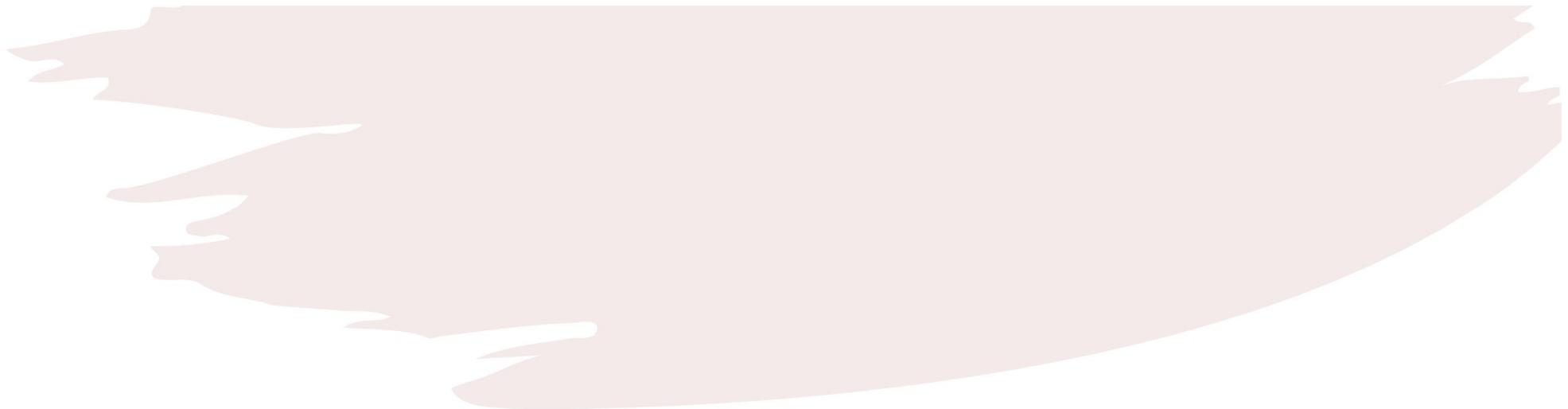


Anatomy Review for Connective Tissue Treatments:

- *Myofascial release*
- *Balanced Ligamentous Tension*

KIM WOLF DO
2025

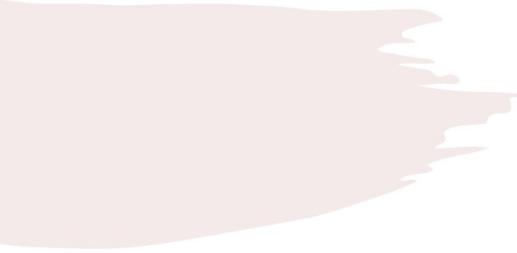


WHY?!?!

