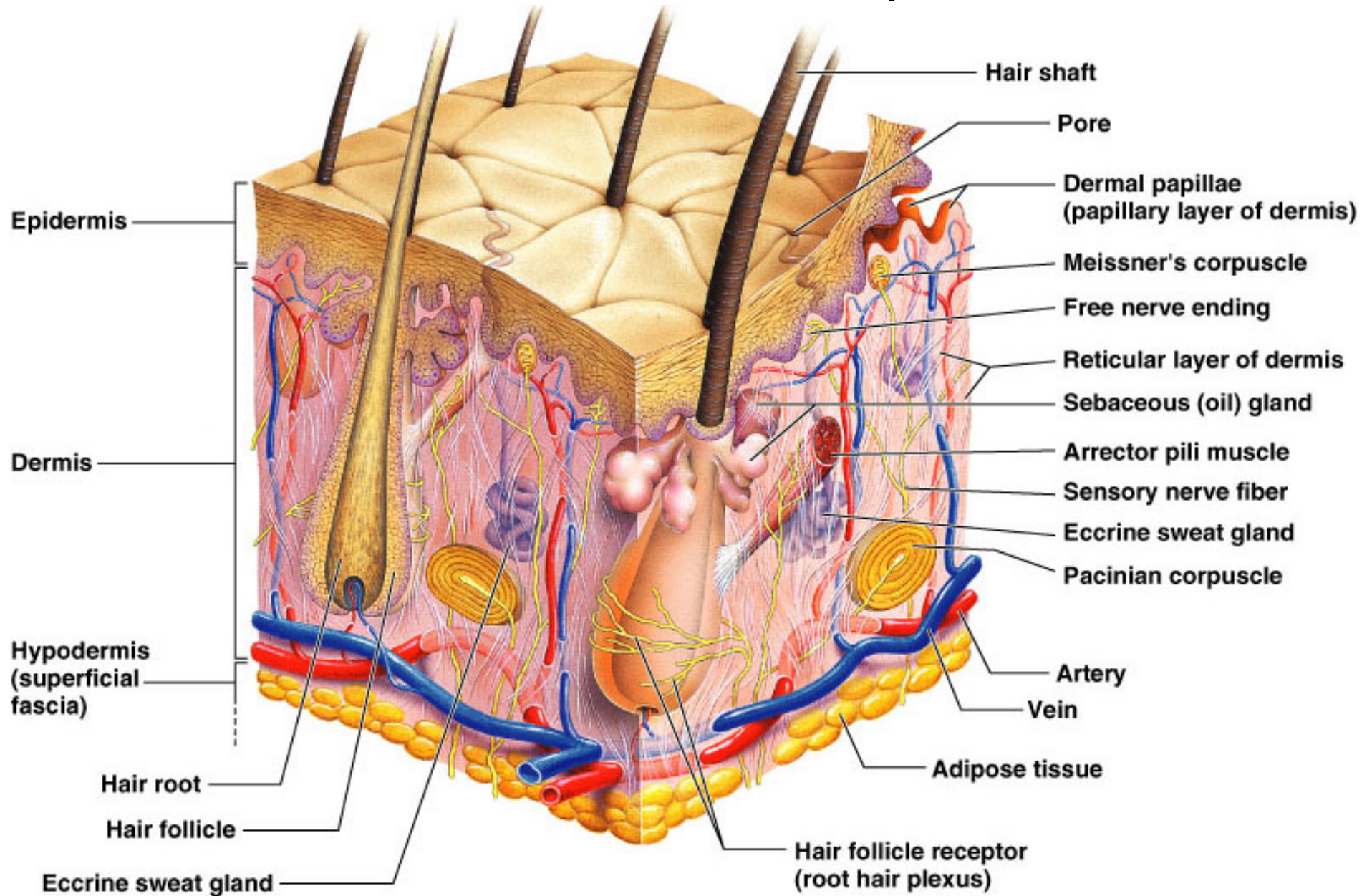


Fascia The Under Appreciated Tissue



Skin (Integument)



Overview of the Skin

- Largest organ of the body (15% of body weight)
- Skin thickness variable, normally 1-2 mm
- Protection
 - chemical barrier (waterproof)
 - physical barrier (tough)
 - immune system activator
- Body temperature regulation
 - blood flow through the skin
 - sweat glands
 - hairs
- Sensation
 - sense touch, temperature and pain
 - provides information outside of the body

Assessment of Skin Color

- Cyanosis is a bluish discoloration of the skin or mucous membranes
 - caused by lack of oxygen in the blood.
- Yellowish color
 - may indicate cirrhosis of the liver due to accumulating bile pigments in body tissue
- Pallor or Blanching:
 - can be sign of anemia or emotional or physical stress
- Black and Blues:
 - Bruises caused by blood escapes circulation and clots underneath the skin.
- Red color(erythema)
 - indicate fever, allergy, infection inflammation and embarrassment.

Fascia

- Connective tissues that plays an important role in human function.
 - 16% of total body weight and stores 23% of total water composition
- It connects all the tissues of the human body together including the muscles, organs nerves and vessels of the body.
- Fascia is a dynamic connective tissue that changes based on the stresses placed on it.

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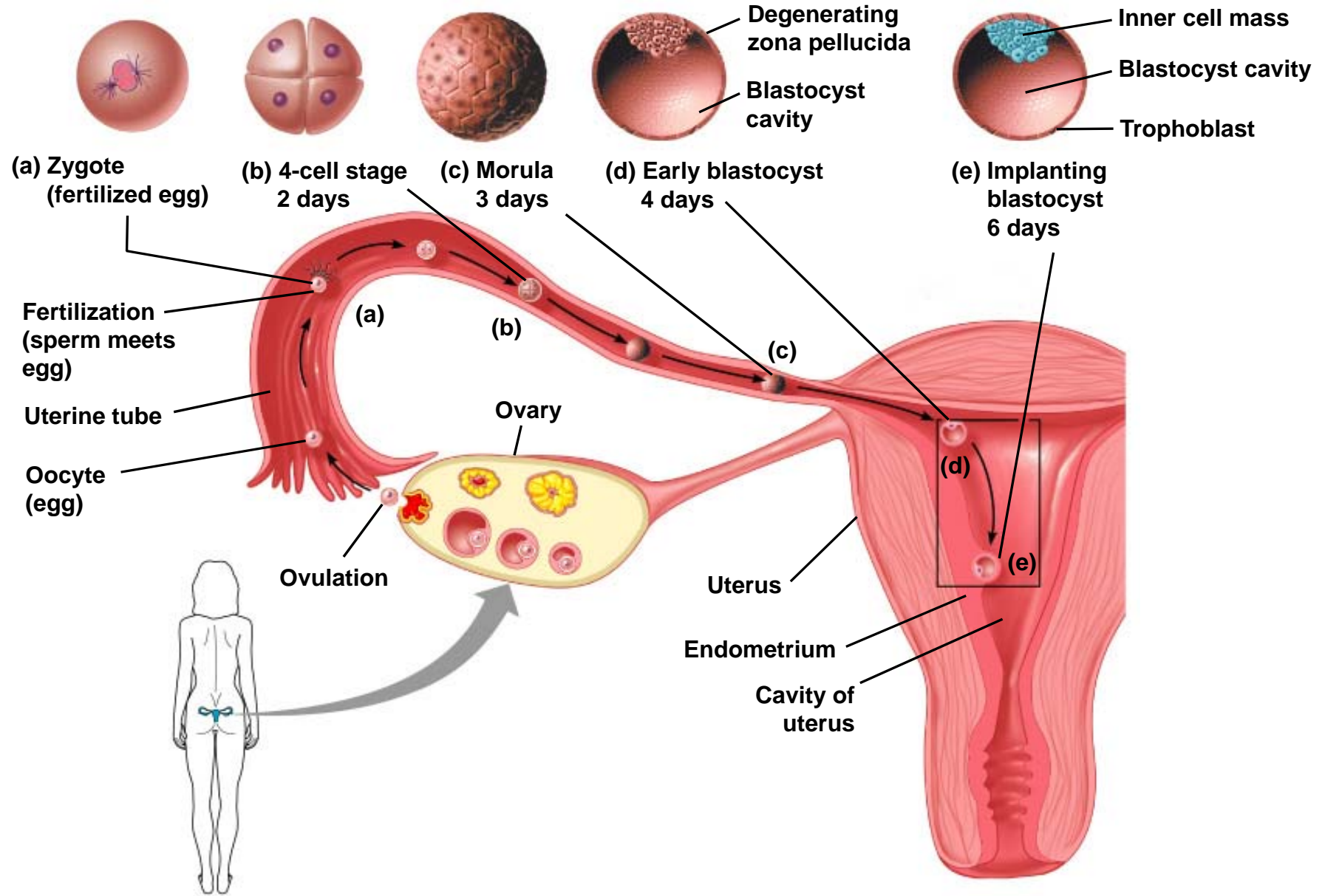
Roles of Fascia

- The fascia plays a major role in circulation of blood and lymph.
 - The fascia is important for the nutrition and metabolism of every cell in the body. (vise versa)
- The fascia is the first line of defense in immune function.
- Disruptions and restrictions within the fascia are associated with disease and movement impairments.
 - Interrupts the flow of blood and lymph
 - Can cause pain and poor compensatory patterns.

Roles of Fascia

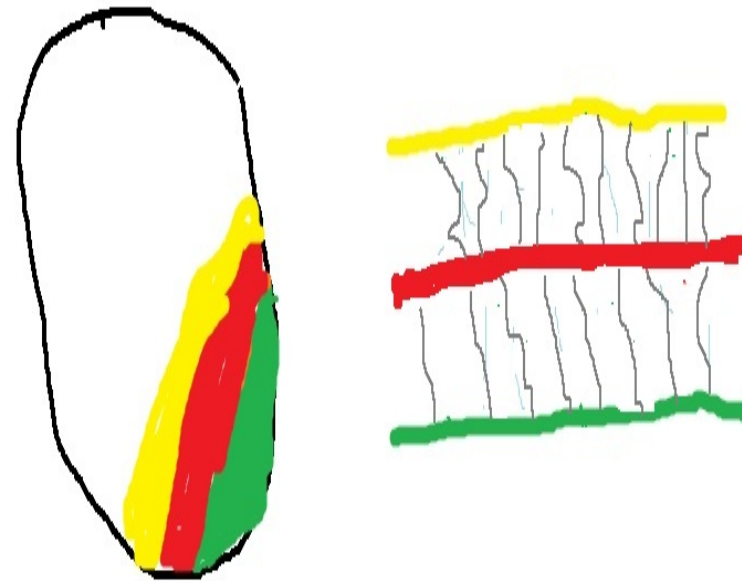
- The fascia is a major contributor of both sensory and proprioception.
 - Matrix of communication between all cells , organs and whole body systems.
 - Provide a tensile support for muscles important to generate force.
- Embryology helps explain how all the fascial system connects all major systems including the nervous system.
- The cells in early in development differentiate into 3 germ layers.
 - Ectoderm: nervous system and the skin.
 - Mesoderm: bones, muscles , fascial tissue and CV system
 - Endoderm: various internal organs and endothelial linings

Embryology Leading to Stem Cells



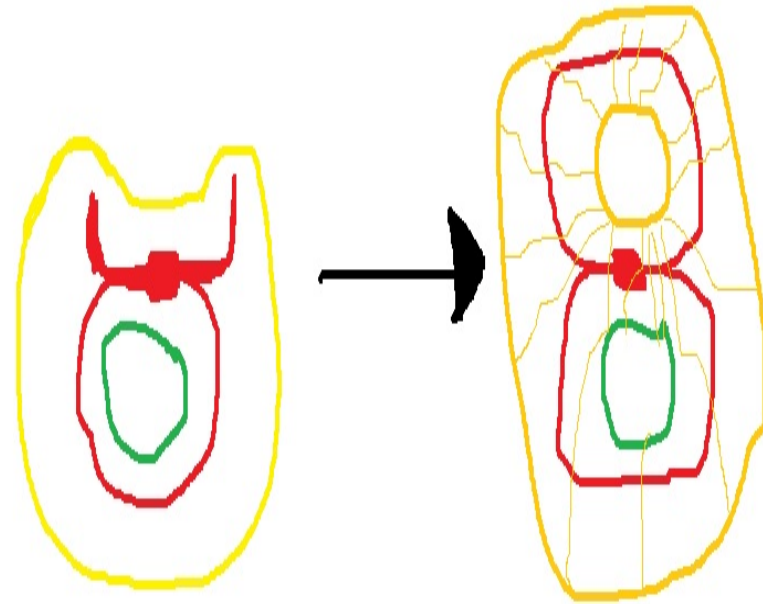
Trophoblast Differentiates Into 3 Germ Layers

- Trophoblast give rise to
 - **Ectoderm**: skin, sensory receptors and the nervous system
 - **Mesoderm**: bone, muscles and connective tissue,
 - **Endoderm**: respiratory airway and much of the digestive system.
 - **Early reticular fibers** connecting the 3 layers will eventually be replaced with stronger collagen fibers .

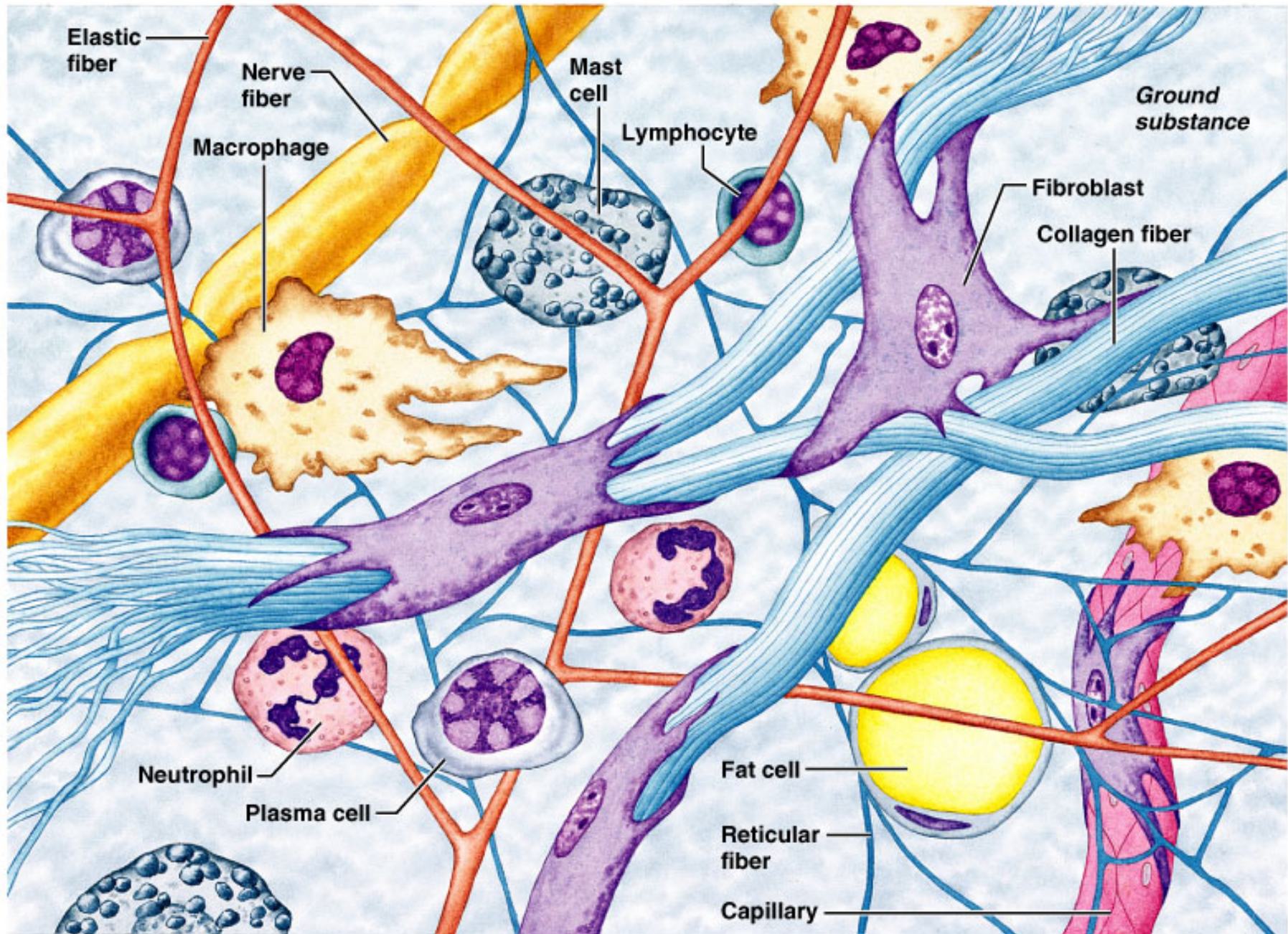


Migratory Patterns of Germ Layers

- The **mesoderm** encapsulates the **ectodermal** structures anteriorly and **nervous system** posteriorly.
- The space between the layers is filled with various layers of **connective tissue** such as **fascia**.
 - The fascia has **sensory receptors** that project to the skin. It also has its own receptors located within it



Recipe for Fascia

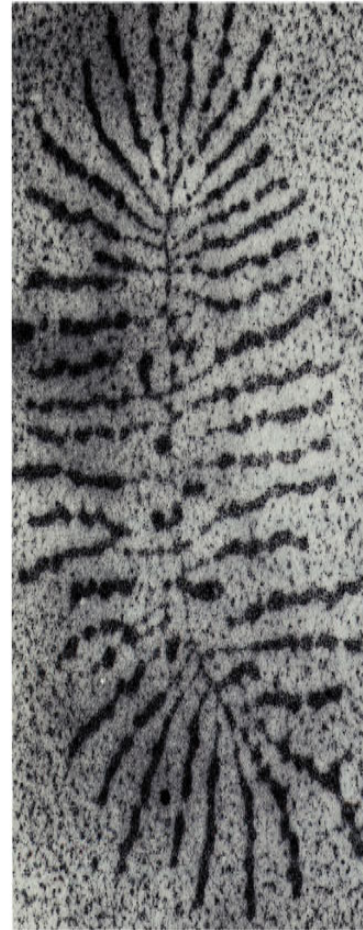


Fascia at a Cellular Level

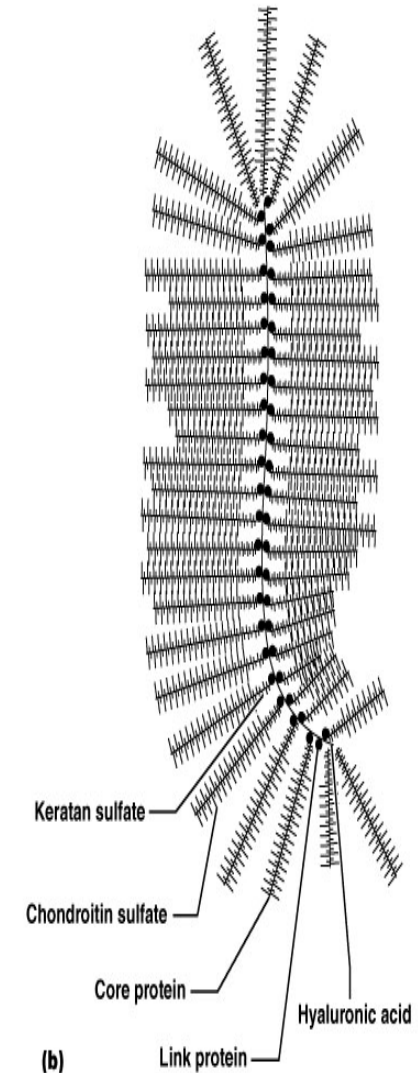
- Cells include:
 - Fibroblast: synthesize collagen, elastin, reticulum and ground substance.
 - Fibrocyte: mature fibroblast that maintains connective tissue.
 - Macrophage: cells active during inflammation and infections to assist in cleaning up cellular waste products and foreign antigens.
 - Mast Cells: secrete histamine (vasodilator) and heparin (anticoagulant)
 - White blood cells : destroy antigens and produce antibodies in response to infection

Connective Tissue Ground Substance

- Viscous watery gel that provides a scaffold that creates the framework for collagen and various cells.
 - Important for the diffusion of nutrients and waste products.
 - Provides lubrication between collagen fibers
 - Glycoaminoglycans helps maintain interfiber distance.
 - Proteoglycans: assist (GAGS) by binding water.

