Jacksonsville Sports Medicine Program

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Myofascia Pain and Dysfunction:

When Special Tests Aren't So Special!

Objectives

- Participants will have an improved understanding of movement dysfunctions as they relate to muscle and connective tissue limitations.
- Participants will be exposed to basic pain science including referred pain patterns and the use of palpation for the identification of various myofascial tissue disorders and trigger points.
- Participants will gain knowledge in the application of manual therapy techniques for the treatment of myofascial pain, trigger points and fascia restrictions.

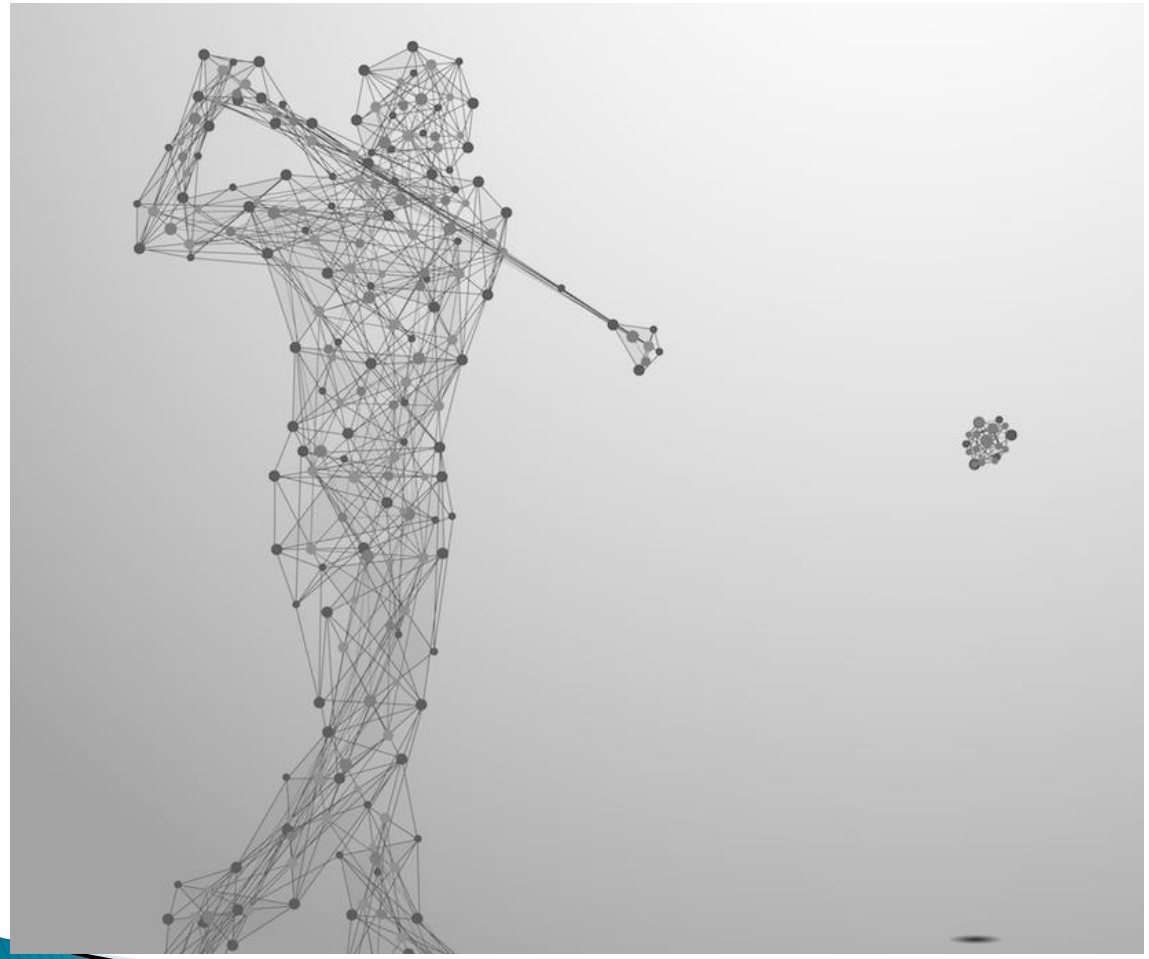
Musculoskeletal System: Myofascia Pain and Dysfunction

Prominent Individuals

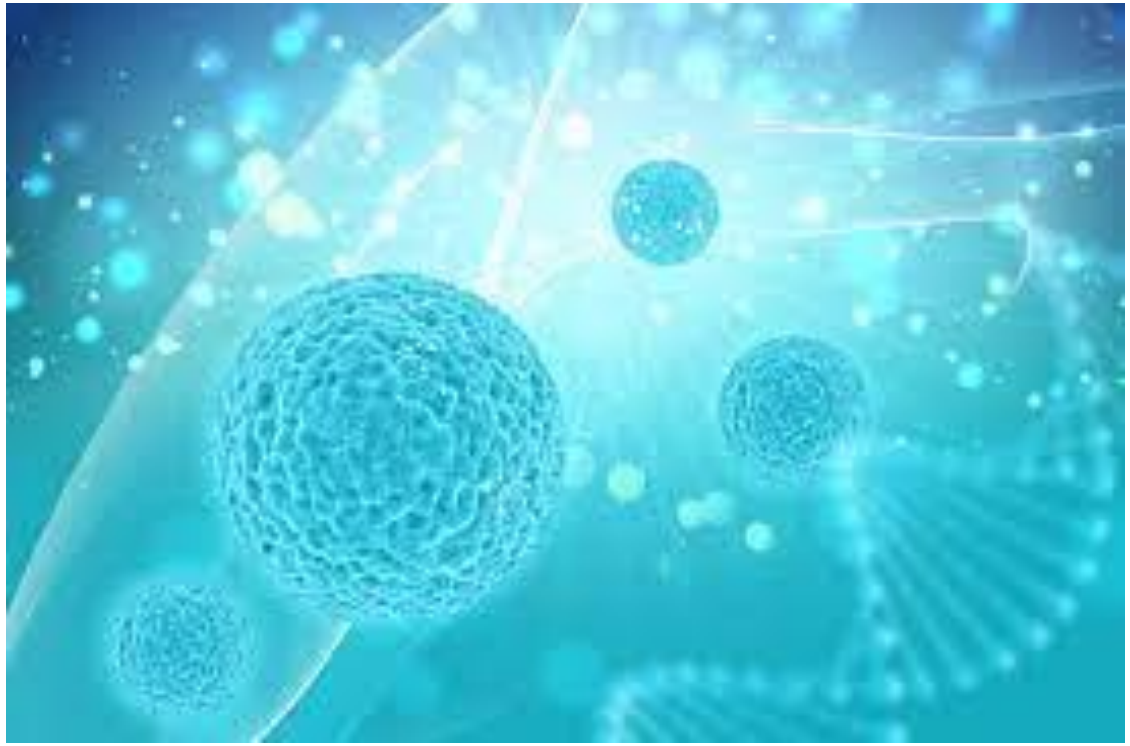
- Irvin Korr PhD: strain/counter strain, *"Proprioceptors and Somatic Dysfunction"*
- Vladimir Janda: upper/lower crossed syndromes
- Jan Dommerholt PT, DPT: Ehlers-Danlos Syndrome
- Janet Travell MD/David Simons MD/Joe Donnelly PT,DHS:
- *Myofascia Pain and Dysfunction: The Trigger Point Manual*
- Robert Schleip: Fascia researcher and author
- Tom Myers: *Anatomy Trains,* Fascia expert/author
- Diane Lee PT,DPT: *The Pelvic Girdle*
- A. Vleeming: muscle slings
- Bruno Bordoni, et. al.: Biotensigrity or Fascintegrity

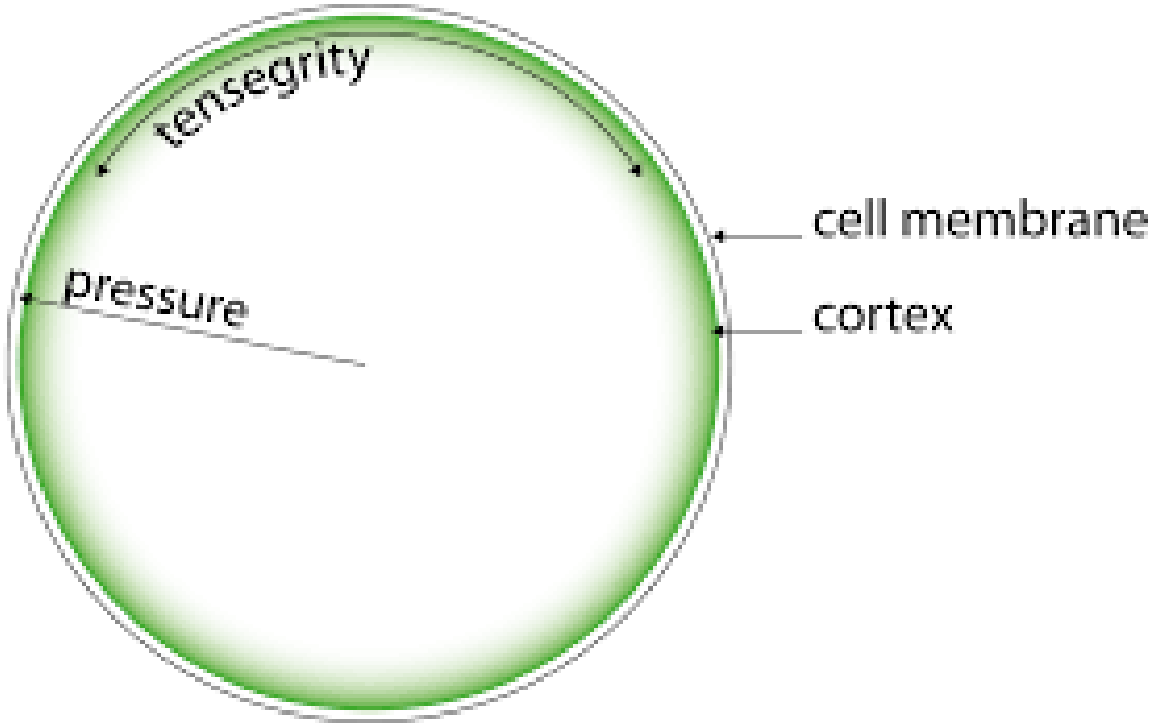
Tensigrity: Tension + Intregity

Biotensigrity: is the application of tensegrity principles to biological structures.