**WHY DOES OPP REVIEW SO MUCH ANATOMY IN THE MFR AND
BLT LECTURE SERIES?**



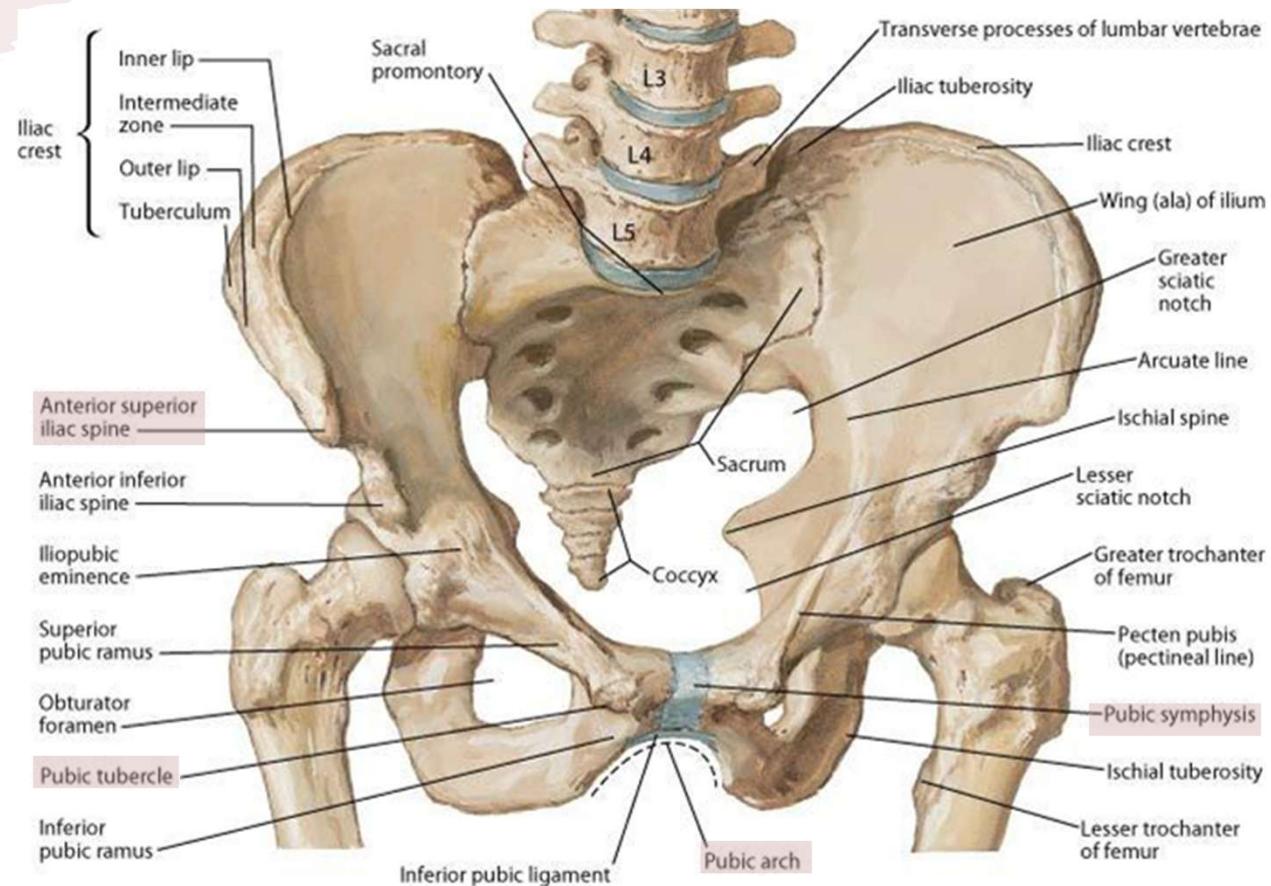
Sacrum and Pelvis



Anatomy

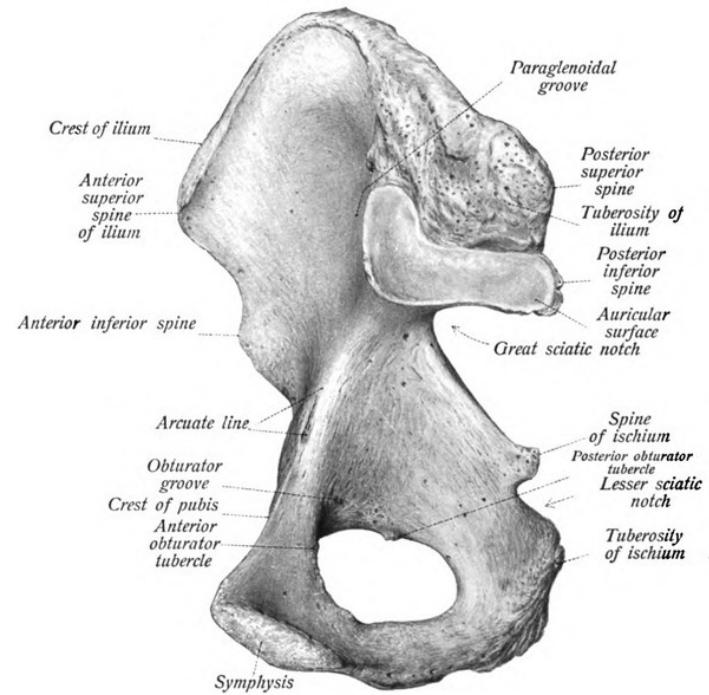
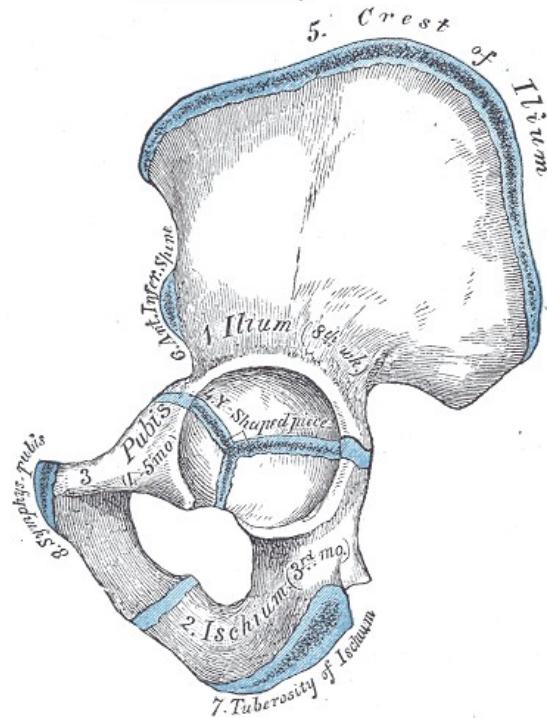
- Bones
- Ligaments
- Muscles
- Myofascial structures
- Viscera
- Nerves, blood and lymphatic vessels
- Ischiorectal fossa

