



Hypermobility 113

Fascia

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Who Am I?

- Professor Emeritus, Physical Therapy, Clarkson University.
- Staff PT, St. Lawrence Health System, Potsdam NY.
 - Clinical specialties: hypermobility, chronic pain, fibromyalgia, headaches, temporomandibular disorders
- Facilitator of the North America Allied Health Professionals ECHO
- Member of:
 - The Allied Health Working Group of the International Consortium of Ehlers-Danlos Syndromes and Hypermobility Spectrum Disorders
 - The National Academy of Sciences, Engineering and Medicine Committee on Selected Heritable Connective Tissue Disorders and Disability.
- Author of "Chronic Pain" chapter in *Physical Rehabilitation* textbook for PT students
- Lrussek@Clarkson.edu
- <https://webpace.clarkson.edu/~lrussek/>
- I do free weekly Zoom lectures for people with HSD (see website)

**I do not have any
conflicts of interest to report**

Hypermobility Lecture Series Schedule

- HSD 101: Basics of HSD/hEDS and self-care
- HSD 102: POTS and POTS self-care, basics of MCAS
- HSD 103: Pain management in HSD/hEDS
- HSD 104: Safe exercise selection and progression with HSD/hEDS
- HSD 105: Posture and joint protection
- HSD 106: Gut issues in HSD/hEDS, POTS, MCAS
- HSD 107: Fatigue in HSD/hEDS and POTS
- HSD 108: Headaches, migraines, & TMJ pain associated with HSD, POTS and MCAS
- HSD 109: Breathing disorders in HSD
- HSD 110: Lumbar instability
- HSD 111: Conservative management of cervical instability
- HSD 112: The Vagus Nerve
- HSD 113: The role of fascia

I will refer to these if you want more info



Russek: HSD113 - Fascia



Relevant Handouts Available



I will refer to these if you want more info

- <https://webpace.clarkson.edu/~lrussek/research.html>

• Self-Care Strategies

- [Breathing](#). Breathing incorrectly can increase pain sensitivity, headaches, jaw pain, and more.
- [Heart-rate variability biofeedback](#). Biofeedback to increase activation of your parasympathetic nervous system can help quiet sensitive nerves and decrease pain.
- [Sleep Hygiene and Positioning](#). Sleep posture and sleep hygiene strategies.
- [Sleep Checklist](#). Sleep is critical to good health. This checklist of sleep promoting strategies can make sure you don't overlook any options.

• Pain Management

- [Pain self-care plan](#). Create a pain self-care plan to improve your pain management.
- [Pain flare management plan - PDF version](#). Create a flare management plan so you know what works when you have a flare.
- [Free chronic pain management apps for teens](#)
- [Curable chronic pain management app](#). Cognitive behavioral approaches to pain management. Contact Dr. Russek if you are interested in 6 weeks free access: lrussek@clarkson.edu



Disclaimers

The information in this presentation is for general purposes, only, and may or may not apply to your situation.

Check with your health care provider before starting any new treatment approach to ensure that it is appropriate and safe for YOU. I cannot diagnose or make specific treatment recommendations in this lecture.

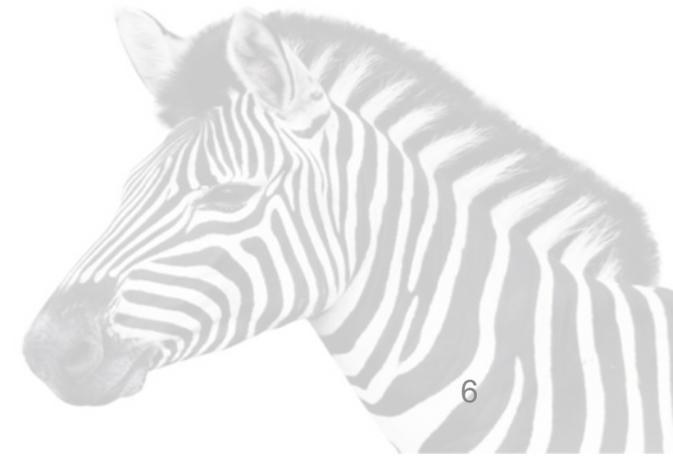
Our understanding of fascia is rapidly evolving. Some information in this presentation includes hypotheses, Not yet demonstrated by research



Objectives

By the end of this session, participants should be able to:

1. List locations and types of fascia in the body
2. Describe the functions of fascia
3. Relate the functions of fascia to structure
4. Describe how we might be able to improve the health and function of fascia



Why is Fascia Important in HSD?

- Fascia is a type of connective tissue, and may be abnormal in patients with HSD
- Fascia is found almost everywhere in the body
- If fascia is weaker in HSD, it could make many structures in the body more vulnerable to damage
- Fascial tension can make you feel 'stiff' or 'tight' even if you are hypermobile
- Fascia appears to be thicker in people with HSD
- Fascial adhesions might place abnormal stress on loose joints
- Tight fascial bands might compress/damage structures



Might Fascia be Important in MCAS?

- Fascial is an organ that has normal physiological processes
 - Transports fluids, nutrients, chemical signals through the body
- Fascia normally provides a pathway to flush toxins and inflammatory chemicals out of the body
 - If this function is not operating properly, there may be a build-up of inflammatory chemicals causing diffuse chronic pain and adhesions
 - Neurogenic inflammation (reverse firing of pain-sensitive nerves) allows a sensitive nervous system to cause inflammation in the fascia; this inflammation would be diffuse as inflammatory chemicals flow through fascia
- Inflammation decreases the tissue mobility/sliding function of fascia
(Wang, 2021)

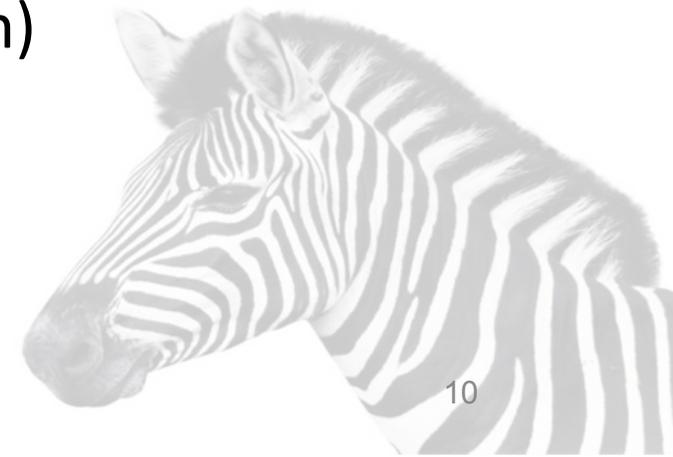
Might Fascia be Important in POTS?

- Much of the extracellular fluid in our body is in fascia
 - If these fluids are not able to flow normally, fluid may build up in places it shouldn't, leading to swelling in hands and feet, and POTS reactions
- Autonomic nerves travel through fascia and contain fascia
 - Adhesions in these nerves may alter function and POTS
 - Video showing how manual therapy to these autonomic nerve bundles can alter heart rate in a person with POTS:
<https://counterstrain.com/conditions/pots/>
- The autonomic nervous system controls contraction of fascia
 - Dysautonomia can cause fascial tension or tightness



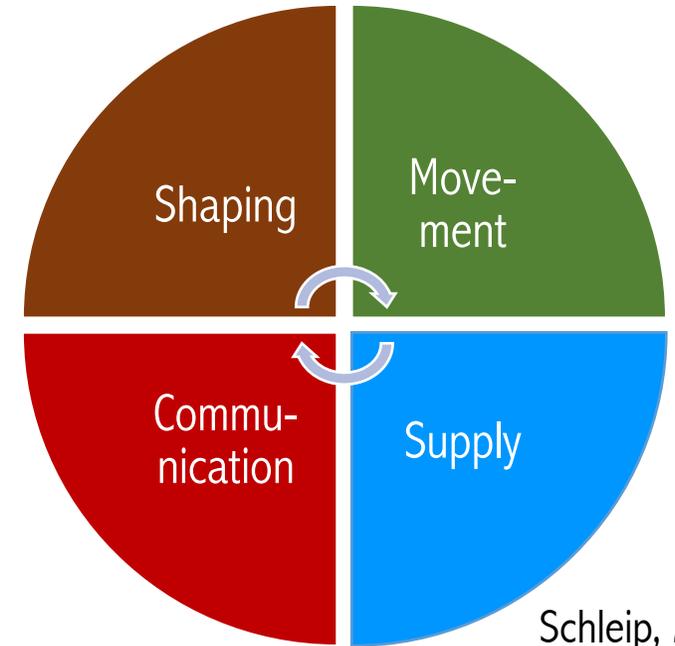
Where is Fascia Found?

- Most connective tissue is considered fascia
- Fascial sheets (e.g., thoracolumbar), tendons, ligaments
- Loose connective tissue (e.g., subcutaneous)
- Internal and external wrapping of muscles (e.g., epimysium)
- Internal and external wrapping of nerve (e.g., endoneurium)
- Spinal cord and brain wrapping (dura and meninges)
- External wrapping of bone (periosteum)
- Wrapping around and connecting organs (e.g., pericardium)
- Wrapping around blood vessels
- Scar tissue



Functions of Fascia

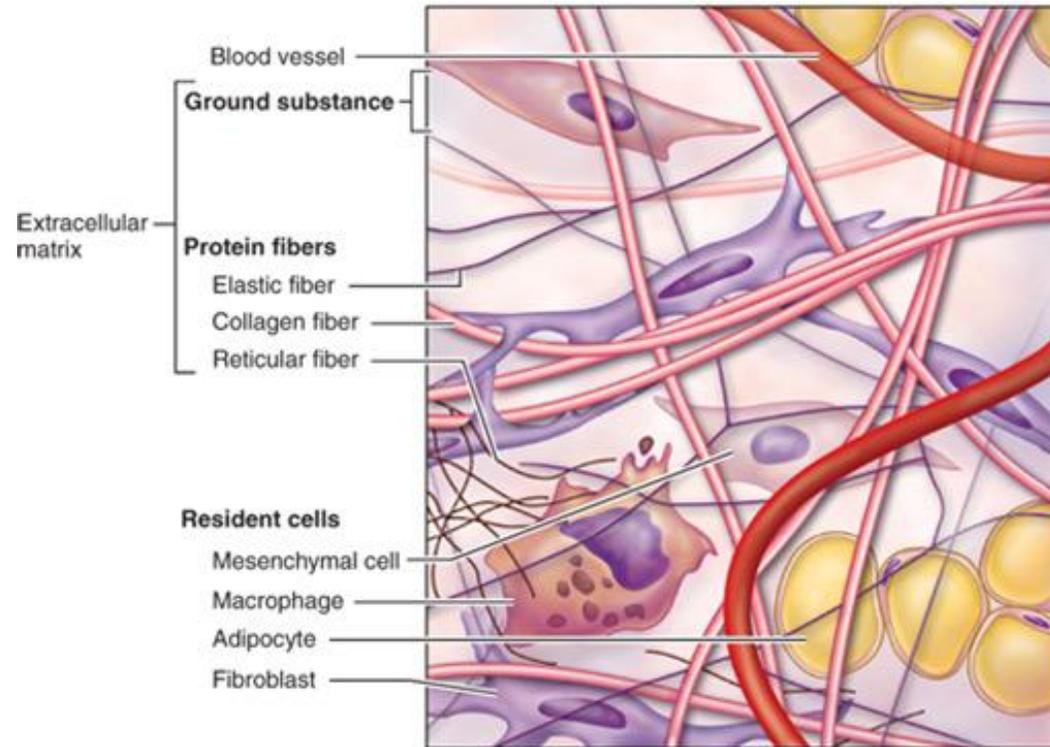
1. Protects and shapes structures enveloped
2. Increases stability of structures
3. Distributes tension among tissues of the body
 - Transfers forces among muscles & skeletal structures
 - Contraction of fascia alters tissue stiffness
4. Allows movement between tissues: lubrication
 - Including skin, muscles, nerves, blood vessels, organs...
5. Allows cellular communication to transmit information throughout the body
 - Biochemical and piezoelectric
6. Provides sensory input, including proprioception, interoception, and nociception
7. May contribute to mood & psychological state through interoception
8. Transports fluids and nutrients
 - Via lymphatic and blood vessels that travel through fascia
 - Also within extracellular fluids, as a third part of the circulatory system
 - May control blood flow through contracting/relaxing blood vessels