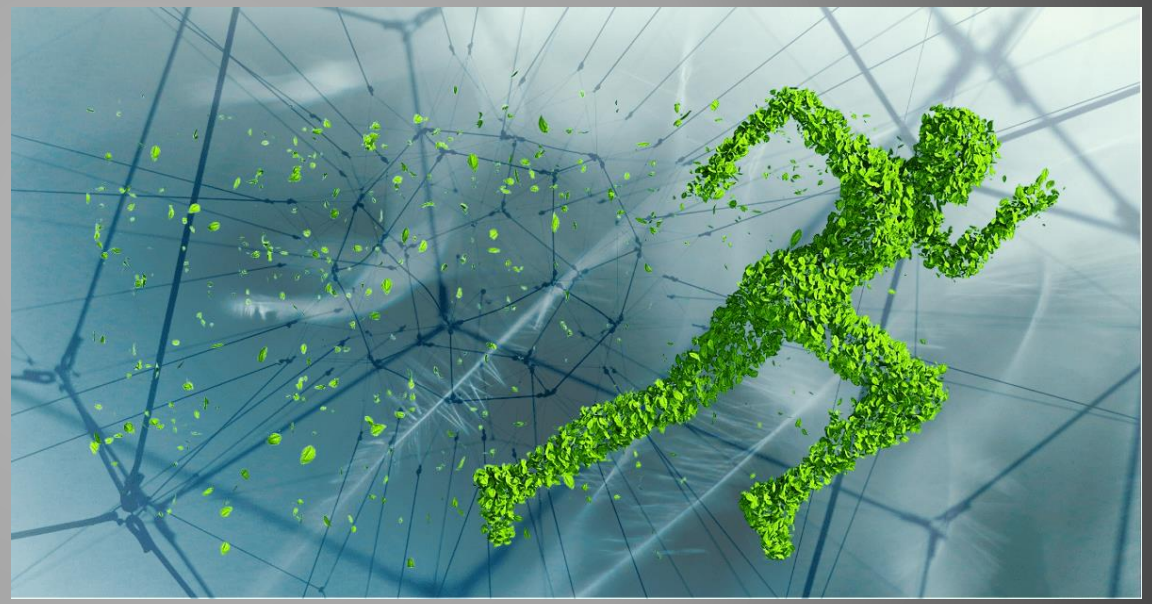


Cellular Biotensigrity





Biotensigrity => Fascintegrity



Fascia

- ‘Fascia’ is a vague term that is derived from the Latin for a band or bandage. It has long been used by gross anatomists to embrace a spectrum of undifferentiated mesenchymal tissues that wrap around what are sometimes regarded as being the more ‘specialized’ organs and tissues of the body, or form a packing material between them.

  -Mike Benjamin (2009)

Benjamin et al.

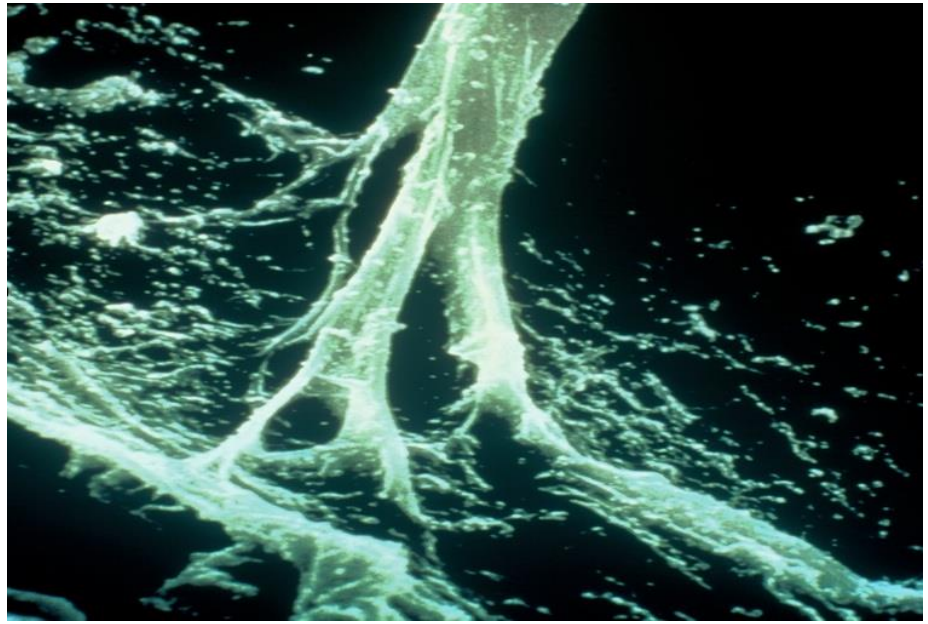
- Looked at overview of research conducted on fascia and its primary functions
- Superficial fascia conveys blood vessels and nerves to and from the skin
- Promotes movement between skin and deeper structures
- Deeper fascia helps for connections between muscles and muscle to bone

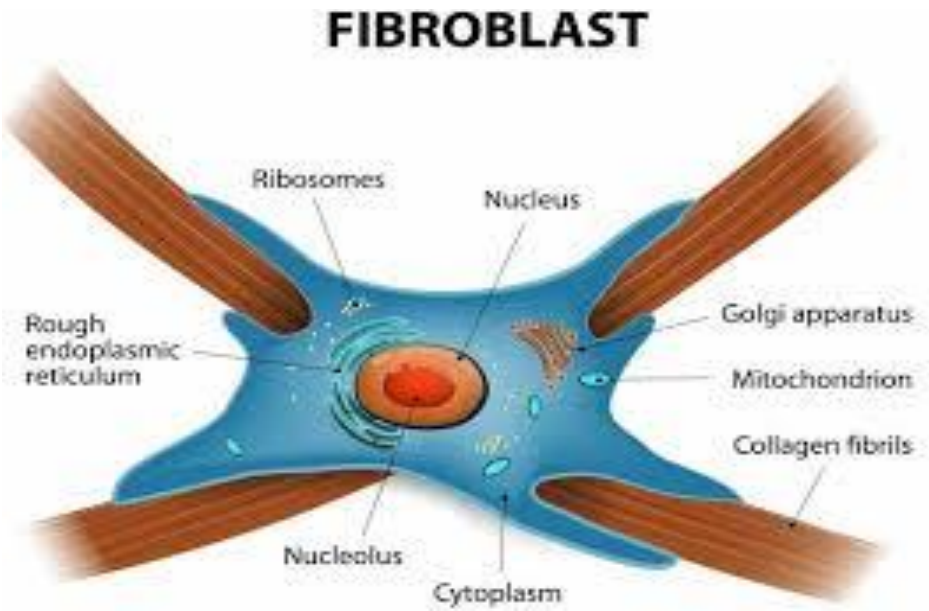
Benjamin et al. (cont)

- Deeper fascia demonstrates networks of vessels with strong neural innervation to the vessels and small amounts within the fascia itself
- Deeper fascia can be distinctly separated from the surrounding epimysium by a gel-like loose connective tissue that allow gliding and is rich in fibroblast
- Strong proponent of force dissipation

Histology

- The dominant cell is a fibroblast, although the accumulation of actin stress fibers within these cells in response to mechanical loading has led some authors to consider many of these cells to be myofibroblasts (Schleip et al. 2007)




FIBROBLAST
Ribosomes
Nucleus
Rough endoplasmic reticulum
Golgi apparatus
Mitochondrion
Collagen fibrils
Nucleolus
Cytoplasm

Nash et al. 2004

- The cutaneous ligaments do extend from the deep fascia and help assist anchoring the integument and are more widespread and assist with resisting many forces including gravitational.

Langevin 2004

- Fibroblasts grown in tissue culture have been shown to react within minutes to a variety of mechanical stimuli (stretch, pressure, traction, shear forces) with cellular responses ranging from changes in intracellular calcium and ATP release, to signaling pathway activation, actin polymerization

Langevin 2004 (cont)

- Externally applied mechanical forces in loose connective tissue are likely to have substantial effects on fibroblast mechanical signal transduction processes.
- Fibroblasts may participate in a body-wide signaling system responding to mechanical forces and influencing other physiological systems.

Langevin et al.2005&2006

- Areolar tissue demonstrates most cell diversity…rich in fibroblast that communicate via gap junctions assisting with mechanotransduction
- The fibroblast do respond to stretch by changing shape via the cytoskeleton

Langevin et al 2004 & 2006

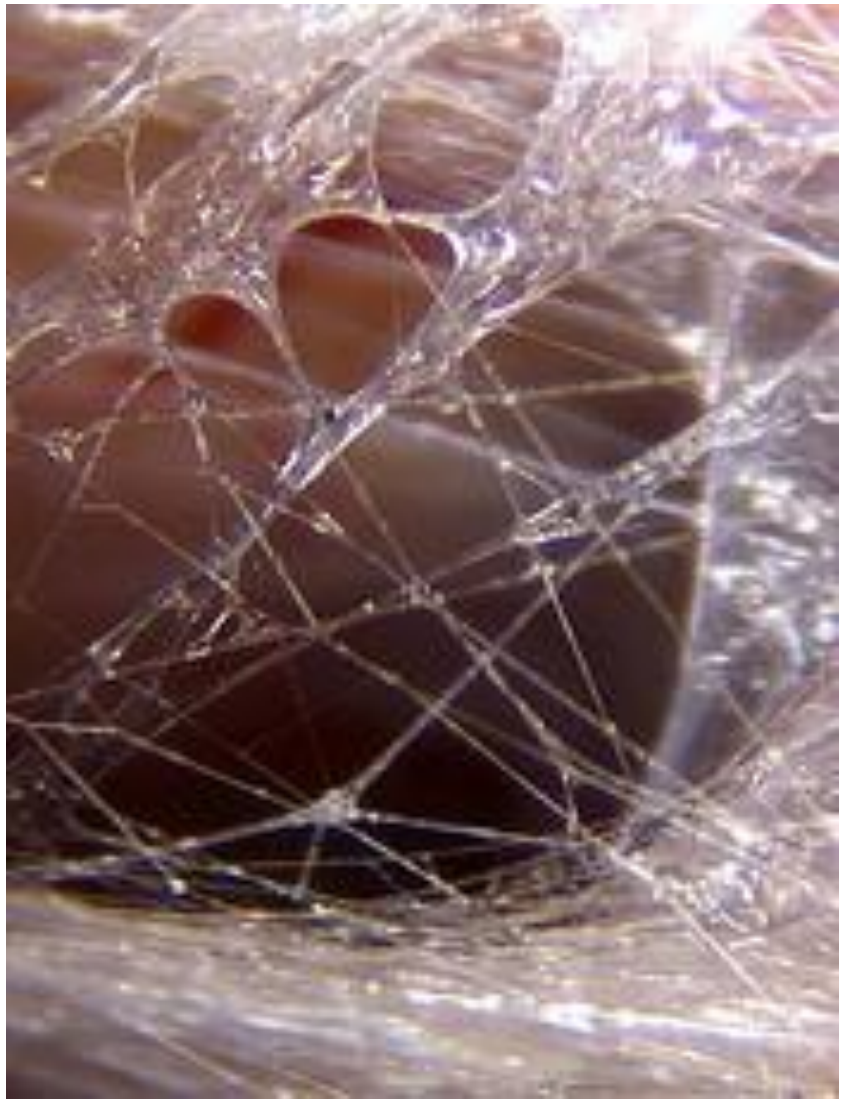
Connective tissue is continuous throughout the body and is rich with fibroblasts which communicate with each other via gap junctions.