Bony Anatomy - Pelvis



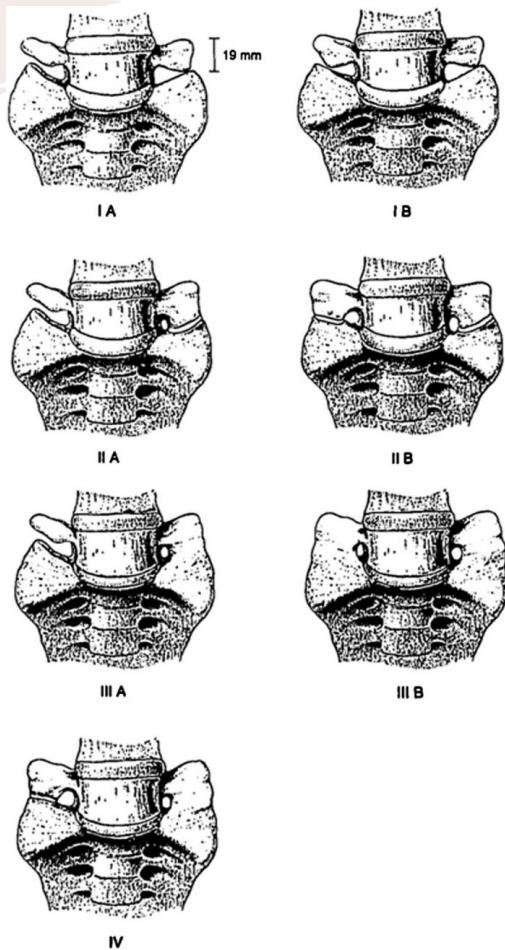
Bony Anatomy - Innominate

By eight centers { Three primary (Ilium, Ischium, and Pubis)
 { Five secondary



sacrum is 5 bones that fuses in mid-20s - 30s

Lumbosacral Junction



Castellvi radiographic classification system.

In one study from 2011, about 35% of participants had some variation of the bony anatomy in this region (most common was IA). In another study from 2014, the prevalence was around 10%.

