Fascia in Osteopathy

Implementation, Application & Tensegrity

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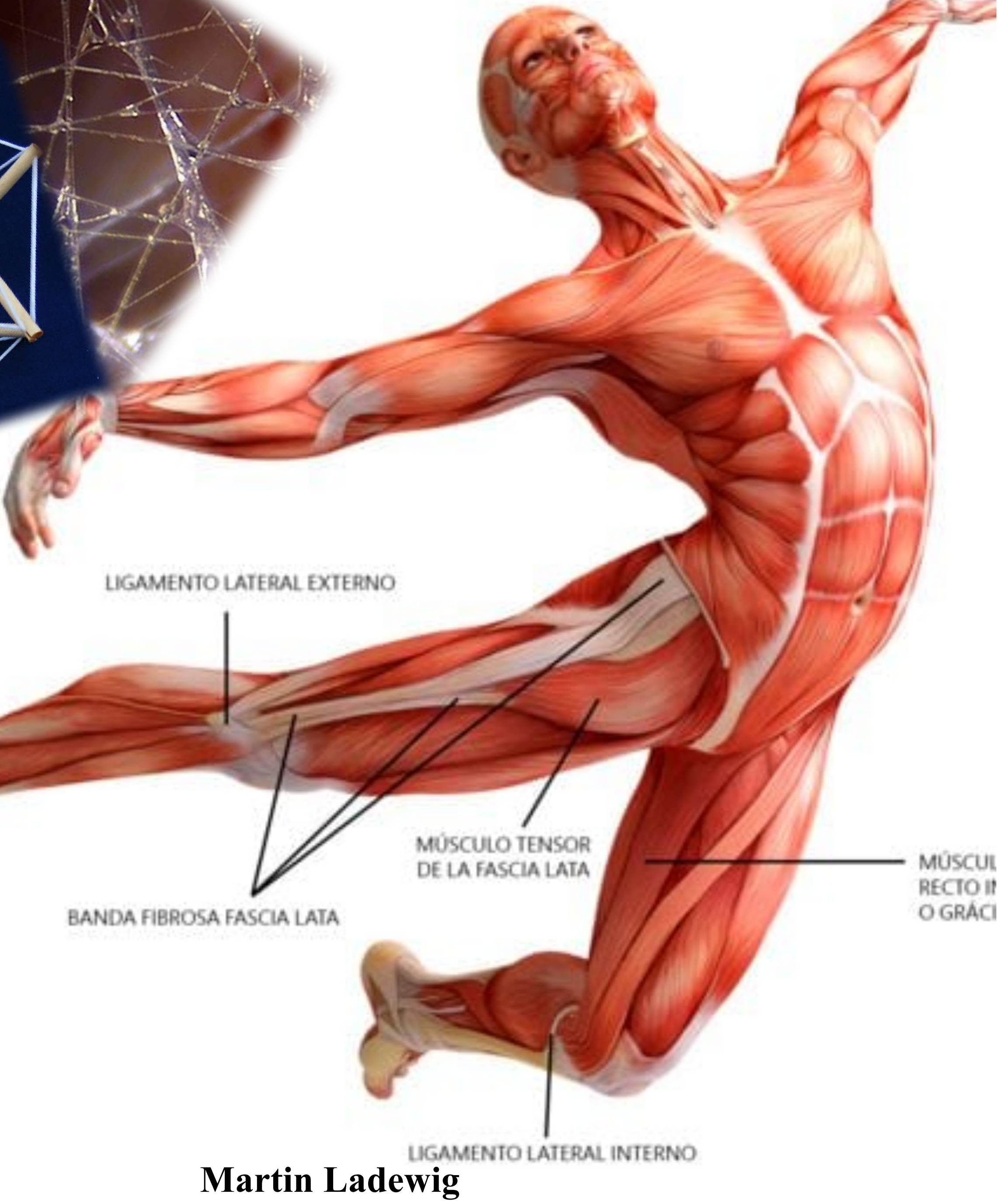

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Bachelor of Science in Osteopathy

Contents

Introduction/thesis:

In this project I will discuss and describe the fascial system anatomy, physiology, and its implementation and application in the Osteopathic field.
Furthermore, I will discuss the concept of tensegrity and its role in the osteopathic field. I will especially describe the tensegrity of the spine & dura and its connections with the cranium and pelvis.
I will discuss the myofascial lines of tension (Described by Tom Myers) especially the superficial back line will be discussed in detail because of its role in spine tensegrity.

What is fascia?

In basic fascia is connective tissue that unites all the aspects of the body. It surrounds our brain, nervous system, our organs, bones, ligaments, joints capsules and muscles.

The anatomy of fascia

The components of fascia from a cellular level are fibroblasts, mast cells, adipose cells, macrophages, leukocytes and plasma cells.

The fibrous elements of fascia consist of collagen, reticular and elastic fibers. The fascia of the of the human body consist of 3 basic elements:

- Collagen
- Elastic fibers
- Ground substance

Fibroblasts

Fibroblasts are the principle cell of connective tissue. They have morphological features such as discoid or fusiform shape with long cellular extensions. The fibroblasts are capable of a relatively high rate of synthesis of complex carbohydrates, collagen, elastin and reticular fibers and other macromolecules of the ground substance.

When stretching, pressure or tension is applied to fascia it stimulates the fibroblasts (noted by Gehlsen, Ganion and Helfst in 1999)
Studies have shown increased production of fibroblasts when mechanical pressure is applied (Helen Langevin 2004) which means mechanical force can influence the fibroblasts to modify their mechanical and physiological appearance throughout a person´s lifetime.