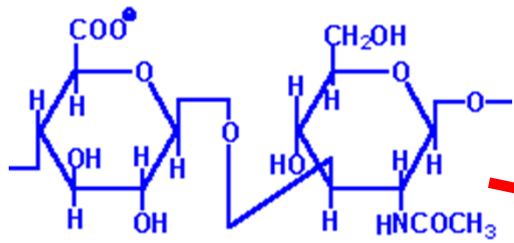


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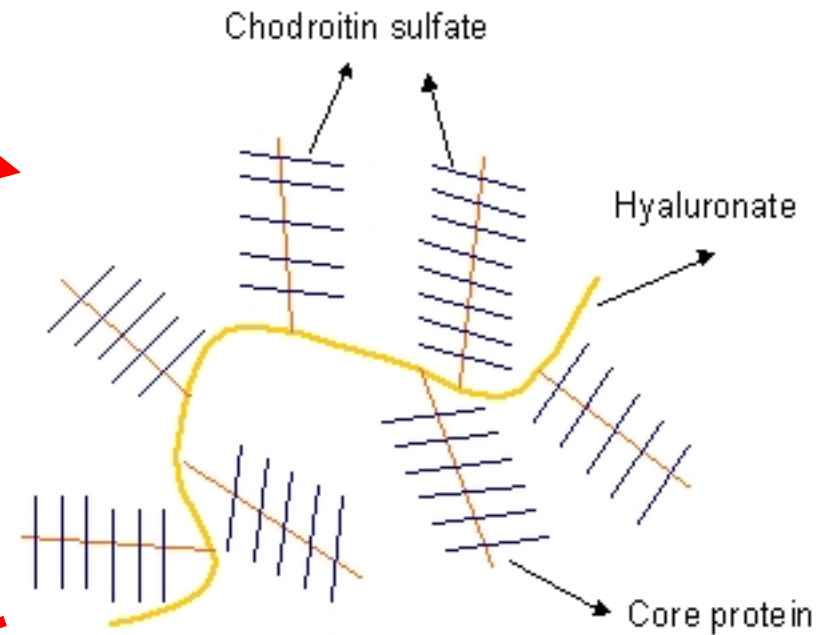
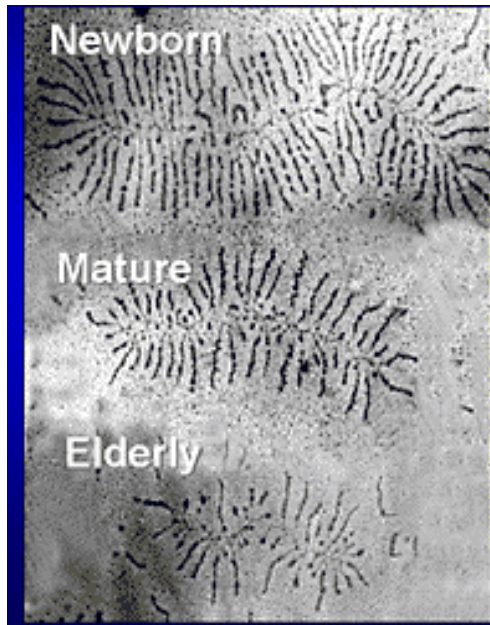


(b)

Proteoglycans



Glycosaminoglycan
(Hyaluronate)



Proteoglycan

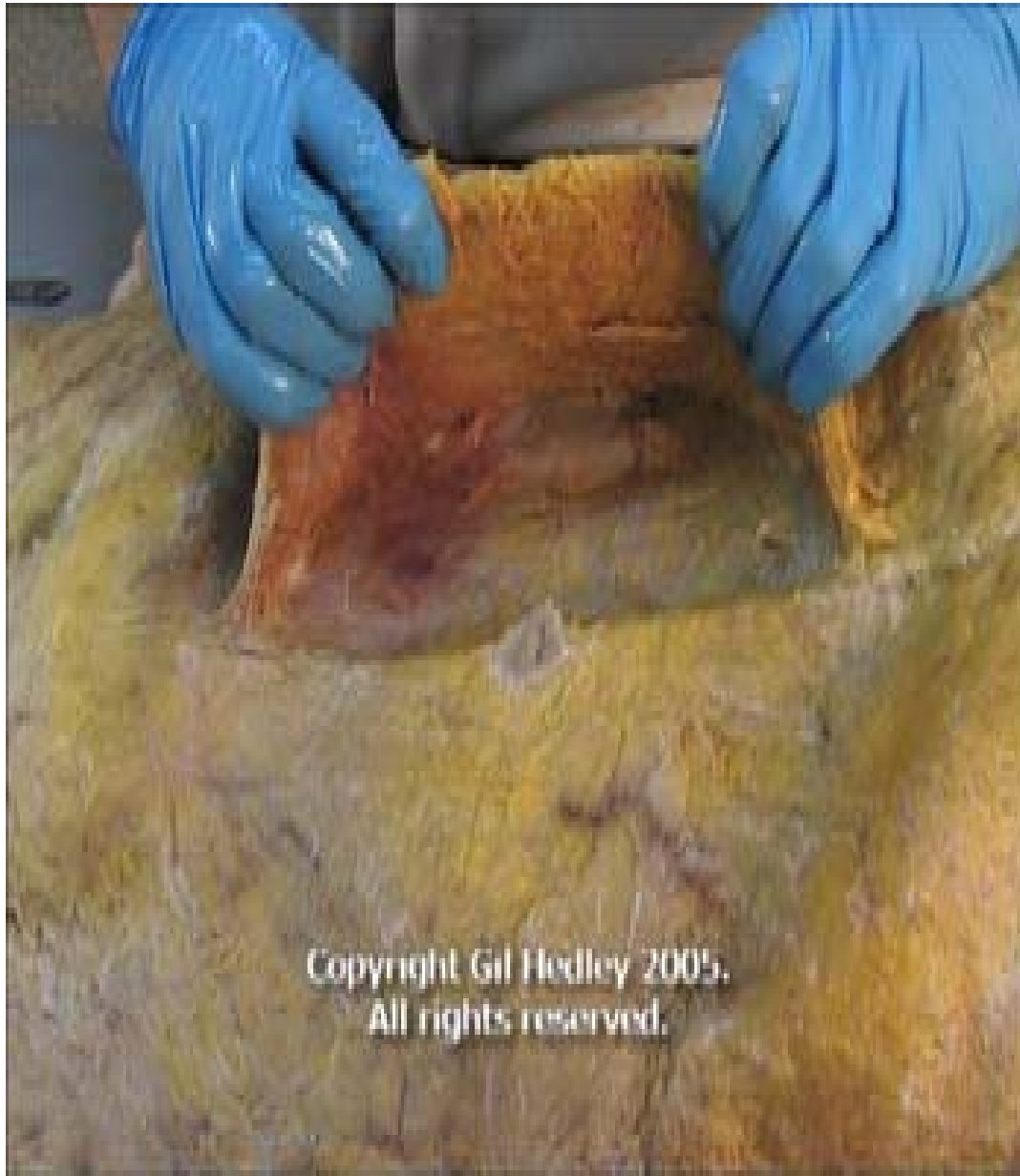
Mechanical Properties of Fascia

- Collagen fibers:
 - tensile strength
 - elastic fibers contribute to its ability to recoil.
- Ground substance:
 - allows the fascia the to compress and expand.
- The amount of collagen, elastic and ground substance varies in different types of tissue.
 - ITB , Subcutaneous fascia of gluteus maximus and ligamentum flavum.

Tensegrity Man



Superficial Fascia



- Fascia can be divided into different types.
 - Superficial : 3 distinct layers :
 - Superficial layer
 - adipose connective tissue and collagen fibers .
 - Membranous layer
 - collagen and elastic fibers run parallel to the skin.
 - Deep superficial layer
 - Loose connective tissue
 - Anchors superficial fascia to deep fascia.

Light Passing Through Superficial Fascia



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Connective Tissue Anchoring Superficial Fascia to Deep Fascia



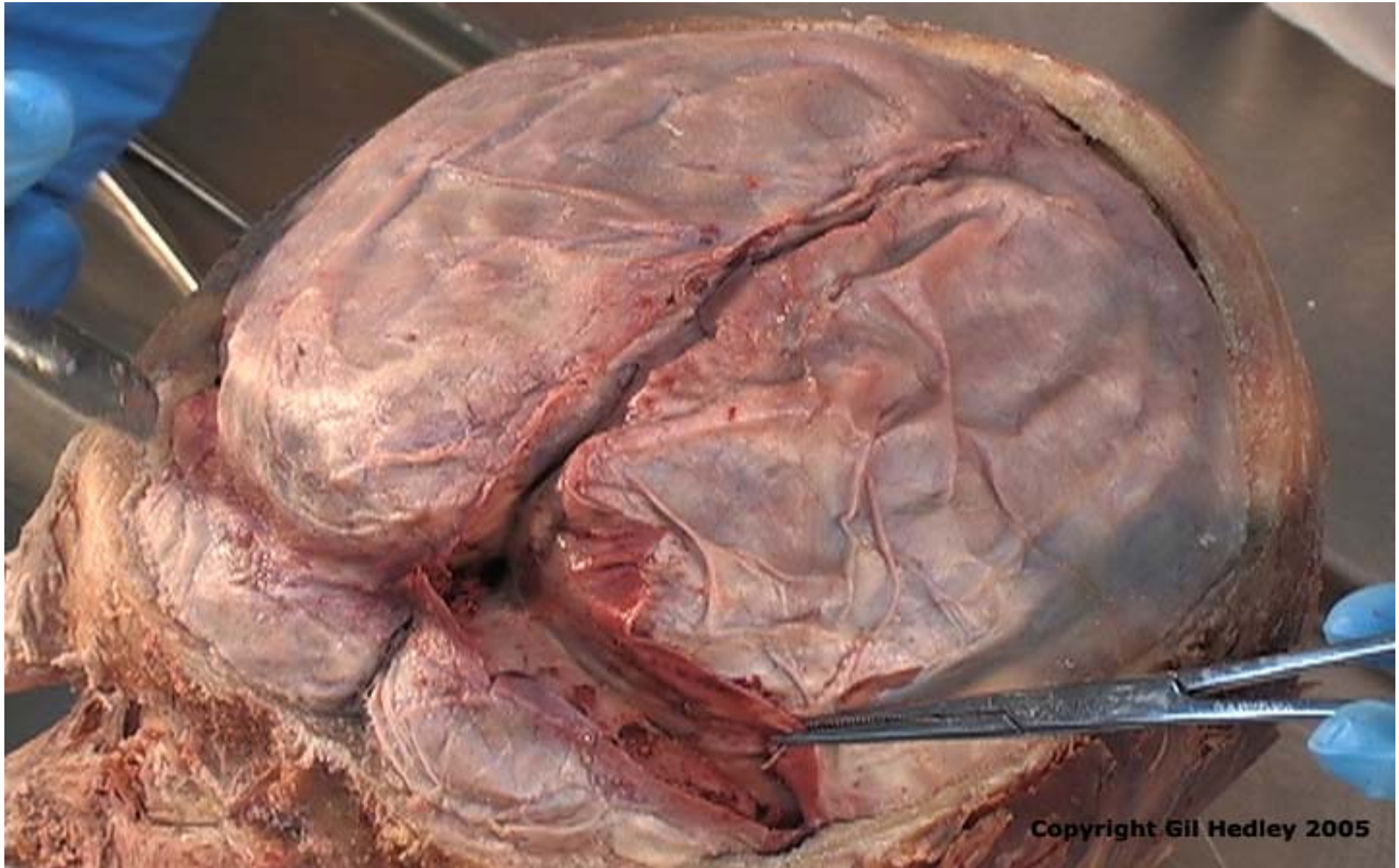
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Deep Fascia

- Note the deep fascial alignment.



Dura Matar

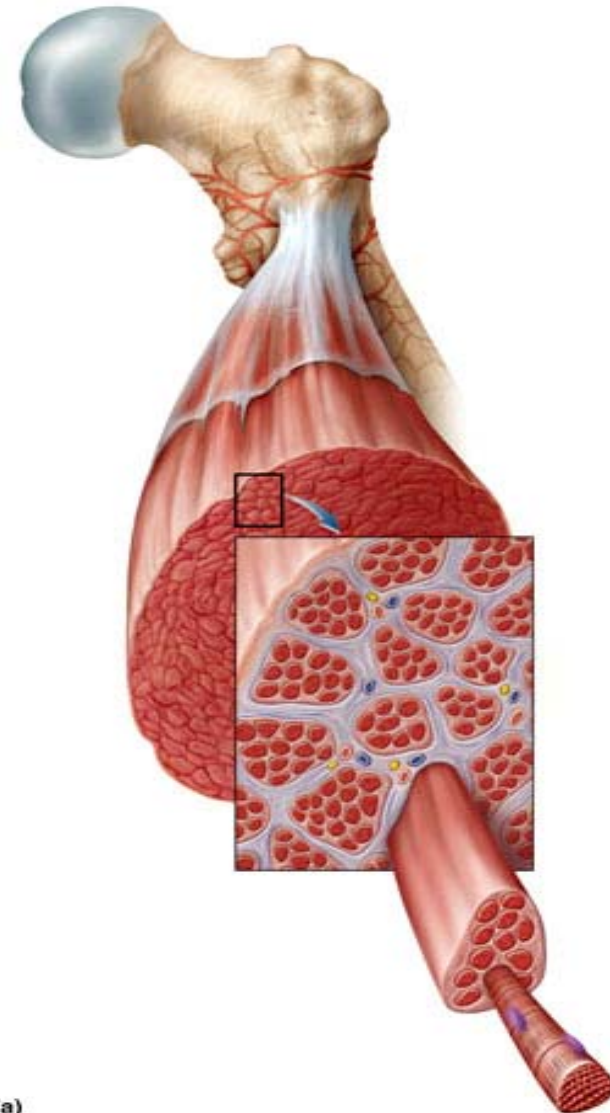


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Deep Fascia

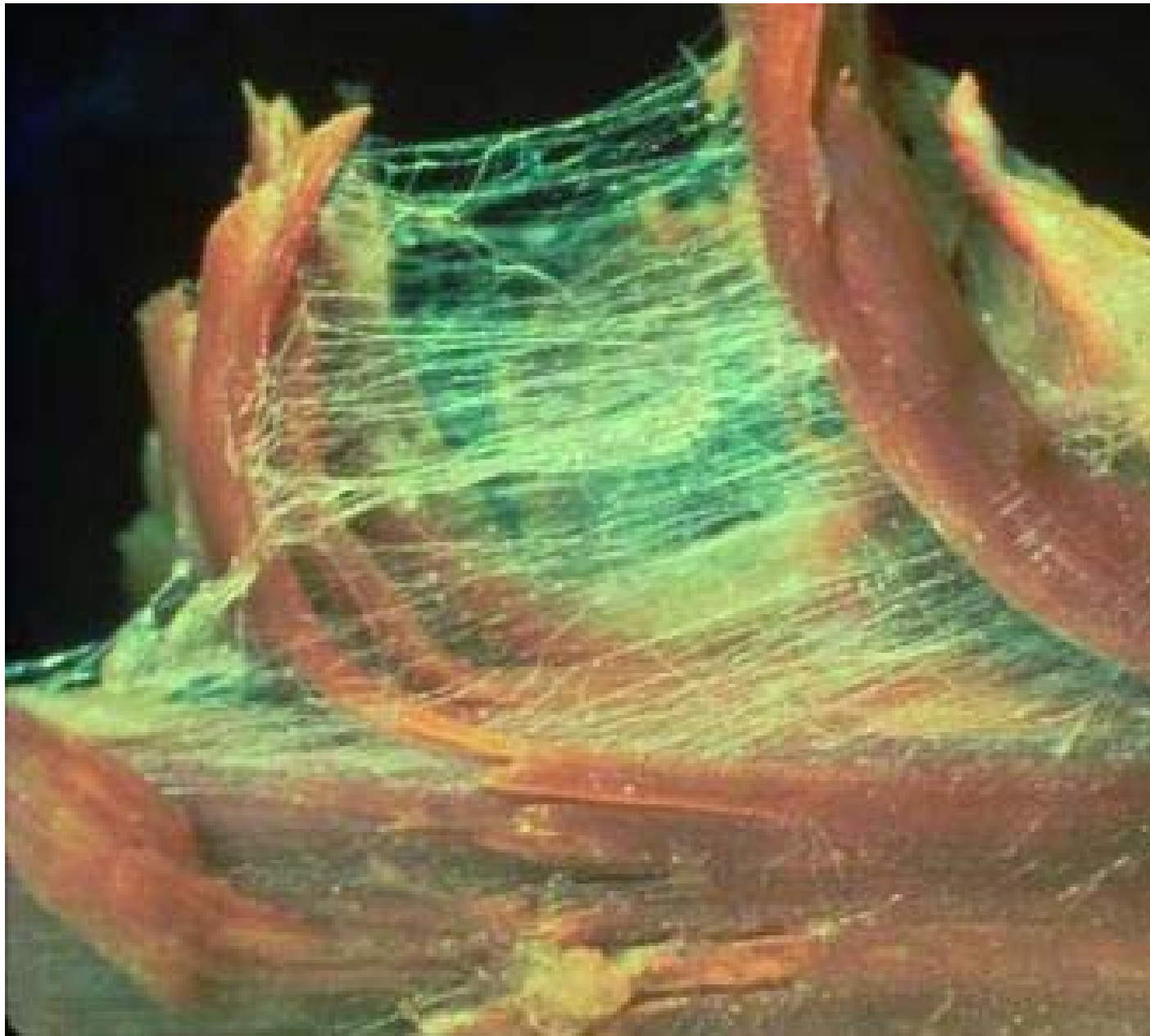
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- Deep fascia is continuous connective tissue sleeve that covers the muscles throughout the body.
 - Fascia is integral to individual muscle fibers
 - **Epimysium**
 - **Perimysium**
 - **Endomysium.**
- Fascial recoil works synergistically with their muscles.
 - plyometric training



(a)

Fascial Mess Between Various Muscle Fibers



Fascial Receptors

- Fascia roles as a sensory organ was originally postulated by A. T. Still in 1899.
- The sensory role is critical for proprioception and giving the brain a 3 dimensional construct of the body.
- Studies demonstrate there are 4 major types of infrafascial mechanoreceptors. (Schleip)
 - Golgi
 - Pacini
 - Ruffini
 - Interstitial

Mechanoreceptors

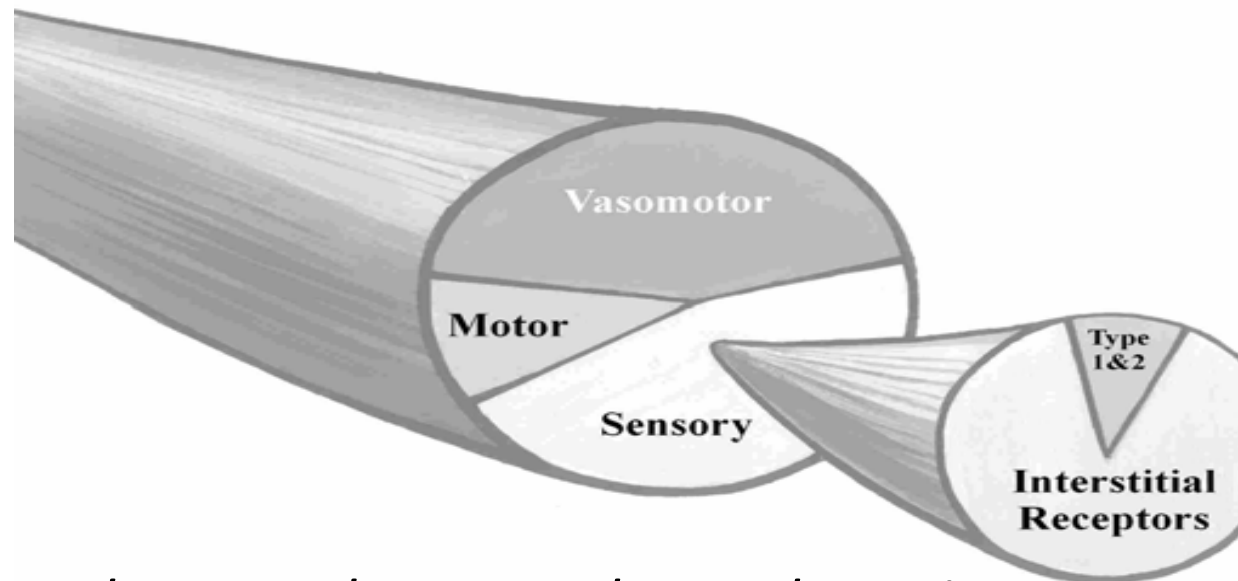
- Pacini: Respond to rapid pressure changes.
- They are located in deep capsular layers, spinal ligaments, and muscle tendon.
 - They play a major role in proprioceptive feedback.
 - Stimulate them with:
 - high velocity adjustments,
 - rocking, shaking,
 - vibratory tools and rhythmic joint compression.