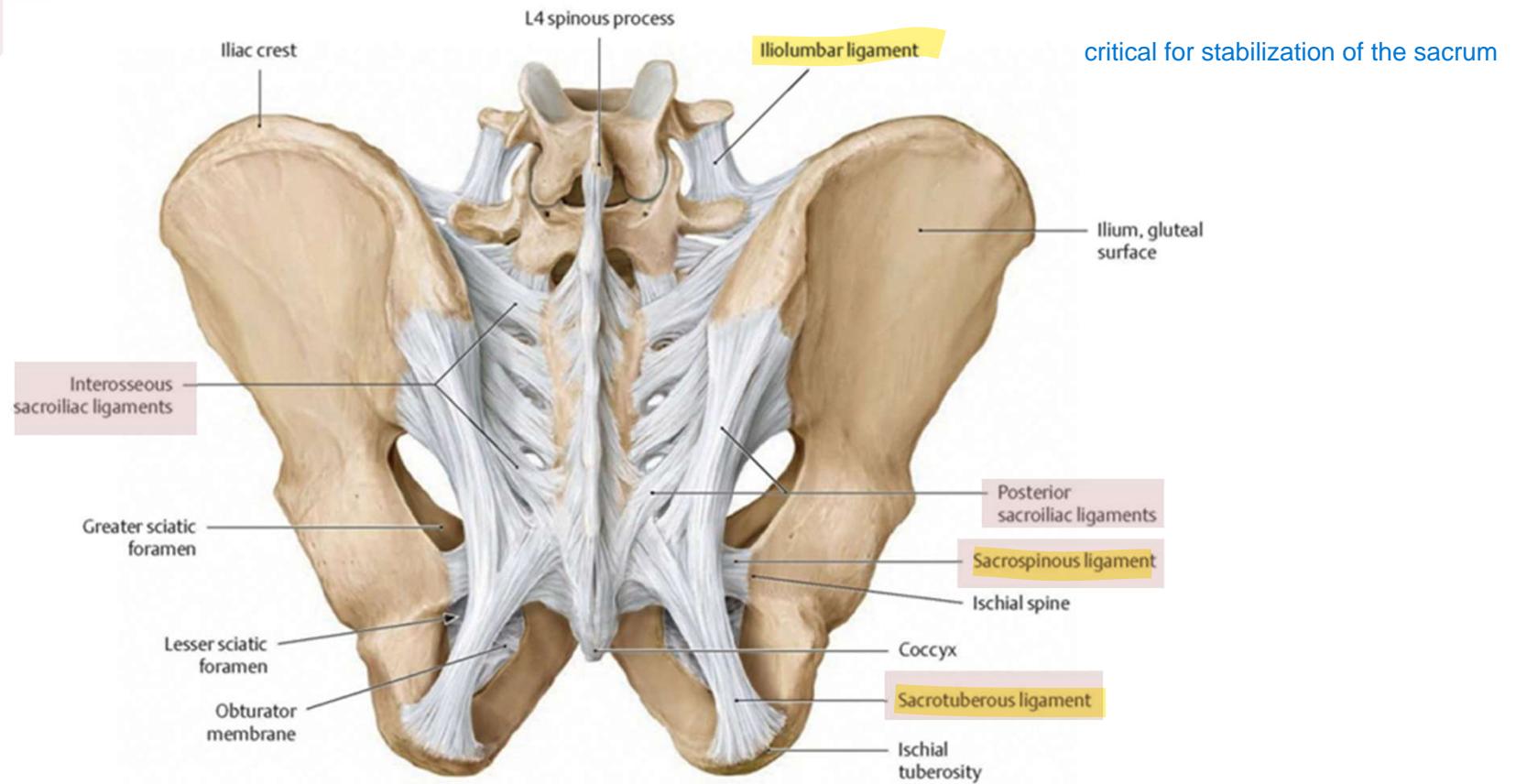
trust hands and if feel something different could actually be feeling something different

Posterior Pelvic Ligaments

“Hang the sacrum from above”

- Primary
 - Posterior SI Joint Ligaments
 - Long dorsal ligament
 - Originates from PSIS, most superficial and dorsally located
 - Vertical Fibers
 - Prevents hyperextension
 - Short dorsal ligaments (aka Dorsal sacroiliac transverse ligaments)
 - Horizontal fibers between the sacrum and ilium
 - Prevent hyperflexion
- ▶ Secondary
 - ▶ Sacrotuberous ligament
 - ▶ Sacrospinous ligament
- ▶ Other
 - ▶ Interosseous sacroiliac ligaments
 - ▶ Provides for **multidirectional** structural stability
 - ▶ Larger in females assigned at birth than males assigned at birth
- ▶ Thoracolumbar fascia- not ligament- important for long lever treatment