Mast Cells

These cells are involved in immune system activities and are contributors to a variety of inflammatory conditions in the joints, skin, other organs and the brain. There are 2 types of mast cells

- Mucosal mast cells
- Connective tissue mast cells

Mast cells secretes chemical mediators such as histamine and heparin. Mast cells contains receptors that bind immunoglobulin E (IgE) when an allergen binds to IgE it causes a chemical reaction which disrupt the cell wall and triggers a release of chemical mediators from the mast cells.

Adipose cells

There are 2 types of adipose tissues, White adipose tissue (WAT) & Brown adipose tissue (BAT). WAT accumulates and stores large amounts of lipids. BAT uses the stored lipids to generate heat, a process also known as thermogenesis.
Physiologically the adipose tissue protects the fascia from physical trauma and serves as thermal insulation.

Macrophages

There are 2 types of macrophages:

- Normal macrophages
- Inflammatory macrophages

Normal Macrophages are associated with the skin, connective tissue, lymph nodes, liver, spleen, lungs and bone marrow

Inflammatory Macrophages are associated with healing of a wound or autoimmune inflammation.

Macrophages can be fixed or motile (free). Some organs such as the spleen and lymph nodes consist of both fixed and free macrophages.
Connective tissue is comprised of fixed macrophages which are found in sheets of fascia within fibers of collagen and elastin.
Mechanical disruption or force placed on a sheath of fascia due to acute trauma or chronic damage will lead to an activation of the macrophages which release enzymes, collagenase & elastase, which will degrade collagen and elastin fibers to initiate the remodeling process and an inflammatory response.

Fascial fibers

There are 3 types of fibers found in fascia:

- Collagen fibers
- Reticular fibers
- Elastic fibers

Collagen fibers

There are 15 types of collagen molecules that have been discovered. The main types of collagen that are found in connective tissue are type I, II, III, V and XI. Type I is the most abundant. Tendons are made of type I collagen, predominantly, while all types of collagen can be found in the skin.

Table 1-1 Collagen Types in the Human Body

Collagen Type	Structure	Tissue Location/Distribution	Function
I	Fibril Forming	Connective tissue of skin, bone, tendon, ligaments, dentin, sclera, fascia, and organ capsules (accounts for 90% of body collagen)	Provides resistance to force, tension, and stretch
II	Fibril Forming	Cartilage (hyaline and elastic), notochord, intervertebral disc, vitreous humor of the eye	Provides resistance to pressure

This table shows a description of collagen fibers type I & II, type I dominates accounting for 90% of the collagen in the body.

Collagen fibers lies in 2 different planes:

- Unidirectional
- Multidirectional

Unidirectional

The fibers lie in in a single direction that corresponds to the force direction applied to the tissue. This is primarily found in ligaments whose role is mechanical

Multidirectional

This is seen where collagen fibers are arranged in multiple superficial planes. Examples of this is seen in:

- Aponeurosis
- Capsules of the kidney & liver
- Tendon sheaths
- The peritoneum
- Pleura & pericardia

Collagen is flexible and makes framework of great strength. In fascia, collagen makes the fascial tissue strong and gives the ability to guard against overextension

Collagen fibers processes other properties in addition to strength. They can resist traction and other mechanical forces and are able to stretch 5% of their original length. Collagen is insoluble in cold water but soluble in warm water, this gives collagen a gelatinous property.

Elastic fibers

Characterized by being long and rectilinear, they anastomose to each other and sometimes they attach to collagen as well. The interlacing fibers of the superficial fascia do not anastomose but are orientated in multiple layers to form a network. The superficial fascia as unit of loose connective tissue allows the skin and muscles to upon each other independently.

The relationship between collagen and elastin makes up the mechanical properties of the connective tissue. Elastin fibers lies parallel with an excess length of collagen fibers in areas where elasticity is required, such as arteries and skin.

The collageno-elastic complex in fascia

In all tissue, including fascia, the elastic fibers are woven together with the collagen. This is crucial in determining the mechanical properties of the fascia but also the way fascia responds to from outer and inner forces. Commonly the collagen fibers wrap around the elastic fibers and attaches in one common site. This connection between the 2 fibers is transverse which seemingly allows the collagen to return to its normal length when pressure or tension is applied to the fascia.

Studies have shown that this complex has different responses to forces depending on how much deformation of the tissue after force applied to that tissue.
If the fascia is stretched to 30% of the original length, the elastic fibers will stretch first followed by the collagen fibers. When this mechanical force stops, the collageno-elastic complex enables the tissue to return to its original length.
If the tissues are stretched more than 30% of their length, both the elastic fibers and the collagen fibers will stretch at the same time. If the tissue is stretched more a short period of time, the fascia will return to the original length. However, if the fibers remain stretch for a long period of time, the fibers will not return to the original length, but the surrounding fascial matrix will be affected

Ground substance

Have several primary functions. Contains a high proportion of water, which allows the function of diffusion of nutrients and other substances including:

- Gases
- Hormones
- White blood cells
- Antibodies
- Cellular waste

The high content of water also enables it to absorb and disperse shock throughout the body. The ground substance also has the function of keeping the connective tissues lubricated to allow easier sliding on one another.