Mechanoreceptors

- Ruffini : respond to lateral shearing.
 - Inhibit the sympathetic activity in the entire body.
 - Located in ligaments of peripheral joints, dura mater, outer capsular layers.
 - Slow steady shearing pressure is needed
 - Suboccipital release

Mechanoreceptors

- Golgi: located in muscle tendons, aponeuroses, ligaments and joint capsules.
 - They are stimulated with slow sustained stretching close to muscular attachments.
 - Active movements may be more effective in stimulating these receptors
 - Myofascial and active release techniques can stimulate these receptors
 - Active stretching : yoga, Feldenkraus and myofascial unwinding



- *A typical muscle nerve there are almost three times as many sensory neurons than motor neurons.*
- *Type 1 &2 afferents include muscle spindles, Golgi receptors, Pacinian and Ruffini endings.*
- *The majority of the sensory input are type 3&4 afferents*
 - *Interstitial Receptors which are intimately linked with the Autonomic Nervous System.*

Schleip R

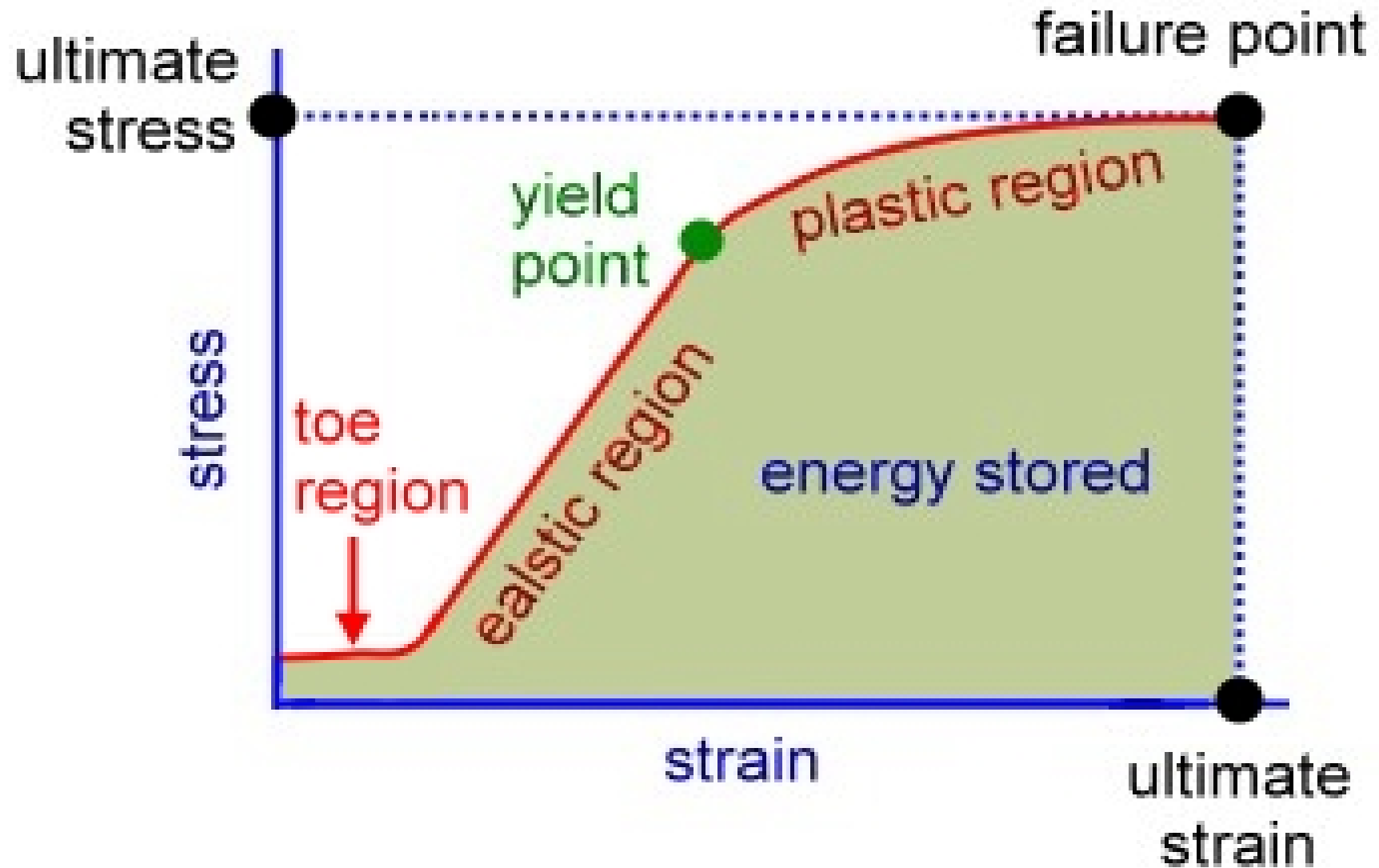
Mechanoreceptors

- Interstitial : Smaller multimodal receptors that function as thermal, chemo-receptors, pain and mechanoreceptors.
- 50 % of mechanoreceptors are high threshold pressure (HTP)
- 50% Low threshold pressure units (LTP) respond to gentle stimulation.
 - They are highly concentrated in the periosteum.
 - Stimulation can promote vasodilatation and enhance tissue nutrition. (ANS)
 - They are influenced by neurotransmitters and neuropeptides
 - Lower threshold which stimulates rapid firing of pain receptors contributing to chronic central pain.
 - Stimulate periosteum structures ,interosseous membranes and other fascia associated with bones.

Fascial Response to Stretching

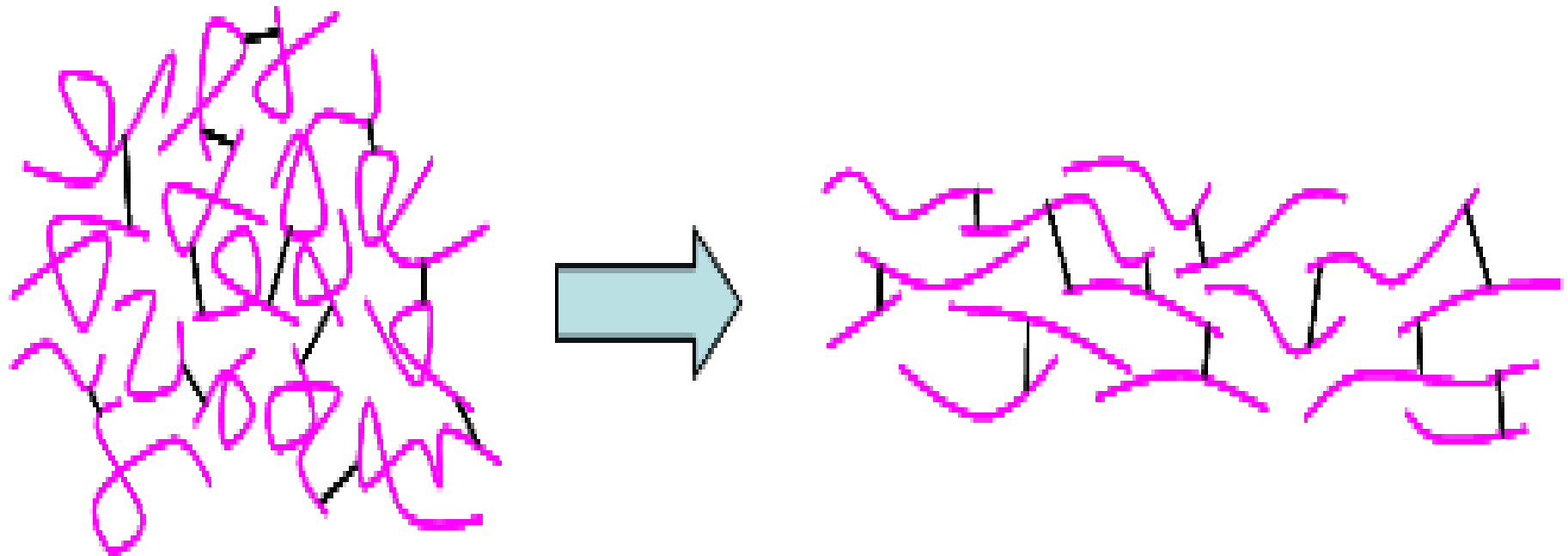
Schleip

- Comprised mostly of water.
 - Ground substances that is very hydrophilic.
- Stretching studies show that when you stretch fascia water initially is squeezed out but as it relaxes more will enter.
- The higher composition of water increases fascial stiffness
 - assist in the muscles to generate more force.

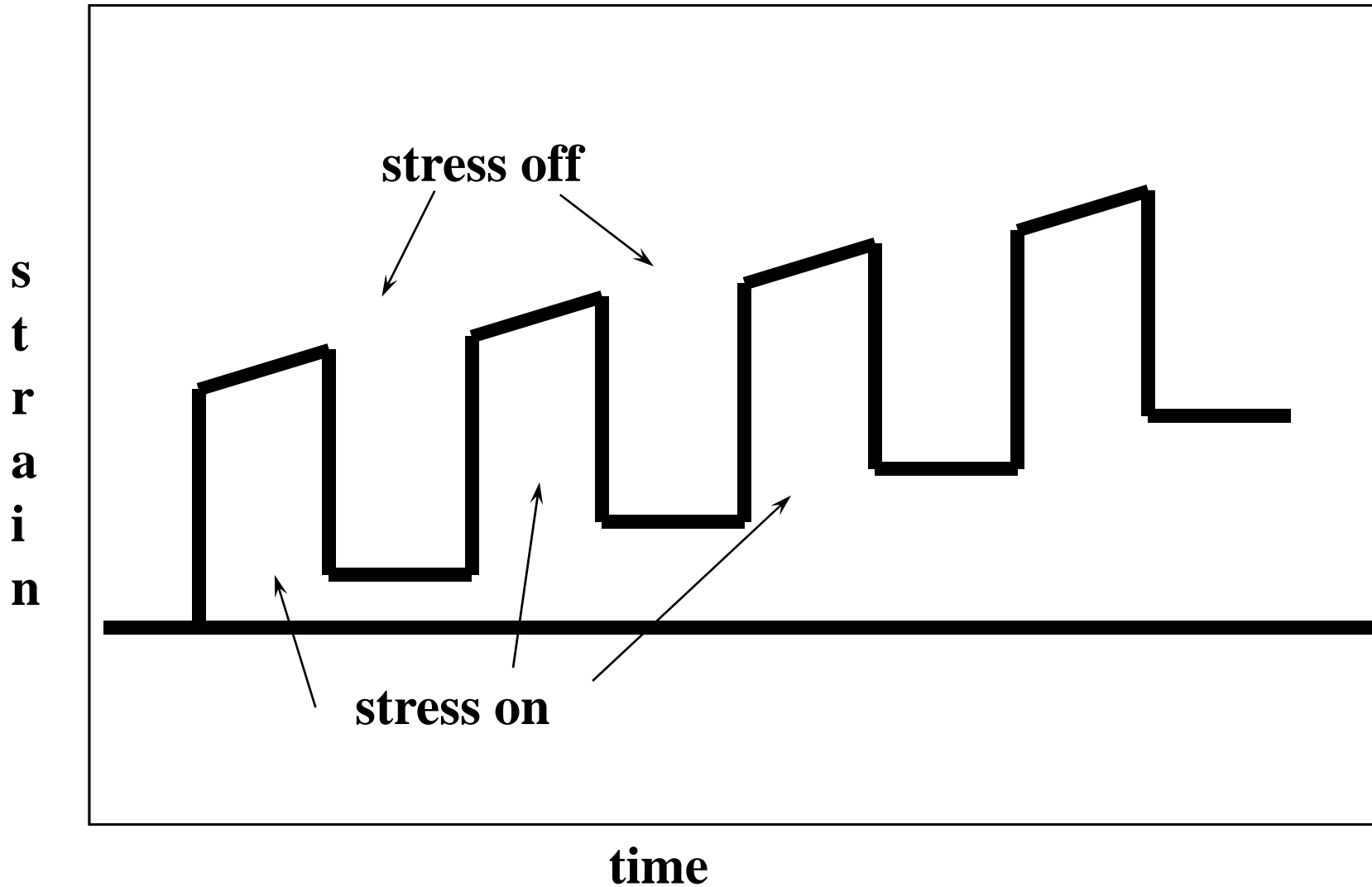


Stress-Strain Curve of Collagen Fiber

Break collagen cross-links and
increase inter-fiber distance.



Repeated Elongation

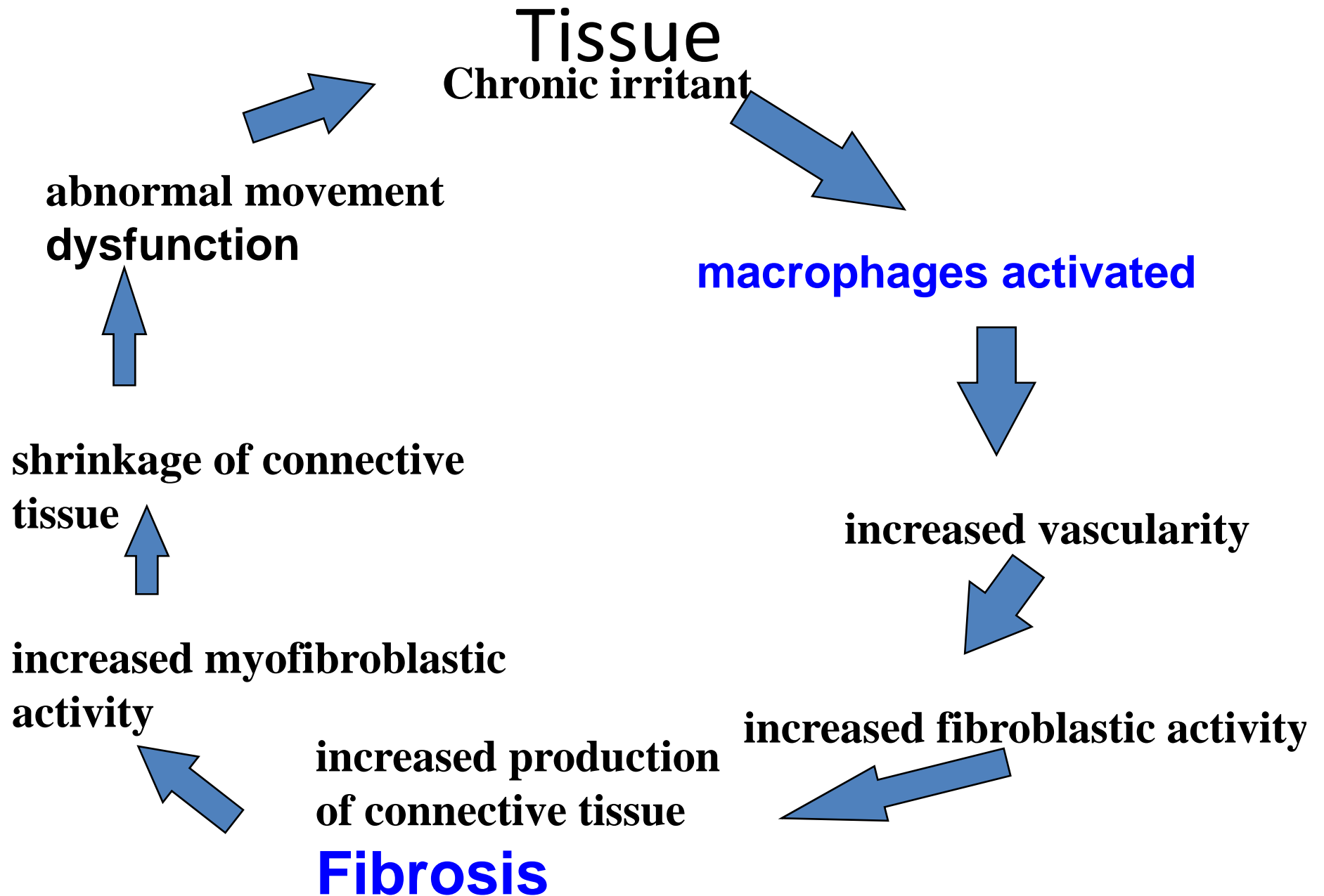


Fascial Tonicity

(Schleip)

- Fascia appears to have smooth muscle located in the following:
 - 1. ligaments and tendons,
 - 2. dura mater
 - 3. meniscus and intervertebral discs
 - 4. visceral ligaments
 - 5. bronchial connective tissue
 - 6. Ganglia of the wrist.

