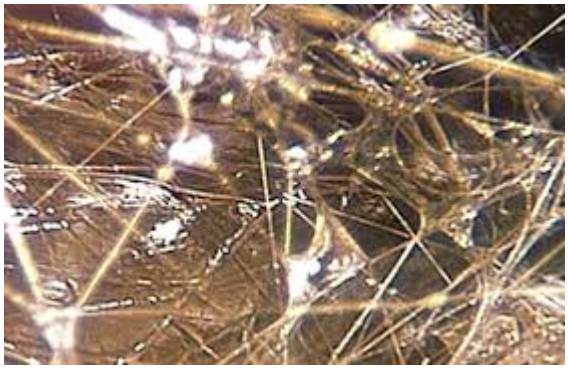


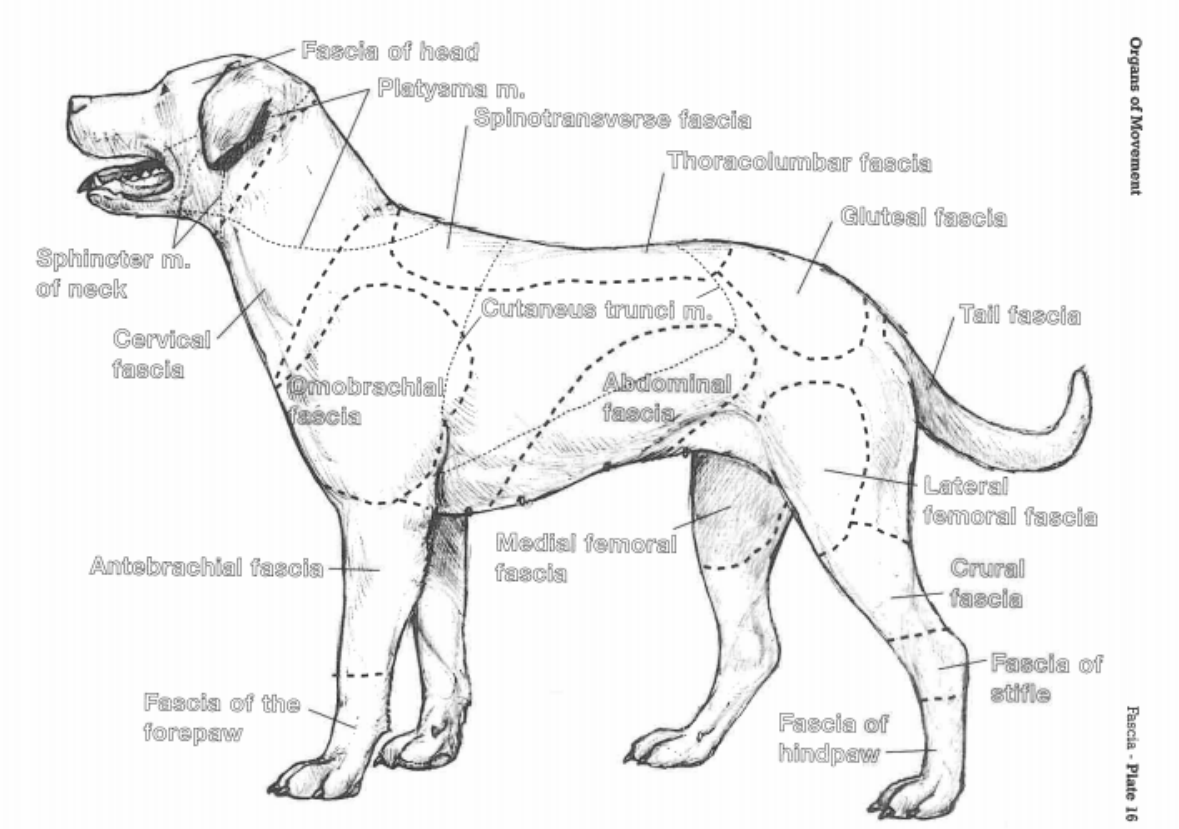
Image of fascia fibres (source: https://www.caninekinetics.com.au/blog/myofascial-pain-in-dogs-what-is-it-and-how-to-we-treat-it)

This interwoven pattern makes it incredibly strong and means that it is infinite – unlike other tissue structures that have a definite beginning and end. Fascia is arranged in 4 layers:

1) Superficial fascia = pannicular fascia: lies under the skin to keep muscles and skin separated and gliding past each other. It is fibrous but very elastic and is responsible for thermoregulation and circulation including lymphatic flow. It attaches to the
2) Deep fascia = axial and appendicular fascia: surrounds the hypaxial and epaxial muscles and extends to tendons and bones including the spinal column. It ensures freedom of movement by partitioning the muscles with so-called septa or compartments; allowing for smooth “gliding” past each other and organs. This layer is responsible for muscular tension conduction and is what is most relevant to canine osteopathic treatments as the focus is on the biomechanical system.

3) Meningeal fascia: surrounds the nervous system and brain
4) Visceral fascia: connects to the organs in the thorax and abdomen as well as reaching cranial to the pharynx. It allows for motion between the body wall and organs and functions as a conductor of neurovascular cell bundles between these structures (Lesondak, 2022)

Although it is impossible to separate fascia into individual parts, there are distinct regions that can be named in the deep layers of fascia in the dog. Knowledge of these areas is vital in osteopathic practice to consider compensational issues:



(Source: Kainer, R. A. & McCracken, T. O., 2003, Dog Anatomy – A Coloring Altlas, Teton New Media)

Fascia has many valuable functions such as being an overall “suit” of protection, a spiderweb that holds everything in the body together but at the same time allows for smooth gliding of muscles. The most important aspect may be that fascia will step in in times of injury and help produce scar tissue (myofibroblasts) and collagen to help stabilise and repair the area (Broadhurst, 2019).

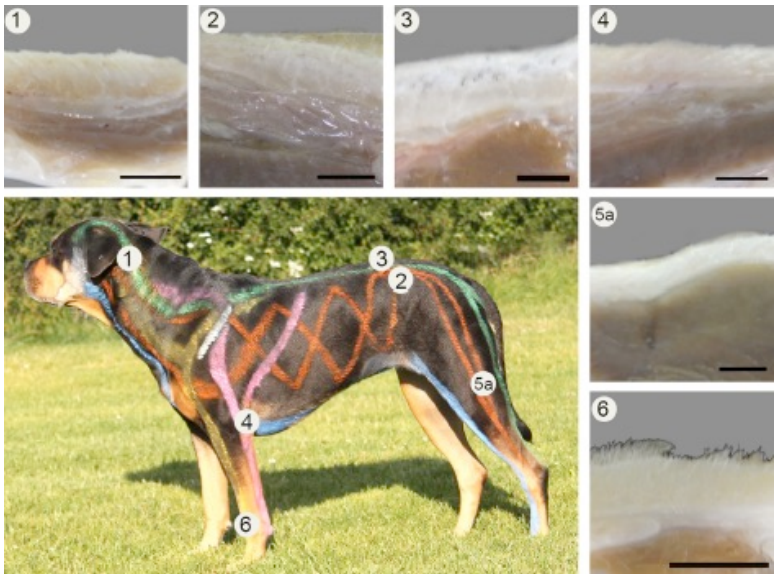
Due to its histological make-up, location, function and close connectivity to all body structures, human medicine increasingly explores the benefits of treating fascia and this interest now extends to veterinary science. An article in the Journal of Anatomy compared the fascia of humans, horses and canines and indeed found that human and canine fascia (unlike the equine one) is very much alike but the difference in biomechanics must be considered. Several dogs were dissected and different layers of fascia of the regions of the canine body that are functionally different to humans were examined. These were compared in order to evaluate the structure and biomechanical characteristics of the fascial tissue in dogs. These regions were:

- R1: regio colli lateralis (caudo-ventral to the ventral part of the atlas wing and m. cutaneus faciei and m. brachiocephalicus)
- R2: regio abdominis lateralis (cranio-ventral to the tuber coxae and m. cutaneus trunci and m. qbliquus abdominis,
- R3: regio lumbalis (paravertebral to L4 and m. cutaneus trunci and m. longissimus thoracics),
- R4: regio axillaris (caudal to the region superimposed by the tuber olecrani in a neutral posture and m. cutaneus trunci and m. pectoralis ascendens),

- R5: regio genus lateralis (border between the cranio-distal part of m. biceps femoris and fascia genus at the level of the mid-distal part of the patella and m. biceps femoris)
- R6: regio carpi (in the midline at the level of the intercarpal joints)

These regions were chosen due to the difference in biomechanics: humans as being upright flat-footed bipeds and dogs as being four-legged digitigrades. This also takes the variation of the spinal column into consideration: that of the canine being horizontally arranged to withstand gravity and transmit movements from the powerhouse that is the hind end to the front whereas the spine of humans possesses an extra curve compared to dogs in order to fulfil vertical stability.