Fascial divisions

We can characterize fascia in 3 divisions:

- Fascia superficialis
- Fascia profunda
- Deepest fascia

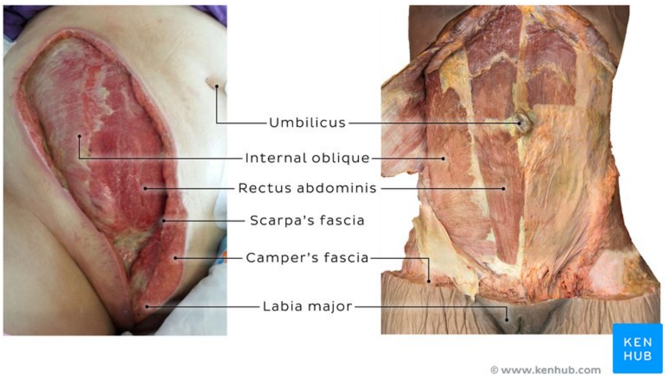
Fascia superficialis

The outer layer of connective tissue located beneath the dermis of the skin, sometimes also referred to as the subcutaneous tissue. It serves as a pathway for nerves and blood vessels, it also contains various quantities of adipose tissue.
This layer of fascia is more prominent on the posterior half of the body. The main function of this layer of fascia is protection and support. It anchors the skin to the underlying myofascial sheath while providing a cushion for protection.

Because of the variety of physiology of this layer of fascia, only 2 fasciae can be identified in the superficial fascia:

- Scarpa´s fascia (anterior trunk)
- Colle´s fascia (peritoneum)

In the extremities, both upper and lower it is very difficult to separate the superficial fascia



This picture illustrates the Scarpa´s fascia

The superficial fascia consists of several horizontal layers which contain various amounts of superficial fat deposits. An increased number of fat cells gives rise to cellulite. This is primarily seen in women or obese individuals.
There are 2 types of cellulite:

- Primary
- Secondary

Primary cellulite is normally seen in younger women.
Secondary cellulite usually starts to appear after the age 35 and may combined with primary cellulite. It is associated with aging, sun damage, dramatic weight loss & liposuction. It results in skin laxity because of the gravitational forces, this causes damage to the tissues which means weight loss is not very effective in reducing secondary cellulite.
Surgical correction is more effective.

The superficial fascia varies between the sexes primarily in the breast and pelvic areas. This allows the female breast to increase in size. In females the superficial fascia is not closely adhered to the pelvic musculature, which allows for easier and larger fat deposits in this area.
In males the superficial fascia is tightly attached to the pelvic musculature a few centimeters below the iliac crest.

Fascia profunda

Found just under the superficial fascia. It encapsulates muscles, both individual and bundles of muscles. This is the middle layer of the 3 layers of connective tissue. It consists of fat and a fibrous membrane. It often fuses with the periosteum of the bone protuberances such as:

- Linea nuchae superior
- Linea temporalis superior
- Arcus zygomaticus
- Margo inferior mandibulae
- Clavicula
- Sternum
- Processi spinosi of the vertebrae
- Protuberances of the peripheral joints

This fascia also encloses the glands and form sheaths for the nerves and vessels.

Deepest fascia

This fascia is situated within the dura of the cranial sacral system where it surrounds the central nervous system.
This is the inner most layer of fascia that is identified in our bodies. It surrounds and protects the brain and the spinal cord from trauma.
Dysfunction in these tissues may have significant and maybe widespread neurological effects.

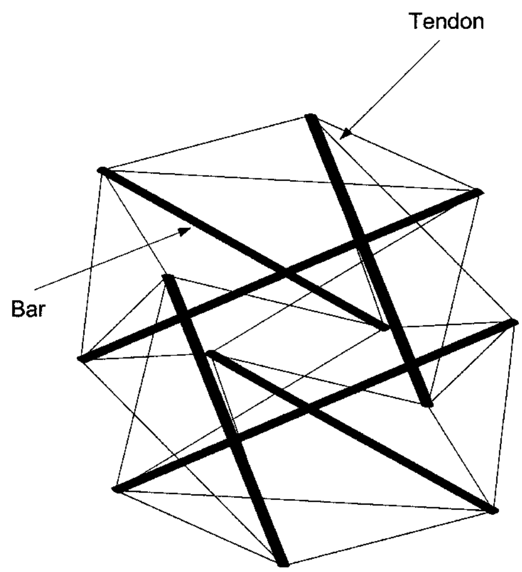
Tensegrity

The concept of tensegrity was first introduced in 1961by an architect named Richard Buckminster Fuller. The word "tensegrity" is the union of 2 words; tension & integrity. Tensegrity is the property some tissues or structures possess of maintaining their integrity as a result of continuous tensile integrity.

A tensegrity-based structure is composed by a continuous series of tension resistant components called tendons and a series of discontinued compression resistant elements called struts.

This is the only requirement of the tensegrity model: tension must be continuous, and compression must be localized.

Tensegrity models are independent of gravity; gravity dependent structures are not able to withstand applied tensile forces



Tensegrity structures are prestressed in that way that they require continuous transmission of internal tension to maintain stability.
They are composed by tension resistant structures that pull inward and compressive structures that pull outward.
Cells for example, are build, like a tensegrity model, so as to resist for the various external and internal forces acting upon them.

Tensegrity applied to the human body

In this model we will see the bones as the compression elements (struts) and the ligaments as the tension resistant elements. When looking at this model we should remember that the fascial system is continuous throughout the body and from this it is possible to see that it complies with the concept of tensegrity.
The body shows the presence of prestress, the muscles have a physiological resting tone which means that they always possess a slight tension. The ligaments of the spine have been shown to be held in a degree of tension as well and from this it can be conceived that other ligaments possess the same features and behave in a similar way.