Repetitive Trauma to Connective



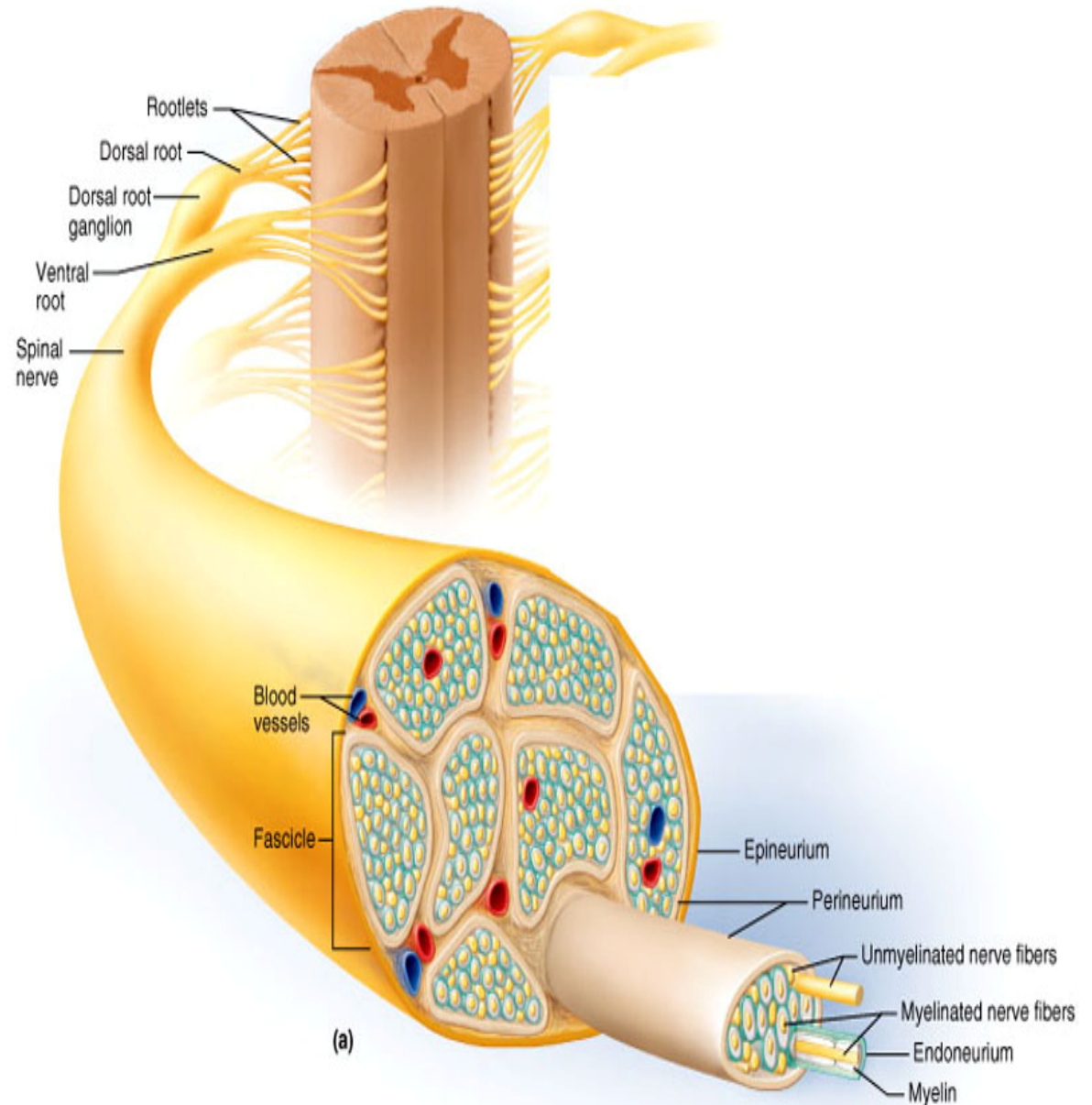
Myofibroblasts Associated Diseases

- Pathological diseases such as frozen shoulder or club feet
 - facilitated by over excitation of myofibroblasts.
 - These cells respond under tension.
 - Adrenaline has no effect in relaxation of myofibroblast.
 - Nitric oxide appears to relaxes these muscles.
 - How can we increase nitric oxide in these tissues.

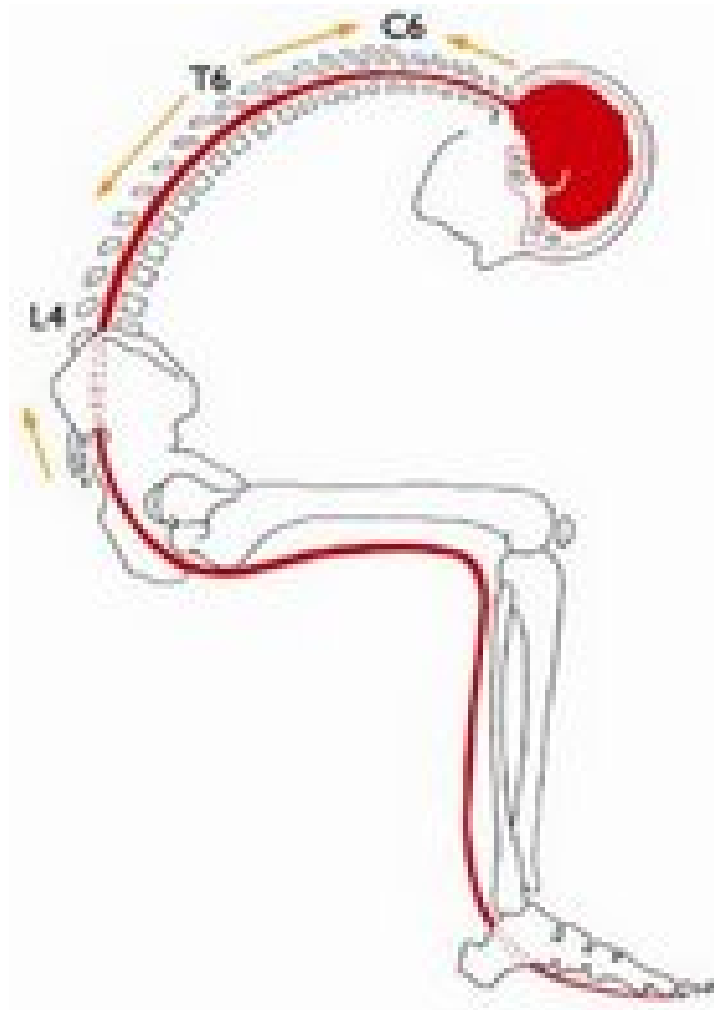
Connective Tissue and Nerves

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- Proper nerve function needs:
- Mobility:
 - within nerve and surrounding tissue.
- Nutrition
 - DM, alcoholics perifascial restrictions
- Abnormal neurodynamics
 - Pain
 - Numbness/tingling
 - Worse with movement



Continuity of the Nervous System



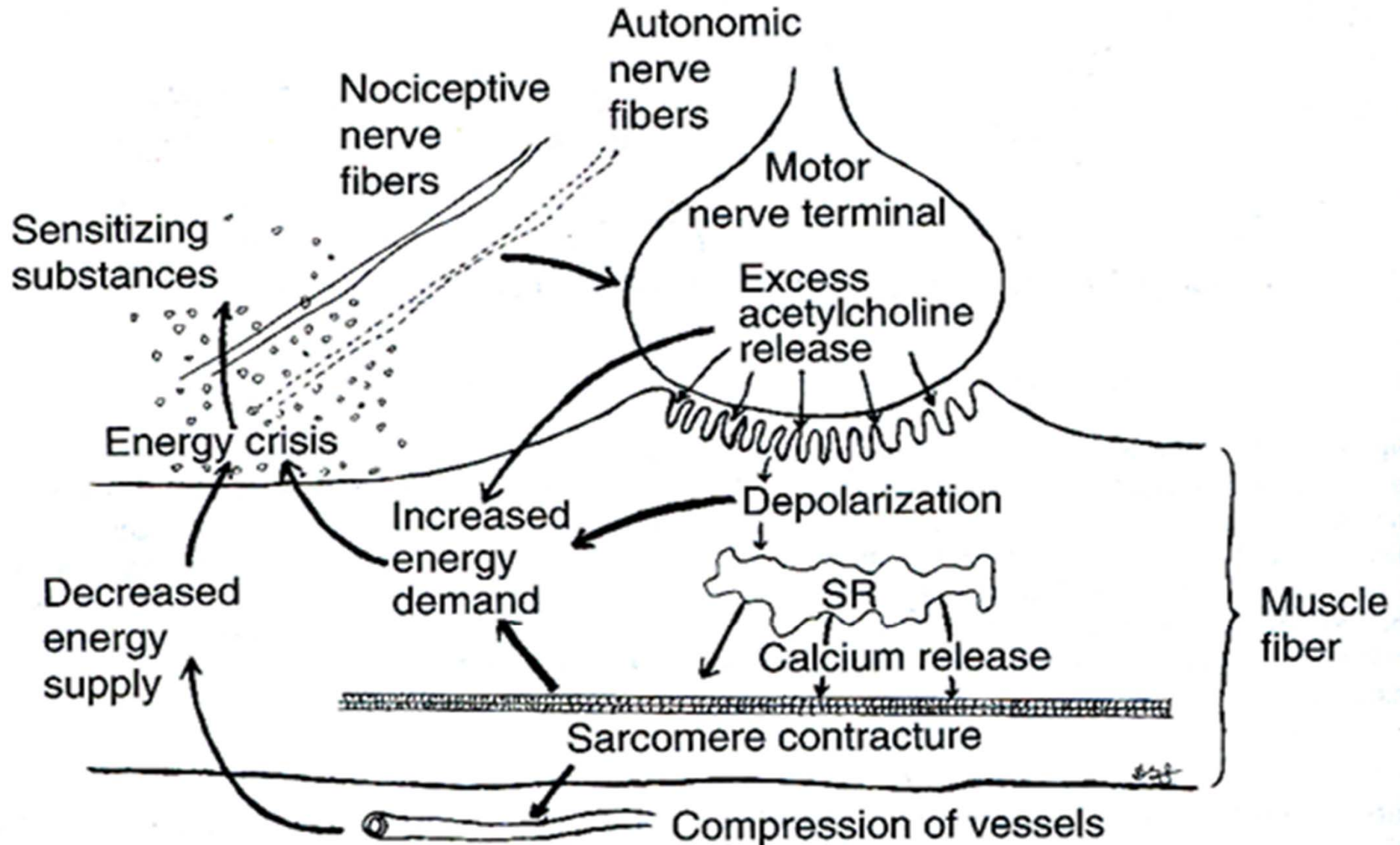
Myofascial Trigger Points

- There may be dysfunction within the muscles and their associated fascia.
- Trigger points are discrete, hypersensitive nodule within tight band of muscle or fascia.
- Classified as latent or active
- Latent trigger point
 - Does not cause spontaneous pain unless palpated.
 - May restrict movement or cause muscle weakness

- Active trigger point
 - Causes pain at rest and when palpated.
 - Palpation with referred pain helps determine if it's a tender point vs. trigger point
 - Found most commonly in muscles involved in postural support.
- Develop as the result of mechanical stress
 - Either acute trauma or microtrauma
- Trigger point development Theories : ATP deficit, ↑ Ach, ↓ cholinesterase ↑ Ca⁺⁺ release from SR, ANS dysfunction (stress)

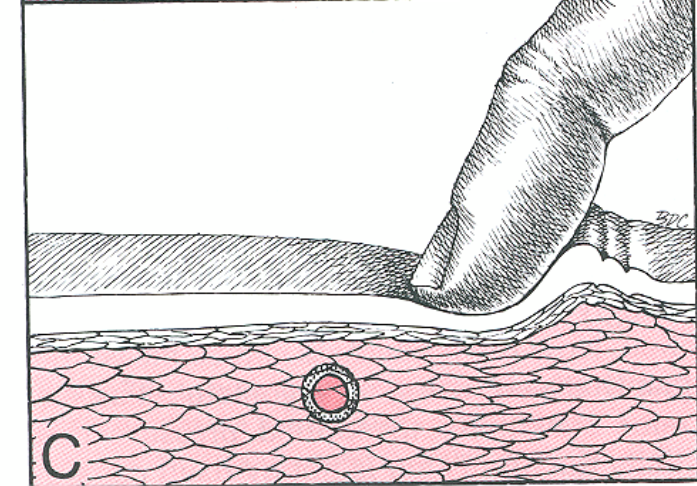
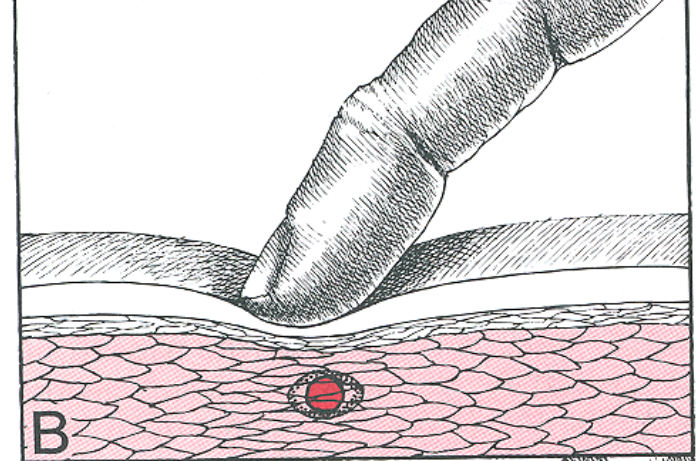
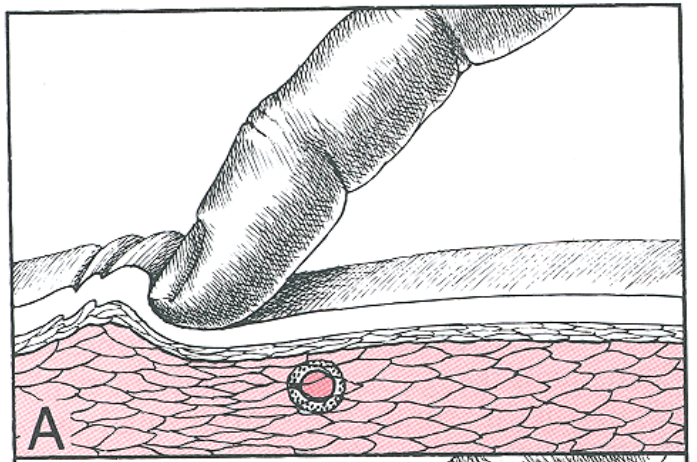
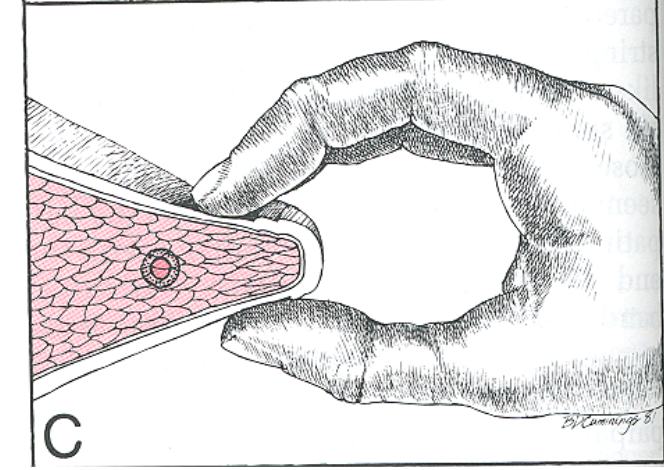
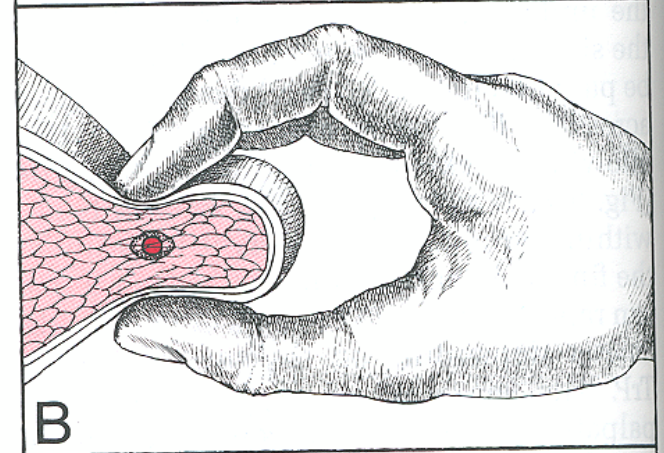
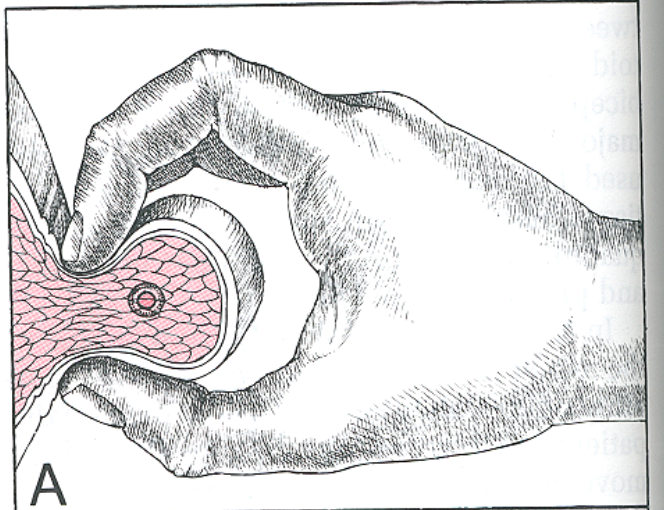
Trigger Point Theories

Dysfunctional Endplate Region

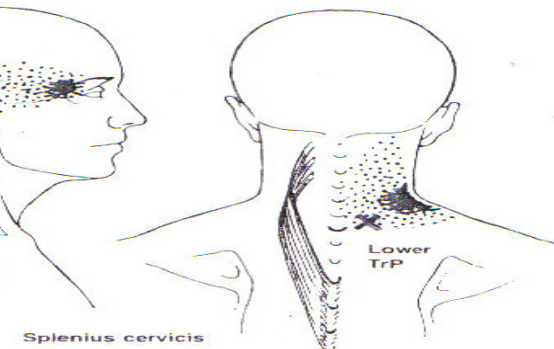
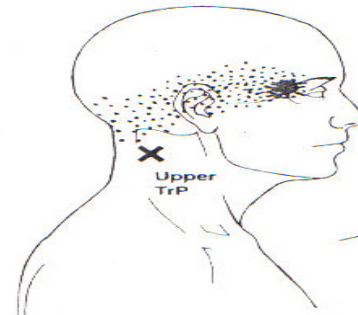
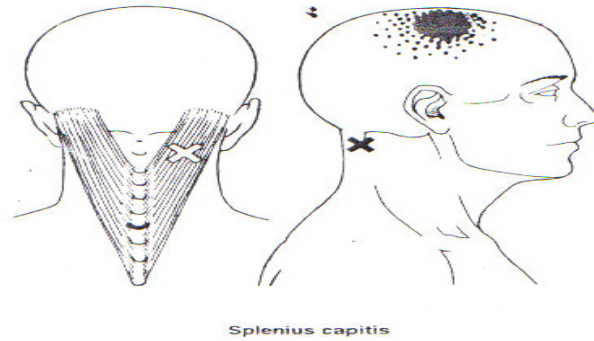
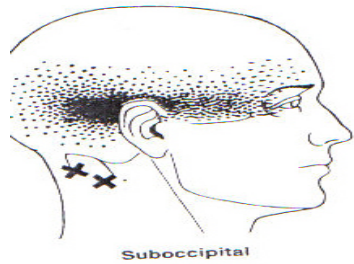
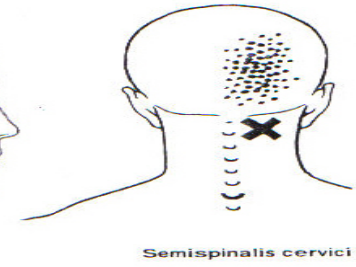
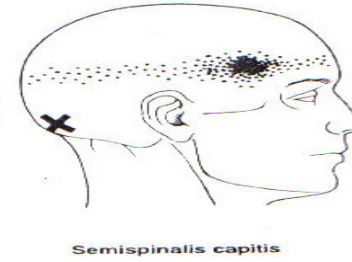
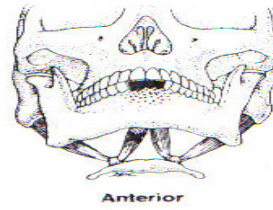
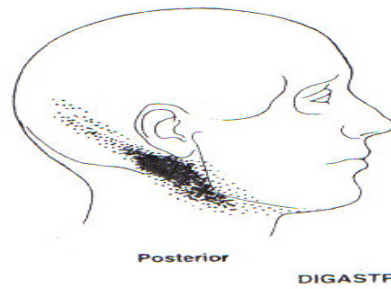
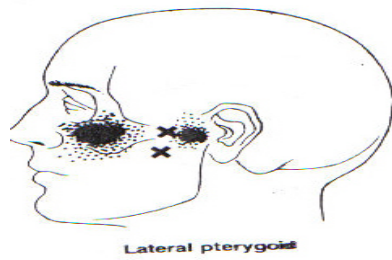
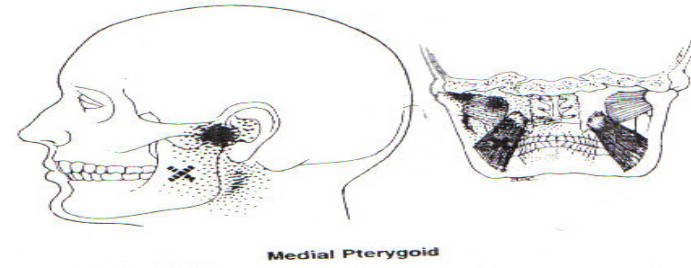
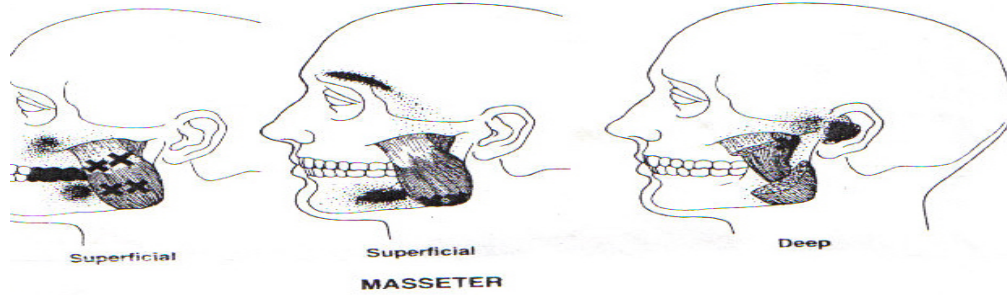
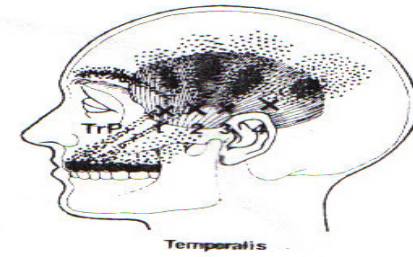
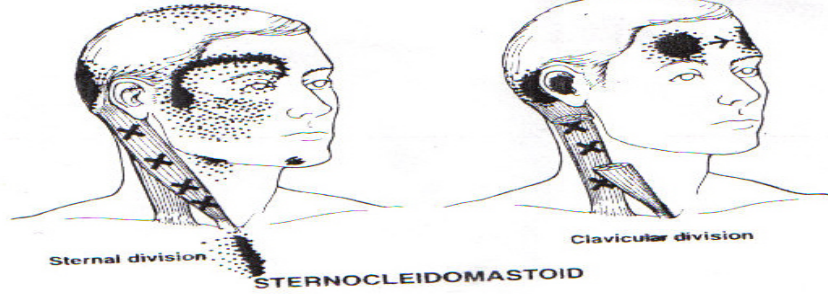
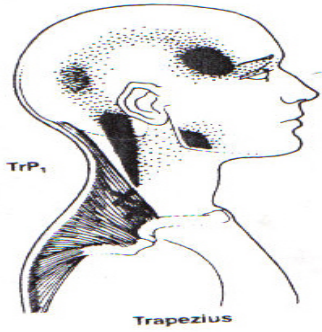