Schleip, 2017;
Bordoni, 2022

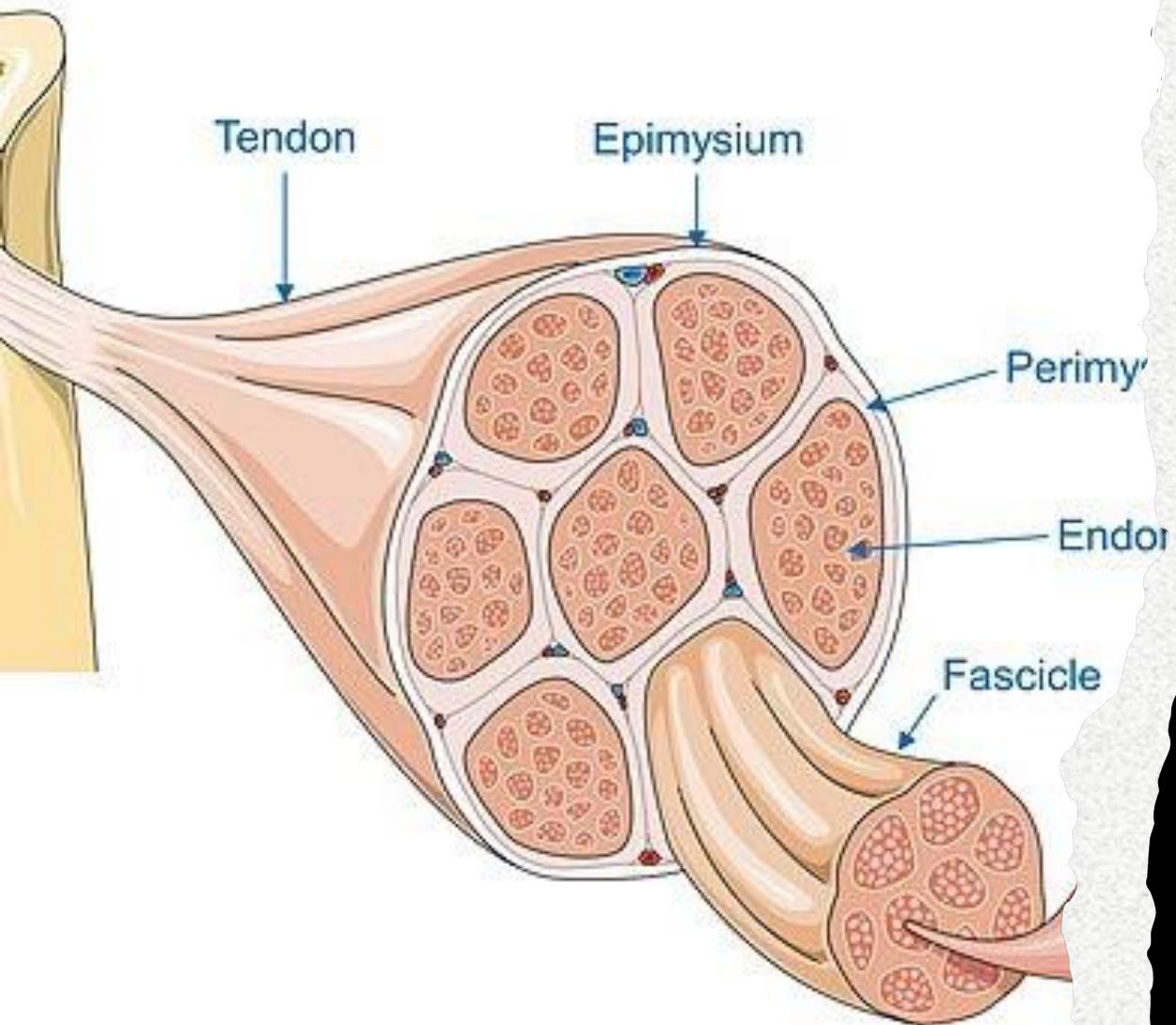


Fascia/Connective Tissue Structure



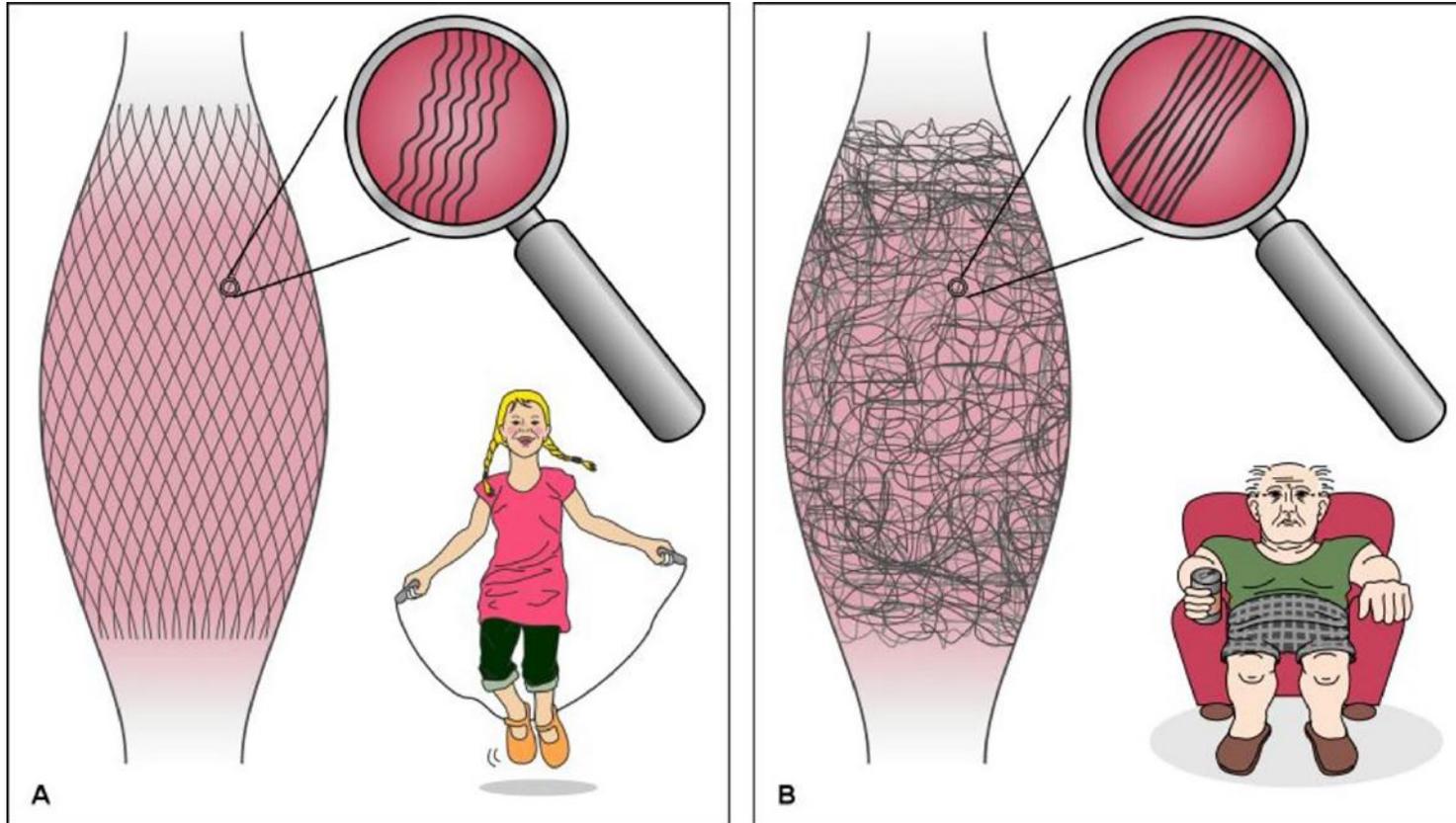
Source: Anthony L. Mescher: Junqueira's Basic Histology, 14th Edition.
www.accessmedicine.com
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- Connective tissue is mostly extracellular material
 - It has fewer cells than many other tissues
 - Collagen, elastin and ground substance often make the majority of the extracellular material
- Fascia includes both solid and liquid components
 - Different types of fascia have different proportions of solid and liquid
- Movement keeps fascia fluid



Fascial Shaping

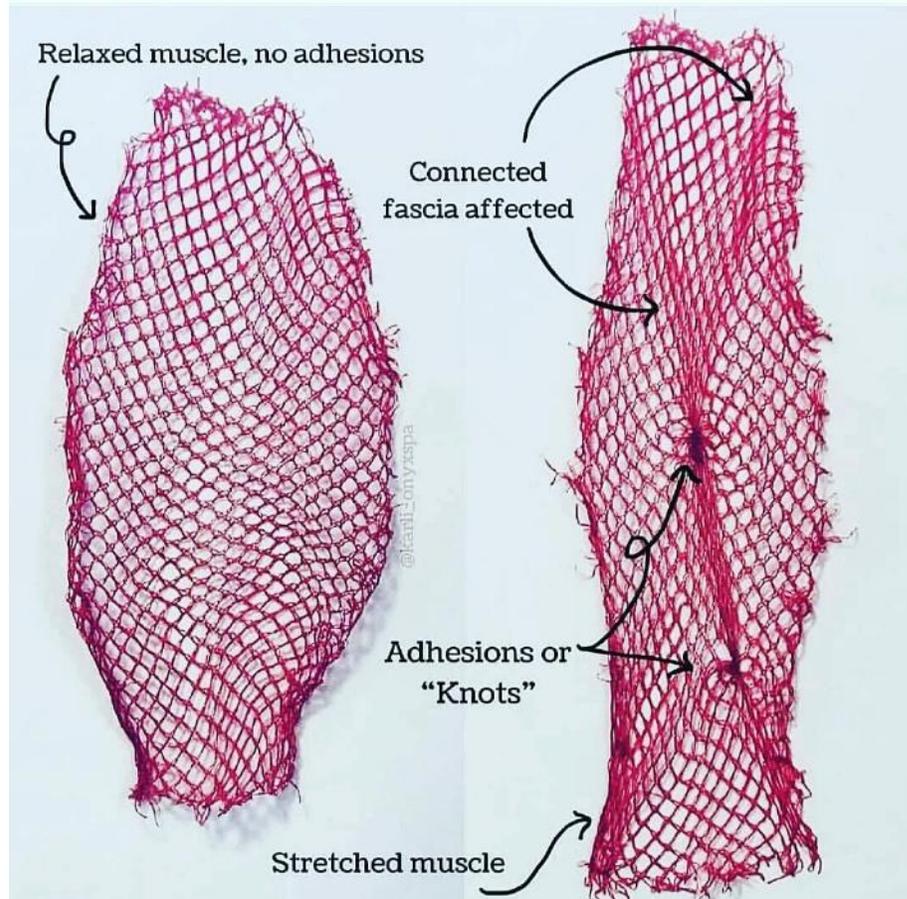
Normal and Abnormal Fascia



<https://bendablebody.com/what-is-fascia-why-you-need-to-stretch-it/>



Fascial Adhesions

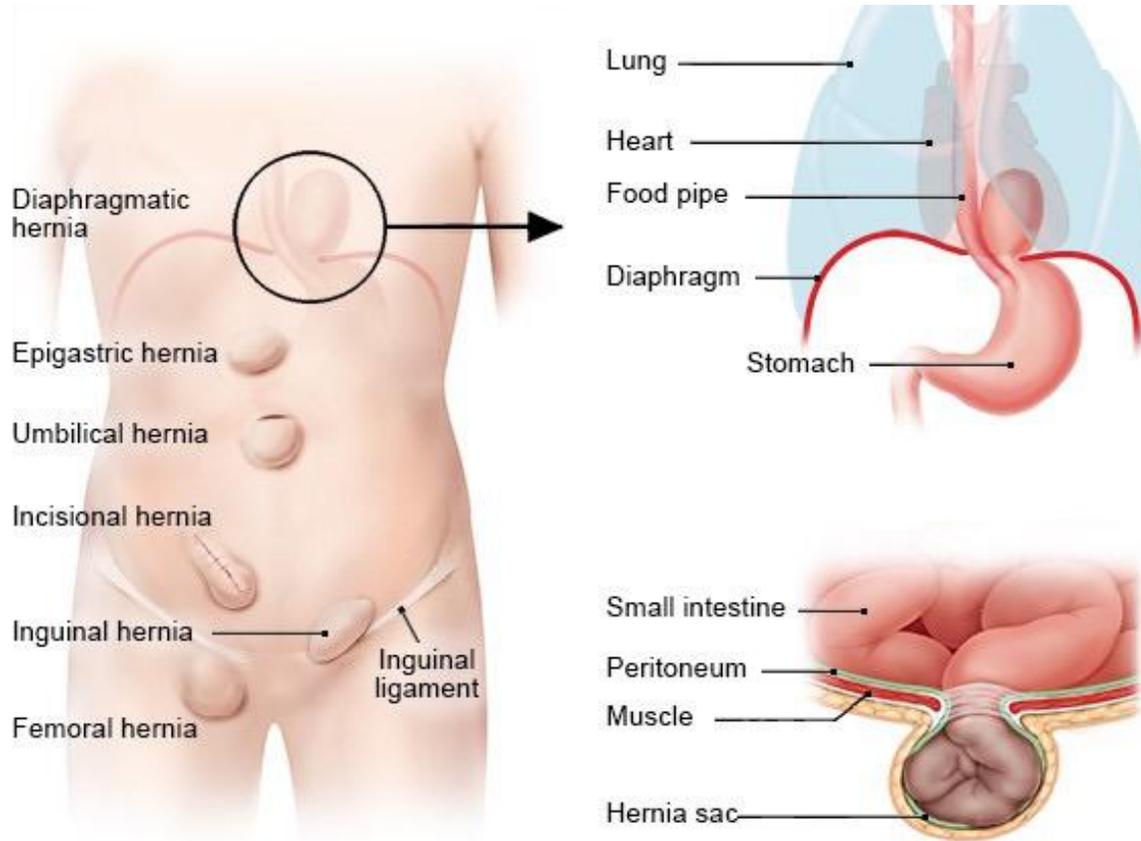


- Fascial adhesions can prevent normal tissue movement
 - For most tissues: muscles, nerves, blood vessels, organs, etc.



