Plasticity

Besides the life defining characteristics and functions of CT described above one characteristic deserves its own section: it's plasticity. The efficacy of the manipulation and movement techniques of all body-oriented therapies are dependent on this characteristic. It is in fact the hope of these therapies. CT's incredible plasticity, its ability to change its structure and functions according to *local* conditions, and to change back again when conditions change is the quality of CT that we work with. It is what can produce a change and bring the system back into balance and health. Stecco (Stecco) described how collagen production responds immediately to changing conditions in the body through the activity of the fibroblasts cells which produce additional fibers. These changing conditions can be any activity the person engages in including rest and sleep, exercises and injury. It is a continuous process but is accelerated by increased activity and injury.

> Tissue damage induces fibroblastic mitosis. Fibroblastic proliferation and degradation is a normal occurrence in everyday mechanical loading such as walking, running and most movements. Even mechanical loading in rest and sleep stimulates CT function. Collagen synthesis in the patellar tendon increases by nearly 100% as a result of just a single bout of acute exercise, and the effect is still evident three days later. In the initial training period, collagen turnover in tendons (i.e. the balance between synthesis and degradation) is increased and there is a net loss of collagen. This enables a tendon to restructure and adapt to an increasing loading pattern. It is not until training continues that there is a net gain in collagen synthesis. (Stecco, p. 6, 2015)

Oschman (2002) describes how this process happens from a bioelectric perspective.

> The mechanisms by which cells lay down or reabsorb supporting materials (collagen) in bone and connective tissue are understood. Electric fields generated during movements signal cells (fibroblasts in connective tissue, osteoblasts in bone) to lay down collagen in the direction of tension, and thereby strengthen the tissues. With less loading or movement, the electric fields are weaker and less frequent, and the cells reabsorb collagen. (Oschman, 2000, p. 157)

In addition, Rolf (1977) wrote about CT's metabolic plasticity from another perspective, and what is from my understanding a more primary level: ground substance. Her explanation

helps to understand the afore mentioned inexplicable responses I began to see in my patients and hear from them once I began working with a CT based model as she also noticed in her treatments. It is also the reason why I have stayed with the model of CT in the touch technique in FA and not any particular anatomical model such as working on myofascial system, fascia, tendons or ligaments. She emphasizes that while fascia is made up of collagen fibers these have to be seen as being embedded in ground substance which is mostly an amorphous semiliquid gel alike to the white of an egg and is the "universal, internal environment".

In a humanistic oriented body psychotherapy such as Functional Analysis the "internal environment" of the patient is what has always been focused on; the patient's experience of him or herself; interpretive interoception. Currently, in psychotherapy in general, there has been less of an emphasis on cognition and content, the history of the patient and what it all means, and more in focusing on how the person feels about that history. For example this paradigm shift has reached psychoanalysis with the concepts of intersubjectivity and relationality and has even influenced biofeedback methods connected with Cognitive Behavioral Therapy.

"…with biofeedback, the clinician is not seeking definitions of feelings that are coming from the frontal lobes; the biofeedback clinician asks about how it feels physiologically…The clinician is looking for physiologically felt sensations. (Kerson, 2019/2020, p. 198)

While Stecco's and Oschman's descriptions comment on how quickly the collagen can change, in explaining plasticity, Rolf points out that compared to the metabolic changes in ground substance, collagen responds more slowly.

Therefore, the speed so clearly apparent in fascial change must be a property of its complex ground substance. The universal distribution of connective tissue calls attention to the likelihood that this colloid gel is the universal internal environment. Every living cell seems to be in contact with it, and its modifications under changes of pressure should account for the wide spectrum of changes seen in Structural Integration.(Rolf, 1977, p. 42)

Colloid gels are easily broken down which is how Rolf understands the rapid changes induced in the body by the pressure applied in physical manipulation as well as electricity and heat resulting in a reduction of its viscosity. It is the connective tissue fibers, not the muscle fibers that are relaxing or better said reorganizing.