Posterior Pelvic Ligaments

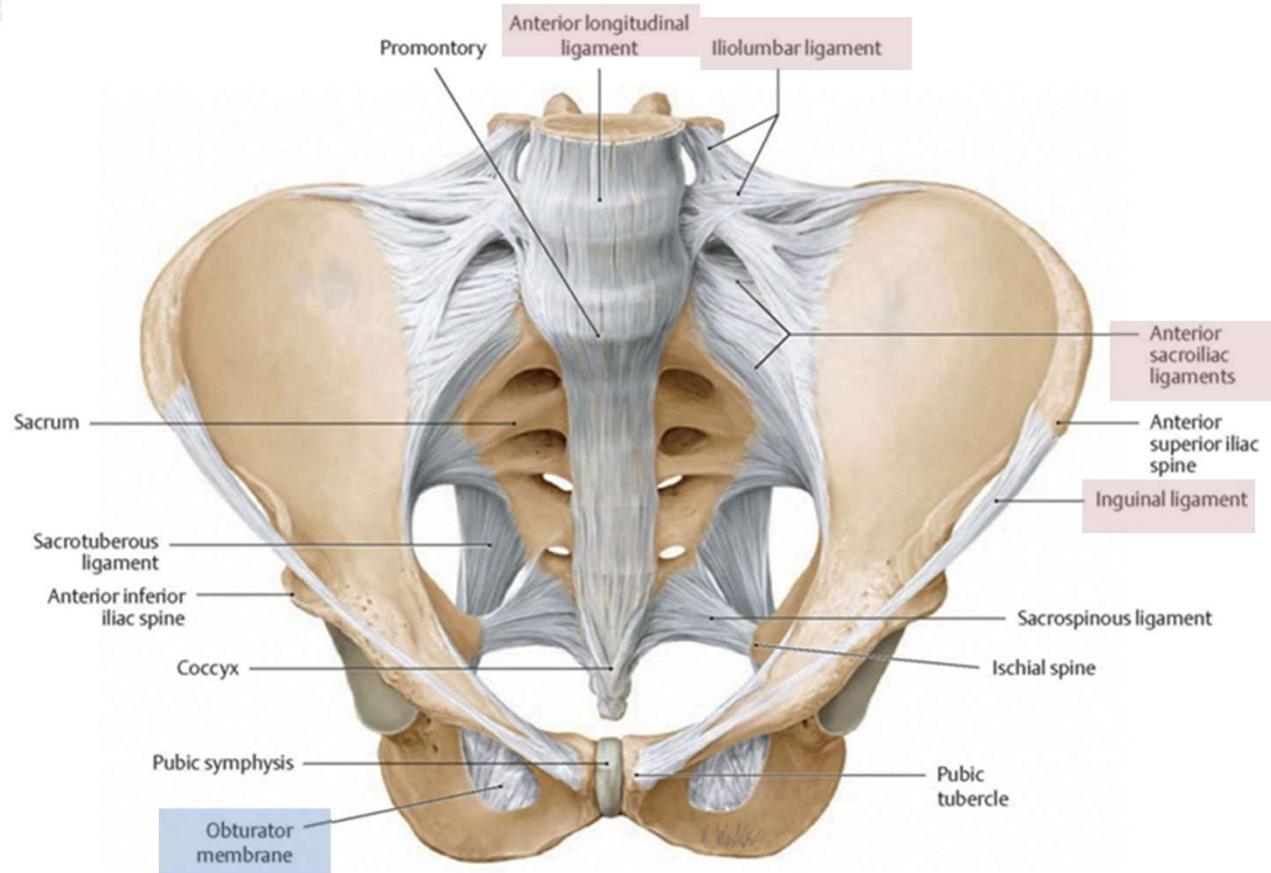


Anterior ligaments

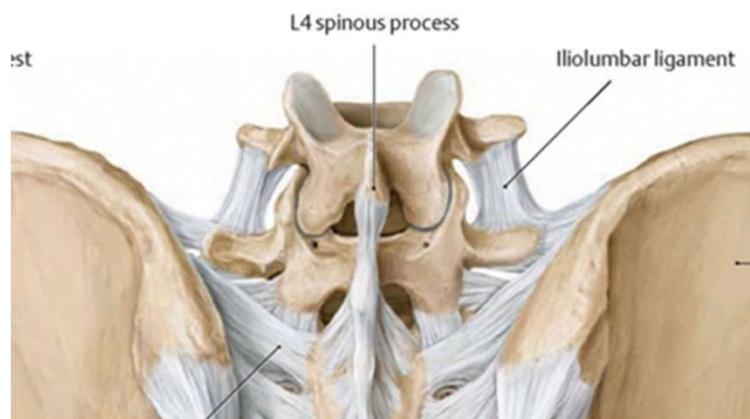
“Suspend the sacrum from below”