The stability of a tensegrity model is generally less stiff and more flexible than the continuous compression structures. If we load the structure in one corner, there will be a pull in the entire structure. Load it too much the structure will eventually break, and not necessarily where the load is strongest. Because the structure distributes strain throughout the lines of tension, the structure may give and break at a weak point.
We can use the same analysis with an injury to the body. At any given site a long-term injury can influence the body in a similar way, the pain or symptoms may arise from a "weak" point somewhere else in the body. The injury happens where it does because of inherent weakness or previous injury. Discovering these pathways and easing chronic strain at some point and remove the painful portion the body will return to the natural part of restoring systemic ease and prevent future injury.

Tensegrity of the vertebral column

The vertebral column consists of 24 moveable vertebrae and 23 intervertebral discs. Furthermore, the sacrum (5) and coccyx (4) contribute with 9 fused vertebrae. These vertebrae are held in place by various ligaments and muscles.
Looking at the spine from a tensegrity-model based view, the vertebrae will be the compression struts and the ligaments will act as the tension elements. This enables the spine to maintain its curvy shape without any or little muscle activity. It will also allow the spine to change shape to adapt to pressure or forces applied from outside and inside the spine, when the force or pressure is released the spine will return to its original shape.
We will take a closer look into these structures that contribute to the tensegrity of the spine.

Ligaments of the vertebral column.

There are various ligaments in the vertebral column, some are short, and some are longitudinal.
These ligaments include:

- The anterior longitudinal ligament

- The posterior longitudinal ligament
- The intertransverse ligaments
- The interspinous ligaments
- The supraspinous ligament
- Ligamentum flavum
- The Nuchae ligament

These ligaments hold the vertebrae in place and allows the spine to maintain its shape and mobility. I will describe these ligaments in detail below.

The anterior longitudinal ligament

This ligament runs on the anterior aspect of the vertebral column.
It attaches on the cranial base, on the vertebral bodies and the intervertebral discs and terminates at the 1st sacral vertebra.
It is narrow at the top but ends up being broad at the lumbar region of the spine. The function of this ligament is to prevent the vertebrae from sliding forward and to help the vertebral column return to the neutral position after extension of the spine.

The posterior longitudinal ligament

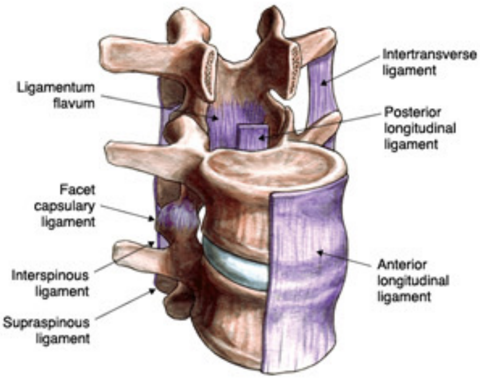
This ligament runs in canalis vertebralis. It runs from the cranial base and all the way down and attaches on the superior aspect of the canalis sacralis.
It attaches on the inferior and superior base of the posterior aspect of the vertebral bodies and on the intervertebral discs.
The function is to prevent the vertebrae from sliding backwards and to help the spine return to the neutral position after flexion of the spine.

The intertransverse ligaments

Runs between the transverse spinous processes of the vertebrae. They are strongest in the lumbar region of the spine. These ligaments help the spine return to the neutral position.

The interspinous ligaments

Lies in between the spinous processes. These ligaments are also strongest in the lumbar region. As the intertransverse ligaments they help to bring the spine back in the neutral position

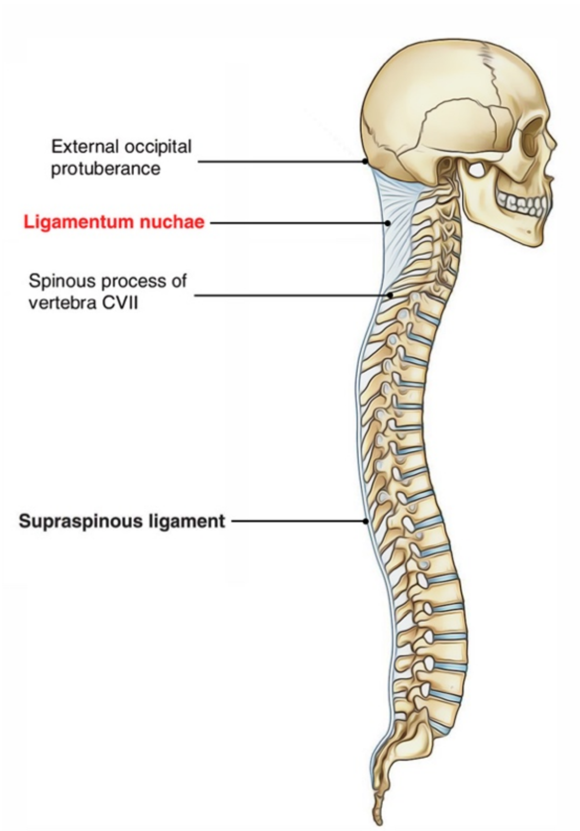


Ligamentum flavum

Has its name because of the yellow appearance. Lies on the inside of the spinal canal where it attaches to the vertebral arch. It has great elastic capacities and helps the spine return to the neutral position after movements. This is done in cooperation with the other ligaments of the spine.

The nuchae ligament & supraspinous ligaments

The nuchae ligament is a thin membranous structure. It runs from the extern protuberance of the occiput and attaches on the spinous processes of the cervical spine. It continues down the spinous processes as the supraspinous ligament and terminates at the cornu sacralis. These ligaments support the head and the cervical spine and helps the spine return to the neutral position after flexion.