Perpetuating factors

- Chronic mechanical stress and postural habits
 - The body lays down fascia based on repetitive use patterns.
 - Inefficient movement patterns trigger abnormal muscle tonus.
- overuse of a specific muscle group-
 - a tennis player's gets lateral epicondylitis
- psychological distress or sleep deprivation.
 - SNS reduces blood flow to skin and fascia.
 - Reduced NO needed for smooth fascial muscle to relax.



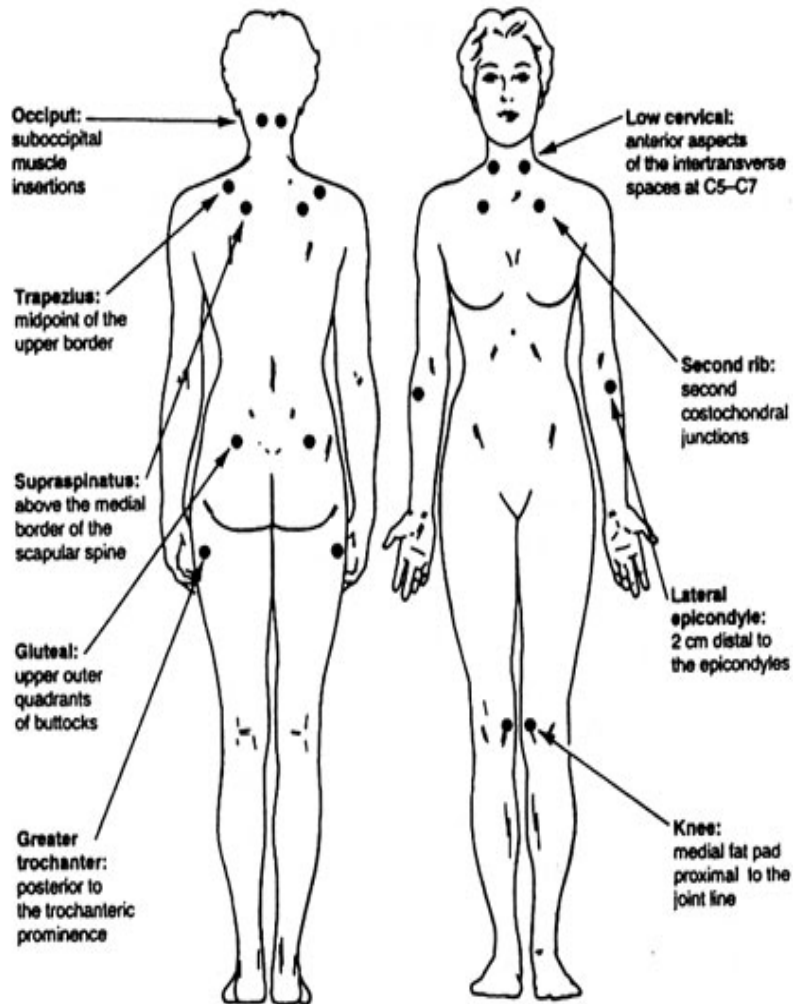
HEAD AND NECK PAIN



Nutritional Considerations

- Proper hydration : The main ingredient in all tissues.
- Key electrolytes and vitamins
 - B- vitamins, Na, K, Ca and Mg play important roles in muscle physiology
- Processed foods are deficient in many of the nutrients necessary for all types of cellular and enzymatic functions.
 - Artificial sweeteners are know triggers for myofascial dysorders.
- A variety whole nutrient rich foods provide the body with all the nutrients known to be important in tissue physiology
 - It also provides the body with nutrients not yet discovered.
 - Provides nutrients in a appropriate ratios which we have evolved to metabolize.

Fibromyalgia

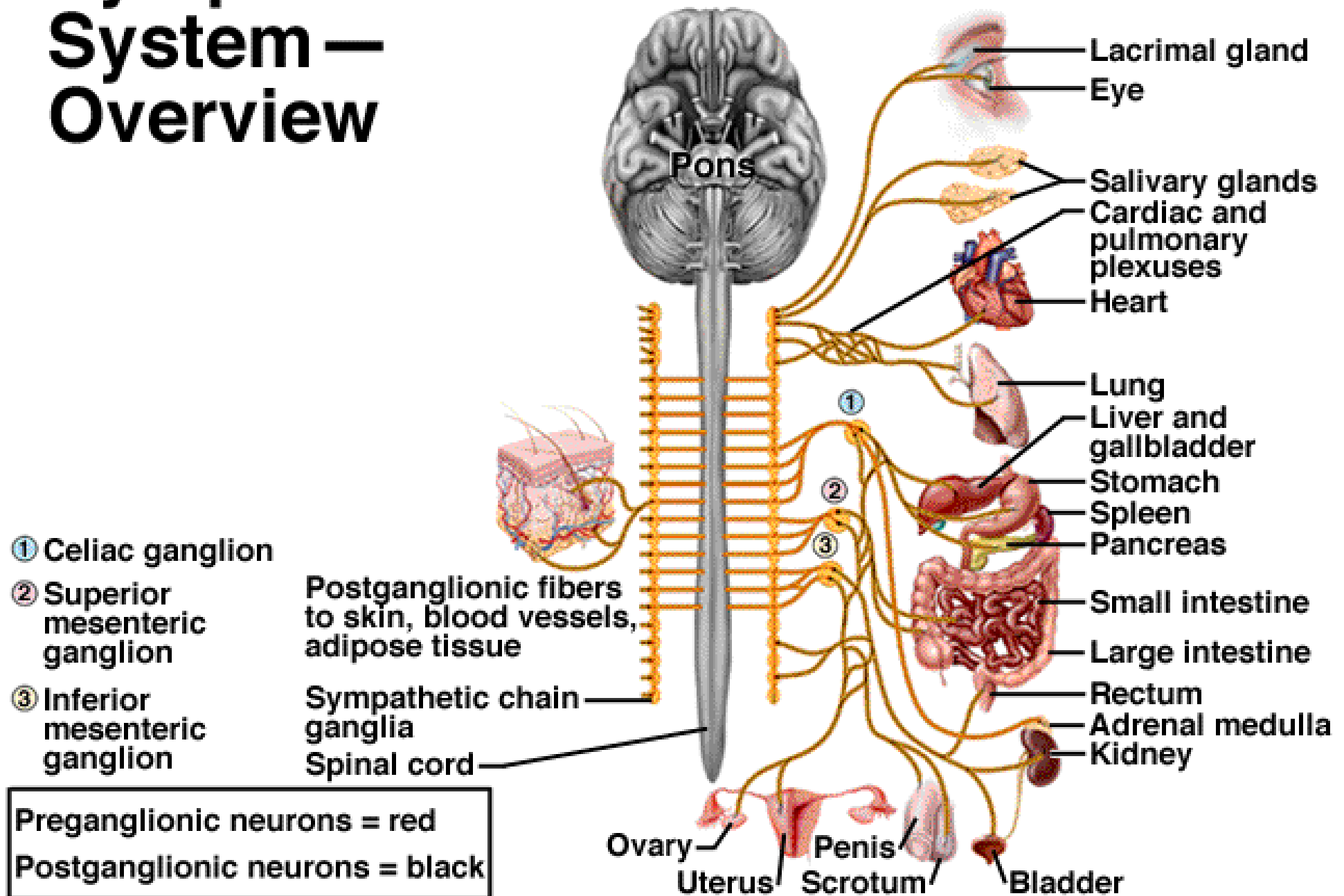


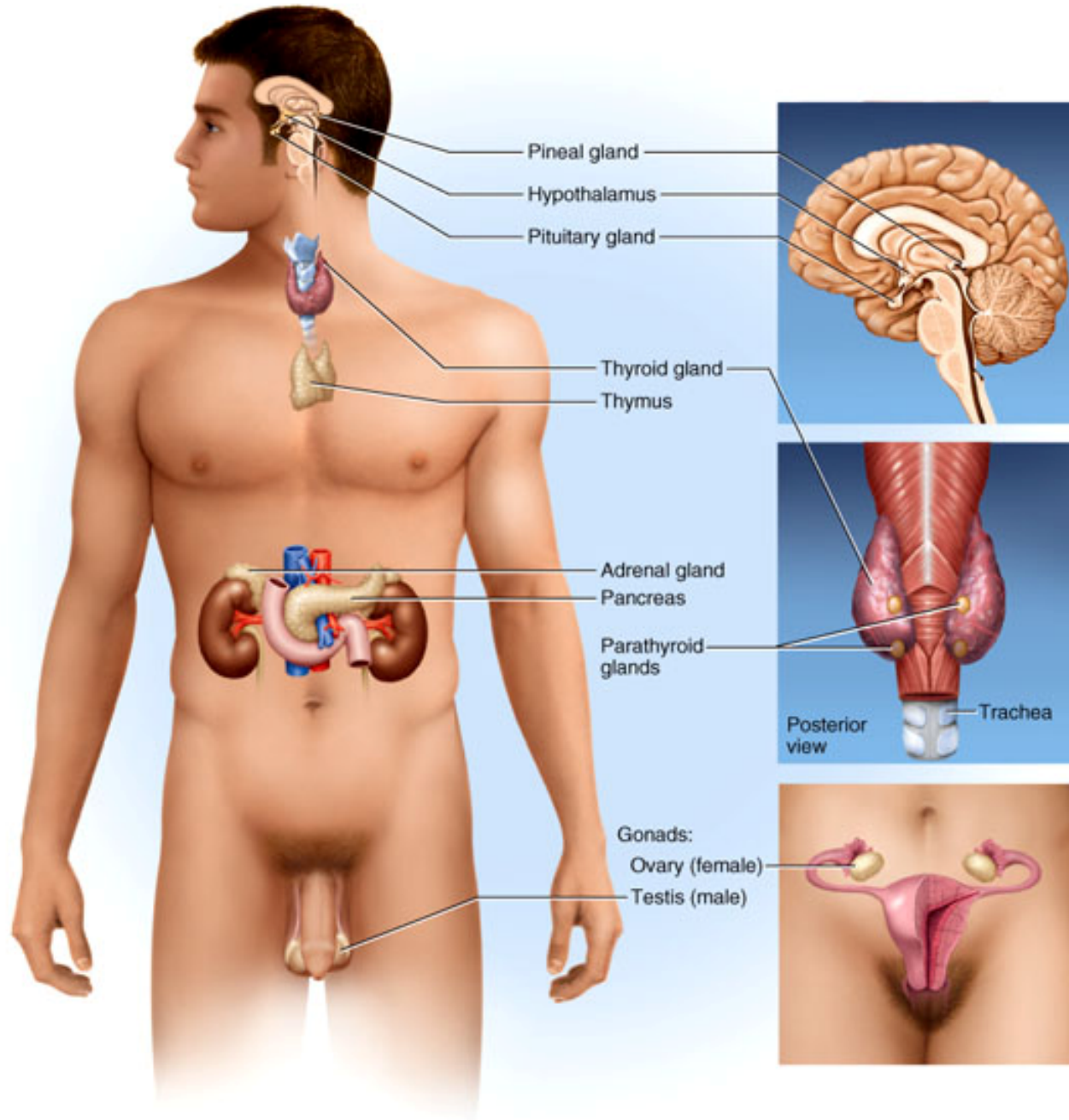
Fibromyalgia Tender Points

General locations of the 18 tender points that make up the criteria for identifying fibromyalgia.

- When a patient complains of pain in multiple areas.
 - Do you really think they have 18 individual problem areas.
- We need to look at the whole person and not treat their symptoms.
 - Be a lumpner not a splitter!
- Where it hurts is where it works!
 - Look elsewhere for the origin of the pain!!

Sympathetic Nervous System – Overview



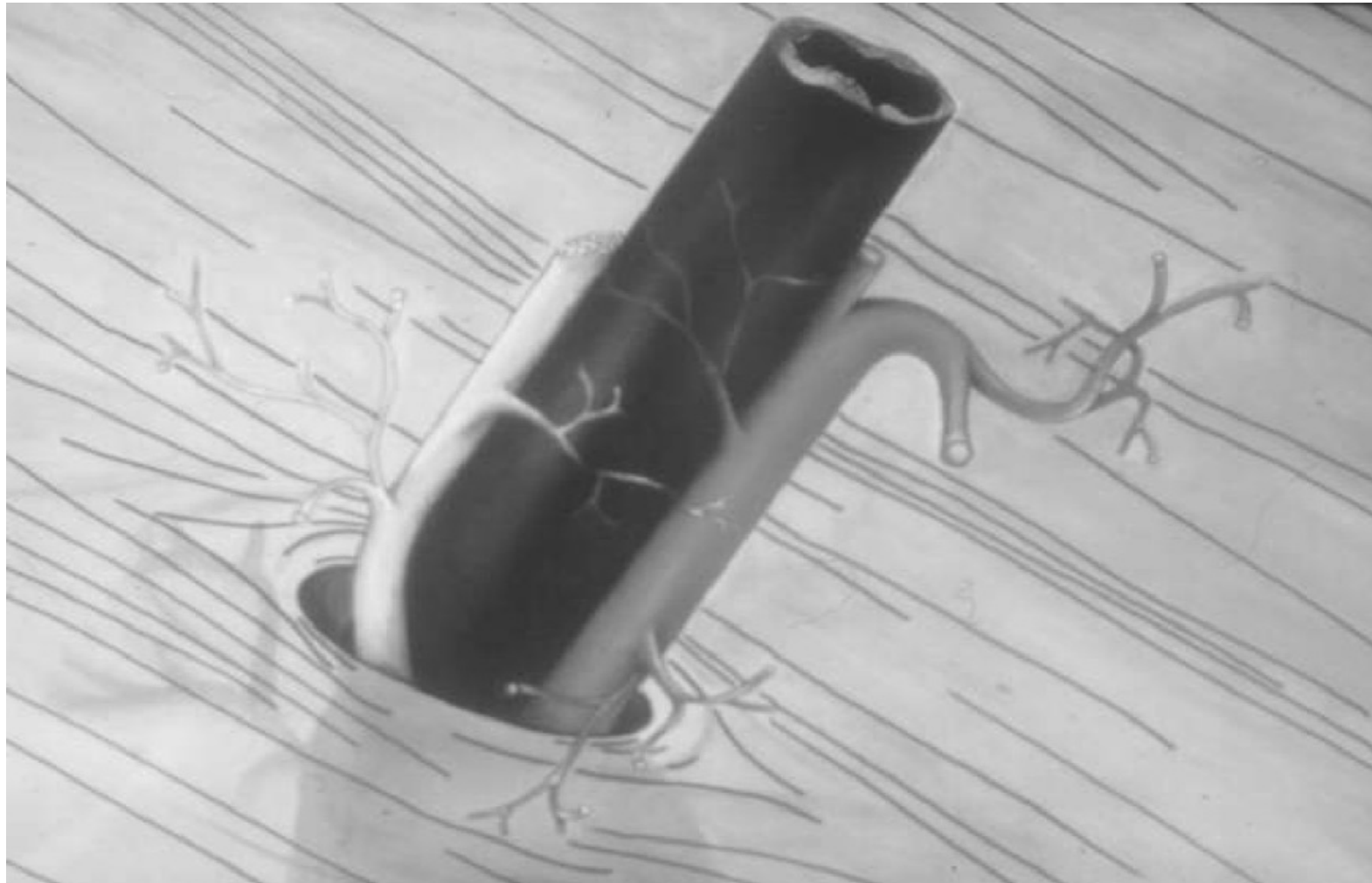


Somatovisceral and Viscerosomatic

- Somatovisceral pain syndromes: myofascial restrictions can cause visceral dysfunctions.
 - Myofascial restrictions in the abdominal muscles can cause vomiting , bowel and bladder problems.
 - The warm water experiment.
- Viscerosomatic pain syndromes: occurs when dysfunctional visceral may cause myofascial constrictions of somatic structures .
 - Appendicitis may cause the abdominal muscles to go into spasm.
 - Prostate cause HS pain

Acupuncture points

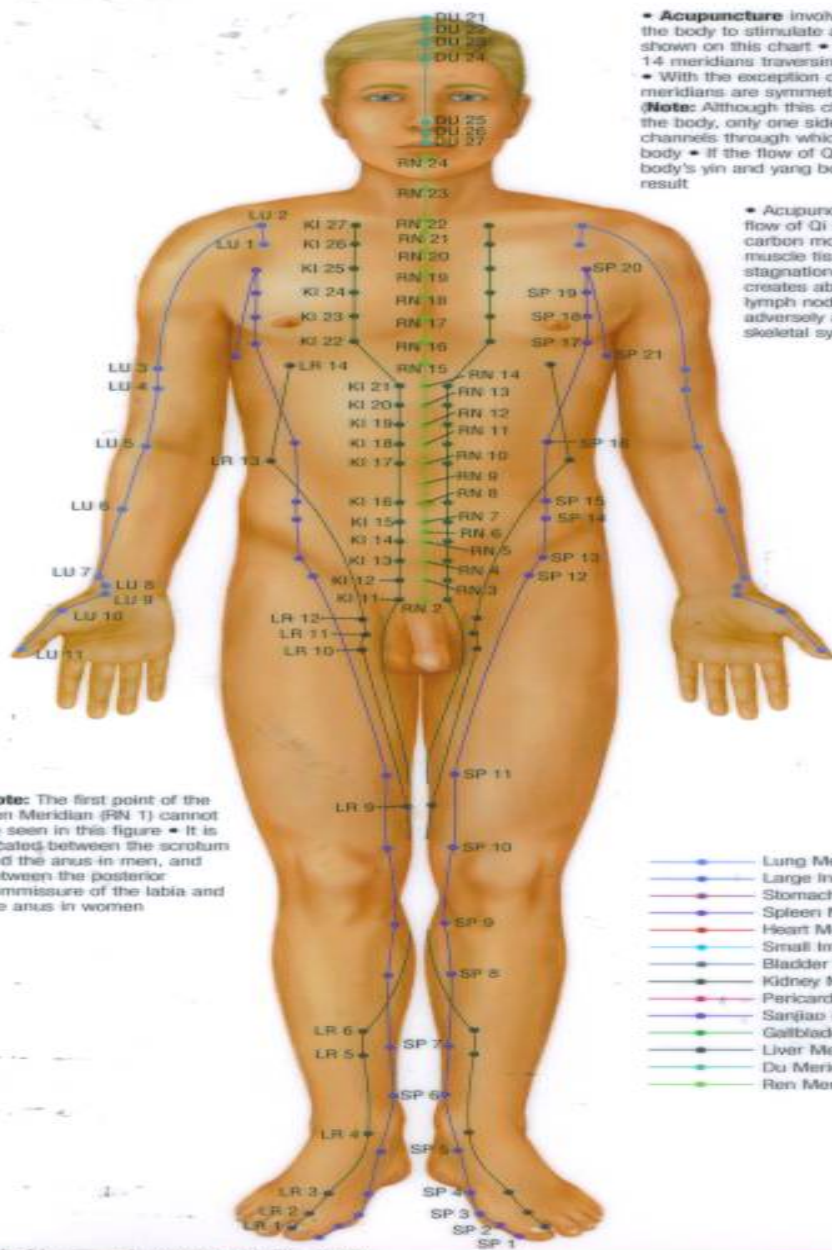
- Acupuncture points appeared to correlate with areas of greater amounts of connective tissue.
- These points are located where nerves artery and veins collectively penetrate the fascia.
- Twisting the needle appears to manipulate the fascia which help reduce pain.
 - Body work also appears to work in this way.