<https://www.mountlawleyphysioandpod.com.au/what-is-fascia/>

Hernias and Cysts: Gaps in Fascia



- Hernias occur when fascia fails and tissue pokes through
- Cysts also form when fluid collects in a pouch outside where it belongs
 - Ganglion cyst, Baker's cyst, Tarlov cyst, etc.
- Piezogenic papules may be similar

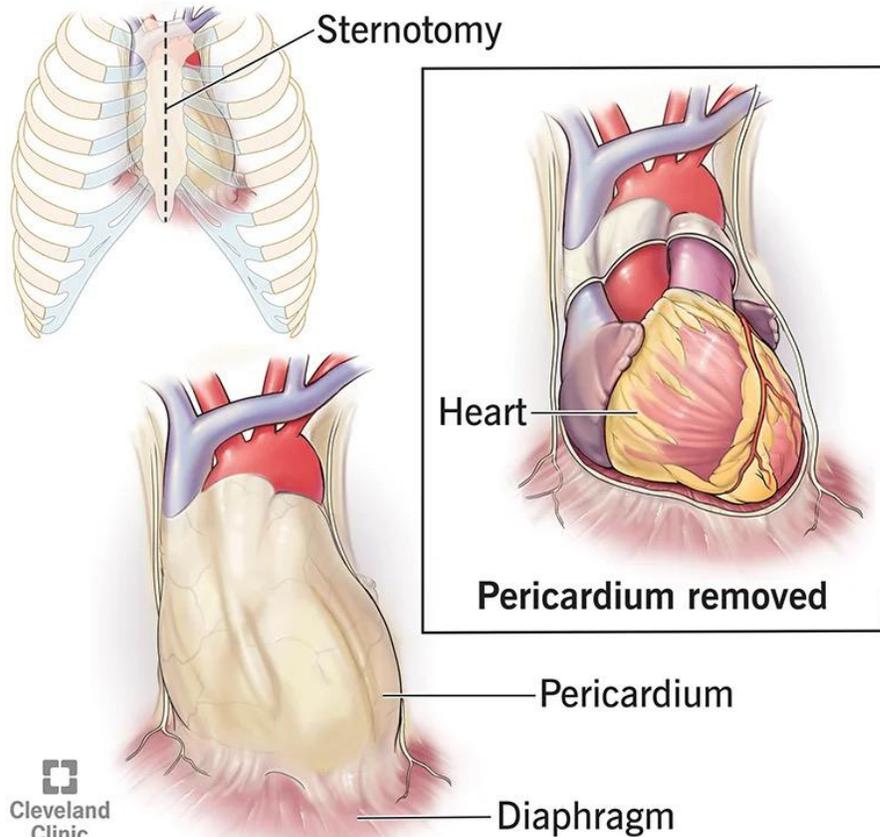


Piezogenic pedal papules. Courtesy of DermNet New Zealand
(<https://www.dermnetnz.org/assets/Uploads/dermal-infiltrative/piezogenic-papules5.jpg>)

<https://www.klinikadigital.net/en/hernia/>

Fascia Shapes & Protects Organs

Pericardiectomy

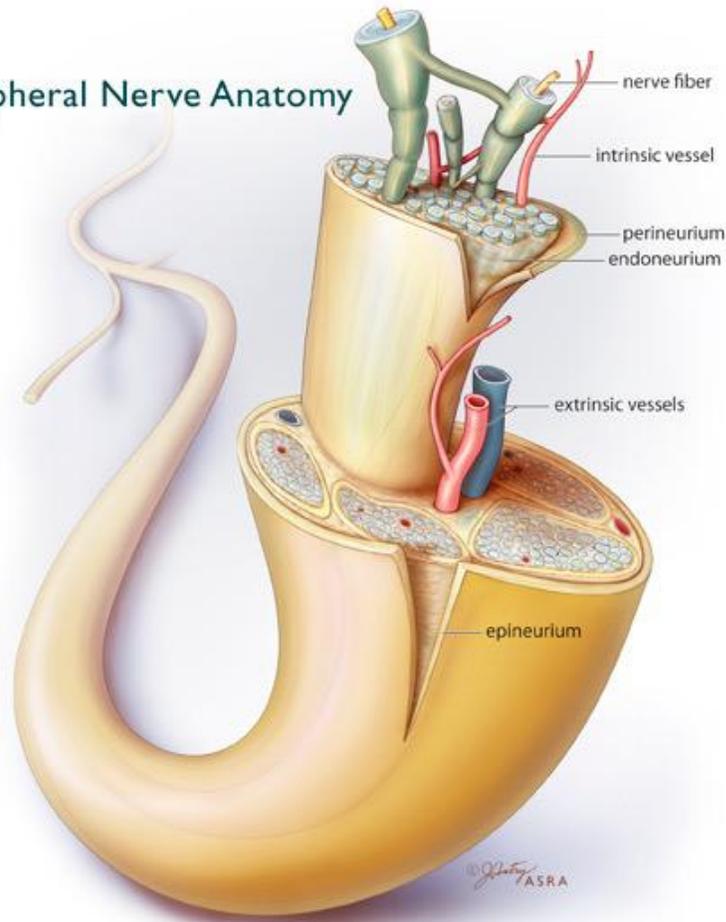


- Organs are wrapped in fascia
- This protects organs, and often improves function
- Allows organs to move relative to surrounding structures



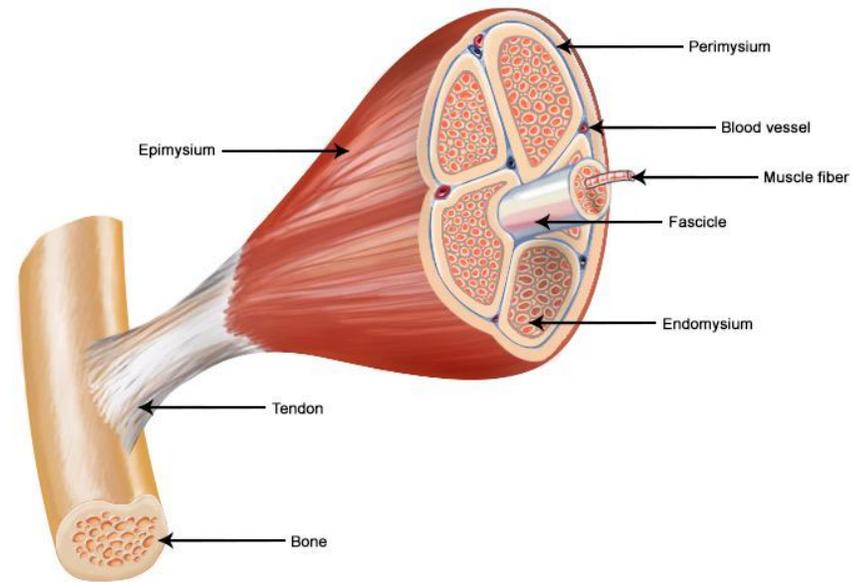
Protects Tissues and Allows Movement

Peripheral Nerve Anatomy



©2009 ASRA

Structure of a Skeletal Muscle



<http://www.bats.ac.nz/detail-where-to-inject-the-la-a-closer-look-at-peripheral-nerve-anatomy-24>

Russek: HSD113 - Fascia



Fascial Wrapping: So, Who Cares?

- If fascia is weak in people with HSD, they may be more vulnerable to problems with the wrapping function
 - People with HSD might have more hernias, cysts, etc.
 - Chronic inflammation in fascia might cause adhesions or stiffness
- Tissues may be more vulnerable due to poor fascial packing
 - E.g., nerve compression may occur more easily because fascia doesn't protect
- Exercise helps keep fascia structure healthy
 - Lack of exercise might cause fascia to become weaker or develop adhesions

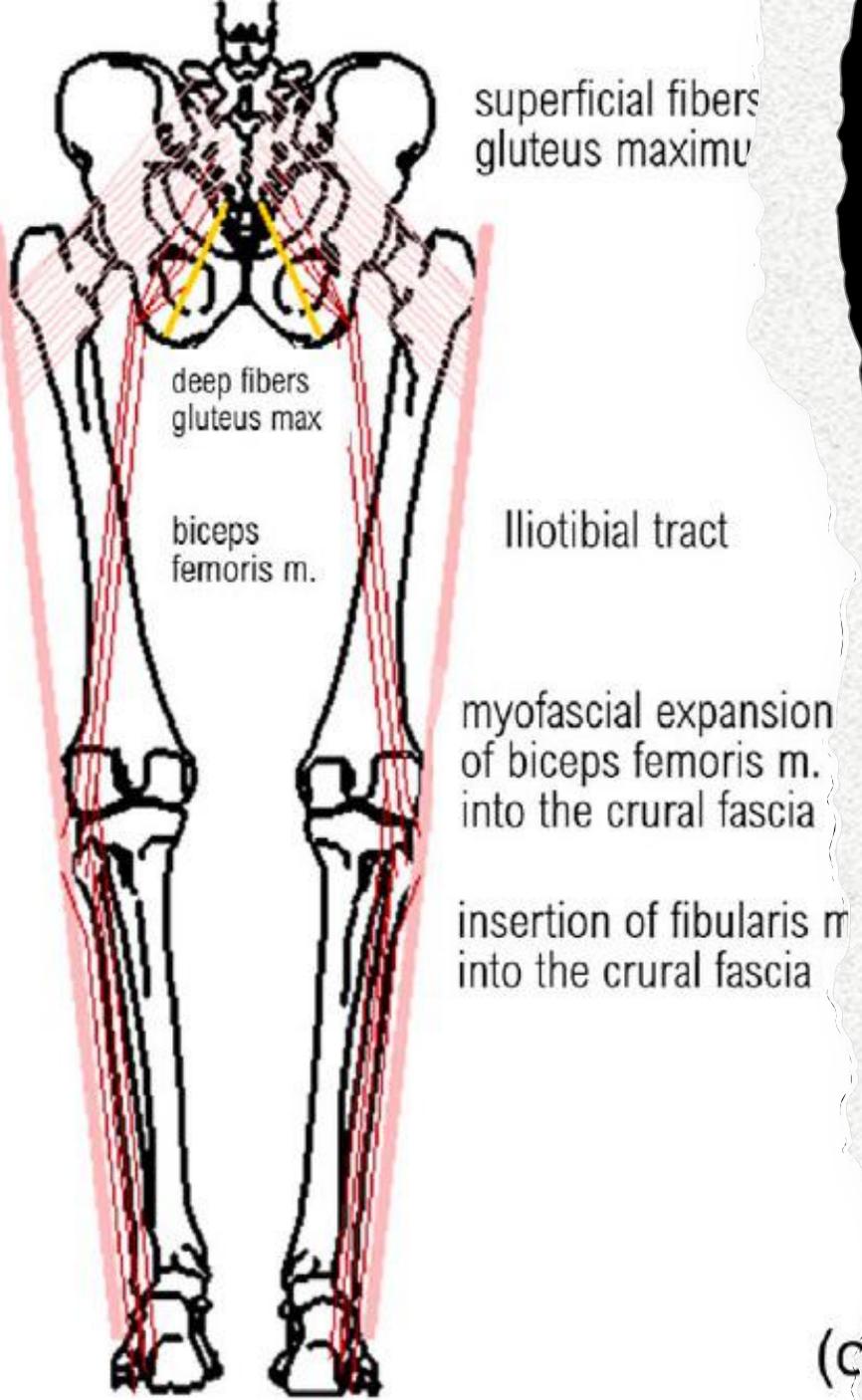




Questions?



Fascial Force Transmission



Fascia Wraps Tissues



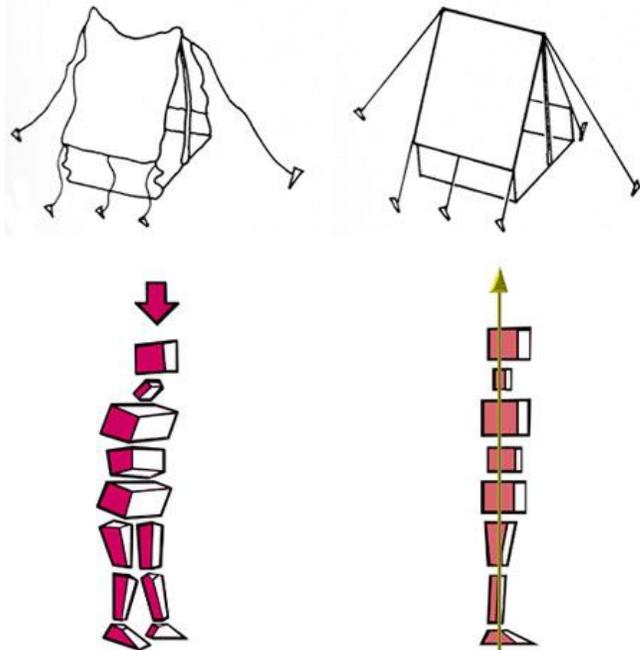
- Fascia connects many muscles to bones or other muscles
 - Much of the force muscles produce is transferred through fascia rather than tendons
- Changes in the tension in this fascia can alter posture and function of muscles
- Fascia wraps and connects organs



Fascia Transmits Forces

- Tensegrity

- Using tension to provide support: it is like tent ropes holding up the tent
- Floppy ropes result in a floppy tent
- <https://www.anatomytrains.com/fascia/tensegrity/>



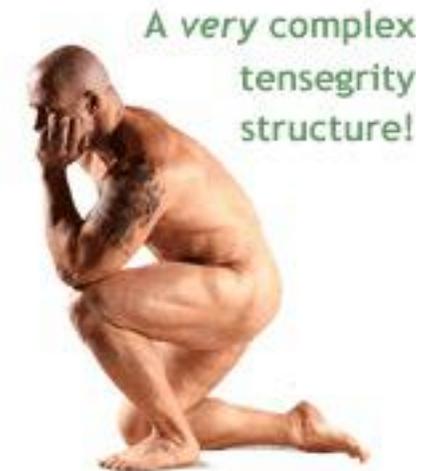
https://rolfyoga.com/English/Faszien_EN.html#.XdHr5S2ZOfU