It was found that between R2-R4 the superficial fascia contained a more abundant amount of elastic fibres than in humans, in R5-R6 they were moderate and even less in R1. R5 showed a densely packed structural composition of fascial tissue and the deep layer in this region (fascia lata) was thicker and contained dense collagen fibres that were firmly connected to the epimysium of m. biceps femoris. (Ahmed et al, 2019).



(source: Ahmed, Waqas & Kulikowska, Marta & Ahlmann, Trine & Berg, Lise & Harrison, Adrian & Sødring, Vibeke. (2019). A comparative multi-site and whole-body assessment of fascia in the horse and dog: a detailed histological investigation. Journal of Anatomy)

Why do we need to consider this structure in osteopathic treatments for our canine patients?

Osteopathic principles classify 5 models of health (or disease) all of which are influenced and either directly or indirectly connected to fascia. As mentioned above, the most relevant model when considering canine patients (humans and other animals) is the:

1) Biomechanical Model

   The musculoskeletal system consists mostly of bones, skeletal muscles, ligaments, tendons, joints, joint capsules. 44%-57% of a dog's weight consists of skeletal, striated muscle mass (Evans, De Lahunta, 2013). Considering that approximately half the dog is muscle and adding all the above-mentioned structures that are included in the musculoskeletal system explains why this model is the "lever", "tool" or "window" to osteopathic treatment techniques. Osteopathy involves manipulation and mobilisation of structures in the musculoskeletal system. This highlights the importance of fascia in treatments when considering that all of these structures have relevant fascial layers connecting, surrounding, separating (for gliding and fluid flow) and innervating them. Healthy fascia is crucial to optimal functioning of muscles as up to 50% of the force of muscle contraction is transmitted via the accompanying fascia. This allows for greater use of tendon elastic energy as the mechanical stress is distributed through the muscles and fascia. Thanks to its high elasticity component, it can absorb and store energy and then go back to its original state once the force subsidies. This process is called "elastic deformation" (Seffinger, 2018).

2) Neurological Model

In relation to osteopathic thinking and treating animals such as dogs who can't communicate verbally with the human therapist, it is important to remember that fascia acts as a "highway" of neural communication. All layers of fascia possess a large number of mechanoreceptors, nociceptors and proprioceptors and other nerve cells and this highlights the connection fascia has to the nervous system. (Liem, T., Tozzi, P., Chila, A., 2019). This is an important point for osteopathic practitioners to consider as they work on the biomechanical model and the neuro-fascial integration influences the maintenance of posture, musculoskeletal biomechanics, peripheral motor regulation and the transmission of pain. When a muscle contracts, the close relation to fascia also changes the tension in the fascia due to the proprioceptive nerves and mechanoreceptors imbedded in it.

Dr. Michele Broadhurst calls fascia the "whole-body-communication system" and she explains that fascia is a sensory organ due to its ability to transmit impulses such as muscle contraction, muscle tone, movement, change in muscle length and position of body parts (proprioception) to the Central Nervous System (CNS) via the muscle spindle cells that attach to the fascia. If the fascia is disturbed, the communication will also be altered or hindered and this could lead to an undesirable change in posture, tightness, motion restriction, pain.