Therefore, fascia can serve as a total body mechanosensitive communication system for the body similar to that of the nervous system.

Neurophysiology

- Fascia is innervated by:

- Type I Mechanoreceptors
  - Inhibit/recruit Type I Mm.
- Type II Mechanoreceptors
  - Inhibit/recruit type II Mm.
- Type III Mechanoreceptors
  - Wide inhibitory/Excitatory effects
- Type IV Mechanoreceptors
  - Pain receptors



Clinical Neurology: Mechanoreceptors

- Type I
  - Firing: Beginning and end range
  - Location: Fascia and Superficial Joint capsule
  - Recruit/Inhibit Type I Muscle Fibers
  - Decrease Pain
  - Slow adapting, activate with HOLD/STRETCH

- Type II
  - Firing: Beginning and mid range
  - Location: Fascia and joint capsule
  - Recruit/Inhibit Type II muscle fibers
  - Decrease pain/Inc ROM
  - Fast adapting, activate with mid range oscillation

Clinical Neurology: Mechanoreceptors

- Type III
  - Firing: QUICK STRETCH in mid/end range (Thrust Manipulation)
  - Location: Fascia and joint capsule
  - SLOW adapting
  - **Huge inhibitory affect over multiple spinal cord levels**
  - Decrease pain/Inc ROM
  - Recruit OR inhibit mm.
  - Sympathetic Effects

Clinical Neurology
Type IV Mechanoreceptors: Pain Receptors

- C Fibers
  - Unmyelinated, slow speed of conduction
  - Heat travels along this path
  - Non adaptive- pain may continue after stimulus removed
- A Fibers
  - Myelinated, fast conducting
  - Cold travels along this path
- Location
  - Blood vessels, bone, type I collagen
  - Not found in muscles

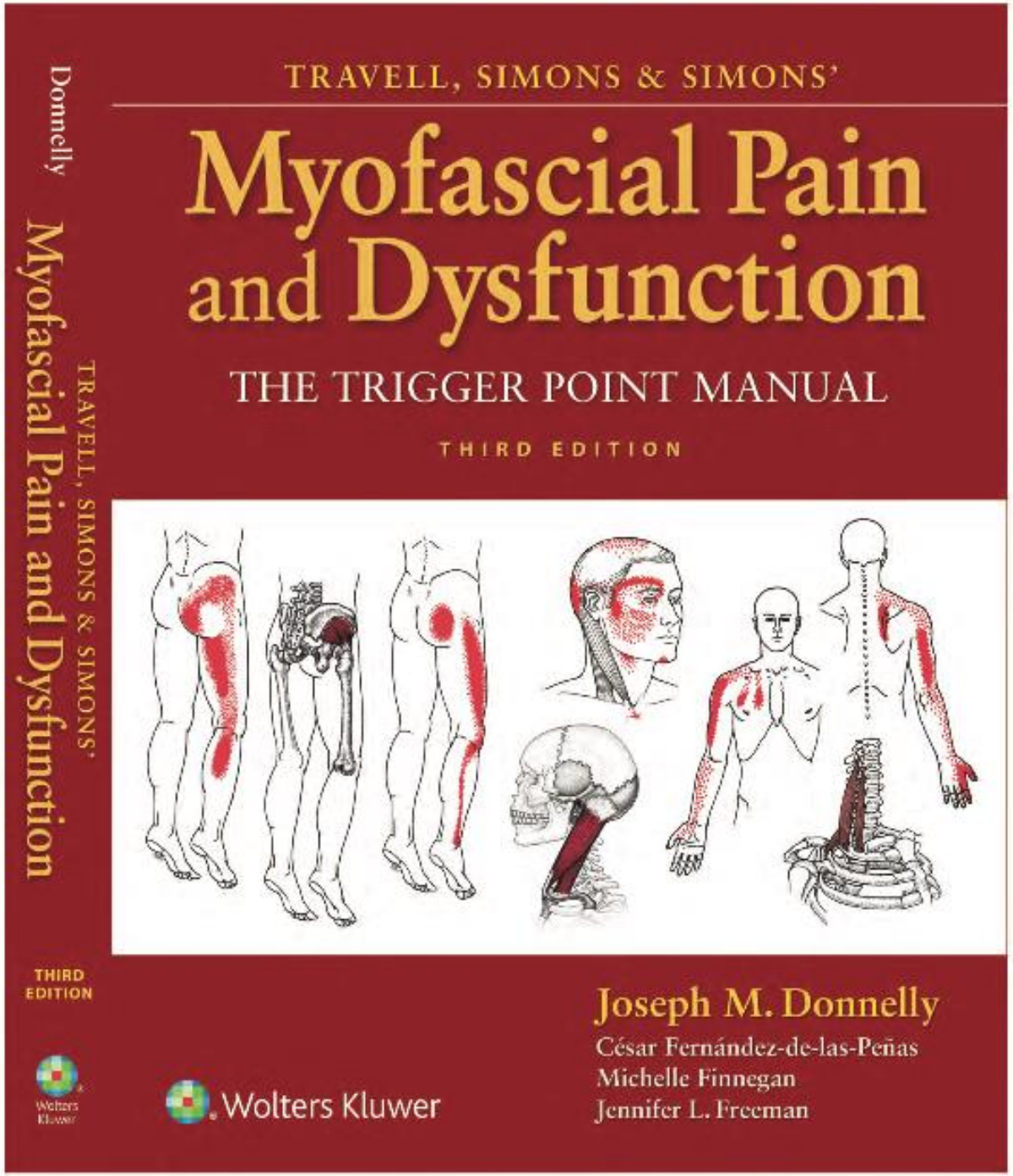
Table 1 Mechanoreceptors in fascia

Receptor type	Preferred location	Responsive to	Known results of stimulation
Golgi Type Ib	● Myotendinous junctions ● Attachment areas of aponeuroses ● Ligaments of peripheral joints ● Joint capsules	● *Golgi tendon organ*: to muscular contraction. ● *Other Golgi receptors*: probably to **strong stretch** only	**Tonus decrease** in related striated motor fibers
Pacini and Paciniform Type II	● Myotendinous junctions ● deep capsular layers ● spinal ligaments ● **investing muscular tissues**	**Rapid pressure changes** and vibrations	Used as proprioceptive feedback for movement control **(sense of kinesthesia)**
Ruffini Type II	● Ligaments of peripheral joints, ● Dura mater ● outer capsular layers ● and other **tissues associated with regular stretching**.	● Like Pacini, yet also to **sustained pressure**. ● Specially responsive to **tangential forces** (lateral stretch)	**Inhibition of sympathetic activity**
Interstitial Type III and IV	● **Most abundant receptor type**. Found almost everywhere, even inside bones ● Highest density in periosteum.	● Rapid as well as sustained pressure changes. ● 50% are **high-threshold** units, and 50% are **low-threshold** units	● Changes in **vasodilation** ● plus apparently in **plasma extra-vasation**

Schleip 2002

Bouffard et al. 2008

- Small bouts of stretching has been shown to decrease transforming growth factor beta (TGF-β1)mediated fibrillogenesis
- This may be correlated to implementing manual therapy techniques to assist with decreasing scarring and fibrosis after trauma, injury, or surgery


TRAVELL, SIMONS & SIMONS'
Myofascial Pain and Dysfunction
THE TRIGGER POINT MANUAL
THIRD EDITION
Joseph M. Donnelly
César Fernández-de-las-Peñas
Michelle Finnegan
Jennifer L. Freeman
Wolters Kluwer
Donnelly
TRAVELL, SIMONS & SIMONS'
Myofascial Pain and Dysfunction
THIRD EDITION
Wolters Kluwer

Important things to remember about pain

- Definition: An upleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage
- Pain is subjective
  - Different experiences between different people
  - Different experiences by same person across different times
- Pain is closely related to emotional states

Muscle Pain

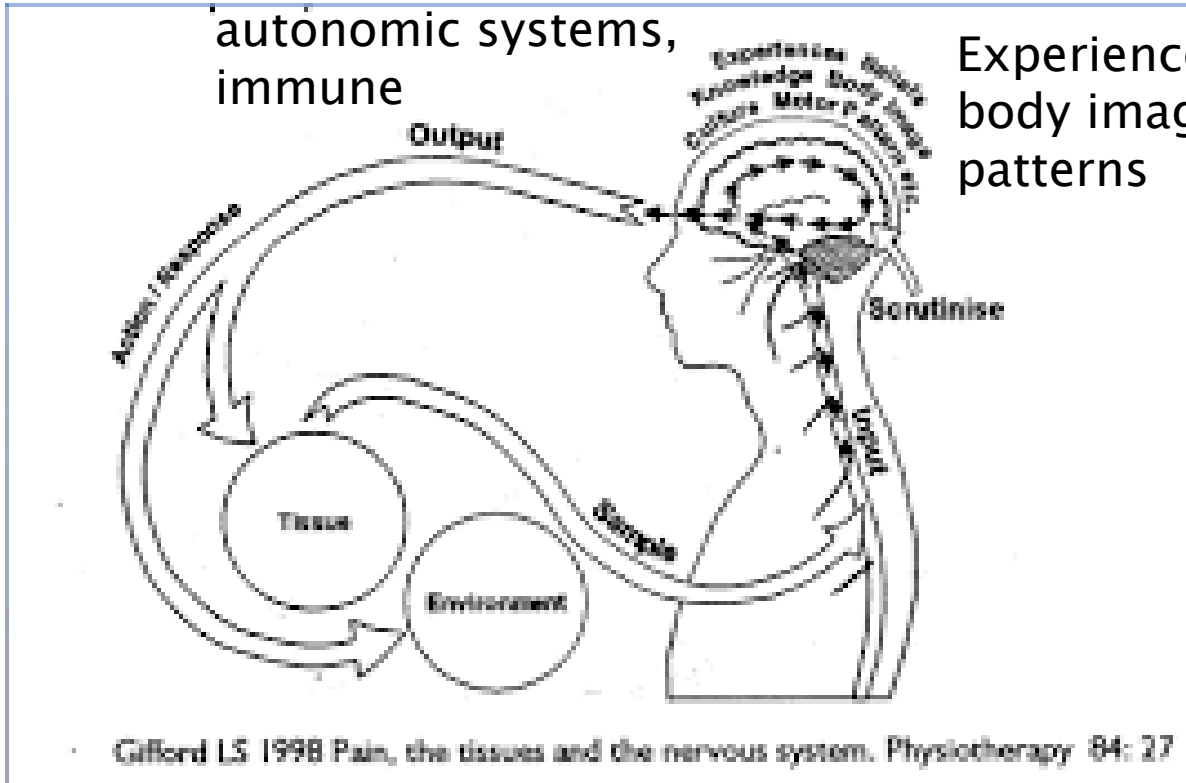
- Inhibited by descending nociceptive-modulating pathways
- Dynamic balance between activation of DH neurons and descending inhibitory systems
- Prolonged input from muscle nociceptors misinterpreted by CNS
- Signs and symptoms?