The majority (82%) of perforation points are topographically identical with the 361 classical acupuncture points in traditional Chinese acupuncture.

Acupuncture Points

Figure 1: Anterior View of Meridians

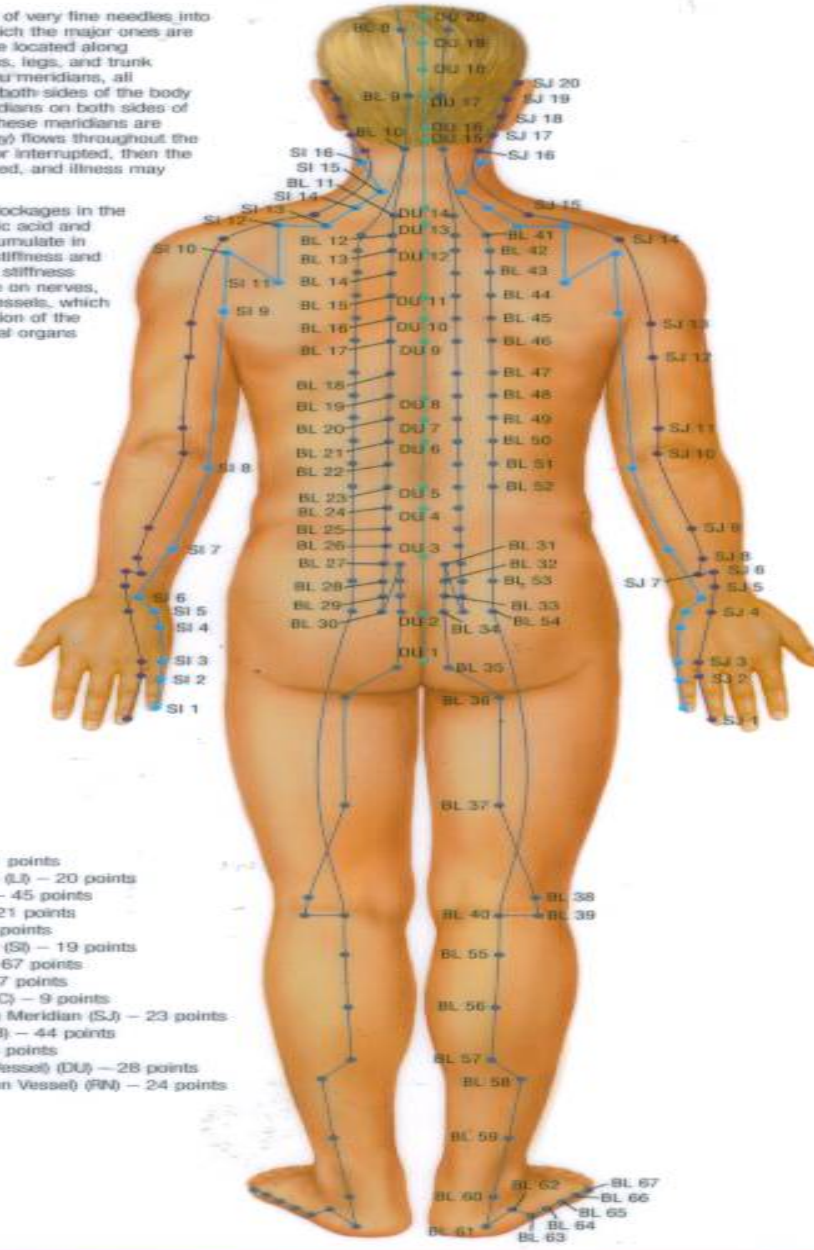


Note: The first point of the Ren Meridian (RN 1) cannot be seen in this figure • It is located between the scrotum and the anus in men, and between the posterior commissure of the labia and the anus in women

• **Acupuncture** involves the insertion of very fine needles into the body to stimulate acupoints, of which the major ones are shown on this chart • These points are located along 14 meridians traversing the head, arms, legs, and trunk • With the exception of the Ren and Du meridians, all meridians are symmetrical, traversing both sides of the body (**Note:** Although this chart shows meridians on both sides of the body, only one side is labeled) • These meridians are channels through which **Qi** (vital energy) flows throughout the body • If the flow of Qi is insufficient or interrupted, then the body's yin and yang become unbalanced, and illness may result

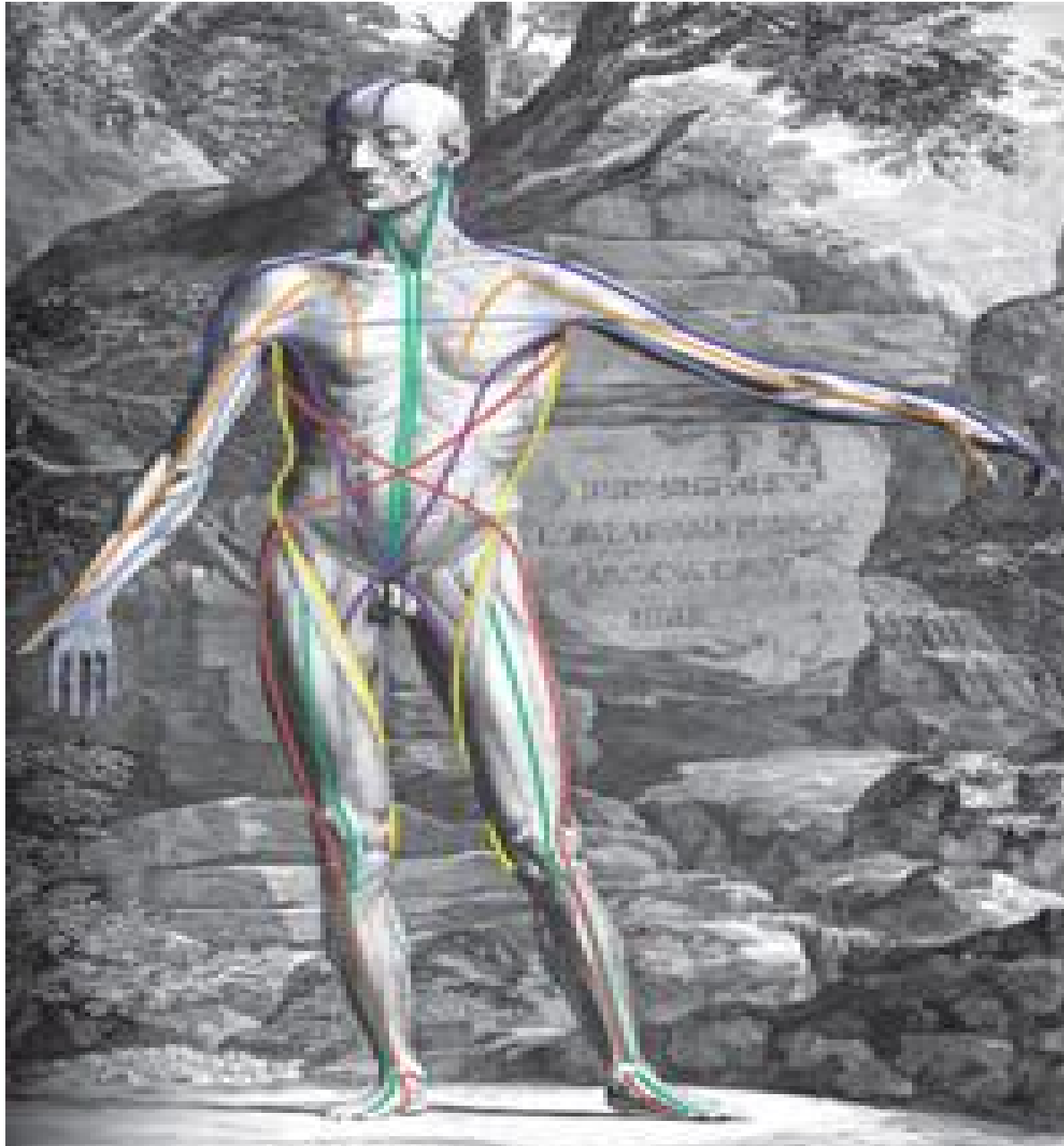
• Acupuncture removes blockages in the flow of Qi by diffusing lactic acid and carbon monoxide that accumulate in muscle tissue and cause stiffness and stagnation of blood • This stiffness creates abnormal pressure on nerves, lymph nodes, and blood vessels, which adversely affects the function of the skeletal system and internal organs

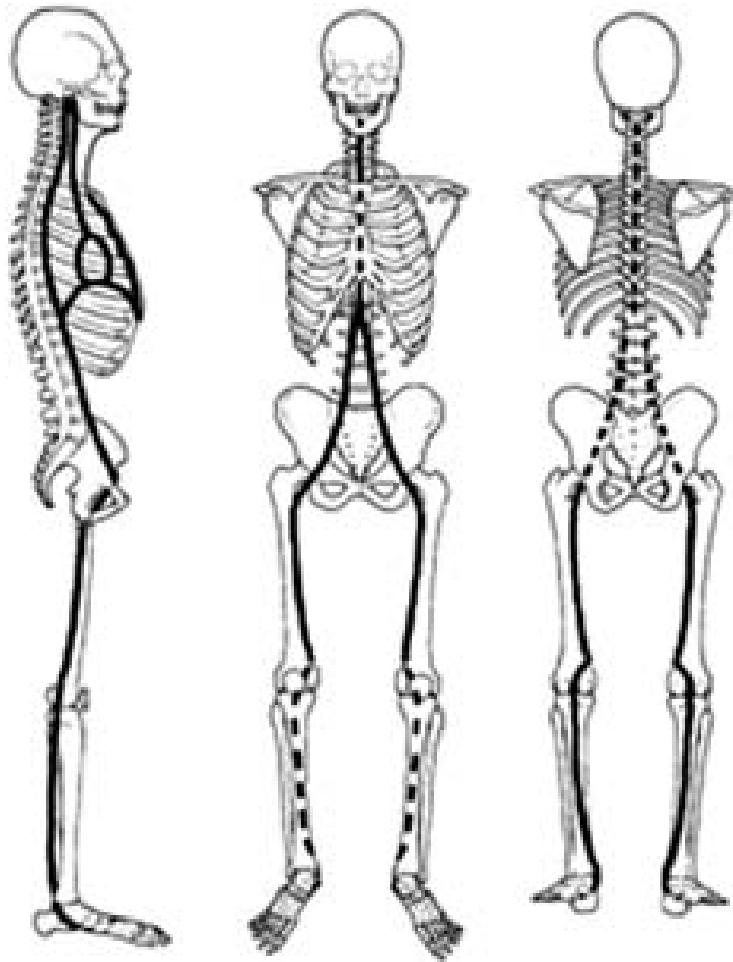
Figure 2: Posterior View of Meridians



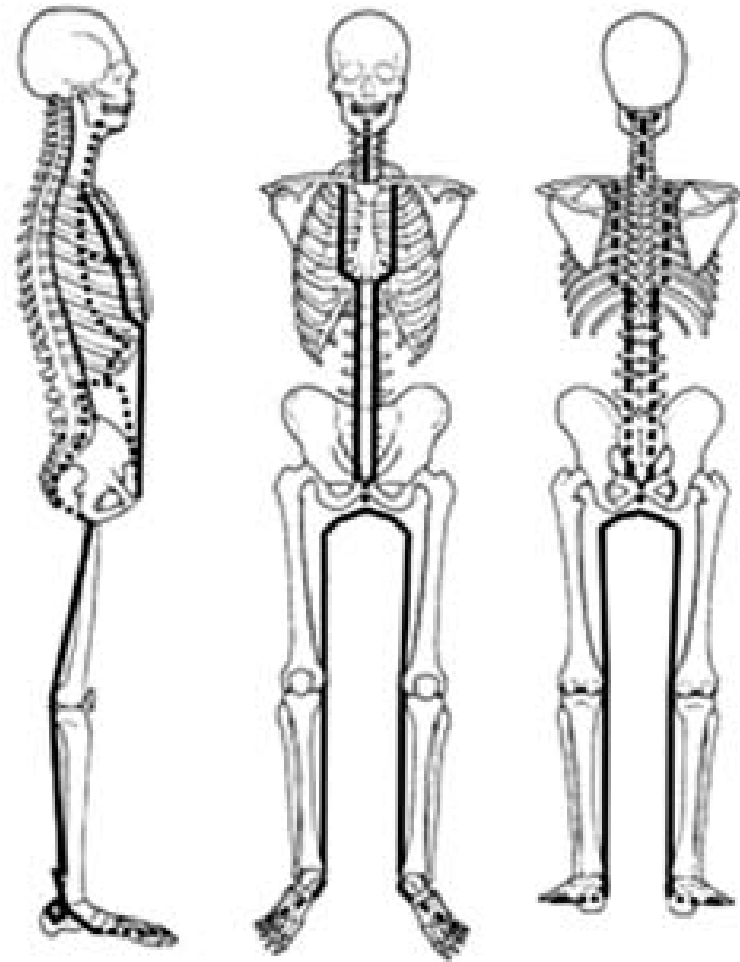
- Lung Meridian (LU) – 11 points
- Large Intestine Meridian (LI) – 20 points
- Stomach Meridian (ST) – 45 points
- Spleen Meridian (SP) – 21 points
- Heart Meridian (HT) – 9 points
- Small Intestine Meridian (SI) – 19 points
- Bladder Meridian (BL) – 67 points
- Kidney Meridian (KI) – 27 points
- Pericardium Meridian (PC) – 9 points
- Sanjiao (Triple Energizer) Meridian (SJ) – 23 points
- Gallbladder Meridian (GB) – 44 points
- Liver Meridian (LR) – 14 points
- Du Meridian (Governor Vessel) (DU) – 28 points
- Ren Meridian (Conception Vessel) (RN) – 24 points