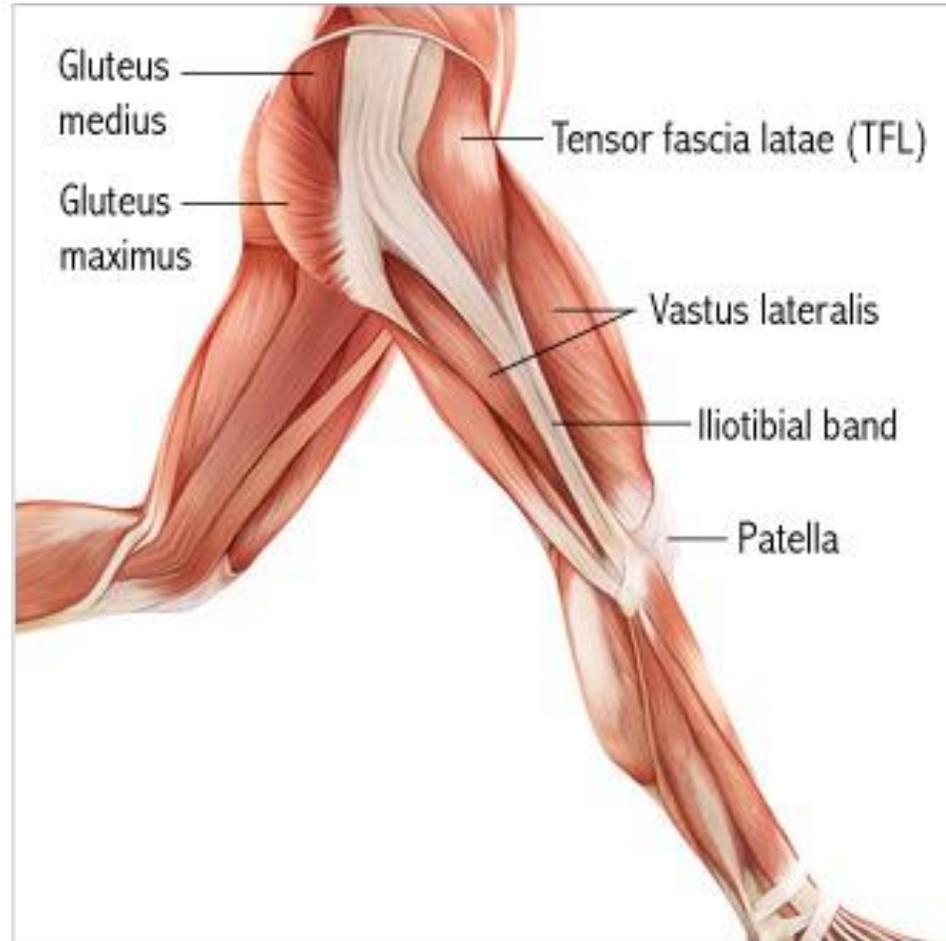
<https://www.painscience.com/articles/ten-trillion-cells.php>



A more complex tensegrity structure



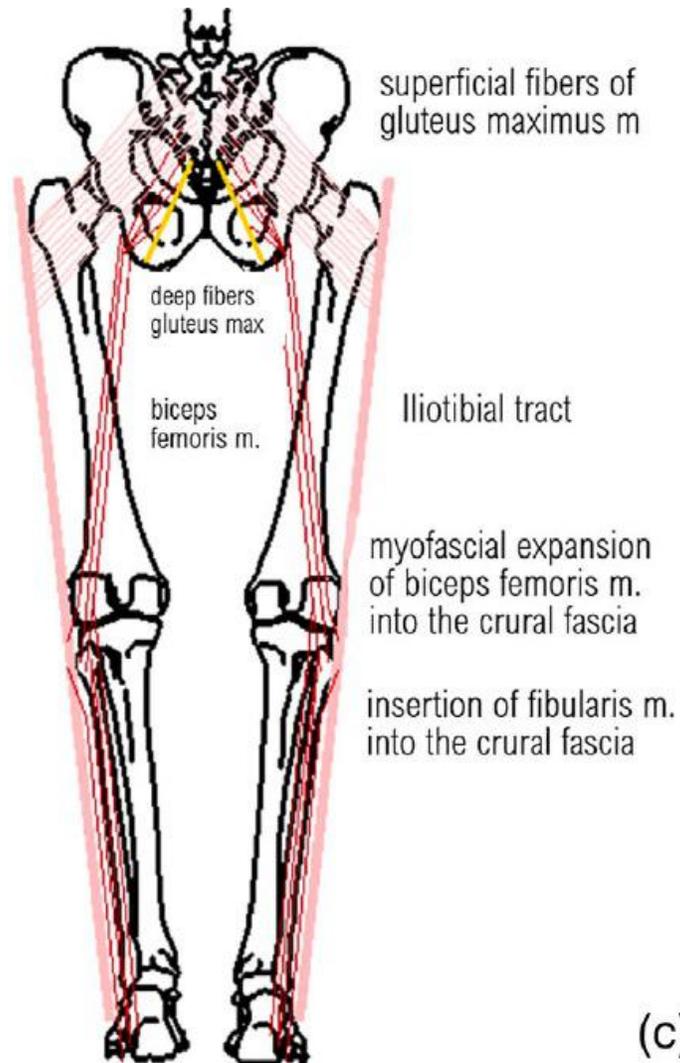
Fascia Transmits Forces



- Example: Iliotibial band (ITB)
- Forces produced by gluteal muscles and tensor fascial lata are transmitted to the ITB
- The ITB connects to the knee and kneecap
- Problems with the ITB can cause knee, hip, or low back pain



Force Transmission



- Fascia transmits forces widely through the body
- Everything is, quite literally, “connected”
- Therefore, you may need to treat the foot to help the hip, or treat the hip to help the neck.

(c)



Fascial Lines

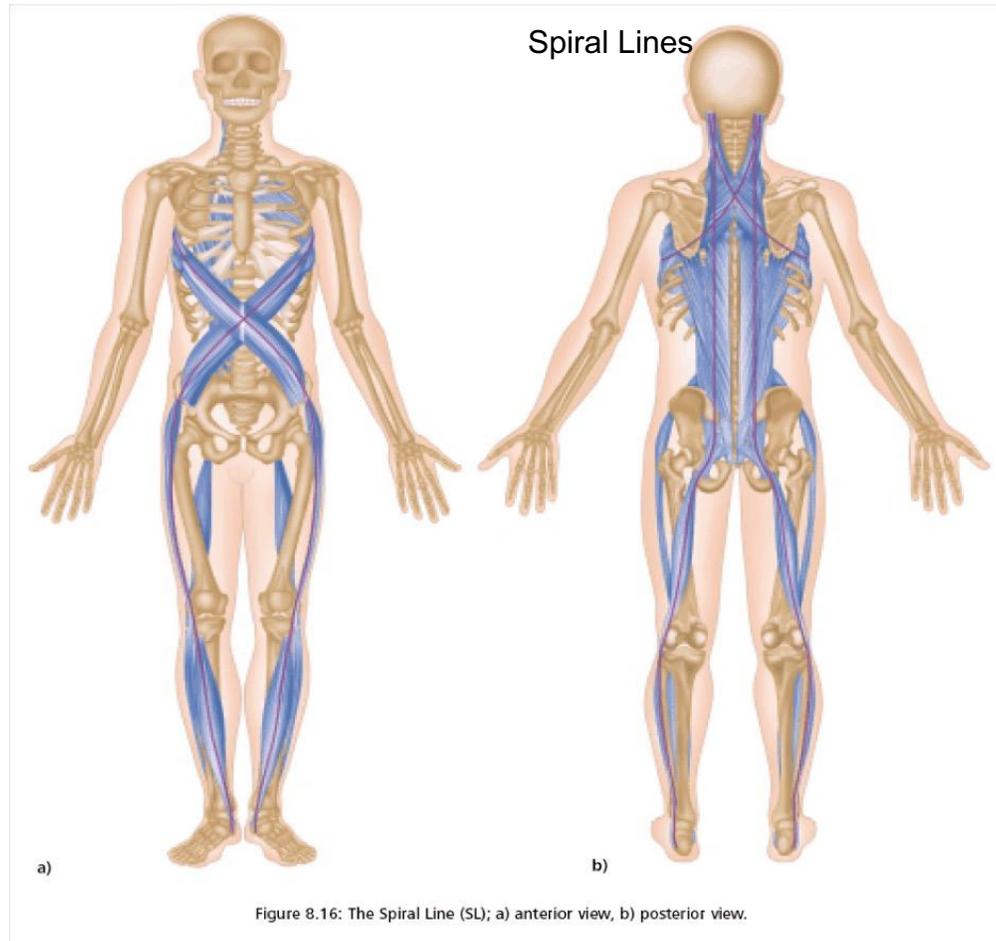
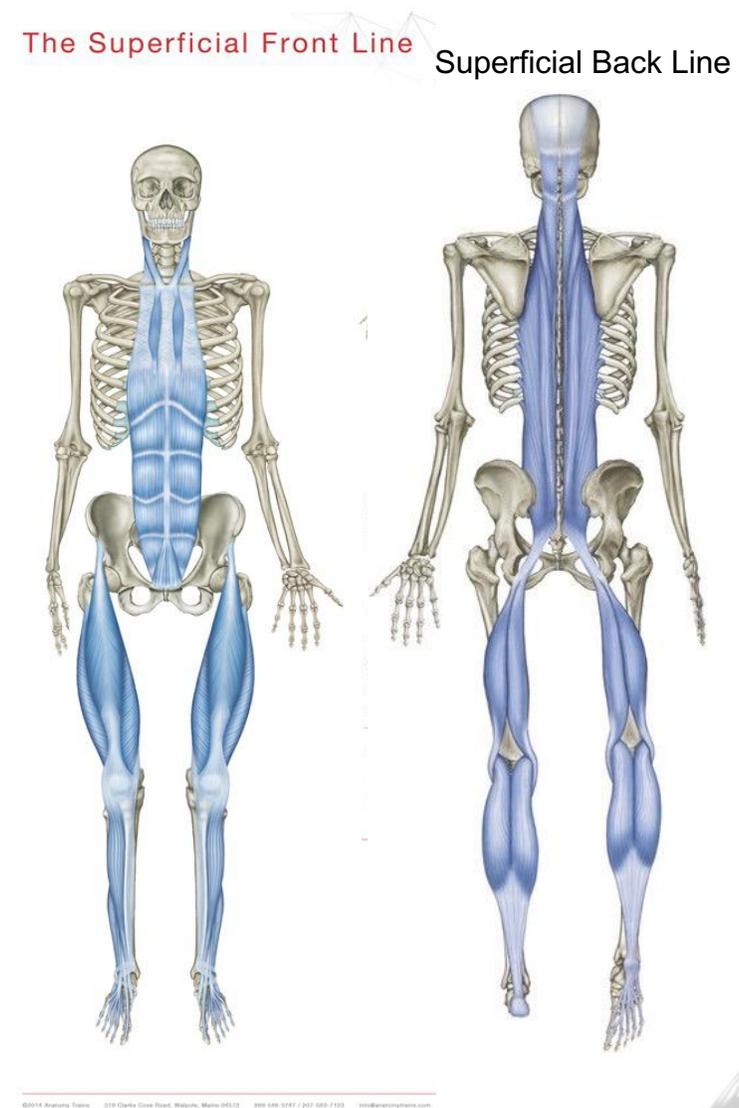


Figure 8.16: The Spiral Line (SL); a) anterior view, b) posterior view.

T. Myers. Anatomy
Trains



Russek: HSD113 - Fascia



When Fascia Causes Problems...