3) Respiratory-Circulatory Model

Still was of the opinion that "The rule of the artery is supreme"; meaning that the circulatory functions are the most important in the body. This is a relevant fact to observe when treating conditions which a dog may present with that are not an

obvious orthopaedic issue. Respiration and cardiovascular flow depend on smooth muscles, arteries and veins functioning well; fascia connects to all of them as well as organs such as the lungs and the diaphragm. Oxygen and nutrients being transported throughout the body depend on hydrodynamics, meaning that the fascia contributes to the movement of body fluids through motion and respiration (Liem, T., Tozzi, P., Chila, A., 2019)

4) Metabolic- Energy Model

Closely related to the fact of fascia being involved in circulatory systems, it is clear that it influences the energy production, distribution and expenditure due to nutrients and oxygen being transported via the cardiovascular system. The metabolic model needs to be in constant harmony to fulfill tasks such as regulation of the endocrine system, waste elimination and immunity and as fascia clings to every organ, vessels and smooth muscles e.g. in the digestive tract and it transmits neural signals throughout each of them, it has a crucial role in maintaining homeostasis. This is an aspect animal / dog practitioners need to consider in their treatments. Modern dogs are facing more diseases than ever before that are stemming from an imbalance in metabolism such as cancer, pancreatitis, allergies. The canine osteopathic practitioner will inadvertently treat this model by working on the biomechanical model as the blood flow to skeletal muscle is in accordance to metabolic processes and the connected fascia promotes lymphatic flow when muscles contract against the fascial layers and therefore increase the pressure in the fascial compartments (septa) to aid in blood and lymph being pumped towards the heart (Findley, T.W., Shawala, M.)

Hermann Baum was able to demonstrate that in dogs small vessels branch off the lymphatic vascular matrix and run along the fascia on the surface as well as on the medial side of the fascia. He explored and made a directory of the lymph vessels in canines that run along the antebrachial fascia, lumbodorsal fascia, fascia lata and fascia cruris to underpin the importance of fascia.

5) Behavioural Model

Still's research into fascia took him so far as evaluating it to having a major role in behaviour or mental health when he called fascia the "dwelling place of his spiritual being" (Liem, T. et al. 2019) due to the close connection to the nervous system. Modern science in psychoneuroimmunology (PNI) found a vibrant link between the nervous system, endocrine function and immune response as these play together to balance the body into homeostasis (Seffinger, 2018). As fascia is attached to and working in constant interaction between these three systems, it plays a role in mental health, including in that of dogs. This is especially true when the canine osteopathic practitioner needs to evaluate and work with acute or chronic pain and its potential consequences it can have on the animal's behavioural well-being such as fear responses, reactivity to certain stimuli, pain coping mechanisms, depression, cognitive dysfunction (shut-down, disobedience, learnt helplessness).

Osteopathic techniques work on fascia in a way that speeds up healing in tissues and organs

In canine osteopathic practice, the therapist will most likely be dealing with pain in a dog which by the time the owner or vet evaluates it, can have been a stressor in the body for some

time. This could be the result of a variety of conditions such as orthopaedic issues e.g. arthritis, injury, genetic disposition such as hip or elbow dysplasia but also due to internal factors such as organ failure, neoplastic growths or even neurological disturbances. Due to the fascia's whole-body-network, a somatic dysfunction, restriction or pain in one area can cause dysfunction in different areas such as local and regional spasms or chronic muscle ache. It has been found that when mechanoreceptors are being worked beyond their limit or are subject to ongoing stimulation, these can change into nociceptors in the fascia, causing pain, dysfunction and possibly chronic change of fascial tissue. This information is transmitted to the spinal cord and brain not only via the nerve cells embedded in muscles but also afferent impulses stemming from the mechanoreceptors located in fascia (DeStefano, L., 2017).

An article by Bruno and Giovanni Bordoni, published in the Journal of Pain Research, identifies the beneficial outcome for patients following osteopathic treatment in relation to fascia and pain on the peripheral nervous system. It states that osteopathic treatments have been found to decrease inflammation and therefore pain reduction when using "neurodynamic" mobilisation techniques. The peripheral nervous system is enmeshed in fascial tissue and thus any mechanical tension e.g. muscle contraction, joint motion is transferred through the nerves in a longitudinal direction. Schwann cells are then responsible for maintaining the nervous system's function, re-shaping, repairing and remodelling behaviour. However, they can only do so if the nervous tissue has retained its elasticity and can glide freely – this is where fascia is essentially a communication device to the nervous system to balance between mechanical force and the adaptation and regeneration of nerves. Osteopathic techniques improve the quality of the criss-cross fascial tissue by decreasing

stiffness, maintaining elasticity, breaking up fibrosis by influencing the metabolic behaviour of fibroblasts and resetting of the afferent nerve pathway which consequentially allows for a more sustainable efferent reply (2015).