Characteristics of Muscle Pain

- *Aching, cramping pain*, difficult to localize and can be referred to deep somatic structures
- Muscle pain activates *unique cortical structures*
- Inhibited more strongly by descending pain-modulating pathways
- Activation of muscle nociceptors is much more effective at inducing neuroplastic changes in the dorsal horn neurons

Circular Model of Pain

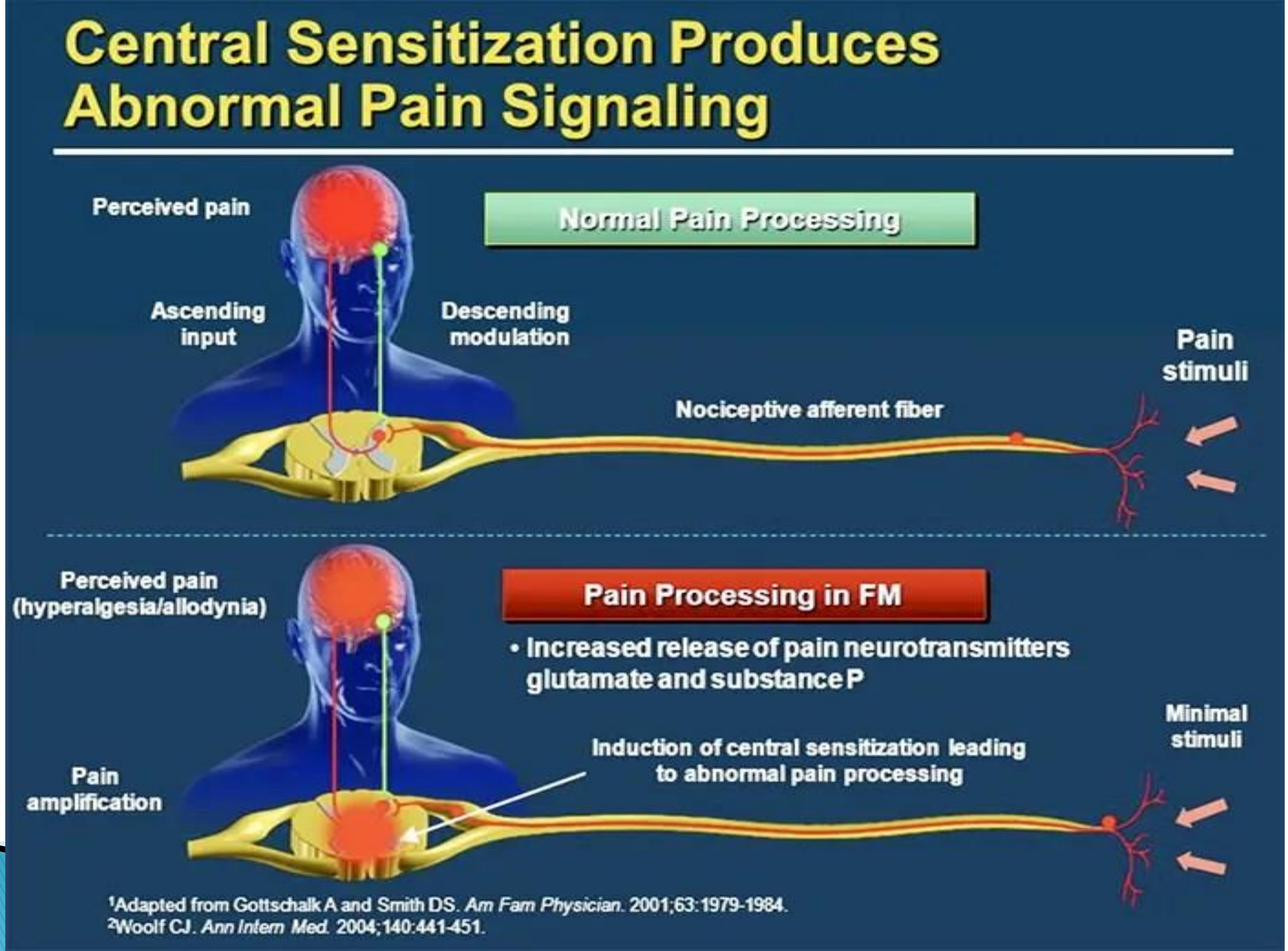
Output: Motor, endocrine, autonomic systems, immune



Gifford LS 1998 Pain, the tissues and the nervous system. Physiotherapy 84: 27

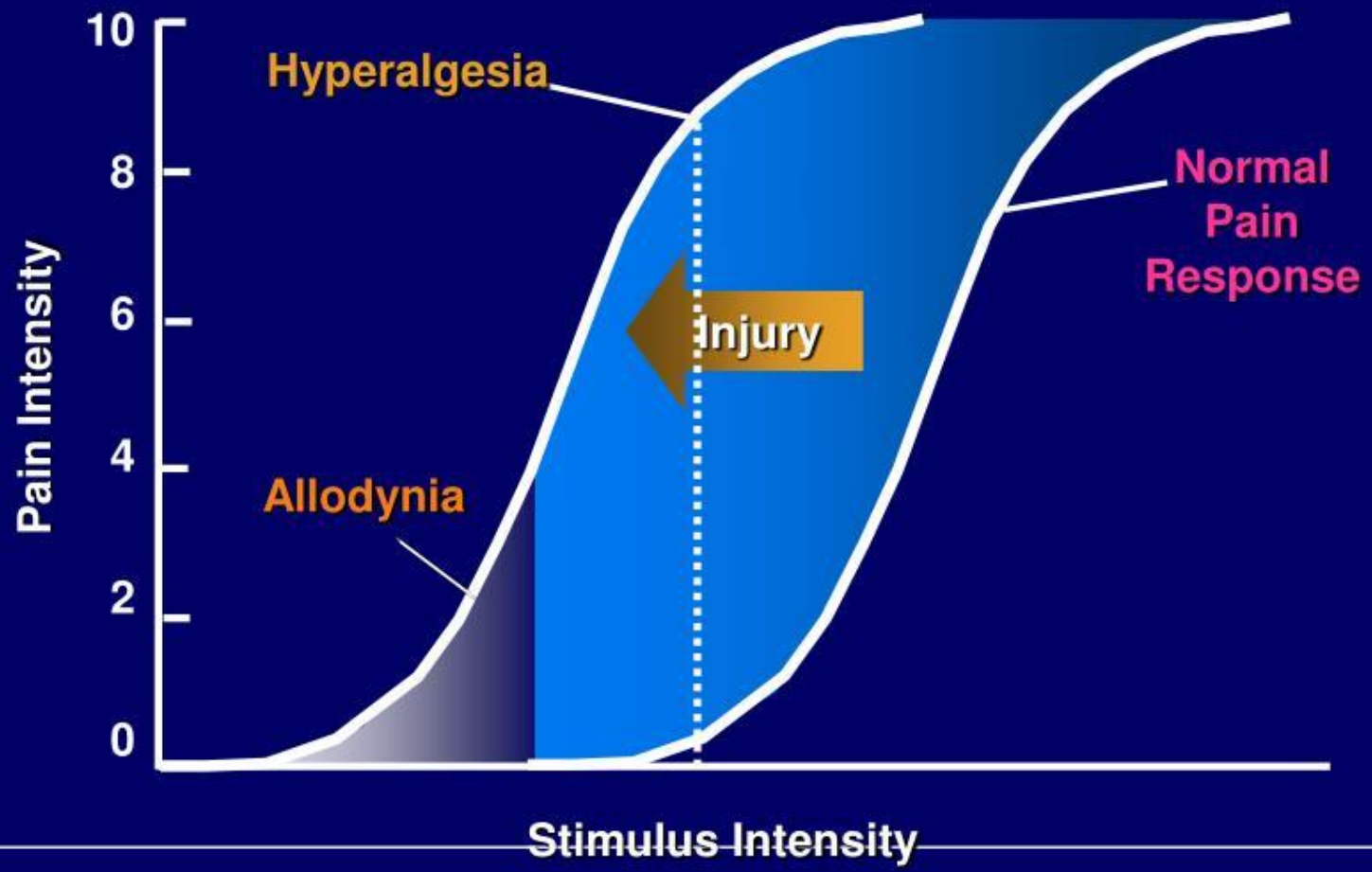
Experiences, attitudes, beliefs, body image, culture, motor patterns

Central Sensitization Produces Abnormal Pain Signaling



[1]Adapted from Gottschalk A and Smith DS. *Am Fam Physician*. 2001;63:1979-1984.
[2]Woolf CJ. *Ann Intern Med*. 2004;140:441-451.