Studies have shown that,

> …application of pressure results in a flow of interstitial fluids and ground substance away from a region of pressure. If stress, disuse, and lack of movement cause the gel to dehydrate, contract, and harden the application of pressure seems to bring about a rapid solation [return to a sol i.e. more liquid] and rehydration. Removal of the pressure allows the system to rapidly re-gel but in the process the tissue is transformed, both in its water content and in its ability to conduct energy and movement. (Oschman, 2000, p. 170-171)

The exercises and voluntary movements used in many forms of body psychotherapy and movement therapies involves stretching which applies stress to the tissue much as the manual therapies do in terms of force, shear as well as exercises. This is one of the conditions that will activate the restructuring of the tissue. Manual therapies are mainly interested in manipulating fascia no matter how it is precisely defined. Body psychotherapy is still focused on Reich's original model of "muscular armor" and so their model is to free the "contractions" in the muscles. Despite the fact that practitioners are in fact affecting the connective tissue, which is what releases the contractions of the muscular armor, BP still thinks in terms of muscle tissue.

The Points&Positions Touch Technique in Functional Analysis is specifically designed to take advantage of the plasticity of connective tissue but in a different manner than either the manual, and the movement therapies or traditional Body Psychotherapy. This will be described further in the Functional Analysis section but for now I will comment on three differences. The first is that FA is interested in all forms of connective tissue within the matrix, not just fascia or the myofascial system specifically. The second is that we do not use shear force or massage on the tissue. We do not manipulate the tissue in the classical sense, but

apply light, specific pressure with a fingertip or gentle compression in the Positional Release manner of Jones. (Jones, 1983) As well, we rarely use exercises or even movements although sometimes spontaneous movements arise during treatment and depending on their quality, we usually support these movements.

This transformative phenomenon that follows as a *restructuring of the CT tissues* is best described by the word *metaplasia;* the transformation of one type of adult tissue into another. With metaplasia we are back to plasma. As mentioned, *Plasia* comes from *plasis*, Greek for moulding.

> The differentiated cell of connective tissue is unique in that it retains its embryonic capacity for multiplication and transformation into other lines of specialized cells. Under ordinary conditions these cells are quiescent and inconspicuous: however, under extenuating circumstances (growth stimulus, injury, disease) …their progeny transform into the specialized cells required to meet the altered circumstances.
> Of equal significance is the activity of these cells in the process of metaplasia; the remarkable regenerative capacity to differentiate into the elements forming the *replacing tissue* is most manifest. (Snyder, 1956, p. 67)

When a muscle is stressed, either from a physical or a psychic injury or a combination of the two, the CT envelope surrounding that muscle will thicken up, the number of fibers woven through the muscle will increase and the tendons that form at each end of the muscle, which is a combined extension of the CT envelope and the intra-muscular CT fibers, (See Diagram II) will also thicken. In addition, if the stress is strong and chronic, involving other muscles in that region of the body, adjacent *muscle envelopes will "glue" to each other resulting in a loss of mobility and function* as typically seen in men and women who do "body building". When they turn to the left or the right, the whole torso moves. There is a loss of differentiation in the muscles which results in *a loss of differentiation in finer and more specific movements and consequently sensations*. It is also possible that, where the stressed tendon is attached to the bone, that area of the bone will enlarge itself creating more surface area for the additional fibers of the tendon to anchor. This is *muscular armor, chronically stressed areas of the body now acting as a unit, thickening up to resist external and internal physical, emotional and psychic stress*. The good news is that due to CT's plasticity, we can

slowly and safely address these conditions. There was always too much risk in BP with certain types of character structures using forceful techniques to break through the muscular blocks. **The plasticity of the CT allows us to continue working on the body, but safely, and, in fact, more profoundly.**