When fascia is overburdened by an excessive load or a prolonged state of mechanical stress, its capacity of elastic deformation turns into “plastic deformation”. This results in a reduced capacity of storing muscle energy and thus makes fascia less resistant to external forces. Fascia will eventually not be able to regain its original shape and elasticity. When the force-transmission relationship between muscle and fascia is disturbed, kinetic energy is out of balance and joint dysfunction, injury, inflammation and chronic postural changes can be the consequence. Extended production of myofibroblasts in the fascia results in fascial adhesions (Seffinger, 2018) which means the fascia gets “stuck” and this results in impaired lymph flow and the skin and muscles not being able to glide past each other.

“Myofascial trigger points” are the result and have the tendency to spread a pain pattern to far away regions in the body via the fascia (Broadhurst, 2019). “Myofascial release” does not lend itself to any one form of manual therapy but merely means that the practitioner works on breaking up the adhesions in the fascia to release muscle tissue.

The canine therapist will not only be feeling for tissue texture abnormalities but also for limitation in range of motion or a “barrier” that can be the result to muscular and fascial fibre restrictions. The obstruction can be related to skin, fascia, muscles, ligaments, joint capsules or a combination of these and alters the symmetry of the range of motion of a joint to the point where the “neutral” has moved off the midline (DeStefano, L., 2017).

In veterinary practice, a physiological barrier often results in a diagnosis of "non-specific lameness". When the canine osteopath is confronted with a dog in such a condition, rather than searching for dysfunction in a peripheral joint, the osteopathic investigation will frequently lead to the origin of the restriction being found along the spine due to fascial binding and muscular tension. This can be regarded and treated as an osteopathic somatic dysfunction (Nevin, T., Colles, C., & Tozzi, P.).

In the canine osteopathic field, this can be done by a few types of manual techniques such as indirect methods (Strain and Counterstain, Functional Technique) and direct methods (Osteopathic Articular Balancing = OAB) or a combination of both direct and indirect techniques (Myofascial Release Technique, Craniosacral).

The most commonly used technique is called "Osteopathic Articular Balancing", a technique that was adapted from human osteopathy by Professor McGregor. This method engages the barrier and works against it towards the pathological restriction. A somatic dysfunction can be found in skeletal, muscular, arthrodial, lymphatic structures and therefore always concerns the fascia.

OAB is used to assess and identify problems and while doing so, treating the individual joints of the dog by a series of long lever-style manipulations. The joint is taken through its planes of articulation and this relates directly to attaching structures such as muscles, ligaments, joint capsules, bursae, tendons and of course the connecting fascia. This type of mobilisation is a gentle engagement between cells and receptors to relax muscles, break up adhesions, increase the production of collagen and speed up healing by decreasing myofibroblasts and

increasing circulation of the tissue (hypothalamic tuning) to heighten cell activity and remodelling (Liem, M. et al).

In contrast to this direct technique, a canine osteopath may choose an indirect technique such as “Functional Technique” in which the practitioner examines the tissue texture of muscles and fascia with one hand while guiding the associated joint towards the position of ease, away from the restriction. This is a well-tolerated technique for canine patients as it is a slow process in which the practitioner can observe the dog while monitoring the tissue response. It works especially well in acute situations as the technique facilitates the restoration of the neuromuscular mechanisms as they were before an injury or somatic dysfunction occurred (DeStefano, L., 2017).

Conclusion

What happens in the musculoskeletal and /or nervous system influences what happens in the fascia throughout the entire body and vice versa. This is the reason why osteopathic treatment techniques work well on the fascia as manual medicine is aiming at bringing back the musculoskeletal system into pain-free, symmetric postural balance so that other structures, systems and organs can fulfill their function effectively and therefore work toward an equilibrium that the body can use to repair lesions and be in a state of ongoing healing and maintenance of the entire body system.

Canine osteopathy is not limiting itself to treating one issue or disease but looks at the whole body and therefore facilitates a more global approach to preventative care and healing.

By using osteopathic thinking and osteopathic techniques that include working on the fascia, dogs can be treated successfully for a variety of conditions as the fascia allows for the activation of self-healing mechanisms through visceral and musculoskeletal systems and therefore has an effect on all models of health.

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