Anatomy Trains

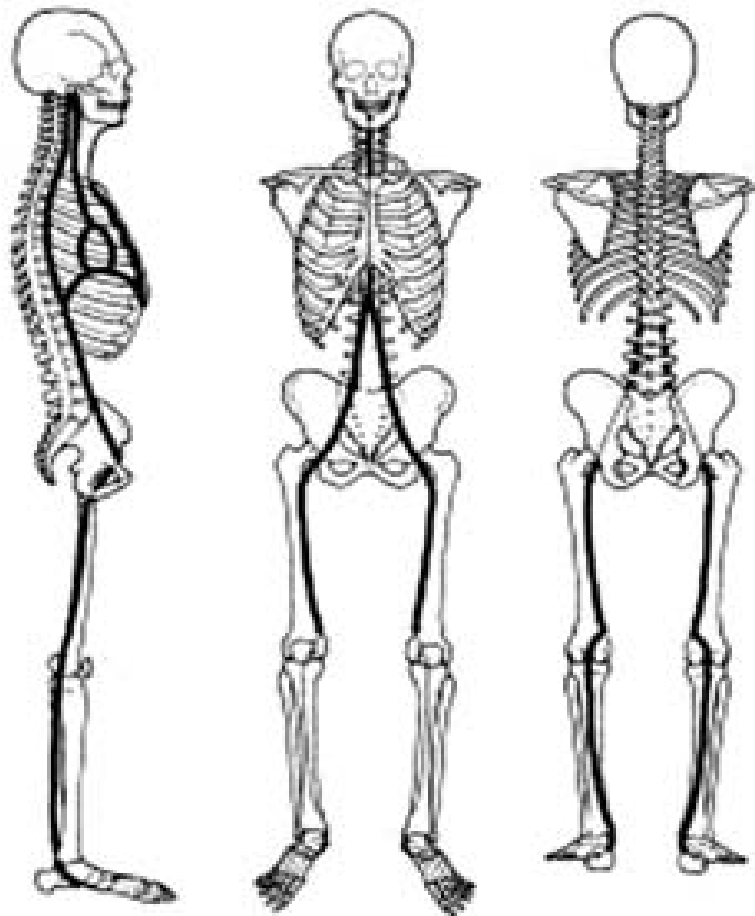




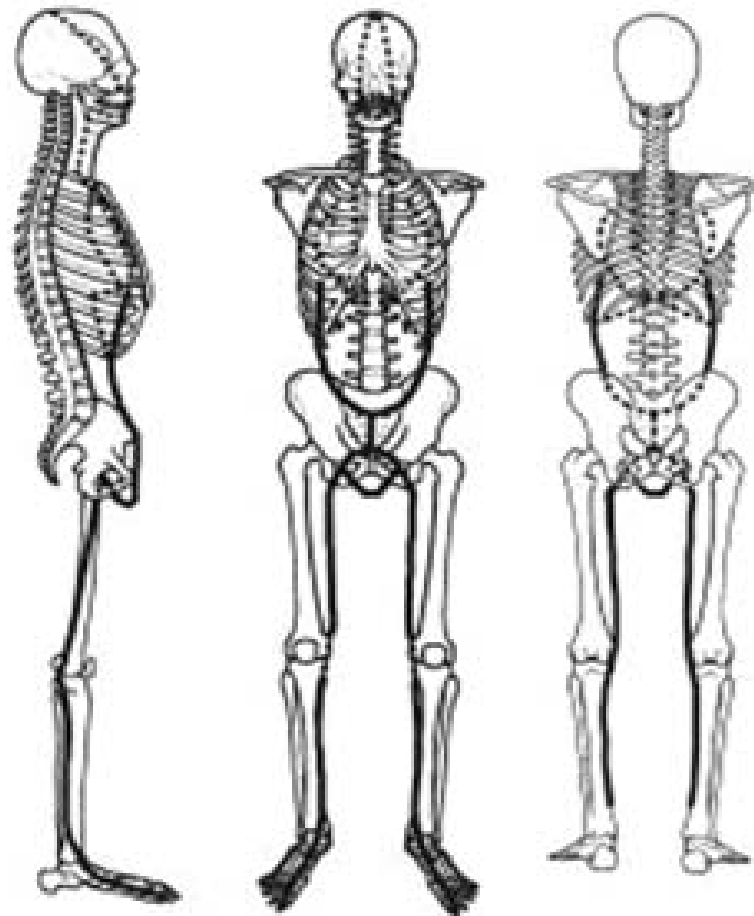
Myofascial Meridian



Kidney Meridian

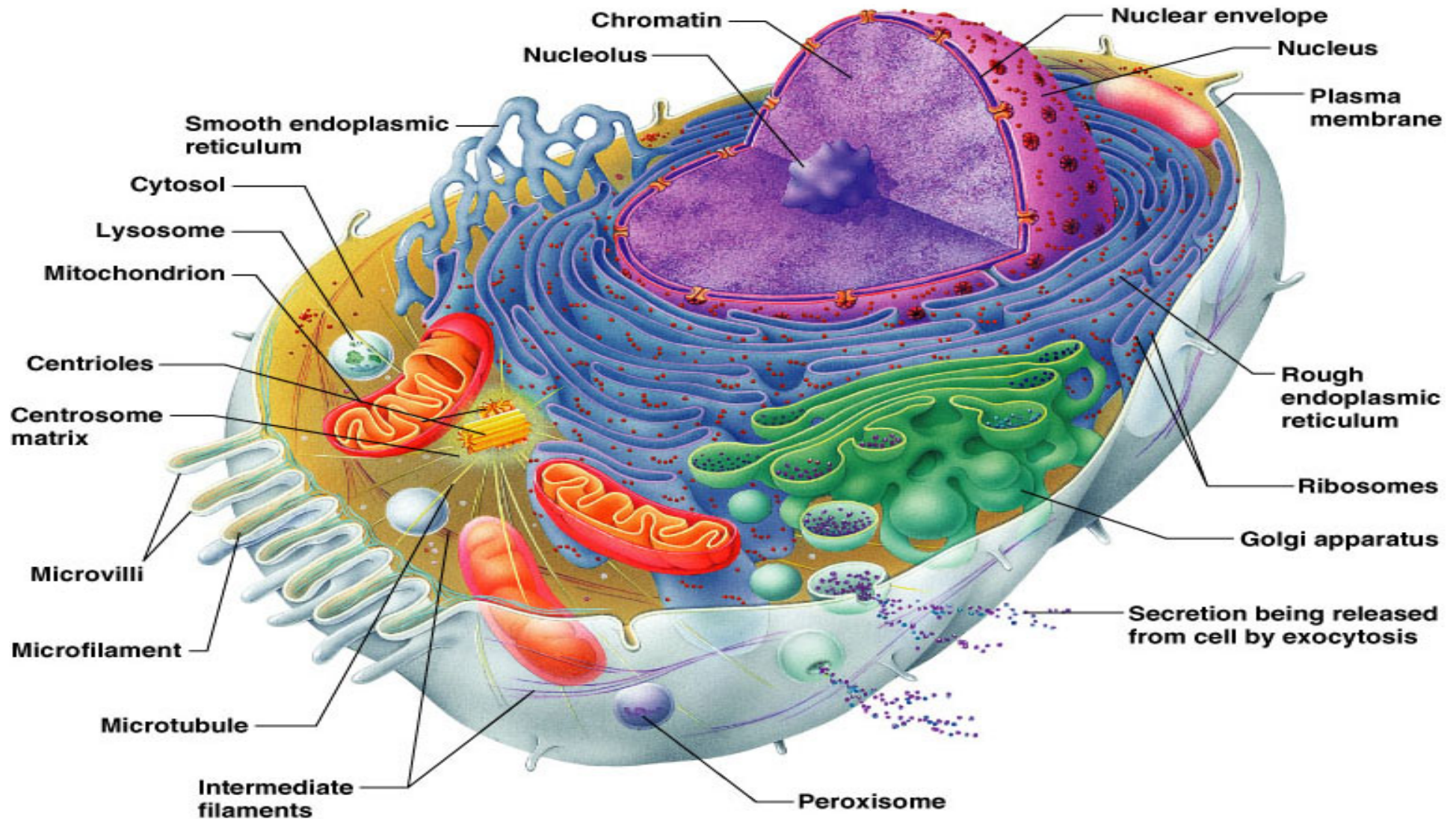


Myofascial Meridian



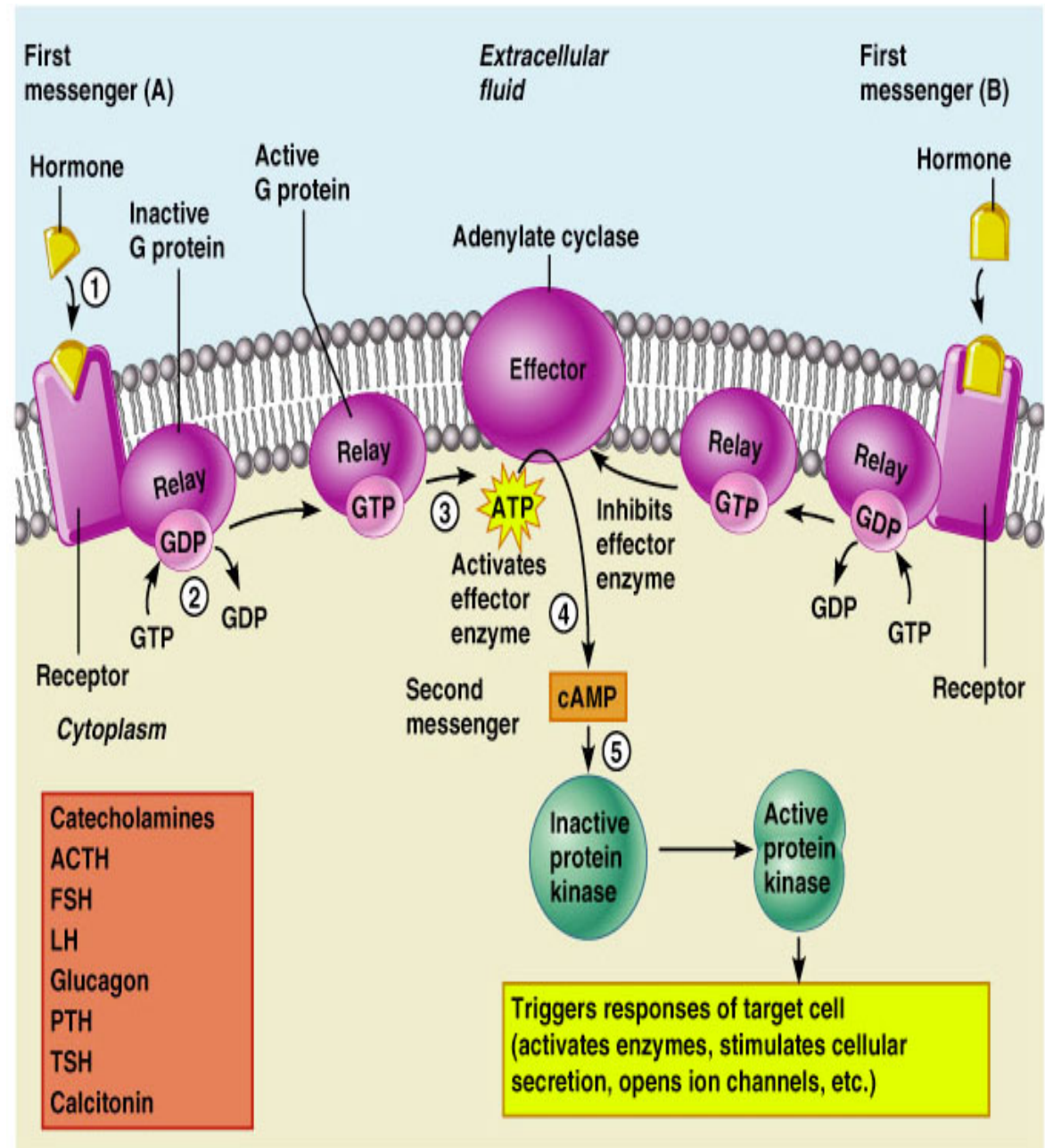
Liver Meridian

Generalized Cell “The Mini You”



Cellular Functions

- Comparing human to cells:
 - The cell membrane and cytosol is analogous to the skin and fascia.
 - The cell membrane
 - receives sensory input through receptors. i.e. hormones, neurotransmitters.
 - That will produce a cellular response
 - The science of epigenetics suggest the cellular functions are more dictated by environmental influences.



The Fascial System Relation to Cellular Structures.

- Skin and Fascia are analogous to the cell membrane of the cell.
 - Just as the cell membrane is critical for intracellular functions and communication.
 - The fascial system plays a similar role in both form and function in the human body.
 - Skin and fascia are both rich in various types of receptors.
 - They provide proprioceptive and sensory input which will effect the motor output of the system.



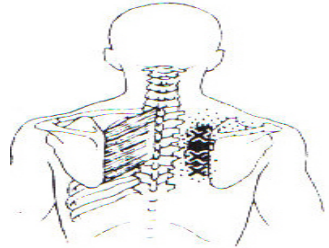
Patient's Responsibility

- HEP: includes self stretches for myofascial restricted tissues, Cardio and resistive training.
- Nutrition: Plenty of water especially post tx and a diet rich in fresh (organic if possible) fruits and vegetables.
- Stress management: diaphragmatic breathing, meditation and getting enough sleep.

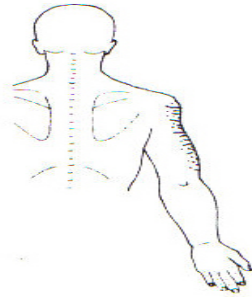
Fascial Take Home Messages

- Fascia is continuous from head to toe.
- Muscles and associated fascia are richly innervated with various receptors making it the largest sense organ.
 - which is important for proprioception and motor control.
- Injury and poor posture can create imbalances which can contribute to chronic injuries.
- Fascial research is still in its infancy.

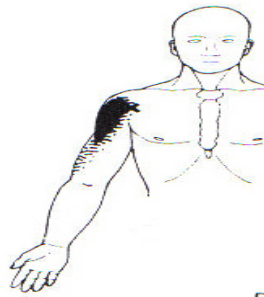
SHOULDER, THORAX, AND ARM PAIN



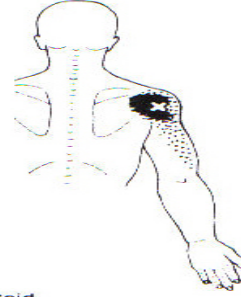
Rhomboideus



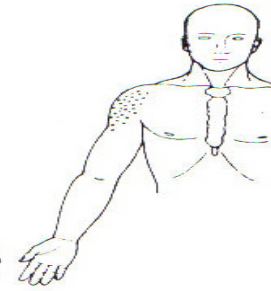
Deltoid



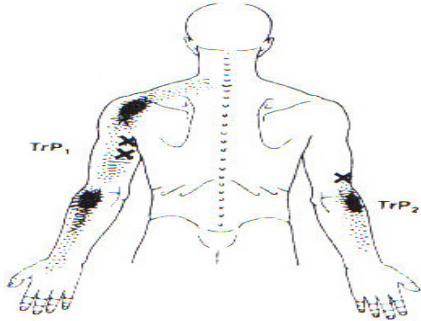
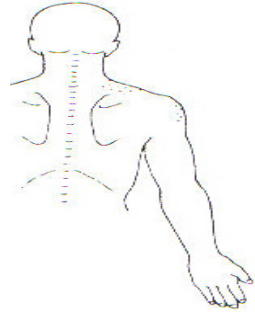
Biceps brachii



Coracobrachialis

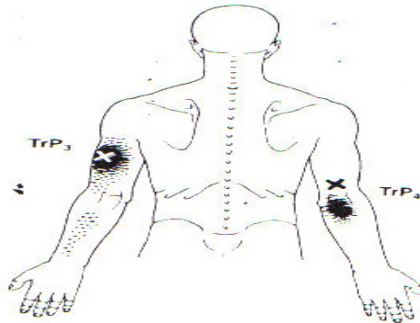


Brachialis



TrP₁

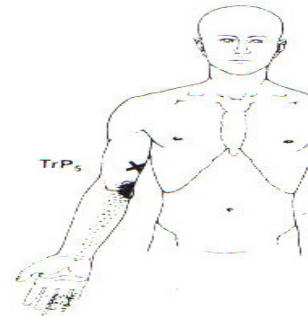
TrP₂



TrP₃

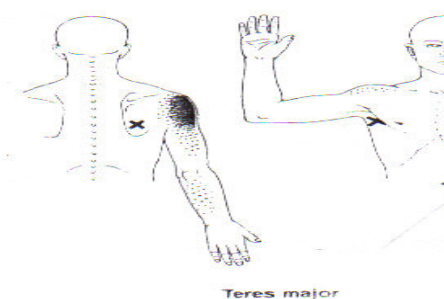
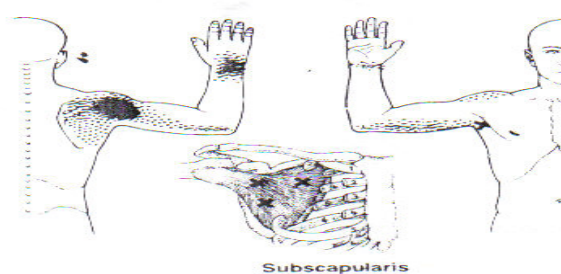
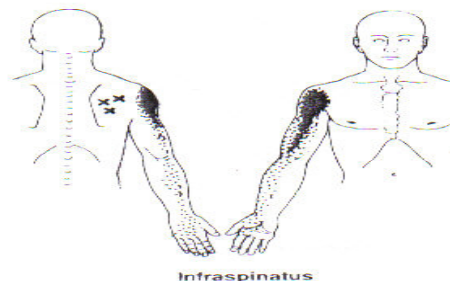
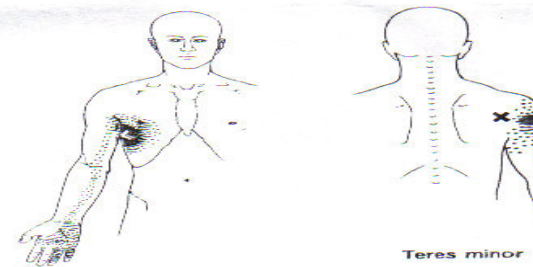
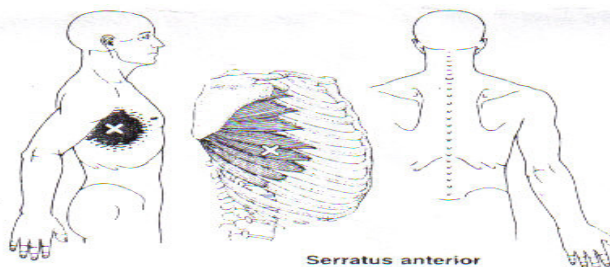
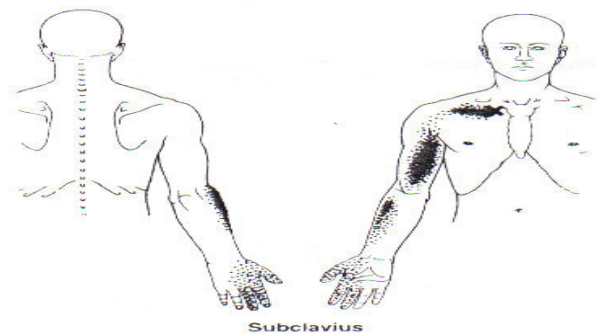
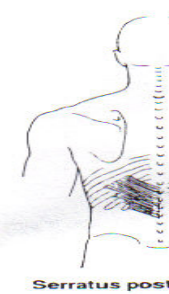
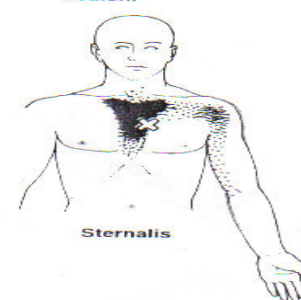
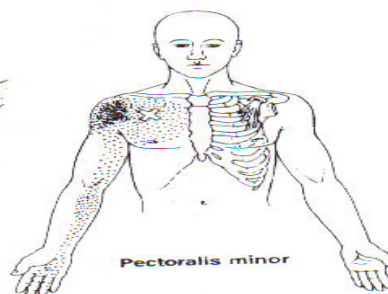
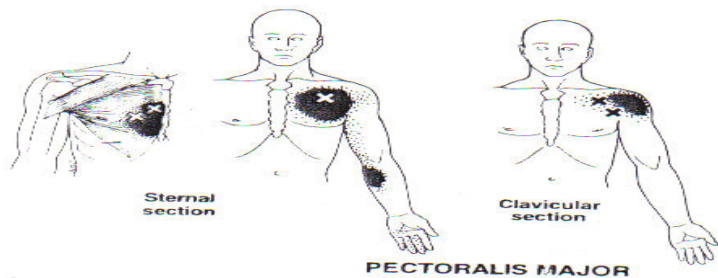
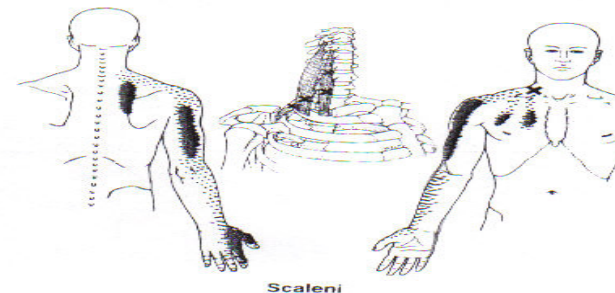
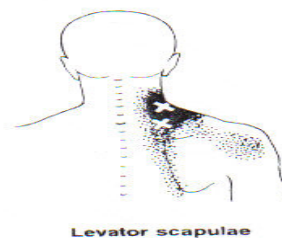
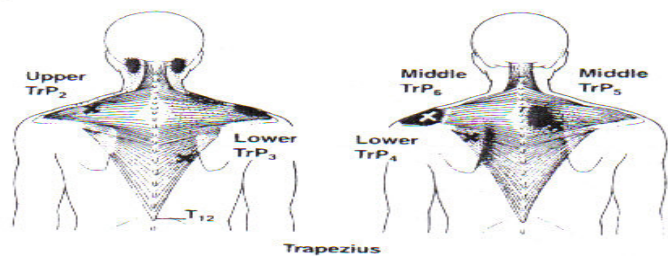
TrP₄