There are three terms I would introduce now. The first was mentioned earlier. **Anisotropy** (Greek: *aniso* - unequal, unsymmetrical, a dissimilar condition, and *tropy* – turning towards, having an affinity for) which manifests as responding differently to the same external stimulus in different parts of the body. This phenomenon is important in our touch techniques as well as in the exercises we use in our therapy models and can be utilized through the properties of connective tissue. In other words, input to the system through touch or movement, varies according to the condition of the individual tissues. *Different patients respond differently – individually – to the same input.* **The patient's body "decides" how to utilize the information experienced through the touch or the movement. It is not so much what is being *transmitted* by the therapist's touch, but what the patient "decides" to receive.** In psychotherapy it has always been understood that the patient's past experiences produces present movement behaviors, thoughts and emotions so the physical phenomenon of anisotropy fits in nicely with a body/mind model. As an additional explanation as to how anisotropy works in the body we include ***hysteresis***, a concept from the physical sciences whereby the output of a system depends not only on its input, but also on its *history of past inputs*. This is because the history affects the value of an internal state. Applied to a psychotherapy model this is the understanding of past experiences affecting present behavior and that the therapist does not directly determine the patient's response to the therapeutic intervention.

Guimberteau's individuality?

The third term is ***thixotropy*** (Greek *thixis* – a touching, plus -*tropy*). *Thixotropy describes the quality of a gelatin, such as plasma/GS, to become more fluid when pressured or heated and more solid when at rest.* This is the plasticity of CT and more specifically of the GS. It is in constant re-organization, responding to both the local and systemic needs of the individual body. It reorganizes in response to positive and negative, internal and external as well as physical and psychic stimuli. As pointed out earlier, *CT can change its viscosity from a liquid to a gelatin to a solid and even to a crystalline state, whereby dehydrated collagen takes on the energetic properties of crystals.* Due to the plasticity of the CT, all these changes can be reversed at least up to a point. Older patients will respond slower and less than younger patients.

As a side comment, it should be appreciated that some of these unhealthy states, are in fact a "healthy" reaction to an unhealthy state and, as Reich emphasized, should not be seen in a pejorative sense; the patient is resting the therapy etc. . The organism is in stress, it has to respond to protect itself. Yet, these responses maybe situationally healthy, but overall detrimental to the organism. The Dunbar Syndrome case presented earlier is a typical example. The young girl lived in a frightening environment. She had to contract to protect herself, she had no choice. That it then produced a life-threatening disorder only indicates the limit of her response. The same happens from a purely physical cause. *If a body becomes out of balance due to an injury and there is no treatment applied soon after, the body will compensate by fibrous buildup. It has no other choice.*

The plasticity theme had a major update in 2003 with a two-part article Schleip (2003, I&II) wrote on fascial plasticity. The changes manual therapists and FA practitioners were feeling in the tissue of the patients were usually attributed to thixotropy. GS as a colloid state which responds to pressure and other forces by changing from a gel to a more liquid sol state. "This gel-to-sol transformation…has been positively confirmed to appear as a result of long-term mechanical stress applications to connective tissue." (Schleip, 2003, Part I, p.12) But

studies showed that the effects of the thixotropy phenomenon could not appear so quickly. Longer application of applied force is needed in order to result in "…permanent deformation of dense connective tissue." (Schleip, 2003, Part I, p. 12.) And these effects are only present while the force is applied returning within minutes to the original gel state when it is released. Then the question arises what is happening in the tissue that therapists are feeling in their hands and that patients are reporting? Common comments from patients in FA are: a melting quality, an opening, a warm flow, a liberation and "you are touching me now". Yet, because of the time element, it seems that these subjective experiences are not a result of thixotropy.

Another explanation has been the **piezoelectric effect** from pressure on the tissue. Because of CT's crystalline qualities *electrical currents can be created in the tissue when force is applied*. This is explained more in the "Touch as Treatment" section but I mention it now because this too has typically been mentioned as a possible explanation for the immediate plasticity change in tissue felt by both practitioner and patient. But Schleip again points out that this process also requires more time than is used in applied pressure during treatment. Both collagen fibers and GS changes do occur because of the piezoelectric effect, but…
" both life cycles appear to be too slow for immediate tissue changes that are significant enough to be palpated by the working practitioner." (Schleip, 2003, Part I, p. 12)
Additionally, the slower softer techniques, as used in FA for example, are not strong enough to create these immediate tissue responses.
I have mentioned earlier in describing the *hydrostatic pressure* created by fascial sheaths binding the body that the tissue changes felt sometimes immediately could possibly be a change in the hydrostatic pressure within that tissue. But the question then arises how could the pressure change without structural changes in the fascial sheaths.