Pain Sensitization



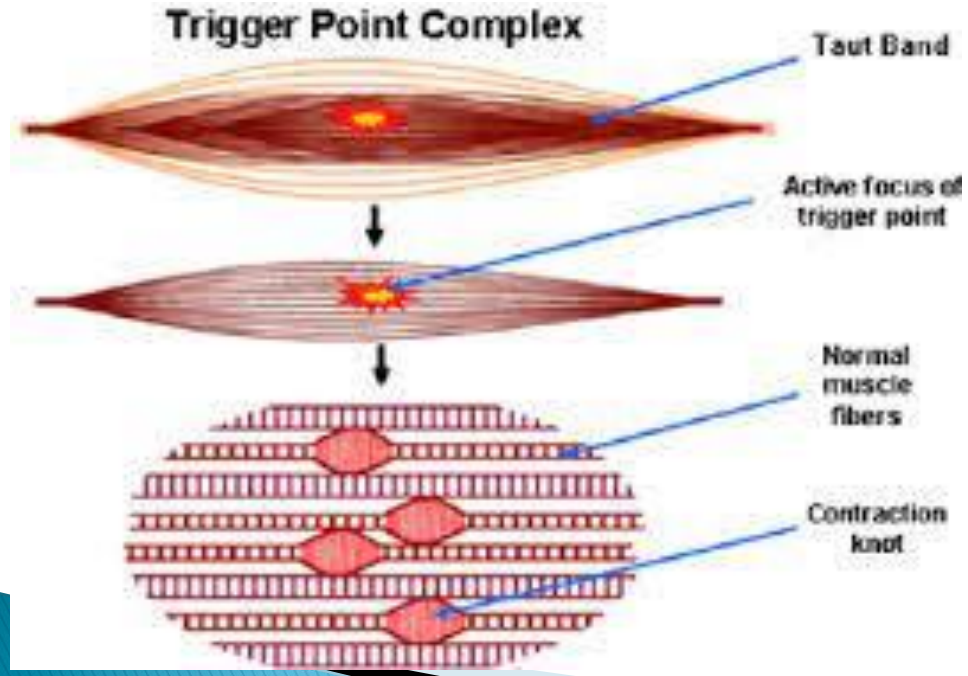
Gottschalk and Smith. *Am Fam Physician*. 2001.

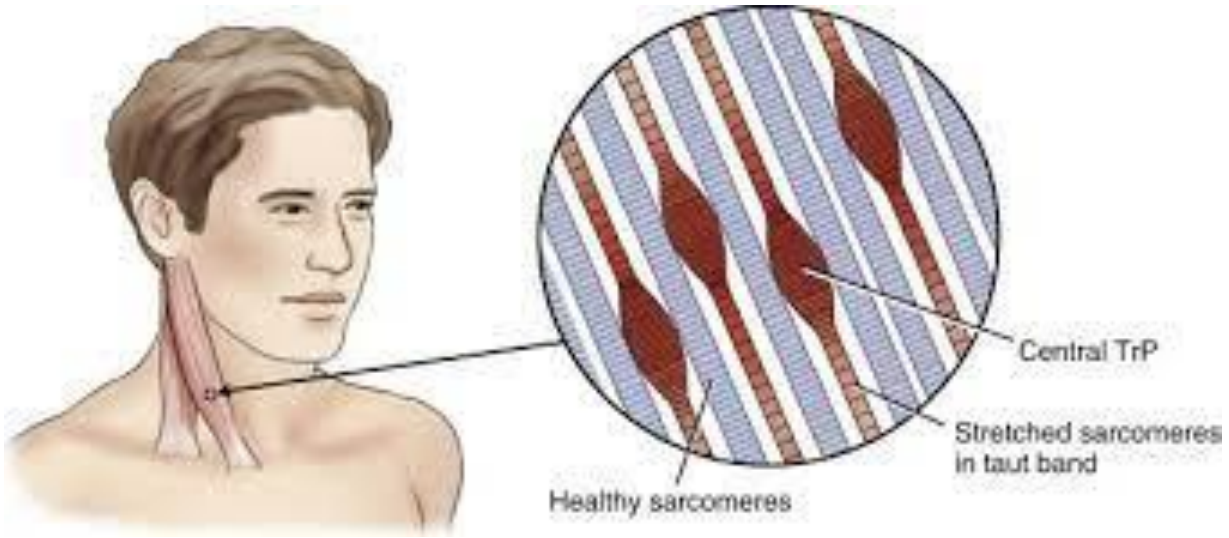
Trigger Point Proposed Definition

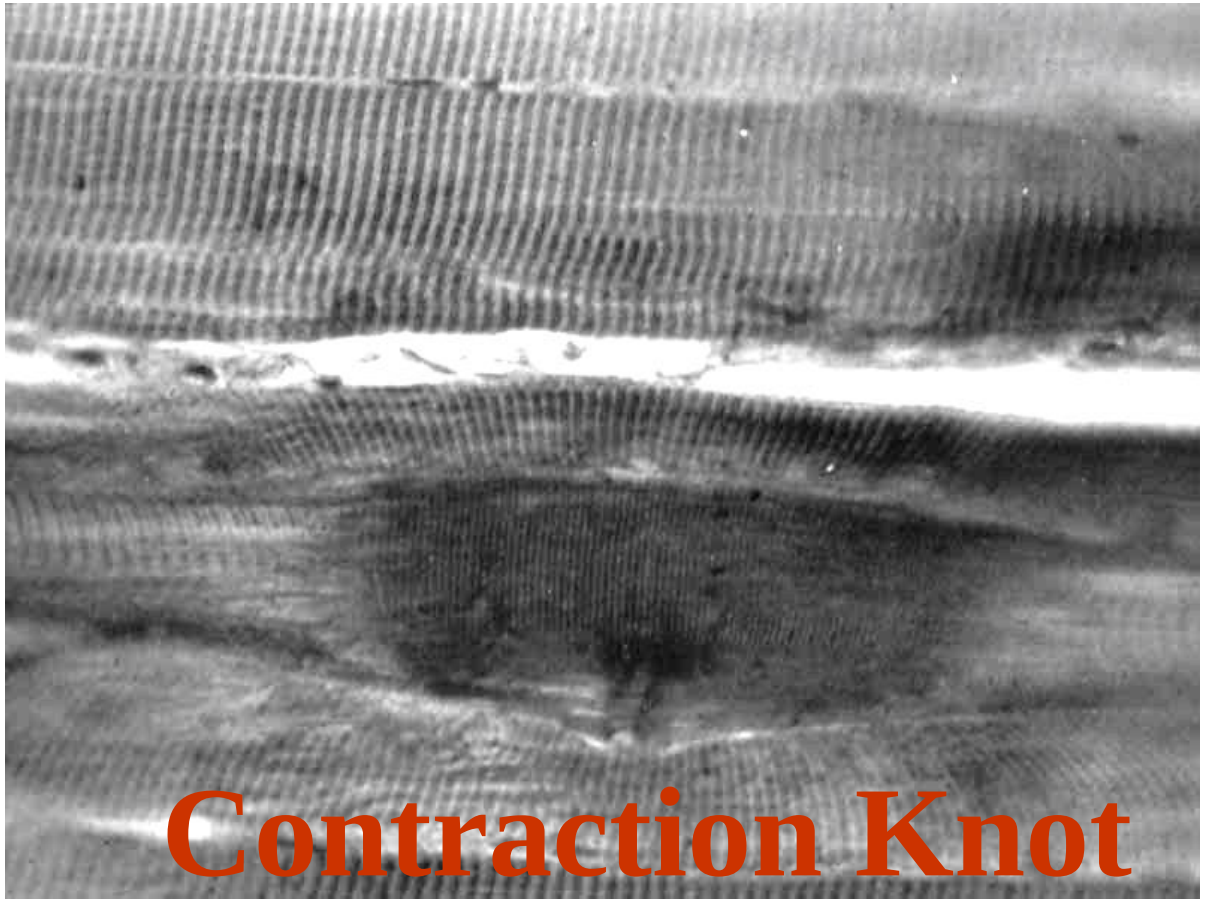
- “ a hyperirritable spot in a taut band of a skeletal muscle that is painful on compression, stretch, overload or contraction of the tissue which usually responds with a referred pain that is perceived distant from the spot.”

What is a trigger point?

- Palpable localized areas of hyperalgesic muscle tissue typically located in a taut band of fibers.







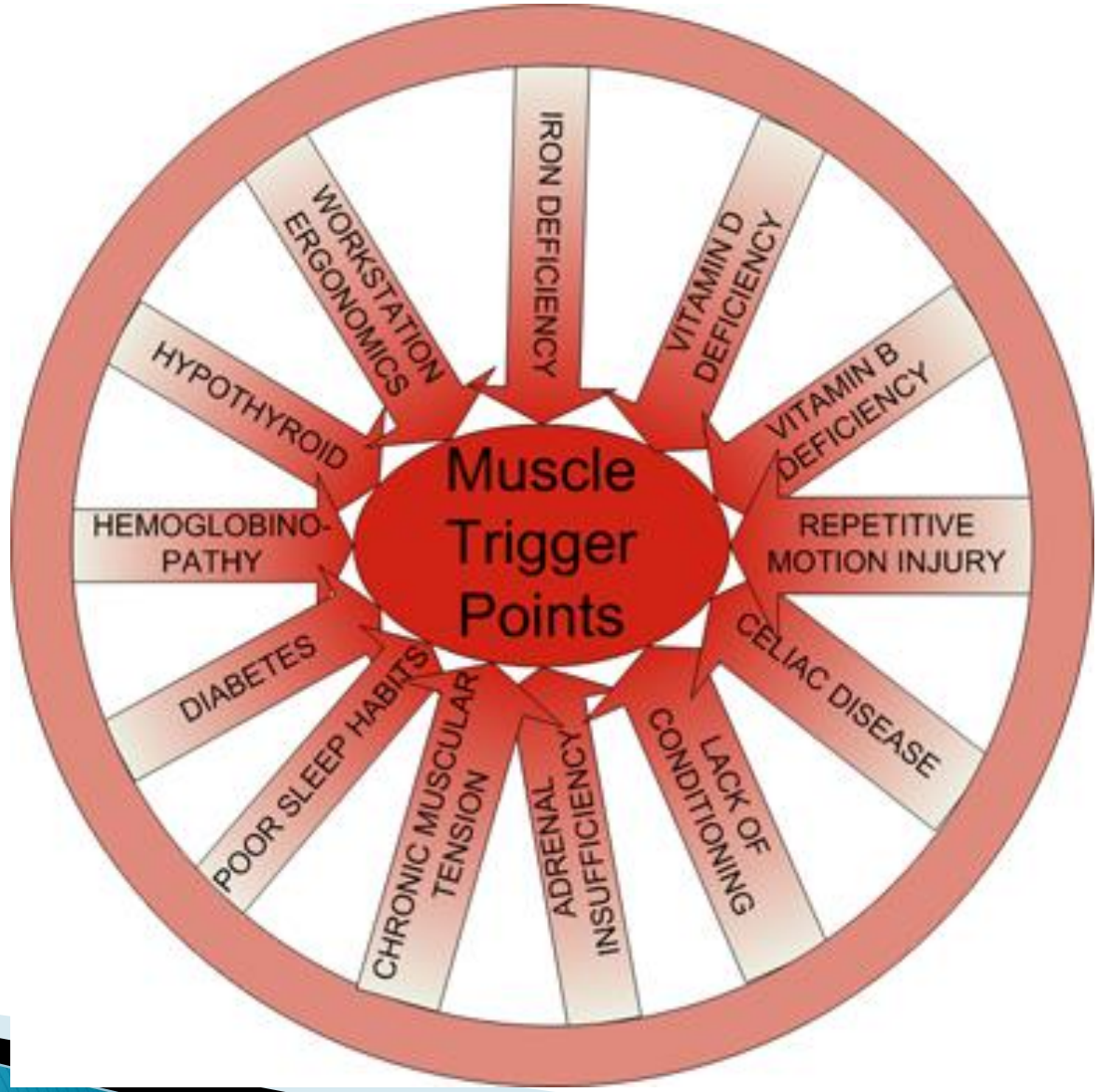
Donnelly JM, Fernández-de-Las-Peñas C, Finnegan M, Freeman JL. Travell, Simons and Simons' Myofascial Pain and Dysfunction: The Trigger Point Manual 3rd ed.; Philadelphia, PA: Wolters Kluwer Health; 2019.