Triceps brachii

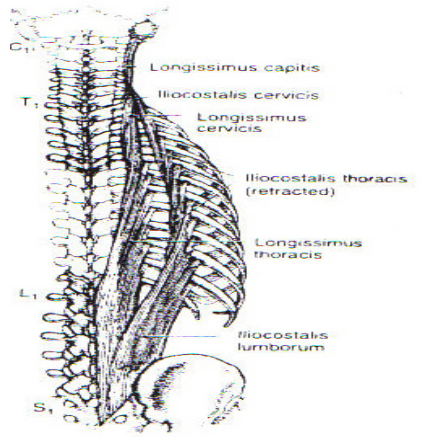


TrP₅

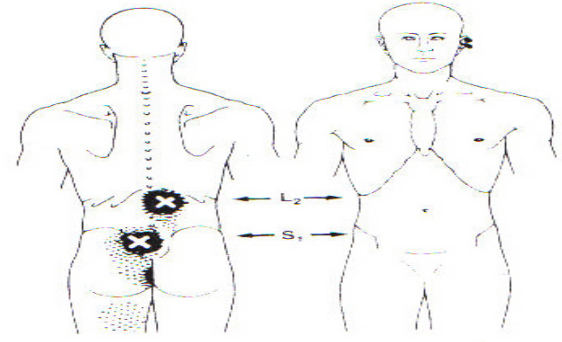
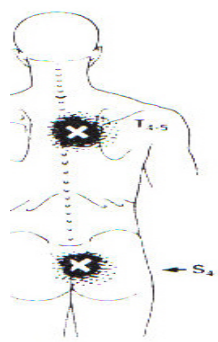
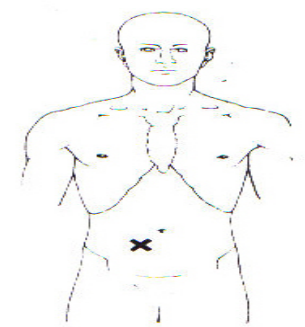
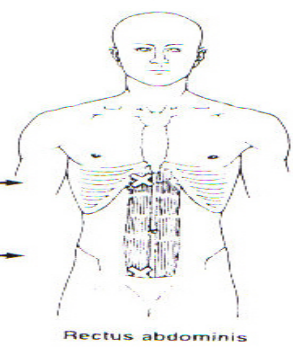
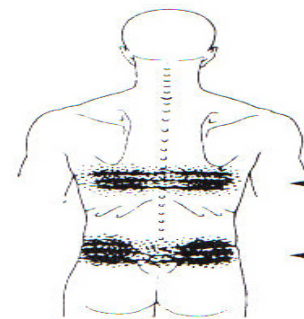
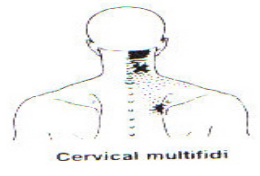
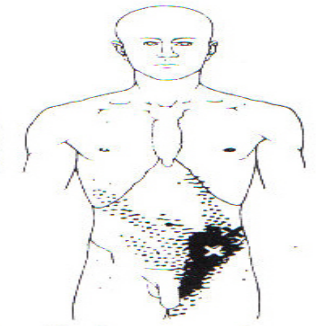
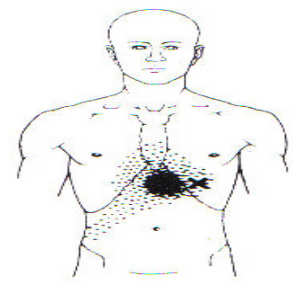
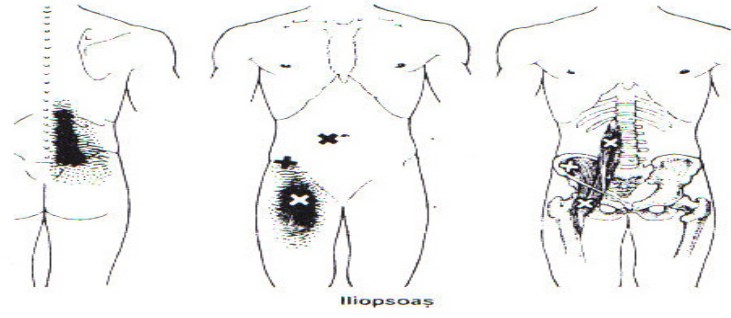
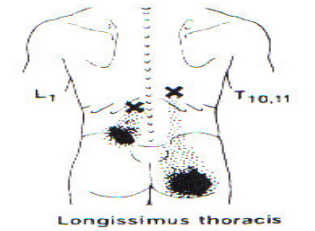
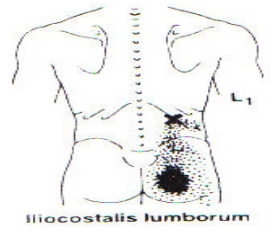
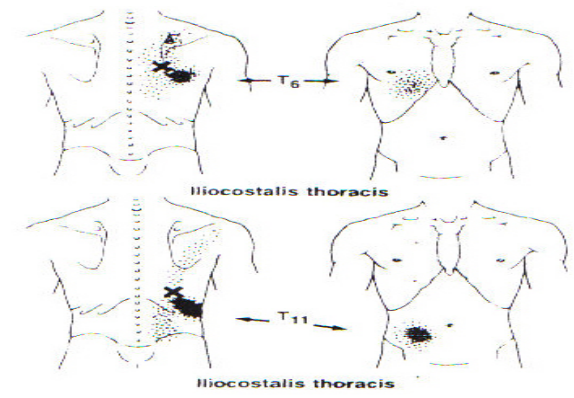
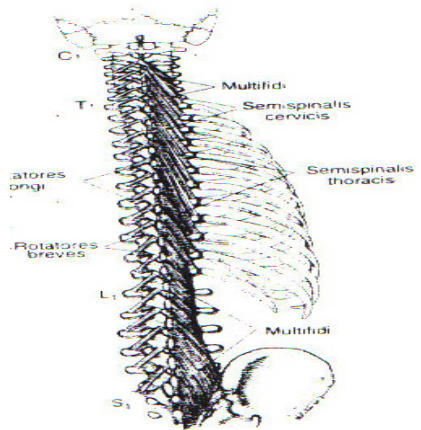
SHOULDER, THORAX, AND ARM PAIN



BACK AND ABDOMINAL PAIN

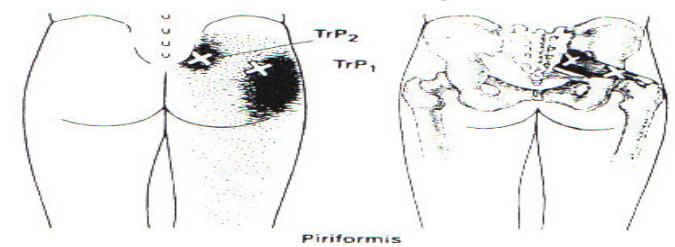
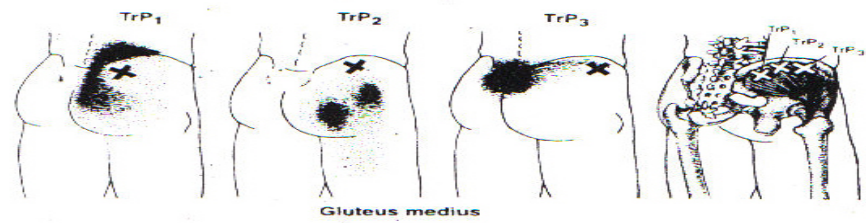
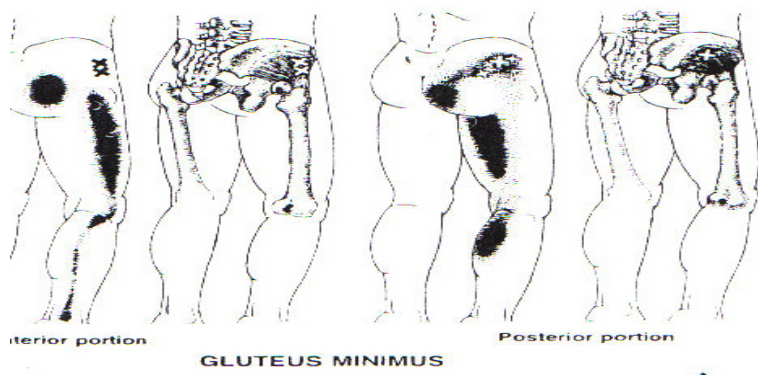
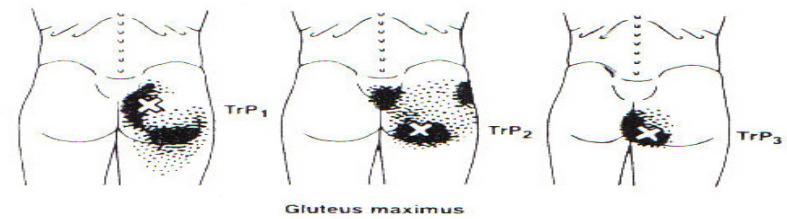
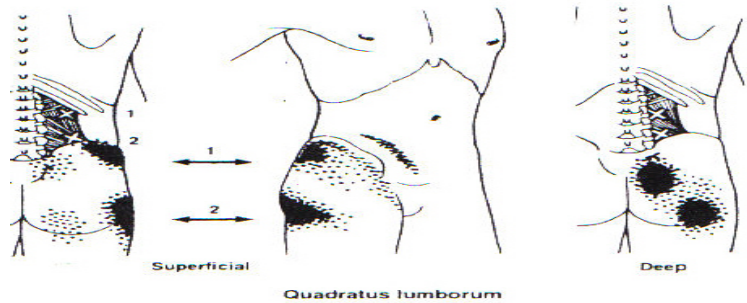


Superficial paraspinal muscles

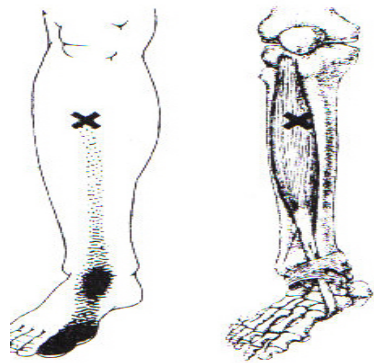


Multifidi

PELVIC, GLUTEAL, AND THIGH PAIN

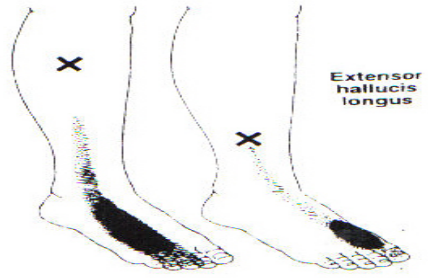


LEG, ANKLE, AND FOOT PAIN

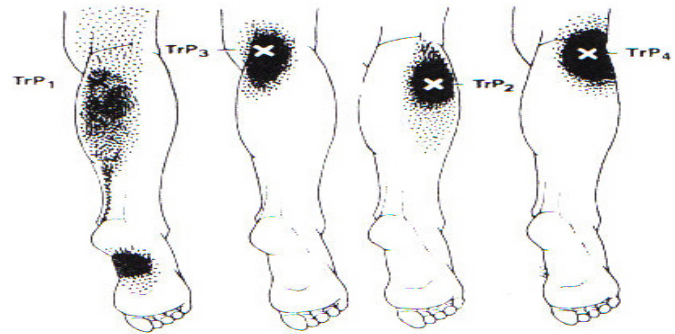


Tibialis anterior

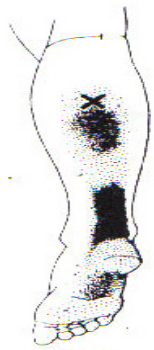
Extensor digitorum longus



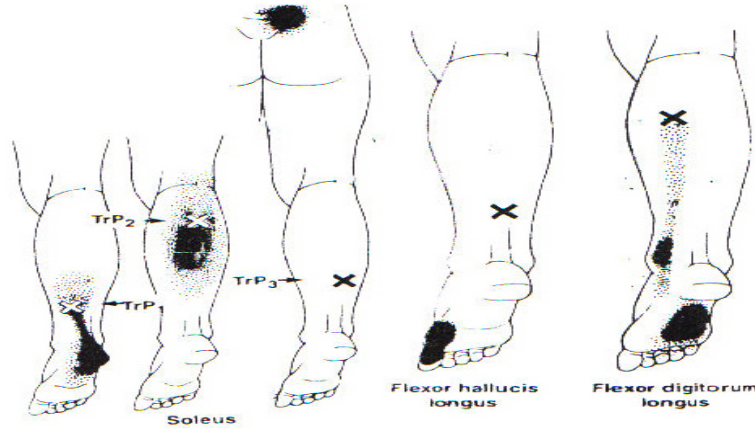
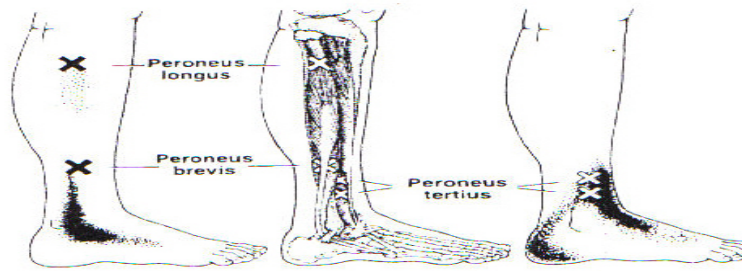
Extensor hallucis longus



Gastrocnemius



Tibialis posterior



Soleus

Flexor hallucis longus

Flexor digitorum longus



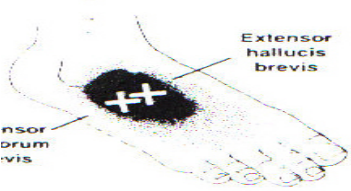
Abductor digiti minimi



Flexor digitorum brevis



Abductor hallucis



Extensor hallucis brevis



Adductor hallucis



Flexor hallucis brevis

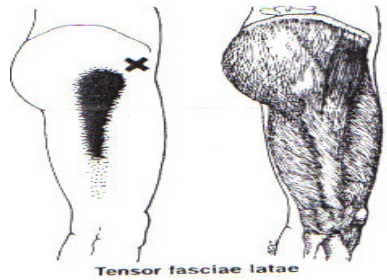


Quadratus plantae

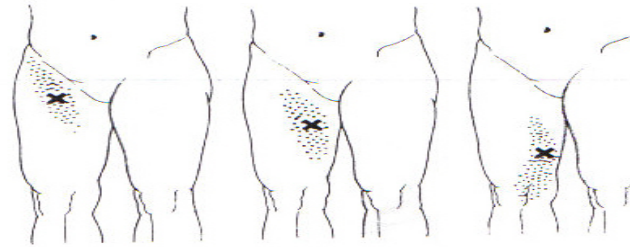


First dorsal interosseus

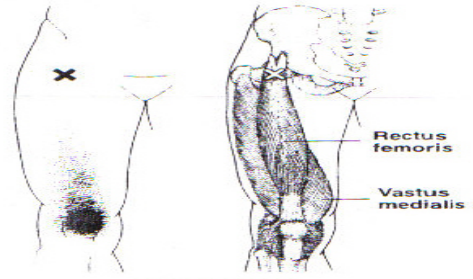
HIP, THIGH, AND KNEE PAIN



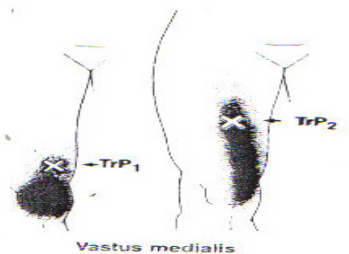
Tensor fasciae latae



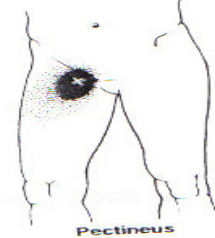
Sartorius



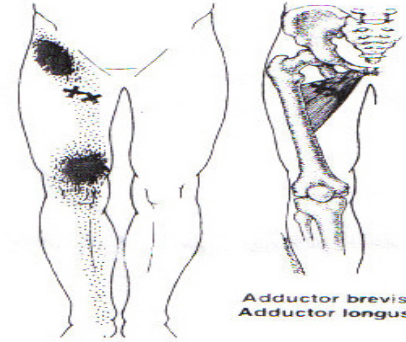
Rectus femoris



Vastus medialis



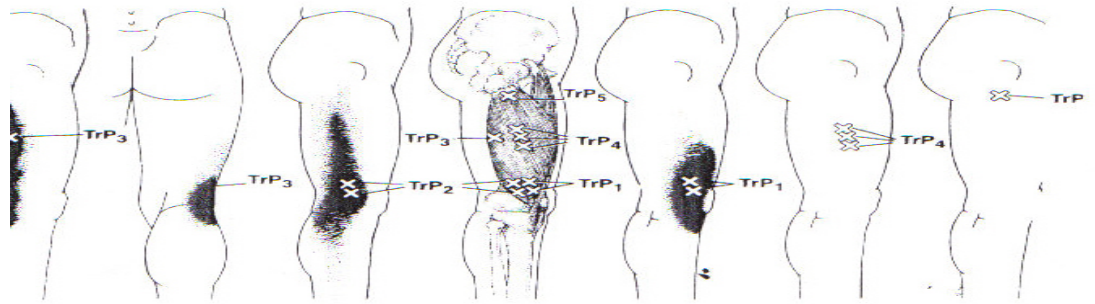
Pectineus



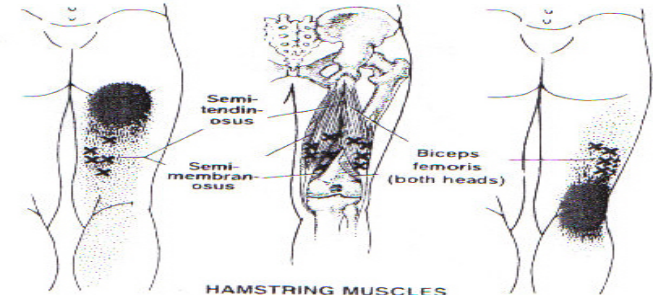
Adductor brevis
Adductor longus



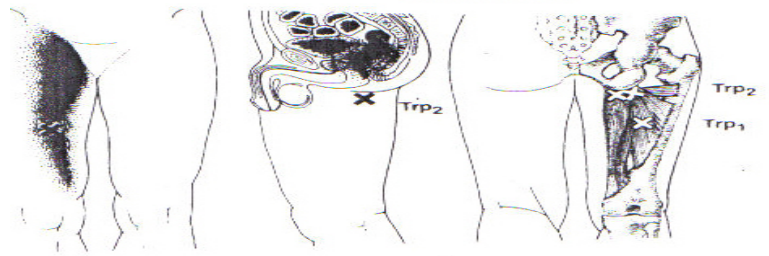
Gracilis



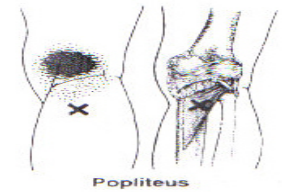
Vastus lateralis



HAMSTRING MUSCLES



Adductor magnus muscle



Popliteus

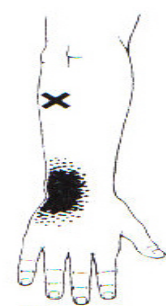


Vastus intermedius

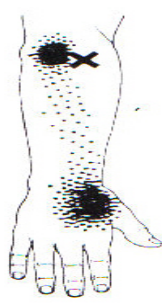
FOREARM AND HAND PAIN



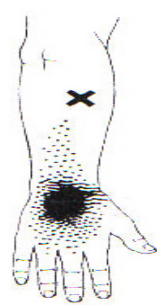
Brachioradialis



Extensor carpi ulnaris



Extensor carpi radialis longus

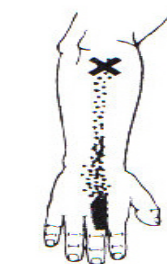


Extensor carpi radialis brevis

HAND EXTENSORS



Anconeus



Middle finger

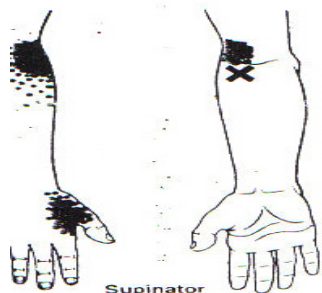


Ring finger



Extensor indicis

FINGER EXTENSORS



Supinator



Flexor carpi radialis



Flexor carpi ulnaris



Radial head



Humeral head

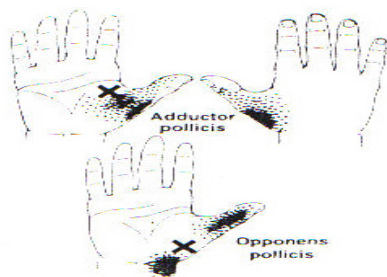
FLEXOR DIGITORUM



Pronator teres

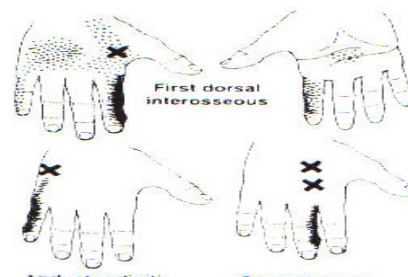


Flexor pollicis longus



Adductor pollicis

Opponens pollicis



First dorsal interosseus

Abductor digiti minimi

Second dorsal interosseus

INTEROSSEI

HEAD AND NECK PAIN