Plasticity and the Central Nervous System

As mentioned earlier, fascia was considered relatively unimportant; inertness, "packing" etc.

Vascularization and innervation was estimated to be low. And if it was appreciated at all, functionally it was seen only for its mechanical properties. Following that, Schleip (2012) pointed out that by the 1990's fascia was seen to be playing an important role in proprioception. He then goes on to describe the importance of the *fascial network as "one of our richest sensory organs"* (Schleip, in Schleip, 2012, p. 77), the overall mass of which may be larger than the surface area of any organ of the body including the skin. Depending on how one calculates fascial sensory nerves and related sensory receptors - (Golgi, Ruffini endings and Pacini cells) *the quantity of fascial receptors might even be more than the retina, which was always considered the "richest sensory human organism."* (Schleip, in Schleip et al, 2012, p. 77) The understanding of its innervation has been updated to show that *fascial system has six times more sensory nerves than muscle tissue*. "…**for the sensorial relationship with our body — whether it consists of pure proprioception, nocioception or the more visceral interoception, fascia provides definitely our most important perceptional organ**." (Schleip, in Schleip et al, p. 77)

(After Schleip, 2017, p. 141)

Schleip (2003) then introduces the need for a "rapid self-regulatory system". Based on the organism's ability to perceive its interactions with the external environment. Plasticity is a way for it to adapt to changing situations within its environment.

It then seems logical that this ability of being more rapidly adaptable is mediated by or is at least connected to - a body system which is involved in the perceptions of our needs as well as of the environment. Traditionally this body system has been called the nervous system. (Schleip, 2003, p. 14)

For Schleip, the analogy of a nervous system as an old-fashioned telephone switchboard is outdated and has been replaced by current concepts in neurology that see the brain as a "liquid system" whereby, … "*fluid dynamics* of a multitude of liquid and even gaseous neurotransmitters have come to the forefront. **Transmission of impulses in our nervous system often happens via messenger substances that travel along neural pathways as well as through the blood, lymph, cerebrospinal fluid or ground substance."** (Schleip,

2003, Part I, p. 14) He advises the reader to **not view the nervous system as a hard-wired cable system, but as a "wet tropical jungle"; a self- regulatory field that is complex, always adapting throughout life.**

Without disagreeing with this model, what is difficult to understand is that all of these activities described above happen in ground substance in one way or another. Why, or how, is new information being passed through the body in order to reorganize and adapt without changes in the GS as Rolf suggested? (Rolf, 1977) Why or how is it that these transmissions of impulses via messenger substances now are flowing whereas earlier they were not? As I understand it, these are all information for the body. What has changed so that now a these messages can be sent? Additionally, as has been argued many life forms don't have nervous systems yet they manage to adapt to their internal and external environments. More on this later.

In staying with the fascial/CNS relationship, Schleip writes that Golgi receptors, a proprioceptive tension detecting sensor wrapped around tendinous collagen bundles, gives afferent nerve information about the tension state of the muscle. They are involved with the lengthening of the muscle, either stretching or contraction. Ninety percent of these receptors are located at the myotendinous junction; the interface between the muscle and the tendon of the muscle. Where the muscle attaches to the bone, through the tendons attachment, there is only 10%. But later research showed that "…passive stretching of a myofascial tissue does *not* stimulate the Golgi tendon receptors." (Schleip et al. 2003, p. 14) Yet there is still a possibility that the *Golgi receptors may be involved since 90% of them are in of myotendinous junctions and other attachments structures.* For example, there is evidence that they are also involved in fine proprioceptive, antigravity motor movements that are too quick for a transmission from brain to, for example, leg.