How do we use TP's as a "window in" for chronic pain patients?

- Trigger points activate the following areas of the brain
  - Periaqueductal gray
  - Anterior cingulate cortex
  - Amygdala

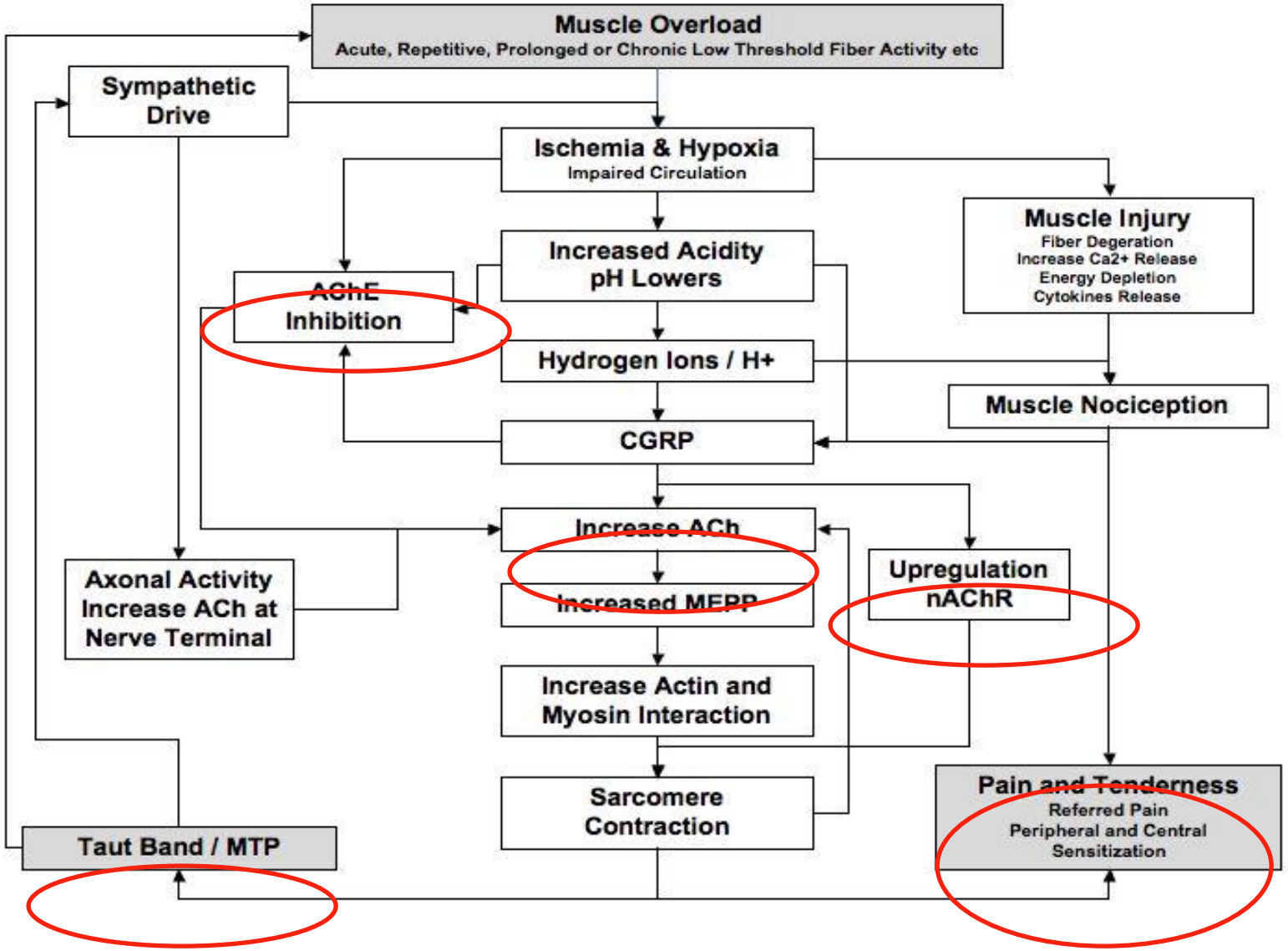
- By diffusing trigger points we are changing the chemical makeup of the treatment area and therefore assisting in regulation of these pathways as well as providing inhibition of the nociceptors

Systemic Perpetuating Factors



Why do we get trigger points?

- Muscle overload
  - Due to excessive eccentric or concentric exercise
  - Prolonged shortened or lengthened position of the muscle
- Radicular pain situations
- Trauma
- Systemic factors/visceral pain



Dommerholt, J. and McEvoy, J., Myofascial Trigger Point Release Approach, in Orthopaedic Manual Therapy; from Art to Evidence, C. Wise, Editor., F.A.

What is happening to cause a trigger point?

- Contraction of the sarcomere
  - Contraction occurs without release
  - Constant contraction is a direct result of the increase in Acetylcholine (ACH) at the neuromuscular junction
    - A trigger point occurs when there is excessive release of Acetylcholine, increased activation of nociceptive receptors, and inhibition of Acetylcholinesterase (ACHe) release at the motor end plate. This enzyme (ACHe) is what inhibits the release of ACH.
      - TP release acts at the trigger point to change this chemical relationship. As ACHe release is restored→ACH is inhibited and the mm fiber is able to relax.
      - TP release also works to improve natural opioid-mediated pain suppression by stimulating local alpha-delta fibers, which in turn stimulate inhibitory interneurons and decrease the process of normal pain transmission to the sensory cortex.

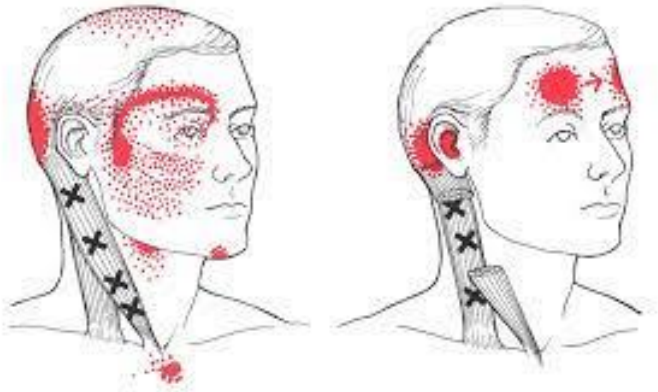
Fernández-de-Las-Peñas C, Dommerholt J. International consensus on diagnostic criteria and clinical considerations of myofascial trigger points: a delphi study. *Pain Med.* 2018;19(1):142-150.

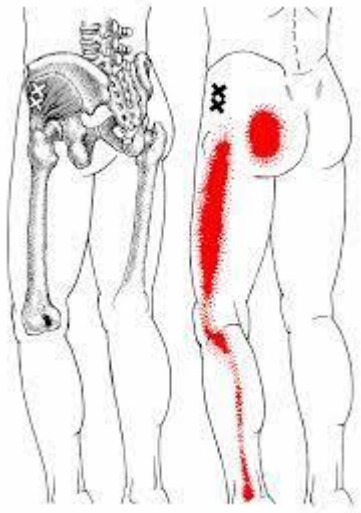
Box 1-1 Clinical characteristics of trigger points

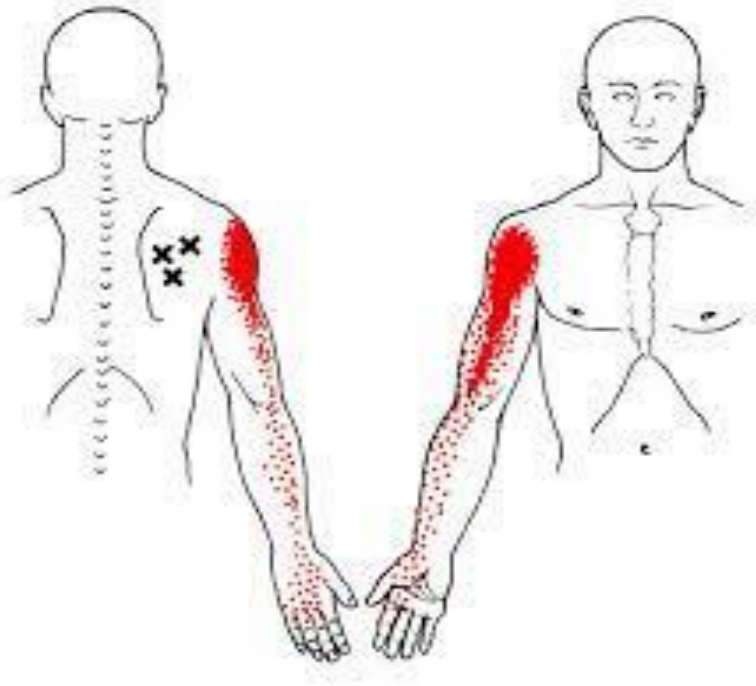
	Common Findings of TrPs	
Simons, Simons and Travell[49]	■ Palpable taut band with cross-fiber flat or pincer palpation ■ Hypersensitive spot within the taut band ■ Local twitch response when adequately stimulated ■ May produce motor and autonomic phenomena ■ May prevent full lengthening of the muscle (restricts range of motion) ■ May cause inhibition weakness of the muscle	
	Active TrPs	**Latent TrPs**
	■ Refers or produces a patient's recognized pain ■ Spontaneous local or referred pain	■ Local or referred unrecognized pain ■ Painful only when palpated or needled
Expert opinion Delphi study[52]	■ Reproduce any symptom(s), not just pain, experienced by the patient ■ Patient recognizes the symptom as familiar ■ The symptom(s) may be absent at the moment of the examination, but will appear during manual palpation	■ Do not reproduce symptoms experienced by the patient ■ Patient does not recognize symptoms caused by cross-fiber flat or pincer palpation