Origin: Ribs/Costal Cartilages, Sternum, Lumbar Vertebrae
Insertion: Central Tendon

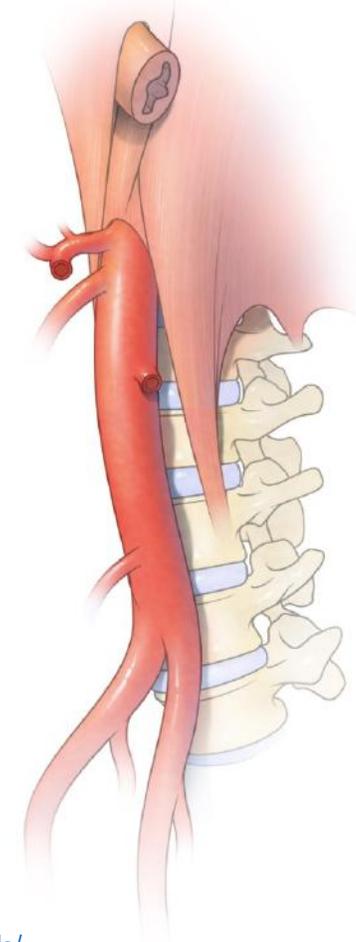
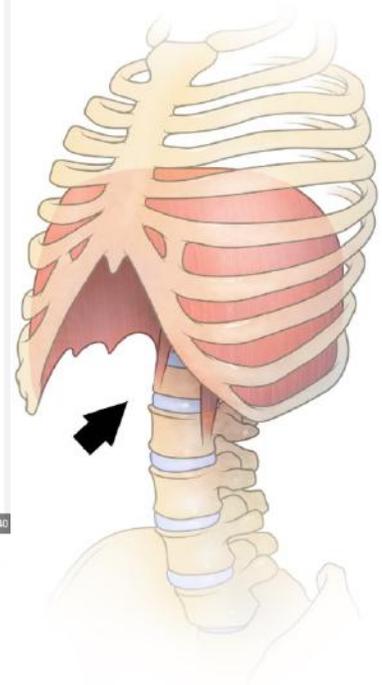
Esophageal Hiatus

Median Arcuate Ligament: arc over aorta (unpaired)

Medial Arcuate Ligament: arc over psoas major (bilateral); sympathetic chains pass posterior to this ligament

Lateral Arcuate Ligament: arc over quadratus lumborum (bilateral)

R and L Diaphragmatic Crus: both crura form aortic hiatus and median arcuate lig.; right crus forms esophageal hiatus



Normal



MALS

- Median Arcuate Ligament Syndrome
 - The ligament is made of fascia
 - If it is pulled too far down, it compresses the median arcuate ligament



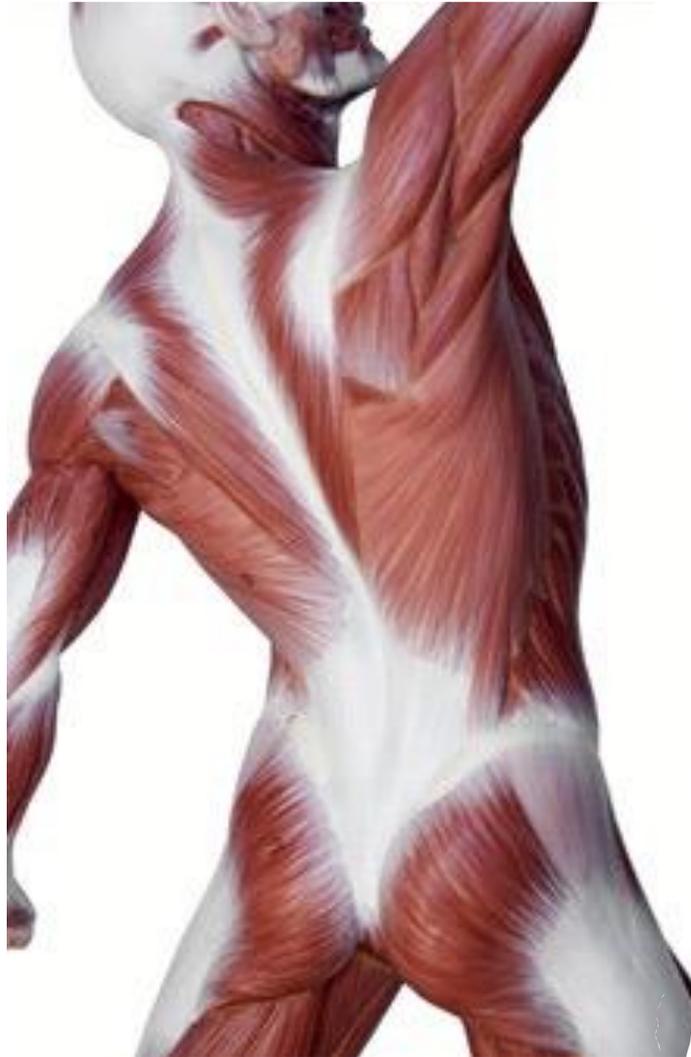
<https://med.uth.edu/cvs/patient-care/conditionsandprocedures/median-arcuate-ligament-syndrome-mals/>
<https://www.chegg.com/flashcards/o-posterior-wall-fascia-muscles-abdominal-aorta-ivc-gonadal-vessels-sympathetic-0d30f525-3803-40b3-a4e3-9b1a40b76cd7/deck>

Fascia Can Actively Generate Force

- Contractile force production
 - In both intra- and extramuscular fascia
 - Very low loads, but potentially for long durations
 - Not controlled by motor nerves, but autonomic nerves and local chemical environment
 - Can contract in response to emotional stress
 - Slow process, occurs over minutes+
 - Lumbar fascia has high number of myofibroblasts
 - May perpetuate musculoskeletal imbalances and contractures
 - E.g., frozen shoulder, Dupuytren's contracture, nerve compression syndromes
- (Schleip, 2017 & 2019)



Fascia Can Cause Muscle Contraction

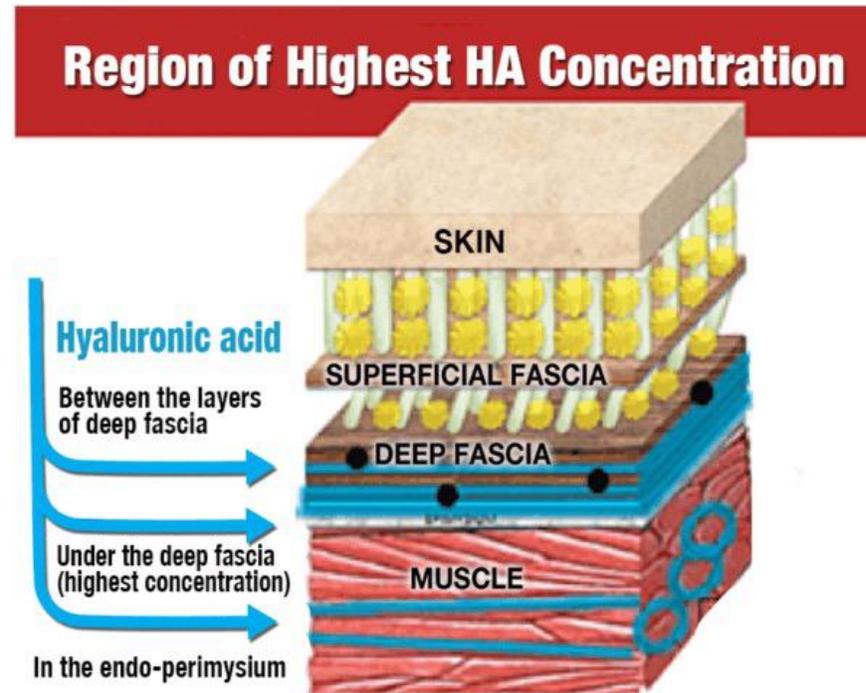


- Pain can cause tension or adhesions in fascia that can trigger or perpetuate muscle spasm
 - Shown to occur in the low back (Brandl, 2022)
- Might contribute to myofascial pain
 - (Wang, 2021)



Facilitating Movement

- Movement occurs between planes of fascia
- Hyaluronic acid in ECM is *thixotropic*: viscosity decreases with movement
 - Decreased movement increases stiffness
 - “Motion is Lotion”

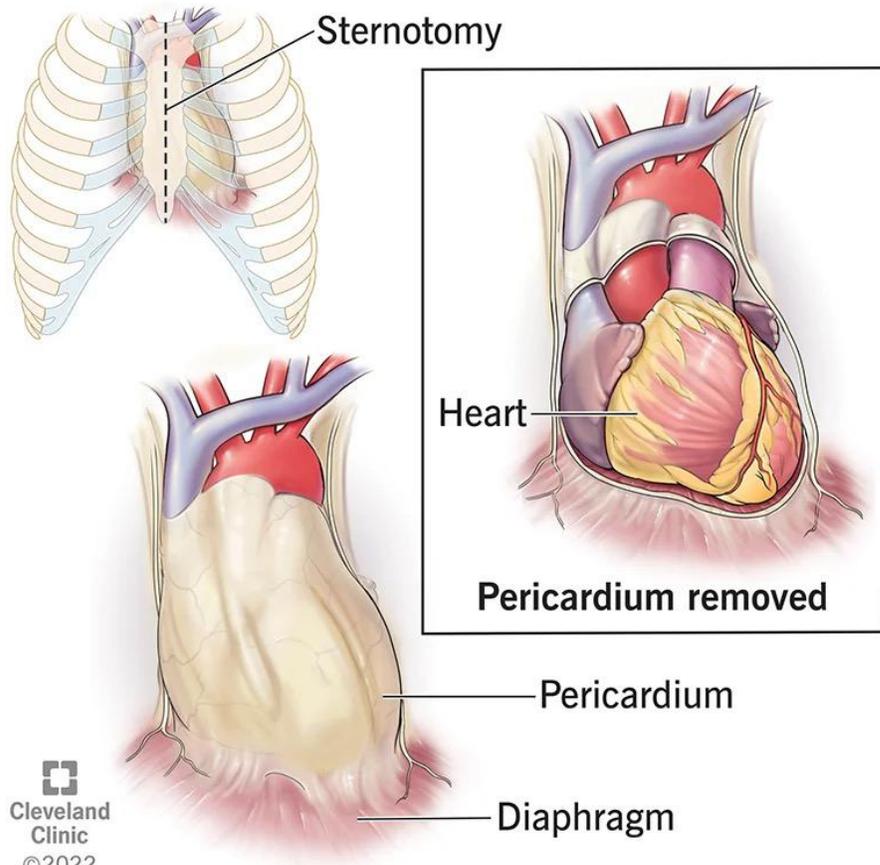


<https://www.n2physicaltherapy.com/blog/fascia-mysterious-tissue/>



Fascia Connects Diaphragm & Heart

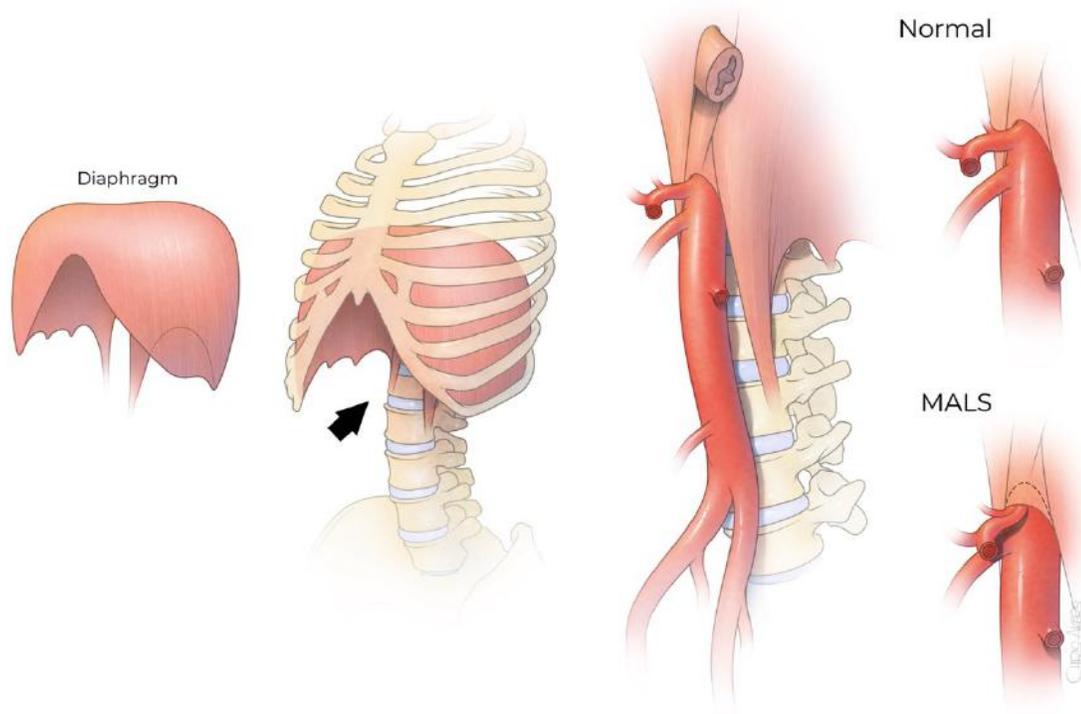
Pericardiectomy



- Fascia connects some organs, such as the diaphragm and heart
- Diaphragmatic breathing improves heart function because of this fascial connection



Fascial Bands can Cause Problems



- Example: median arcuate ligament syndrome (MALS)
 - Involves a fascial ligament that attaches the diaphragm to the spine
 - The ligament can compress the celiac artery, compromising blood flow to the intestines
 - Symptoms: Pain between ribs, below sternum; pain after eating; pain or fatigue after exercise; nausea/vomiting; constipation/diarrhea

<https://med.uth.edu/cvs/patient-care/conditionsandprocedures/median-arcuate-ligament-syndrome-mals/>



Force Transfer: So, Who Cares?