There are also three other *intrafascial* mechanoreceptors that are involved with the CNS: the Pacini corpuscles, the Paciniform corpuscles and the Ruffini organs. These are all found in

"dense proper connective tissue: i.e. in muscle fascia tendons, ligaments, and joint capsules." (Schleip, 2003, Part I, p. 15) Each responds differently to different types of applied force. **The Pacini and smaller Paciniform corpuscles respond to vibration and rapid change in pressure but not to constant unchanging pressure.** This is of particular interest to for **Points&Positions Touch Technique which employs a light, pulsing type of pressure**. *The Ruffini corpuscles respond to long term pressure and can be activated by slow and deep "melting quality", soft tissue techniques* which are also sometimes employed in FA. Schleip pointed out that stimulation of Ruffini corpuscles results in lowering sympathetic activity which supports the "…common clinical finding that slow deep tissue techniques tend to have a relaxing effect on local tissues as well as on the whole organism." (Schleip, 2003, Part I, p. 15)

Further evidence for CNS involvement in fascial manipulation is that greatest amount of sensory input to the CNS comes from myofascial tissue. According to Schleip, a typical muscle nerve will have three times more *sensory* fibers than motor and only 20% of these nerves are the well- known type I and II. **The other 80%, type III and IV, are what are called interstitial muscle receptors** (Schleip prefers interstitial myofascial tissue receptors. It's my suspicion that they were named as "muscle" receptors because of, as discussed earlier, the traditional bias that connective tissue is not important.) Type IV comprise 90% of this type of nerves; they are unmyelinated and they usually have their origin in free nerve endings. **As mechanoreceptors, they respond to mechanical tension and/or pressure and about half of them respond to light touch,** "…as light as *a painter's brush."* This is of interest to the emerging movement in the manual therapies to work with a softer touch and helps to explain some of the physical and emotional effects registered by patients as a result of the Points and Positions touch style.

Plasticity and the Autonomic Nervous System

The ANS is also involved through these receptors. "*Type III and IV receptors …have been*

shown to have autonomic functions, i.e. stimulation of their sensory endings leads to a change in heart rate, blood pressure, respiration etc." (Schleip, 2003, Part I p. 17) Using the model of Mitchell and Schmid, Schleip (Schleip, 2003) presented their "Intrafascial Circulation Loop" to show the relationship between tissue manipulation and the ANS.

Fascia is densely innervated by interstitial tissue receptors. The autonomic nervous system uses their input (plus that of some Ruffini endings) to regulate local fluid dynamics in terms of an altered blood pressure in local arterioles and capillaries plus in plasma extravasation [fluid leakage] and local tissue viscosity. This change might be felt by the hand of a sensitive practitioner. (Schleip, 2003, Part II, p.105)

Back to Ground Substance

In Part II of his article on plasticity, Schleip (Schleip, 2003, Part II) brings the theme of CNS and ANS involvement is fascial release together and returns to Rolf's model of gel to sol changes "…but this time with the inclusion of the central nervous system." (Schleip, 003, Part II, p. 105) Here is a working body/mind model. Schleip is exposing the inner workings of how the body and the nervous systems are intimately entwined. *Activation of the* ***interstitial receptors****, which offer most of the sensory input from myofascial tissue, changes the pressure gradient in fascial capillaries and the viscosity of the ground substance as Rolf suggested in 1977*. When the Ruffini corpuscles are stimulated there is a lowering of sympathetic activity. He also suggested that with an *increased renewal speed* in the GS the piezoelectric phenomena could now be understood to play a role in the immediate effects felt in the tissue by practitioners and patients.

If myofascial manipulation affects both local tissue blood supply as well as local tissue viscosity, it is quite conceivable that these tissue changes could be rapid and significant enough to be felt by the listening hand of sensitive practitioners. (Schleip, 2003, Part II, p. 105)