Two Types of Trigger Points

- Active Trigger Point- palpation of a trigger point that reproduces a familiar pain to the patient… “THAT’S MY PAIN”
- Latent Trigger Point- palpation that facilitates a local pain reaction, but of unfamiliar nature to the patient… “THAT HURTS…BUT IT’S NOT THE PAIN I COME TO THERAPY FOR”







Biotensigrity and Muscle Slings

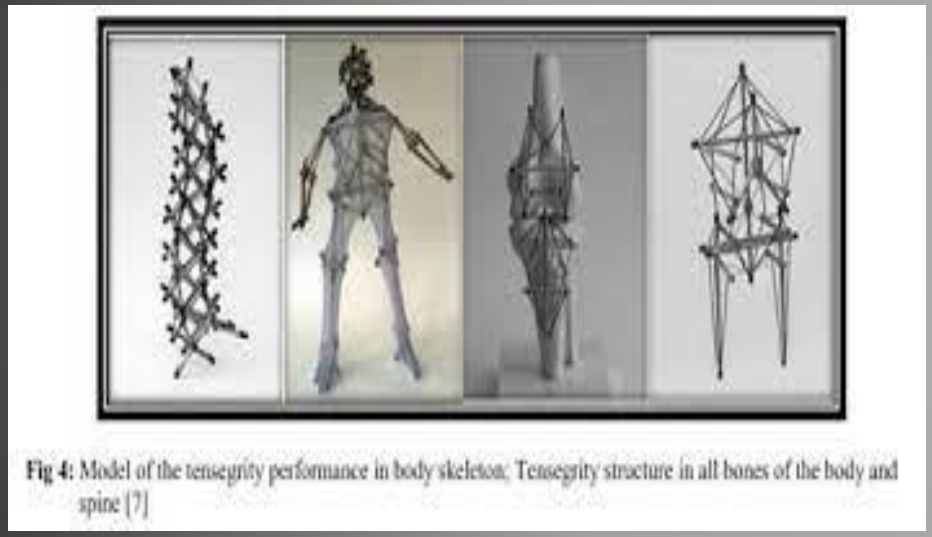
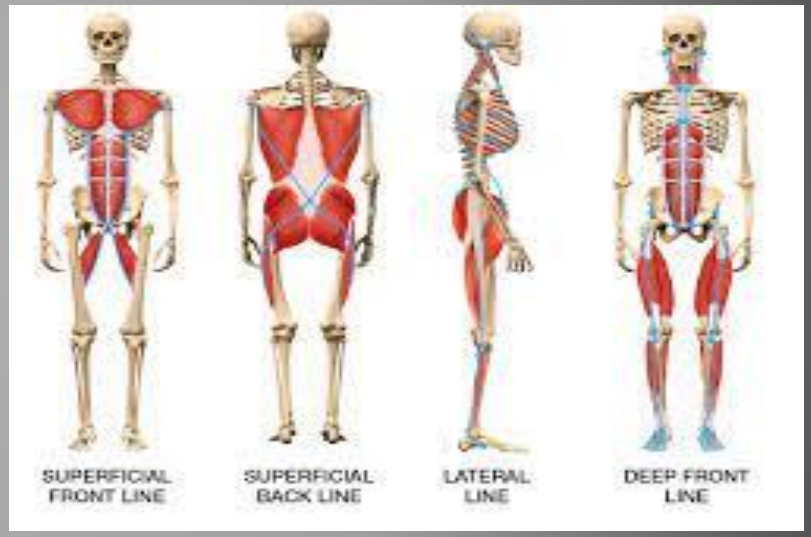


Fig 4: Model of the tensegrity performance in body skeleton; Tensegrity structure in all bones of the body and spine [7]



Vladimir Janda: Crossed Syndromes

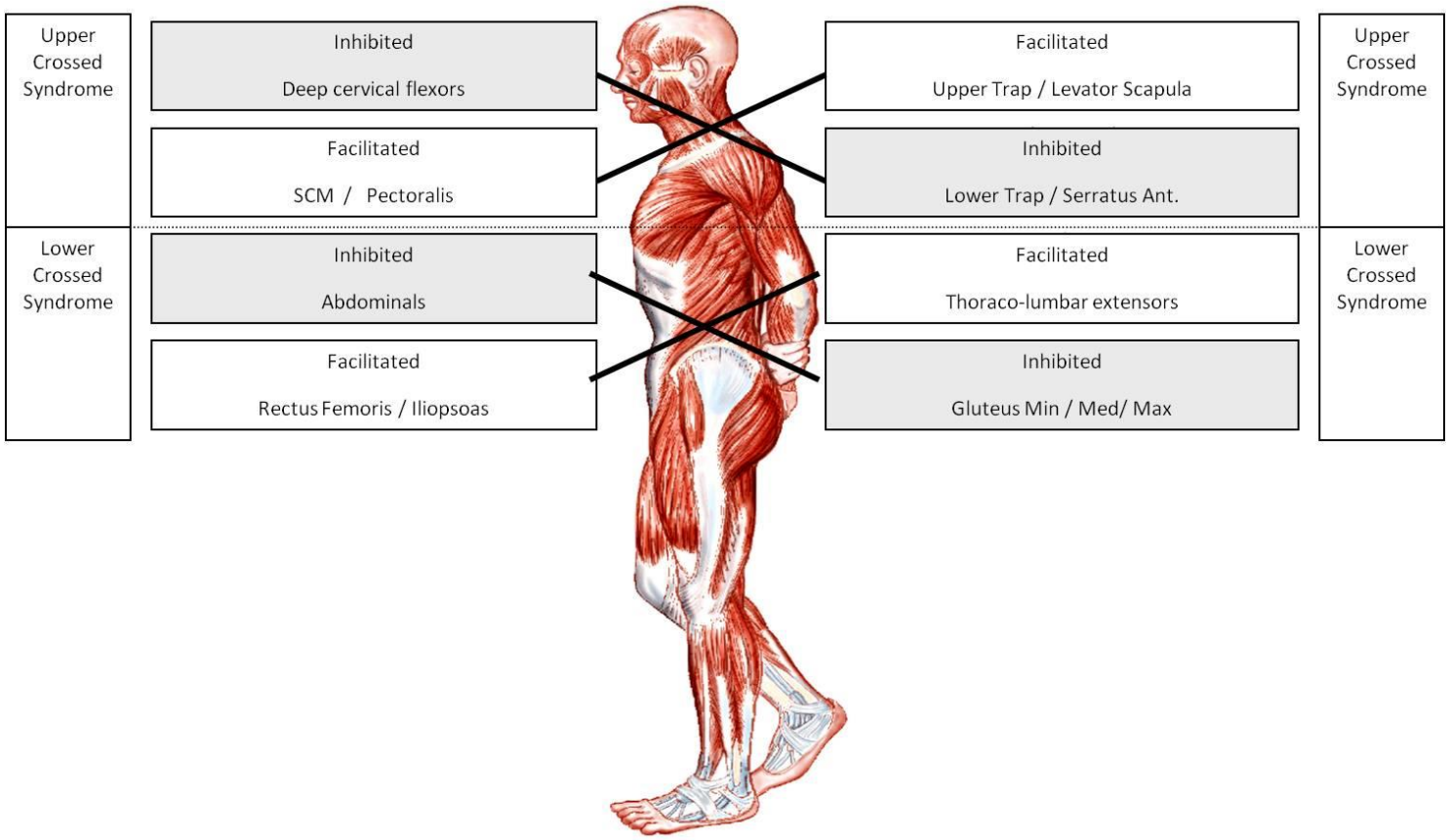


Figure 1 : Janda's Muscle Imbalance Syndromes

Functional Pathology “Lesion”: Vladimir Janda

- Impairment in the ability of a structure or physiological system to perform its job: this impairment often manifests in the body through reflexive changes
- Clinicians must visualize the dysfunction virtually by understanding the complex interactions of structures and systems. INTRINSIC DYSFUNCTION!
- This functional approach allows us to better understand the cause of the pathology rather than focus on the pathology itself.

Assessment and Treatment of Muscle Imbalance: The Janda Approach

Janda and Intrinsic Function

- **Physiological Function**: the response of tissue to dysfunction and damage as well as the healing process itself.
- **Biomechanical Function**: encompasses the osteo and arthrokinematics involved in human movement and the resulting force vectors imparted on tissues. “Kinetic Chain”
- **Neuromuscular Function**: relates to the sensorimotor aspects of movement such as proprioception and reflexes. Requires understanding of motor control and motor relearning for proper exercise and corrective interventions

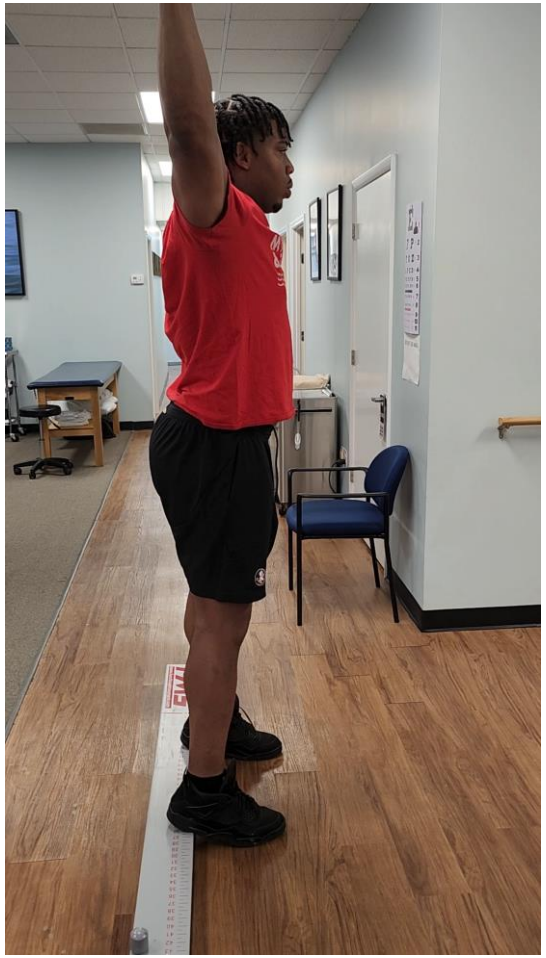
Assessment and Treatment of Muscle Imbalance: The Janda Approach