- Fascial connections often explain why a problem at one location causes mechanical stresses and pain at another
 - E.g., foot problems affecting the hip or knee
- Fascia can contract, and this change in shape and tension affects muscles
 - Dysautonomia and pain both trigger fascial contraction
 - Contracted fascia does not naturally relax, and treatment might be needed
- Connections between tissues might be problematic
 - E.g., MALS is an example of fascial connections causing problems



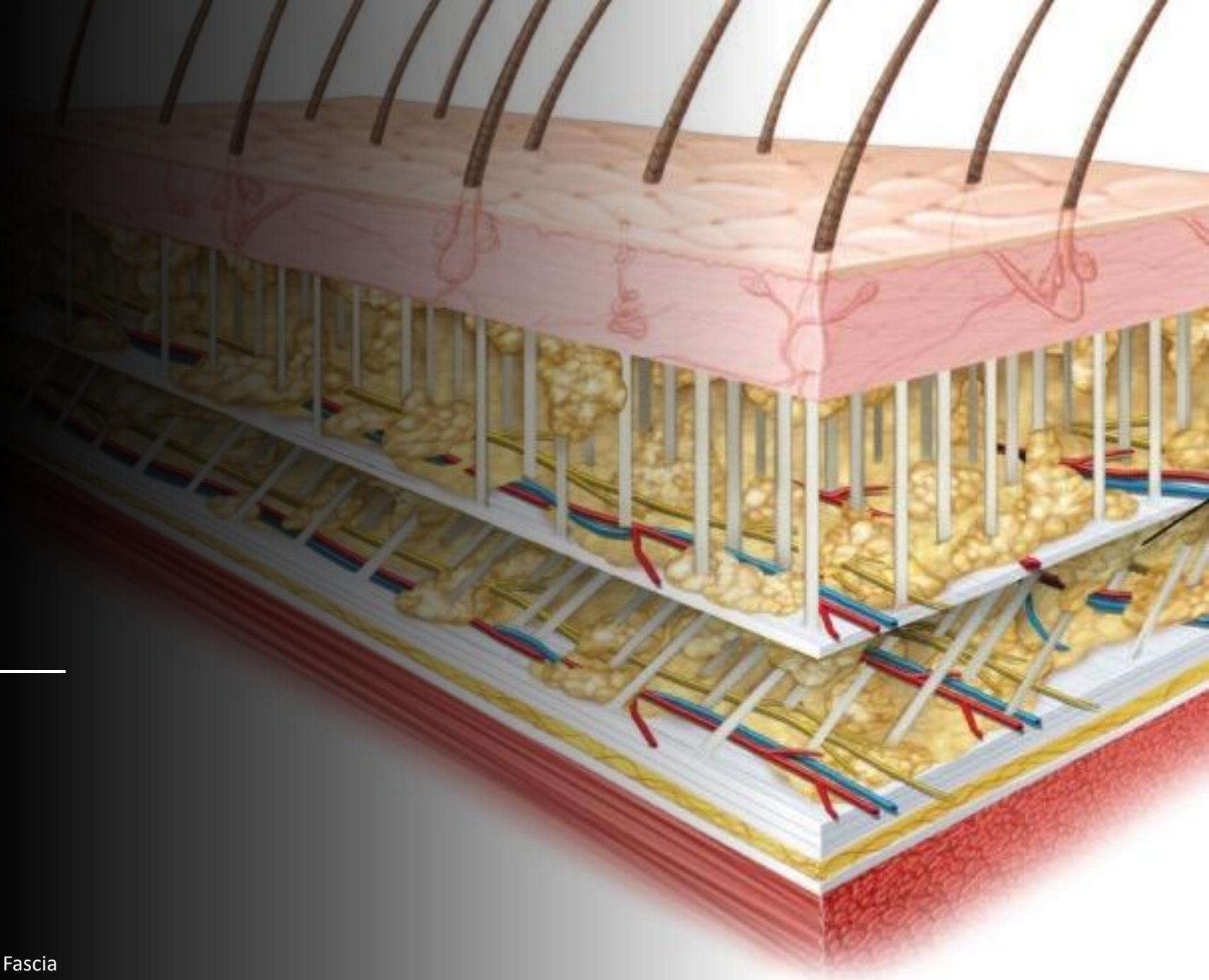


Questions?





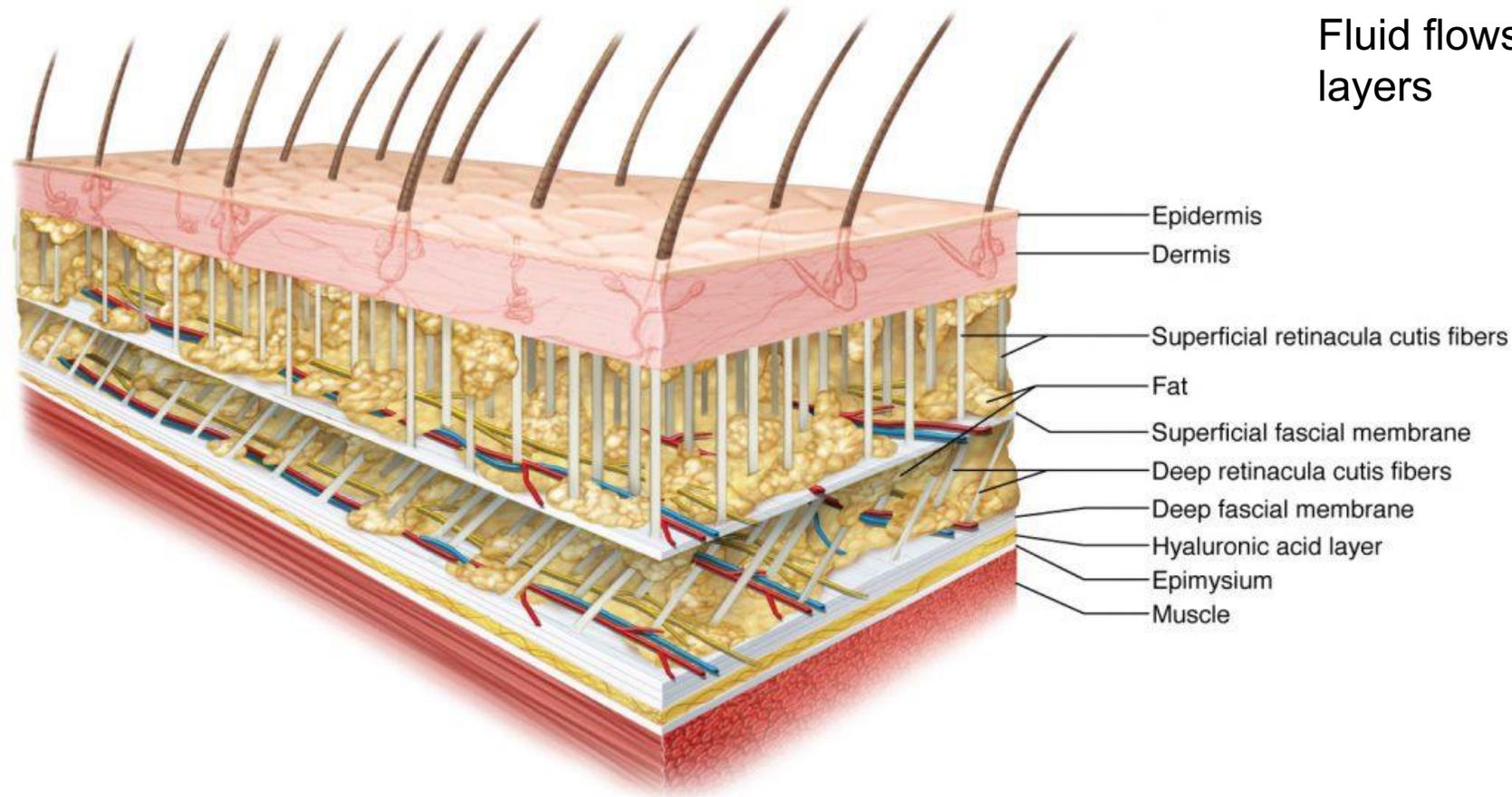
Fascial Fluid Flow



Old Image of Fascia



Recent Model of Fascia



Fluid flows between fascial layers

Muscolino JE. Fascial structure. In. *Massage Therapy Journal*. Vol 512012:73+.

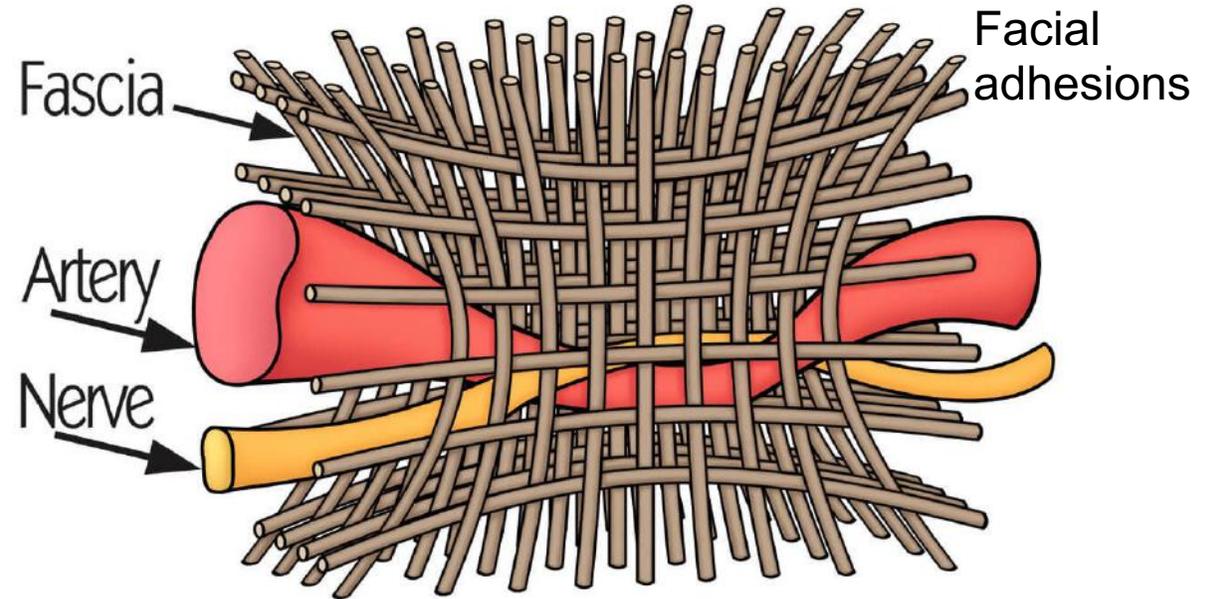
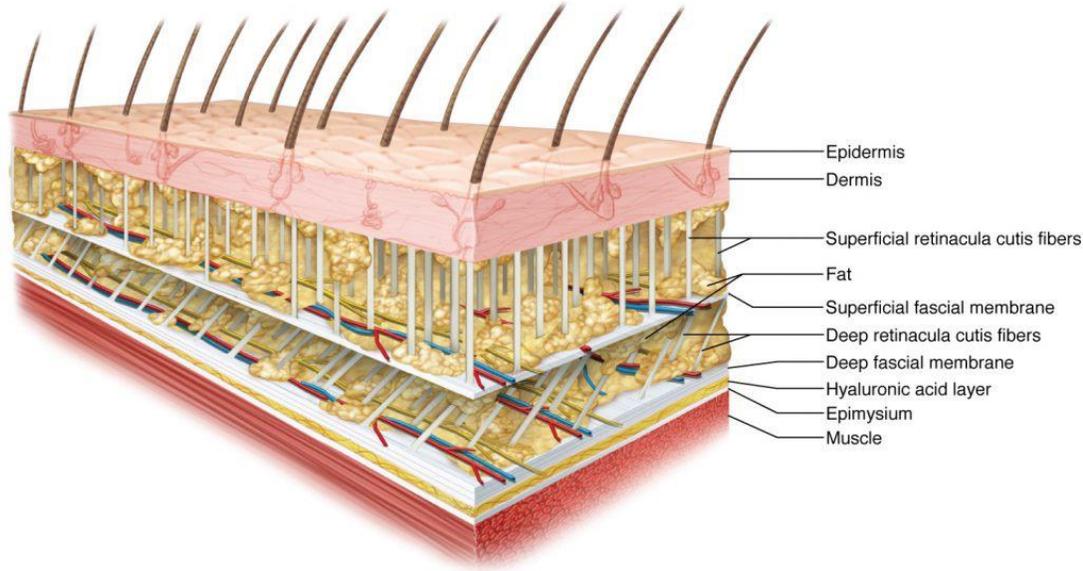


Fluid Flow Through the Body

- Fascia is 2/3 water
- Much of the interstitial fluid in the body is in fascia
- This fluid flows through the fascia
- Fibroblasts (cells that produce and maintain fascia) align perpendicular to fluid flow
- This fluid flow is important for providing nutrients and cellular communication
- Fluid and nutrient movement is influenced by movement



Fascia Allows Fluid Flow in the Body



Fascial adhesions may:

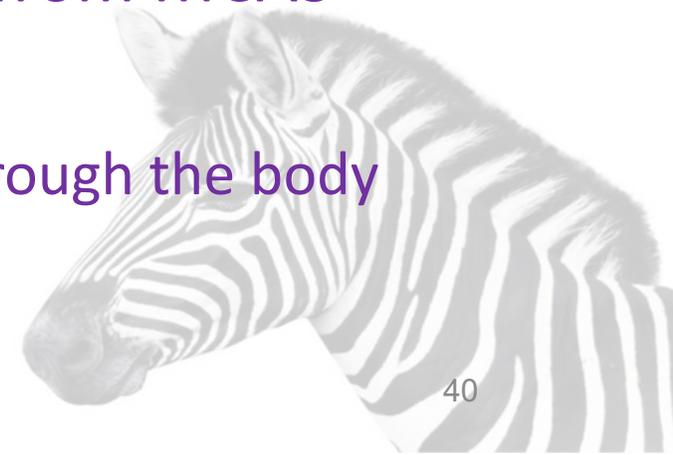
- Interfere with fluid flow within the fascia, causing swelling
- Interfere with flushing of toxins and inflammatory chemicals
- Compress arteries, veins, and lymphatic vessels, interfering with their ability to transmit fluids

<https://clearpassage.com/blog/fascia-and-fascial-adhesions/>



Fluid Flow: So, Who Cares?