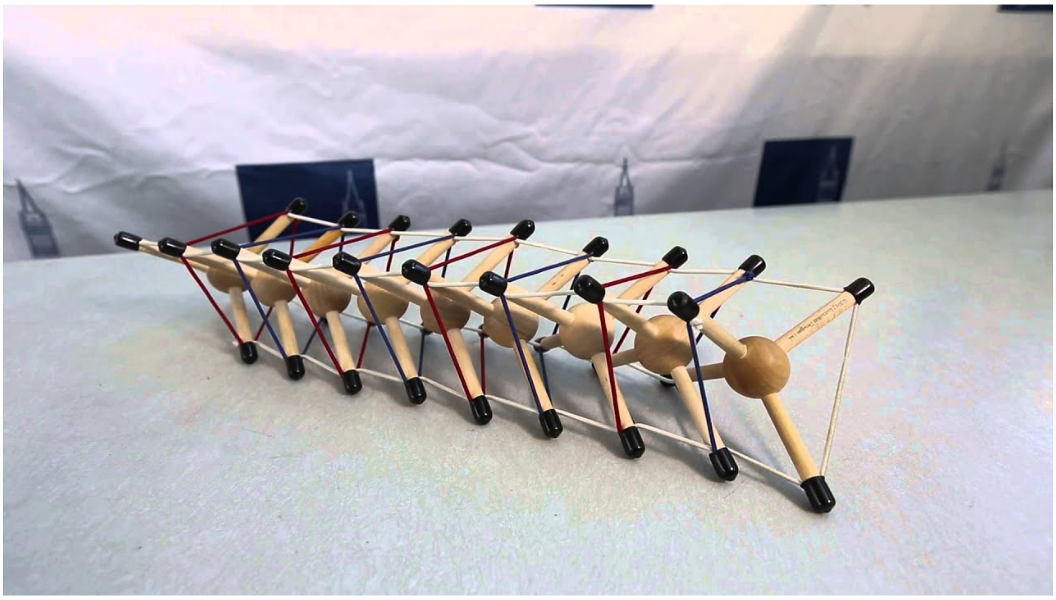


In addition, there are some muscles that are in close anatomical relation to the ligaments mentioned above. These include:

- Mm. rotatores
- Mm. multifidi
- Mm. semispinalis

This muscular system attaches between the spinous processes and the transverse processes. They possess the same abilities as the ligaments of the spine, but because they are muscles, they can actively contribute to the stability and mobility of the spine.

These muscles are short with the Mm. rotatores being the shortest, it runs between 2 adjacent vertebrae.
The multifidi muscles overlap 2-3 vertebrae before attaching on a spinous process. Last but not least the semispinalis muscles overlap up to 7 vertebrae before attaching, these are located in the thoracic and cervical spine.



This model illustrates the spinal tensegrity. It makes it easier to imagine how one dysfunctional segment in spine can have an effect on the whole structure.

As we can see the transverse spinal muscles creates a triangular shape, each triangular segment is linked to another segment through the muscles and ligaments.
Once we see this shape, we can begin to imagine how a distortion of a triangle from a muscle spasm on one side can cause an uneven pull on multiple vertebrae. This could manifest what the "old" osteopaths called a "lesion" and what chiropractors called "subluxation".

A positional shift of a vertebral motion segment is simply a loss of the tensegrity of the transverse-spinal triangles in this model.

Treating the "tension" elements of the spine including muscles, tendons and fascia via therapy and exercise is an important compliment to facet manipulation in order to allow for the global structure of the spine to remain stable.

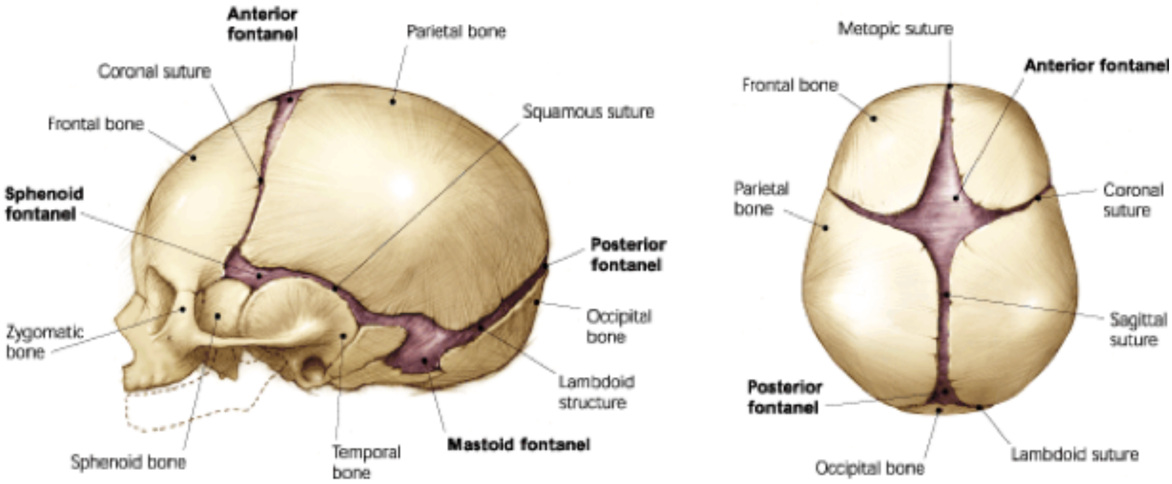
"In bio-tensegrity, micro affects macro, local affects global!" (Dr. S. Levin)

Within our vertebral column lies the spinal cord, medulla spinalis, this structure is surrounded and protected by 3 layers of fascial membranes – the meninges. The outer meninge, the dura mater, is the toughest of the three.
The dura is directly attached to 7 bones in the spine and cranial vault, from caudal to cephalad these bones include:

- The sacrum

- C2
- C1
- The occiput
- The ethmoid
- The sphenoid
- The frontal bone

The cranial vault consists of the frontal, the parietals, the upper part of the occiput, temporals and the sphenoid. These bones are connected through sutures which allows the brain to grow during the embryological stage of life. These sutures persist long after the brain is fully developed (at the age of 7) at least 20 years after this and even after this period there are considerable variations in the pattern and the timing of sutural fusion throughout the life of the human adult.