- Primary
 - Superior joint capsule (anterior sacroiliac ligaments) may be an extension of the iliolumbar ligaments
 - Smooth sheet of dense connective tissue
 - Caudal border of the anterior capsule blends with the cranial end of the sacrospinous ligament
- Secondary
 - Iliolumbar ligaments
 - Other (function other than SIJ support, ligamentous structures that can be both dysfunctional and treated with OMM)
 - Inguinal ligaments
 - Not involved in sacroiliac support, but is important in supporting the structure passing through the femoral triangle
 - Obturator membrane
 - Important in defining the obturator canal, attachment for both obturator muscles

Ligaments of the Pelvis - Anterior



Iliolumbar ligament

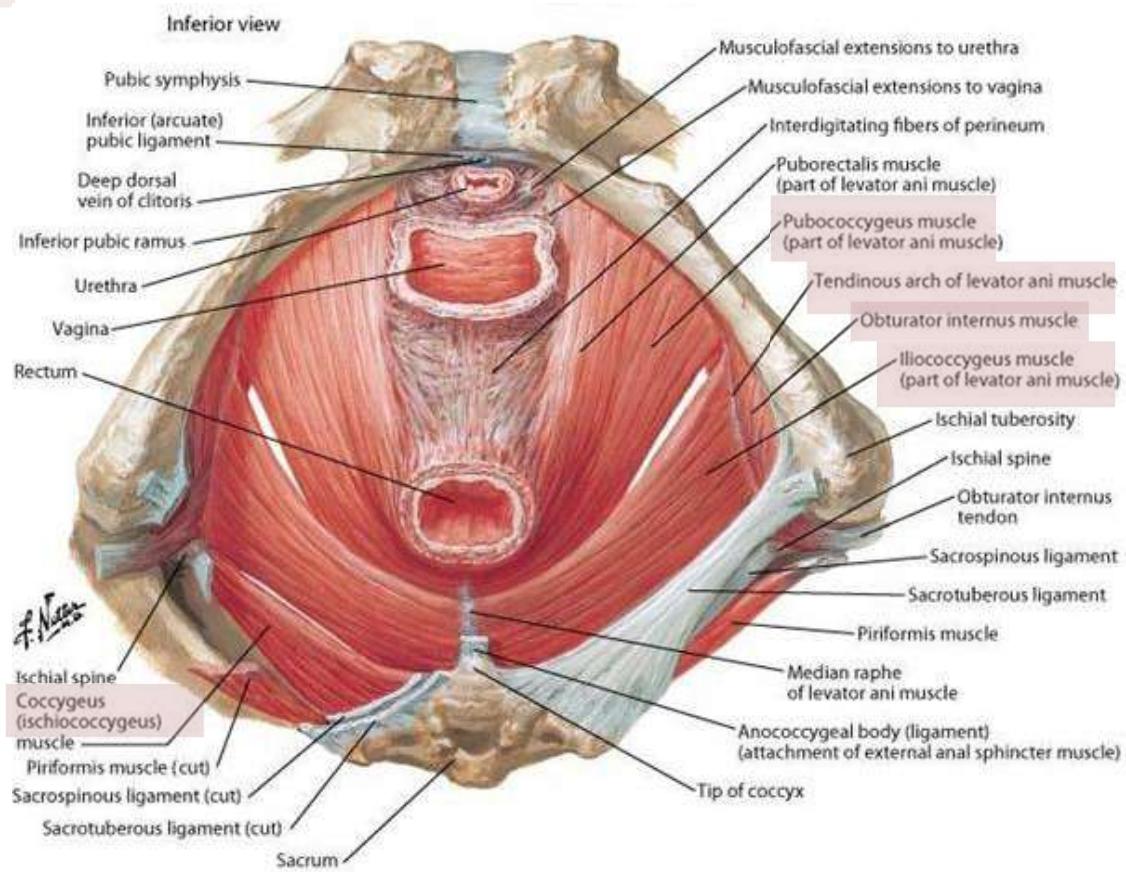


- Large fan-shaped complex ligament
- Transverse processes of L4 and L5 to iliac crest