- Proper fluid flow through the body is essential for nutrition and tissue health
 - Decreased fluid movement compromises tissue health and may increase inflammation and pain
- Problems with fluid flow can aggravate POTS
 - POTS symptoms might be affected by fascial health
- Fascia might be particularly sensitive to inflammation from MCAS
- Motion helps to pump fluids through the body
 - Certain motions might be more helpful for moving fluids through the body



Fascial Sensory Function

Fascia

decreased mobility/increased stiffness
increased mobility/microinjuries

inflammation

**“active”
myofascial pain**

hyperexcitability
ischemia
acidosis

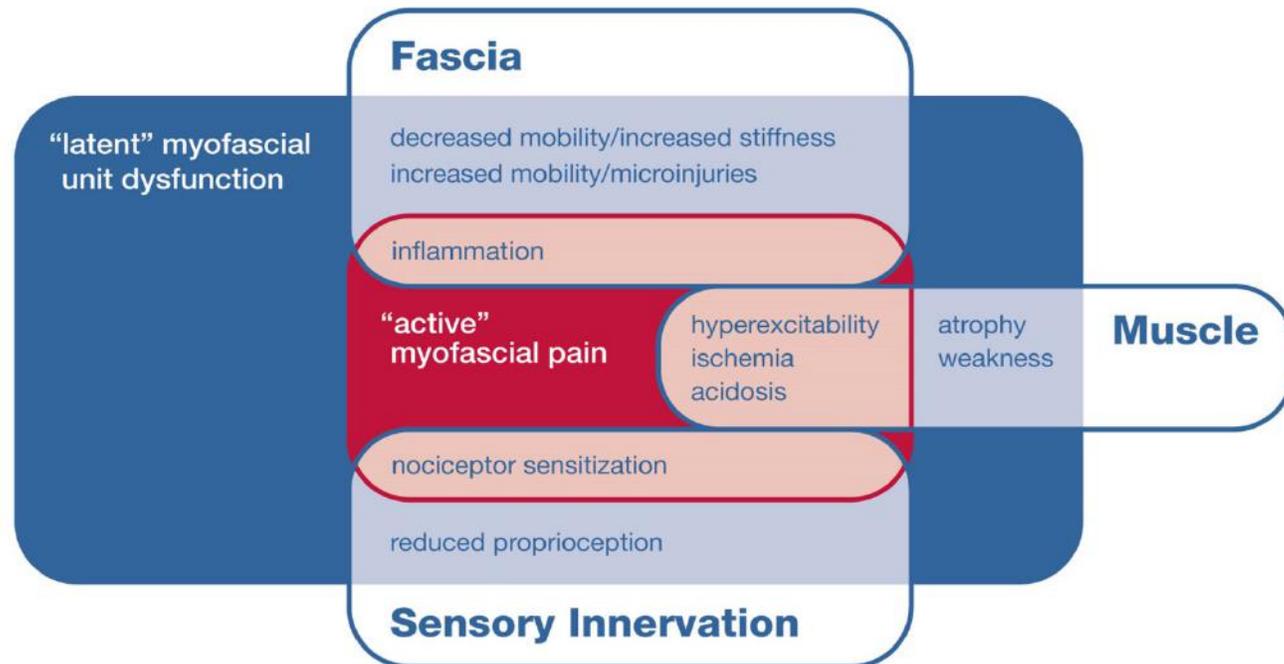
nociceptor sensitization

reduced proprioception

Sensory Innervation

Fascia Has Sensory Nerves

Hypothetical Model Relating Fascia Mobility, Proprioception, and Myofascial Pain



- Many nerve fibers can transmit pain in inflammation
- Sensory innervation also provides:
 - Proprioception: body position sense
 - Interoception: the body senses, interprets, integrates, and regulates signals from within itself

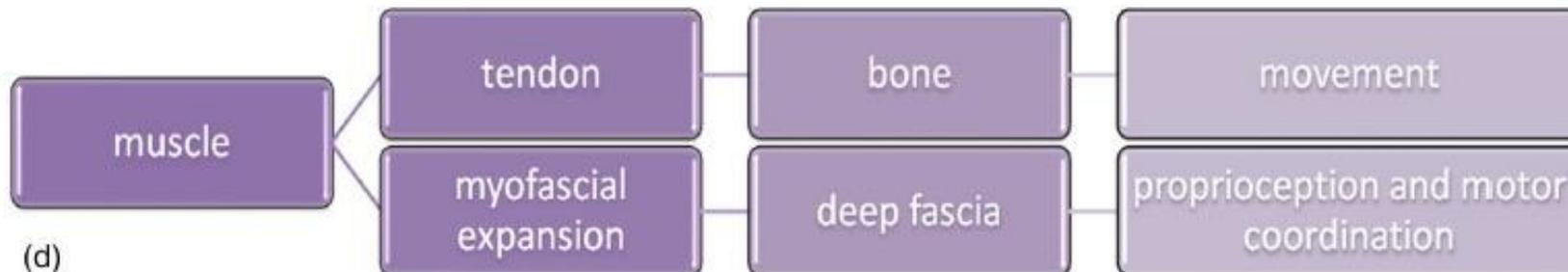
Langevin, 2021

Proprioception

- “...proprioception is defined more narrowly and evaluated as the ability to sense whether a joint is moving in one direction versus another”

(Langevin, 2021, p2)

- Fascia contains high numbers of proprioceptive sensory nerves:
 - Pacinian corpuscles, Ruffini corpuscles, Golgi receptors, interstitial receptors
 - Fascia contains far more sensory nerves than muscle
- Muscle spindles are concentrated where fascia connects.



(d)

(Stecco, 2019)



Interoception

- “Interoception is the processes by which the body senses, interprets, integrates, and regulates signals from within itself”
(Langevin, 2021, p2)
 - Proprioception is a type of interoception
- Interstitial receptors connect to the autonomic nervous system and help communicate unconscious sensation
- Fascia is our largest sensory organ (Scheip, 2017)



Nociception: Pain Perception

- Fascia is heavily innervated with nociceptive nerves
- These nociceptors can become sensitized
- Irritated fascia generates a deep, dull, annoying pain
- Pain is more intense than similar irritation to muscle
- Referral pattern is different from dermatomes: “fasciatomes”

(Stecco, 2019)



Fascial Sensory Function: So, Who Cares?

- Fascia has a lot of nociceptor neurons
 - It can be the source of significant pain, often diffuse, vague discomfort
- Normal sensory input is important for movement
 - Decreased proprioception and interoception can lead to poor motor control
- Abnormal sensory input contributes to chronic pain neuroplasticity
 - The brain needs normal sensory input to process correctly. Lack of input or abnormal input can lead to nociplastic pain through neuroplasticity



How Do We Treat Fascia?



Approach to Management of HSD

Assist patient in identifying and managing systemic comorbidities: education, treatment and/or referral

Decrease central, peripheral, and autonomic pain sensitization

Educate for correct posture and joint alignment, body mechanics, joint protection, appropriate use of splints and braces

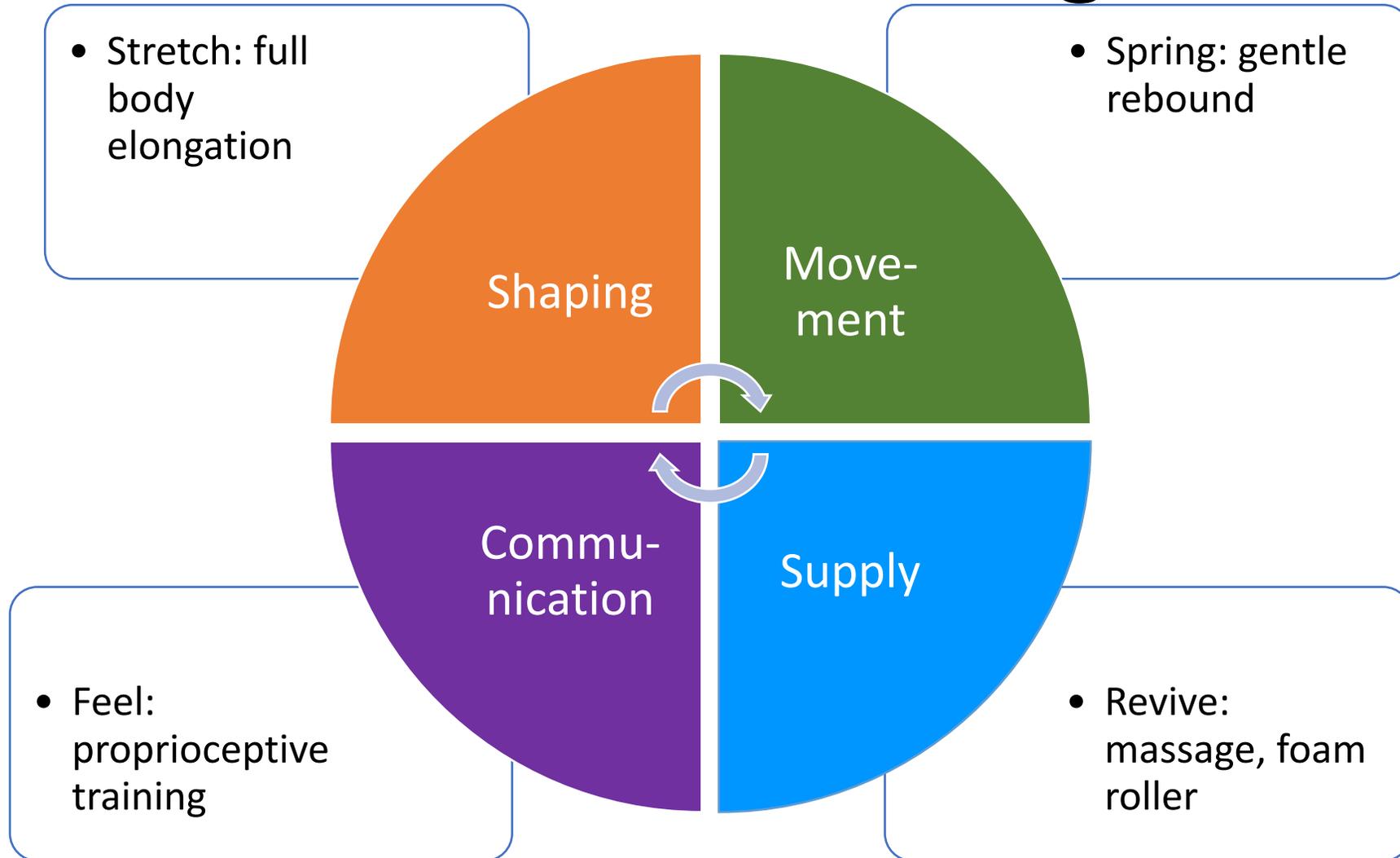
Proprioceptive and motor control training, with training to relax muscles that are guarding