This picture illustrates the sutures of the skull in a newborn.

The dura is suspended from each vertebra by ligaments including the ligamentum flavum. This creates another system of tensegrity where the 7 bones mentioned above are the compression elements and the ligaments and the dura mater are the suspension elements.

This system of tensegrity in the cranium and dural tube, allows the cranium to widen and retract during the Primary Respiratory Mechanism (PRM) and it allows the sacrum to nutate/counter-nutate between the 2 ilia. In other words, the cranio-sacral structure changes shape and returns to its original position.

Because of dura´s attachment to every single vertebra via the ligamentum flavum, dysfunctions in this system will have a direct effect on the vertebral column, the skull and the PRM as well and vice versa.

The Lines of forces

We can look at the body, and especially the spine, from both a purely mechanical and myofascial point of view. Some of the early work from a mechanical point of view, was done by John Martin Littlejohn (1865-1947). J.M. Littlejohn was a student of Dr. Andrew Taylor Still, the founder of Osteopathy.
Littlejohn described 4 lines of forces in the spine:

- The anteroposterior line
- The posteroanterior line
- The anterior central line
- The posterior central line

In this paper I will focus on the fascial connection, as that is my topic.

Myofascial lines of forces

As described earlier in this paper fascia or connective tissue is a continuous structure throughout the body, however certain lines of tension connect differently and affects the body through motion and stability.
Depending on the author, there are 7 lines of tension or force described in different literature. I will briefly discus them all, but with special attention on the superficial back line, as it links directly to the topics discussed earlier in his paper. The 7 lines of tension include:

1. The superficial back line.
2. The superficial front line.
3. The lateral line.
4. The spiral line.
5. The functional lines.
6. The arm lines.
7. The deep front line.

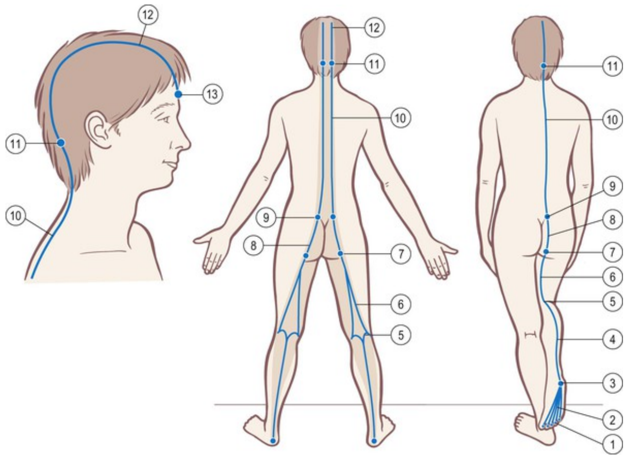
The superficial back line

This line of tension/force is protecting and connecting the entire posterior aspect of the body, the line is split in 2 pieces – from the toes to the knees & from the knees to the eyebrows. When the knees are extended as when we are standing this line is 1 continuous line of integrated fascia.

The overall function of this line is supporting the body in the upright position – preventing the body´s tendency to flex forward like for example the fetal position. The upright position has high demands on our postural muscles, there is a high demand for the endurance of the muscle fibers. Furthermore, it requires strong and heavy sheaths in the fascial portion of the line as in the Achilles tendon, hamstrings, sacro-tuberous ligament, thoracolumbar fascia.

The superficial back line primarily mediates posture and movement in the sagittal plane, either by limiting forward movement or when malfunctioning it maintains or exaggerates excessive backward movement.

There are 2 superficial back lines, one on the left and one on the right, imbalances between the 2 should be observed and corrected along with the observation of bilateral patterns of restriction along this line.



Common postural compensation patterns of the superficial back line include:

- Limitation of ankle dorsi flexion
- Hyper extension of the knees
- Shortness of the hamstrings
- Anterior shift of the pelvis
- Nutation of the sacrum
- Upper cervical hyperextension due to suboccipital limitation

From toes to heel [1,2,3]

The originating station of this line of myofascia is on the underside of the distal phalanges of the toes. It includes the plantar fascia, the tendons and muscles of the short toe flexors. The 5 band of fascia blends together into one aponeurosis – the plantar fascia which attaches on the antero-inferior aspect of the calcaneus bone. These fascia acts as bowstrings to the longitudinal arch of the foot, this also helps the 1st and 5th metatarsal base to have a proper relationship.

From heel to knee [3,4,5]

The fascia does not just attach on the heel bone and stops there. Actually, it continues as a part of the collagenous tissue covering the calcaneus – the periosteum, this tissue surrounds the bones as "plastic" wrapping. If we think this way, we can easily imagine that the plantar fascia is continuous with everything else that attaches to that periosteum. The Achilles tendon has to withstand a high load of pressure, because of this it is not only attached to the periosteum but to the collagenous network of the heel bone itself.
Three myofascial structures blend into the Achilles tendon, the soleus muscle from the profund part, the gastrocnemius muscle from the superficial side and the little plantaris muscle in the middle. The gastrocnemius attaches superiorly on the posterior side of the 2 femoral condyles where it overlaps with the attachments of the hamstrings.