Extrinsic Function-Janda

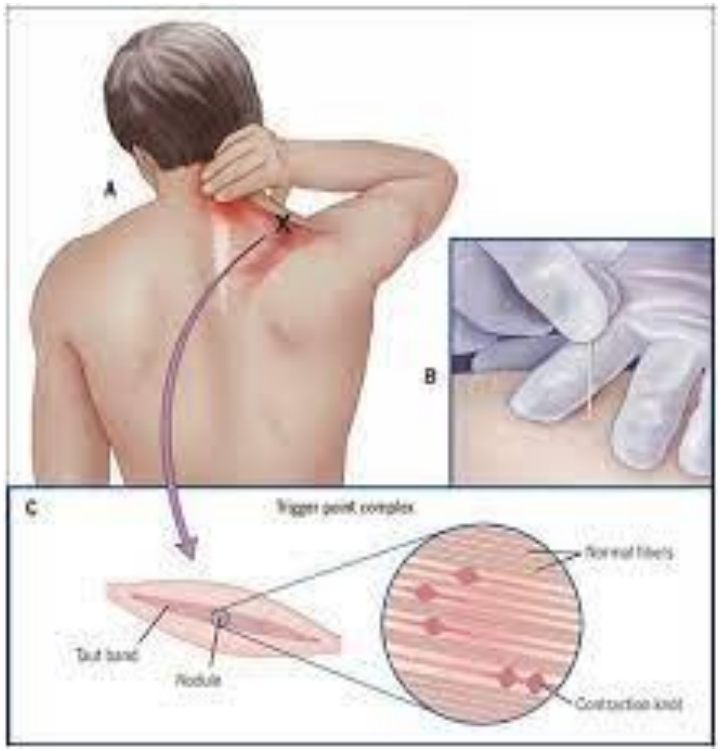
- Specific
- Purposeful
- Synergistic
- Requires Integration of all three intrinsic systems
- Muscle Balance: relative equality of muscle length or strength between agonist and agonist=normal movement & function
- Muscles become unbalanced due to adaptation or dysfunction to complex movement patterns-common in athletes!
- Unbalanced System leads to Dysfunction-Functional Pathology

Functional Pathology

Functional Pathology: Corrected?

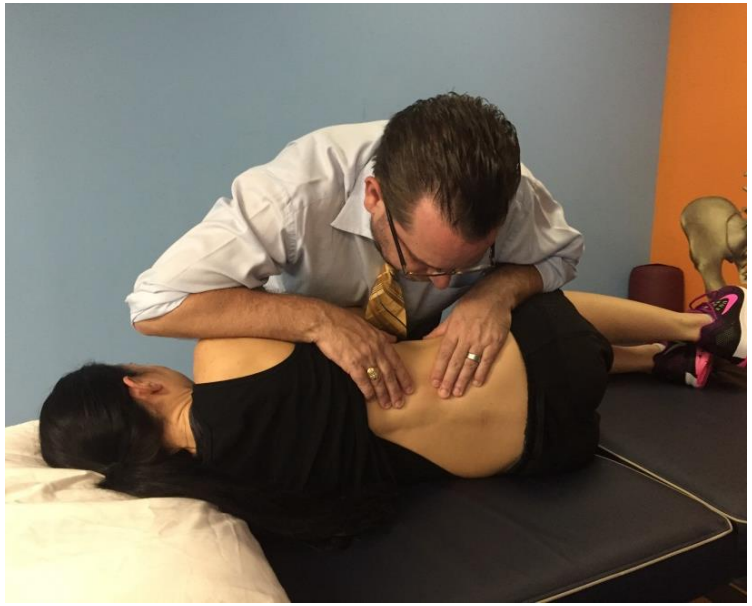


What is in your wallet (toolbag)?



STM/Myofascial Release

- The use of manual contact for evaluation and treatment of soft-tissue restriction and pain with the eventual goal of the relief of those symptoms to improve motion and function.



Myofascial Techniques

- Cross Fiber
- Cross Fiber with Motion
- Passive Pump
- Active Pump
- PNF Techniques
  - Contract-Relax
  - Hold Relax
- Trigger Point
- Strain/Counterstrain
- Positional Release

Cross Fiber

- This technique is applied perpendicular to the tissues line of stress. Used to recruit afferent mechanoreceptors in the skin, fascia, and muscle, which helps to inhibit pain and guarding.

Cross Fiber with Motion

- Same as Cross Fiber, only the target joint is taken through its ROM during the application of the technique (mild stretch). This technique is used to increase mechanoreceptor recruitment in the ligaments and joint capsules to inhibit pain and muscle guarding.

Muscle Pumping – Passive/Active

- Passive: Application of compression and tension through soft tissue in a parallel direction to affect the fluid dynamics of the tissue while applying a mild stretch through the tissue.
- Active: Perform the passive pump, then simultaneously have the patient actively contract the muscle while you release the manual pressure. This is a powerful tool to normalize trigger points.

Contract-Relax

- Development of tension in a muscle by isotonic contraction to facilitate the relaxation and therefore stretch a muscle. By facilitating the relaxation of muscles we can improve circulation and improve extensibility of myofascial tissues.
- To accomplish this, the muscle is placed in a maximally stretched position and resistance is applied to a muscle contraction of the muscle that is being stretched. Movement occurs during this contraction. Following this contraction, the limb is relaxed and upon relaxation, is actively or passively stretched further.

Hold-Relax

- Used to facilitate the relaxation of muscles to gain range of motion. This method uses an isometric contraction rather than an isotonic one.
- To achieve this, the limb is place in pain-free range and an isometric contraction is sustained. The limb is then moved into the new range.

Muscle Energy

- A manual technique that involves the voluntary contraction of a muscle in a precisely controlled direction, at varying levels of intensity, against a distinct counterforce applied by the sport rehabilitation specialist. Essentially, it is the use of muscle contraction to correct a joint's malalignment which occurs when the body becomes "unbalanced".

Muscle Energy Theory

- Malalignments occur due to muscle spasm, weakness, restricted mobility etc.
- Muscle contraction can be isometric, eccentric, concentric.
- Patient controls magnitude.
- A barrier restricts normal motion.
- Muscle contraction allows for improved relaxation and motion.

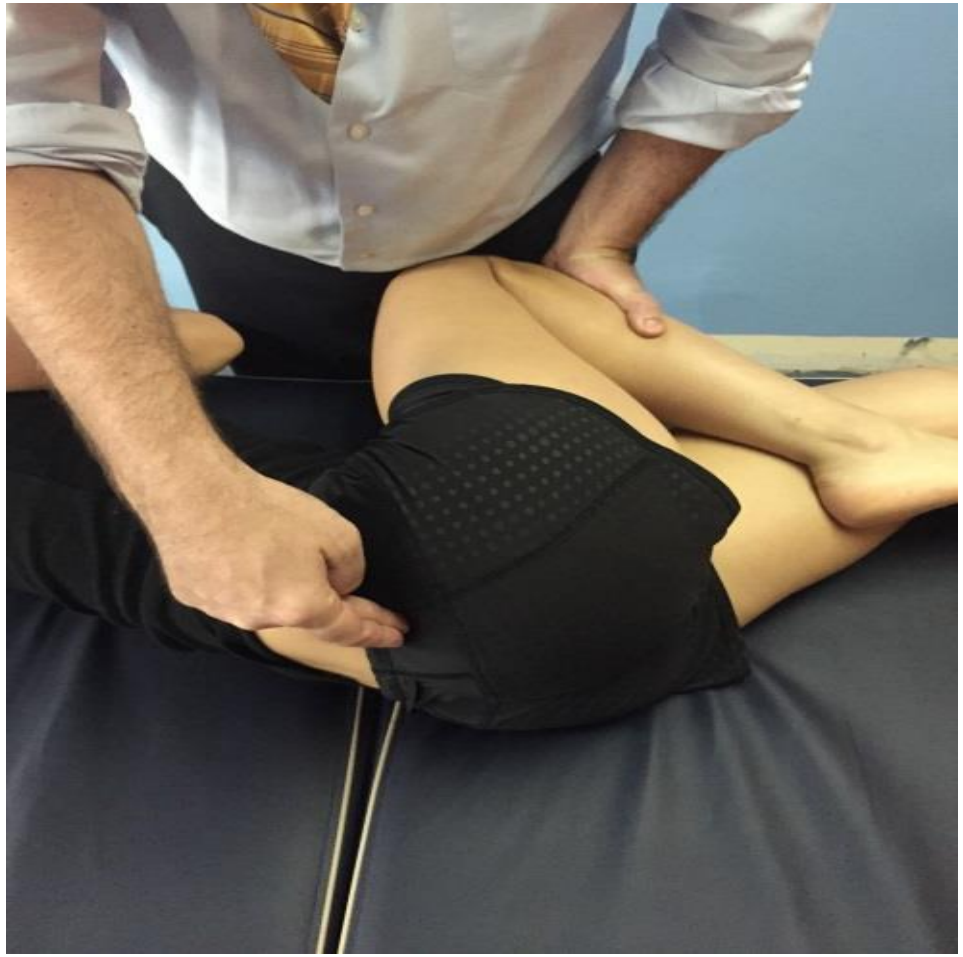
Muscle Energy Application

- Patient's segment is placed at end of barrier.
- Patient contracts muscle while rehabilitation specialist offers resistance.
- Muscle contraction is submaximal isometric contraction (2 oz), 5–10 s.
- Patient relaxes; segment is passively moved to the new barrier.
- 3–5 repetitions are performed.

Muscle Energy Application

- Repeat as prior slide for isotonic contraction but allow thru full ROM
- Resistance should allow motion at an even and controlled speed.
- Refractory period is needed
- Patient relaxes; segment is passively moved to the new barrier.
- 3-5 repetitions are performed.

Trigger Point Therapy



Trigger Point Therapy

- This is applying pressure to a trigger point while the muscle is on slack for 60-120 seconds. Pressure is released when the trigger point is no longer palpable under the finger of the practitioner. In many cases, the patient will feel warmth or tingling when this technique is utilized. This is a powerful tool to normalize trigger points.

Strain-Counterstrain Rationale

- Based on the work of Irvin Korr, Ph.D
  - *"Proprioceptors and Somatic Dysfunction"*
  - Journal of The American Osteopathic Association, March 1975, Vol 74 (7)
- Proposed a neural basis for joint dysfunction incriminating the muscle spindle

Strain-Counterstrain

- A passive positional procedure that places the body in a position of greatest comfort, thereby relieving pain by reduction and arrest of inappropriate proprioceptor activity that maintains somatic dysfunction.
- A mild over-stretching applied in a direction opposite to the false and continuing message of strain which the body is suffering. This is accomplished by shortening the muscle containing the false strain message so much that it stops reporting the strain (indirect technique).

Positional Release

- Based on strain-counterstrain
  - Difference is the use of a facilitating force
  - i.e. pillows, bolsters, etc
- Follows the same steps as strain-counterstrain
- Incorporates maintained compression on tender point
  - Suggested that maintaining contact exerts a therapeutic effect

Questions?