Stabilization, strengthening, muscle flexibility, aerobic conditioning

Integration of proper alignment & movement into function

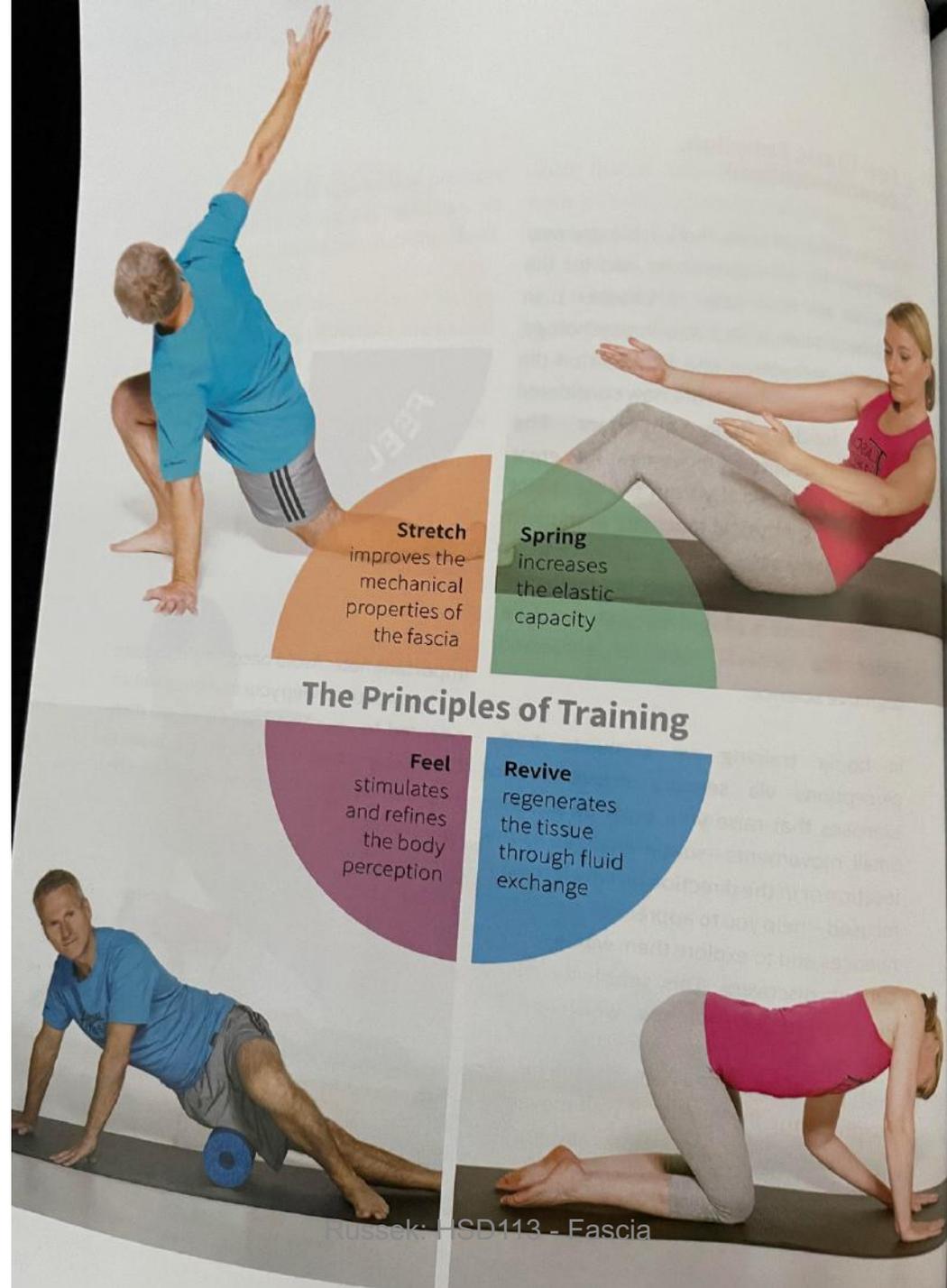
Education about flare management

Function Guides Management

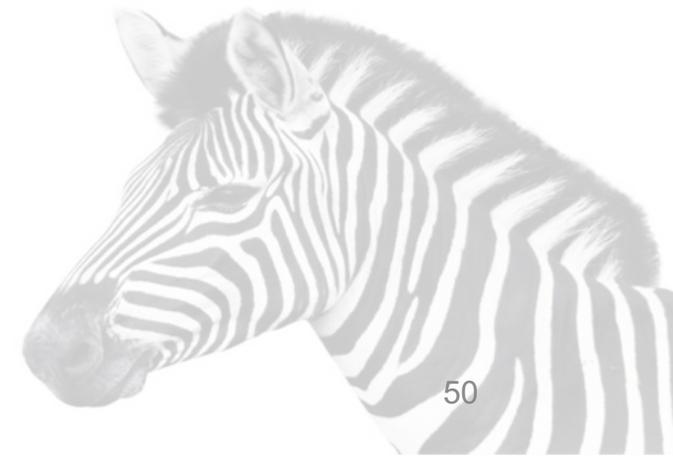


Schleip, 2017

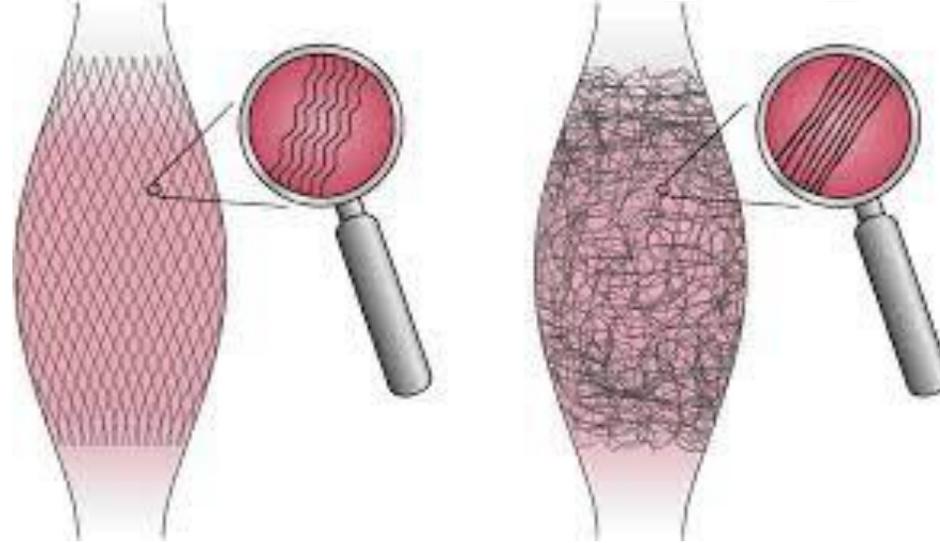




Schleip, 2017



Effects of Disuse & Injury



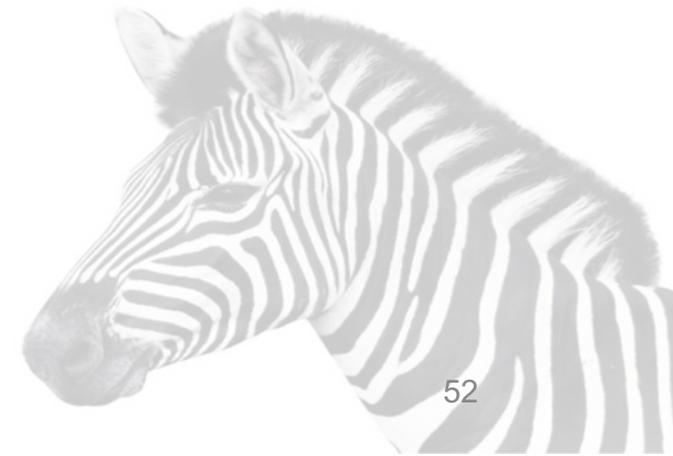
Schleip, 2013

- Immobilized fascia becomes matted
- Loses its crimping and lattice-work structure
- Loses ability to slide and stretch
- Soft tissue injury often affects fascia
- Delayed onset muscle soreness may be due to fascia



Effects of Exercise

- Response to exercise is slower than in muscle because fascial metabolism is slower
 - Increased fiber number and crimping
 - Increased load capacity and elasticity
- Shleip, 2013 & 2017
- Foam rolling and nerve glides are 'exercises' that also influence fascia



Manual Therapy & Fascia

- Myofascial release



- Massage



- Cupping



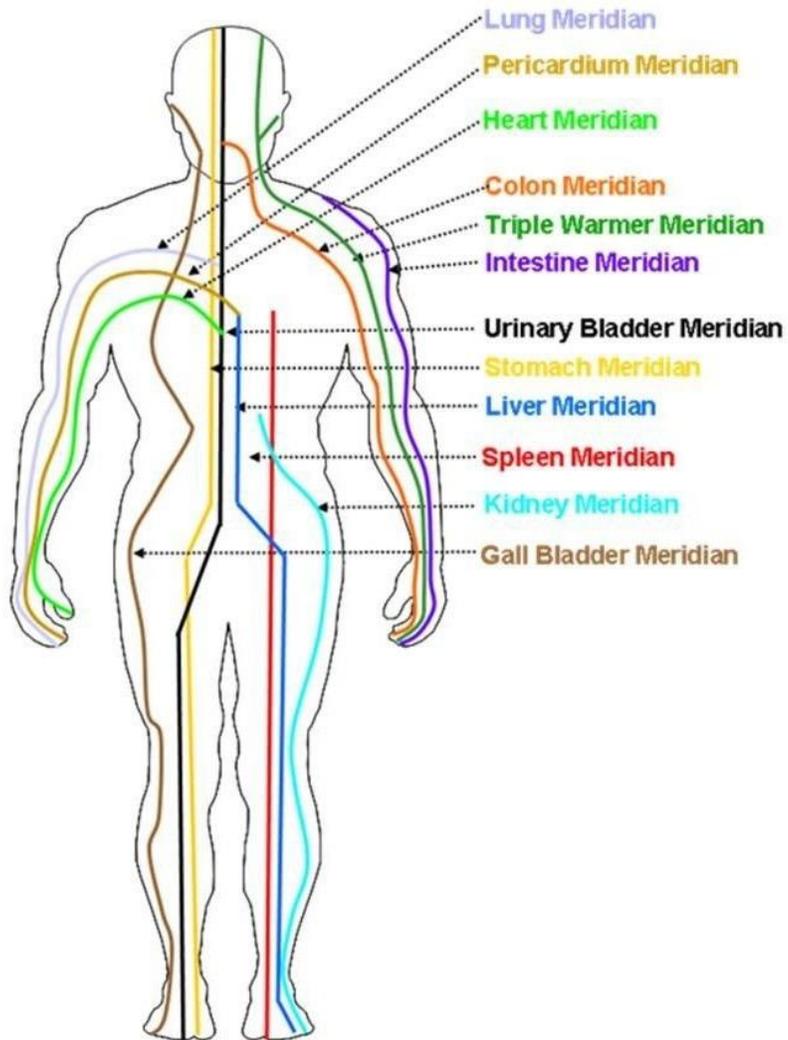
- Instrument assisted soft tissue mobilization



Russek: HSD



Fun Facial Facts



- Acupuncture meridians correspond to fascial densifications
- Acupuncture stimulates fascial receptors that send messages to muscles and the brain (via autonomic nerves)
- Fascial connections with organs may explain some visceral effects of acupuncture

(Yang, 2015)



More Fun Fascial Facts

- Full body-movements in yoga, Pilates, Tai Chi, qigong probably mobilize the fascia
- Yoga may stimulate the autonomic nervous system through prolonged fascial stretches
- Fascial interoceptors relay signals to the insula in the brain – the location which modulates our sense of ‘self’ and emotional state
 - Dysfunction in fascia contributes to depression and anxiety
 - Healthy fascia may relay a sense of wellness

• Shleip, 2017



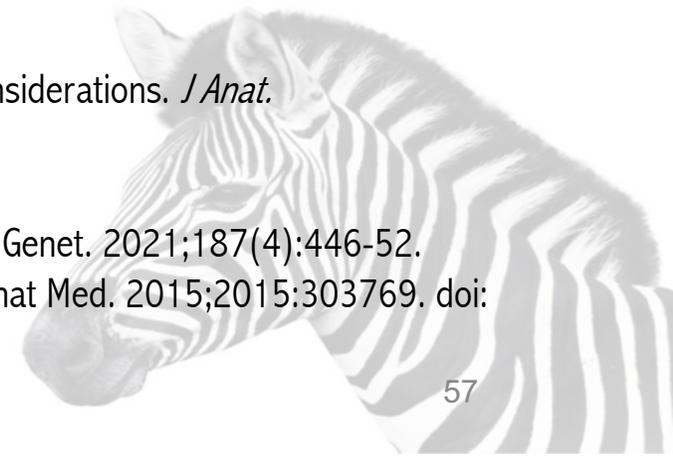
Summary

- Our understanding of fascia has changed tremendously in the past 10 years
- The basic science drives functional and clinical importance
- It helps to understand the basic science and clinical implications
- There is a lot we still don't understand!



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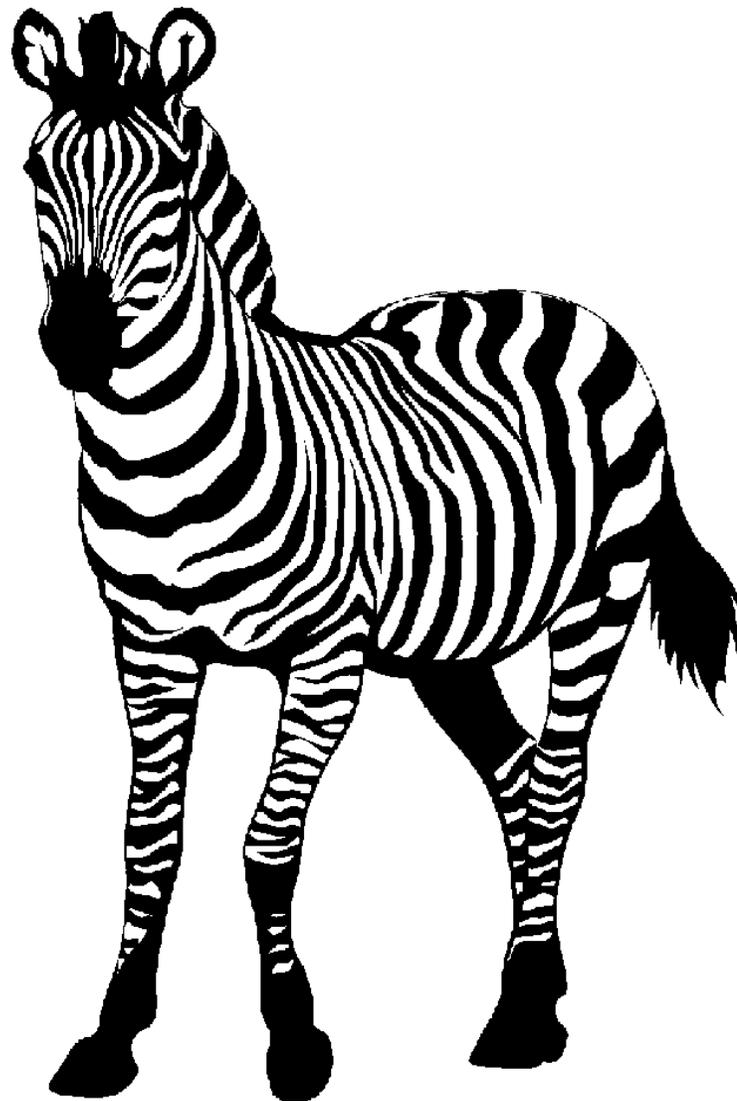


Web Resources

- SciShow 5 min YouTube on fascia: <https://youtu.be/T-UsSmD7mil>
- Fascia in HSD: <https://jeannedibon.com/wellness/fascia-and-proprioception-what-are-they-and-what-do-they-mean-for-those-with-eds/>
- Langevin article online:
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8304470/>
- The Fascia Research Society: <https://fasciaresearchsociety.org>
- Painscience article on HSD and myofascial pain:
<https://www.painscience.com/articles/hypermobility-and-ehlers-danlos-syndrome.php>



Thank
you!





Questions?