From knee to hip [5,6,7]

When the knees are straight, we can continue up the myofascial continuity of the hamstrings which attaches to the ischial tuberosity. The hamstrings consist of 3 muscles:

- The semimembranosus muscle.
- The semitendinosus muscle.
- The biceps femoris muscle

The semimembranosus and semitendinosus muscles make up the medial part of the hamstrings and the biceps femoris makes the lateral part. The hamstrings as group all affect the both the knee and hip joints.

From hip to sacrum [7,8]

If we think of muscles alone, it is hard to see the connection from the hip to the sacrum. But if we look at the sacro-tuberous ligament, the inferior part of this ligament has a continuous connection with the hamstrings. In fact, the biceps femoris muscle can be separated by dissection and traced to the to the sacrum. It is believed that this connection to sacrum probably is degenerated muscle fibers.

From sacrum to occiput [8,9,10,11]

From the superior part of the sacro-tuberous ligament, the erector spinae muscles arise from the sacral layers of this fascia. The erector spinae muscles span from the sacrum to the occiput, with the longissimus and iliocostalis muscles covering the deeper layer of muscles, the semispinalis and multifidi muscles. The even deepest layer muscles – the tranversospinalis group provides the shortest "one joint" muscles. The erector spinae muscle is furthermore imbedded in the thoracolumbar fascia.
The thoracolumbar fascia is a multilayered sheath of fascia with a superficial and profund part which covers the entire spine from the sacrum to the occiput.

From occiput to the supraorbital ridge [11,12,13]

From the ridge of the occiput the SBL continues up and over the occiput because the layers blend together with the galea aponeurosis, also called the scalp fascia. The SBL terminates, with a strong attachment at the supraorbital ridge just above the eye socket.

The superficial front line

This line of fascial tension connects the entire anterior surface of the body from the top of the feet to the side of the skull. This line also runs in 2 pieces, from toes to the pelvis & from the pelvis to the head. When the hip is extended as in the standing position, this line functions as one continuous line of integrated myofascial.

The function of this line is to balance the superior back line and to provide tensile support from the top to lift the parts of the skeleton which are extended forward from the gravity line – the pubis, the rib cage and face. Myofascial tension of the SFL maintains the postural extension of the knees. Furthermore, the SFL protects the abdominal viscera.

The postural sagittal balance of the body is primarily maintained through the SFL & SBL by either an easy or tense relationship between these 2 lines.

The overall movement function of this line is to create flexion of the trunk and hips, extension of the knees & dorsi flexion of the feet.

When we create sudden and strong flexion movements at the joints of this line, it requires a higher proportion of “fast twitch” muscle fibers of the muscles in this connection.
Common postural compensation patterns of the superior front line include:

- Limitation of plantarflexion of the ankle
- Hyperextension of the knee
- Anterior pelvic tilt & shift
- Restriction of anterior rib cage and breathing pattern
- Forward head posture

The lateral line

This line of fascial tension runs on either side of the body. It runs from the medial and lateral mid-point of the foot and continues up the lateral aspect of the leg and thigh. It passes along the trunk in a “shoelace” pattern under the shoulder and continues to the skull and terminates at the ear region.

The postural function of the lateral line is to balance front and back. Bilaterally it balances right and left. Another function of this line is to mediate forces with some of the lines of tension including:

- Superior back line
- Superior front line
- The arm lines
- The spiral line

The lateral line fixes the trunk and legs in a coordinated manner during any activity with the arms.
The lateral line participates in lateral flexion or side bending of the body and trunk, abduction of the hips & eversion of the feet.

It also functions as a “brake” for lateral and rotation movements of the trunk

The lateral line is often essential in mediating left side/right side imbalances and should be assessed and addressed early in a global treatment plan.

Common postural compensation patterns of the lateral line include:

- Ankle pronation or supination
- Limitation in dorsiflexion of the ankle
- Genu varus/valgus
- Restriction in abduction
- Lumbar side bend or compression
- Rib cage shift on the pelvis
- Shorter depth between sternum and sacrum
- Shoulder restriction due to over involvement with head stability

The spiral line

This line of tension "loops" around the body in a double helix. It runs from each side of the skull, running to the opposite shoulder, then it runs around the ribs where it crosses the front of the body at the level of the umbilicus to the hip. From the hip it runs down the anterolateral aspect of the thigh and shin passing under the foot and runs up the back and outside of the leg passing the ischial tuberosity and into the erector spinae fascia, from where it continues al the way the skull where it originated.

The postural function of this line is to wrap around the body in a "double" spiral that helps maintain balance across all planes. It also helps with determining efficient knee-tracking during walking due to the connection with the foot arches. Furthermore, it has myofascial connection with several of the other lines, SBL, SFL, LL.

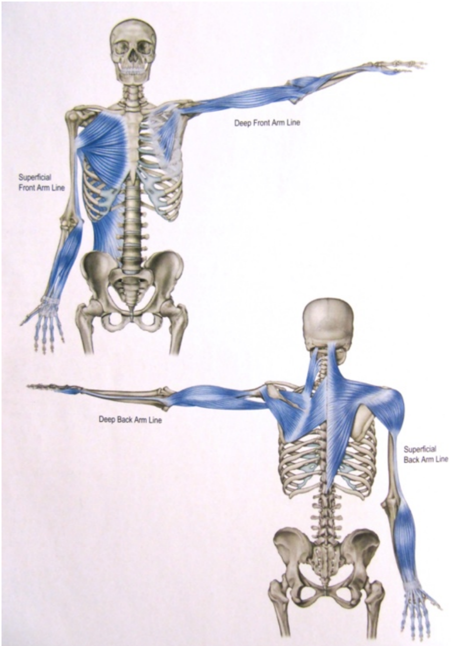
During movement the function of the spiral line is to create and mediate spirals and rotations in the body. When doing eccentric and isometric contraction the spiral line steadies the trunk and leg, keeping it from folding into rotational collapse.

Common postural compensation patterns of the spiral line include:

- Pronation/supination of the ankle
- Rotation of the knee
- Rotation of the pelvis
- Rib rotation on the pelvis
- Lift and anterior rotation of one shoulder
- Shift, tilt and rotation of the head

The arm lines

These myofascial lines are divided in 4 distinct lines. I will not go into details but only briefly describe these lines and their function.

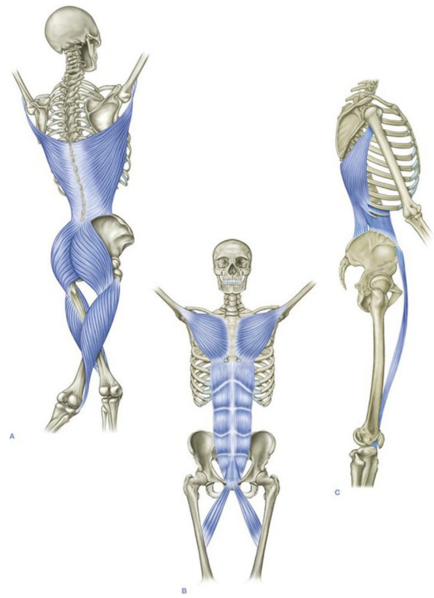


The back lines run from trapezius through the deltoid along the triceps to the extensor muscles of the wrist and fingers.
The front lines run from pectoralis major through the biceps to the flexor muscles of the wrist and fingers.

Because the arms are suspended from the body, they are not a part of the structural "columns" as such. But given their weight and their link to everyday activities, such as driving or computer life, the arms does have a postural function. Strain from the elbow affects the midback, and shoulder dysfunction can have effect on the ribs, neck, breathing pattern etc.

During daily activities our arms and hands are in close relation with our eyes to perform these actions.
The arm lines connect with the lateral, spiral and functional lines.

The functional lines



There are 2 functional lines, the back functional line and the front functional lines. These lines extend the arm lines across the trunk towards the opposite pelvis and leg, or the leg across the pelvis towards the opposite shoulder and rib cage. These lines are called functional lines because they don´t contribute to the postural balance as the other lines do. These lines come into play during sport activities where 1 appendicular complex is stabilized, counter balanced or powered by its contralateral complement.

They involve superficial muscles, mostly, they are used in day-to-day activities where the limbs are moved across the midline, this means that these lines rarely contribute with stiffness or fascial shortness to maintain posture. Once the other myofascial lines have been balanced, the functional lines often fall into place without presenting with further problems.
The functional lines enable us to give extra power and better precision of the movements of the limbs. The lines appear as spirals, so they could be considered as appendicular lines of the spiral line or as trunk extensions of the arm lines.

The deep front line

This line of tension lies in between the left and right lateral lines in the coronal plane & between the superficial front line and superficial back line in the sagittal plane. It is surrounded by the spiral line and the functional lines.
This line has to be considered as 3-dimensional rather than a line of tension, because this line occupies space compared with the other lines.
This line starts on the underside of the foot running up the leg and thigh. It passes the hip joint, pelvis and lumbar spine. It also passes the iliopsoas muscles and the diaphragm.

From the diaphragm it runs through the rib cage and thoracic cavity before terminating at the underside of the neurocranium and the viscero-cranium.
Through the pelvis this line has an intimate relationship with the hip joint and has relations to the wave of breathing.

In the trunk the deep front line lies along the autonomic ganglia, which innervates our ventral viscera. In the neck it counterbalances both the SFL and SBL.

The deep front line plays a major role in the support system of the body including:

- Lifting the inner arch of the foot
- Stabilizing each segment of the legs
- Support to the lumbar spine from the anterior aspect
- Stabilization of the chest, while allowing the expansion and relaxation of the breathing mechanism
- Balance of the neck, which is quite fragile as it carries the weight of the head

Lack of support, balance and proper tonus in this line will produce overall shortening of in the body and will encourage collapse ion the pelvic and lumbar region.

Conclusion

From writing this paper we know that the body has the ability to adapt and compensate from internal and external stimuli. The connective tissue allows the body to compensate and then return to the original position, all this because of the fascial connections and the tensegrity system.
We, as manual osteopaths, can apply these systems of tensegrity and myofascial lines of tension in our everyday practice. These systems can easily be implemented in the way we examine and treat our patients. In my opinion applying this in my daily practice, it presents a greater understanding, both for me but also for the patients, because I am able to give a better explanation regarding their complaints and pain patterns.
Furthermore, it gives a greater knowledge on how the body is able to compensate throughout the entire whole of the bodily structure.
Knowing the basic structure of the connective tissue, gives a better understanding on how chronic dysfunctions or imbalances one place in the body, can have an effect on a whole other point or structure somewhere else, and maybe this point is in another region of the body.

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