Pelvic floor Muscles

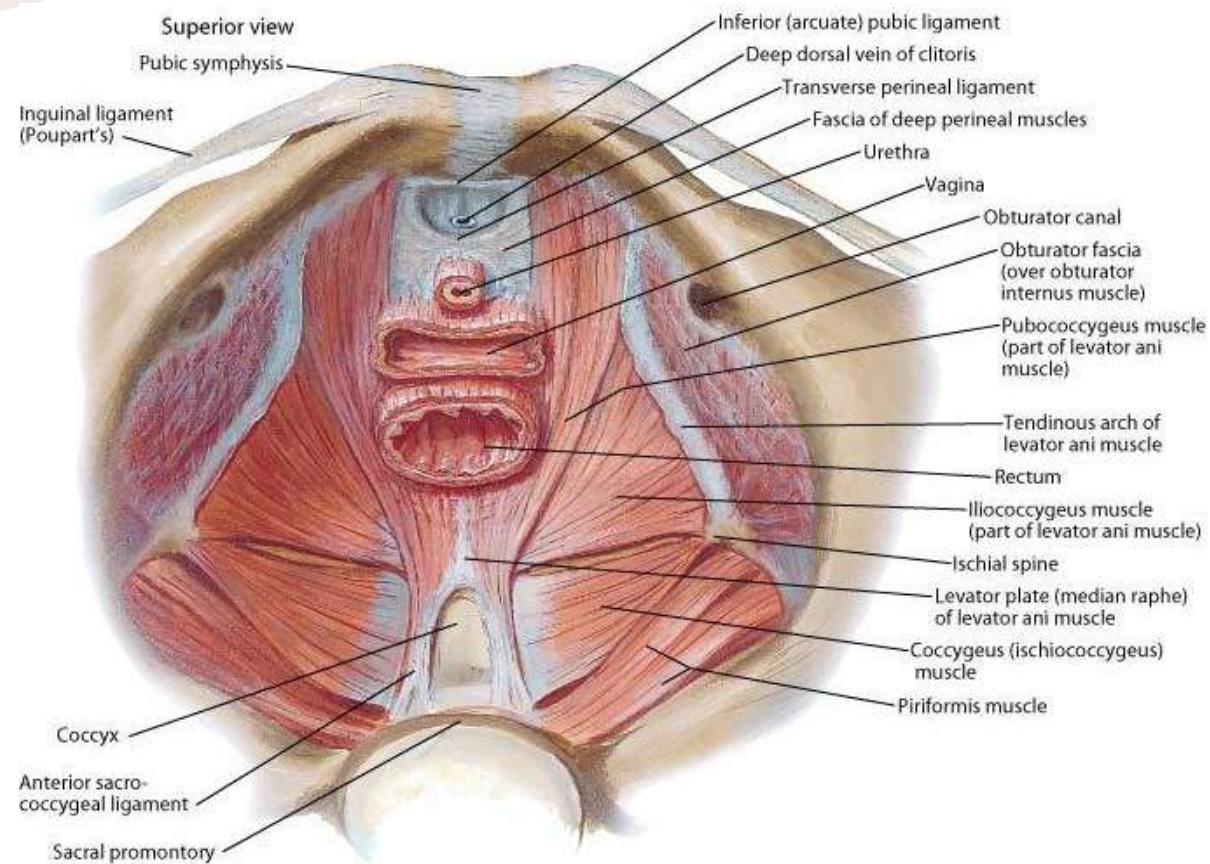
- Deep layer
 - Pubococcygeus
 - Coccygeus
 - Iliococcygeus
 - Puborectalis
- Superficial layer
 - external anal sphincter
 - perineal body
 - possibly the puboperineal (or transverse perinei) muscles

Pelvic Floor – Inferior View

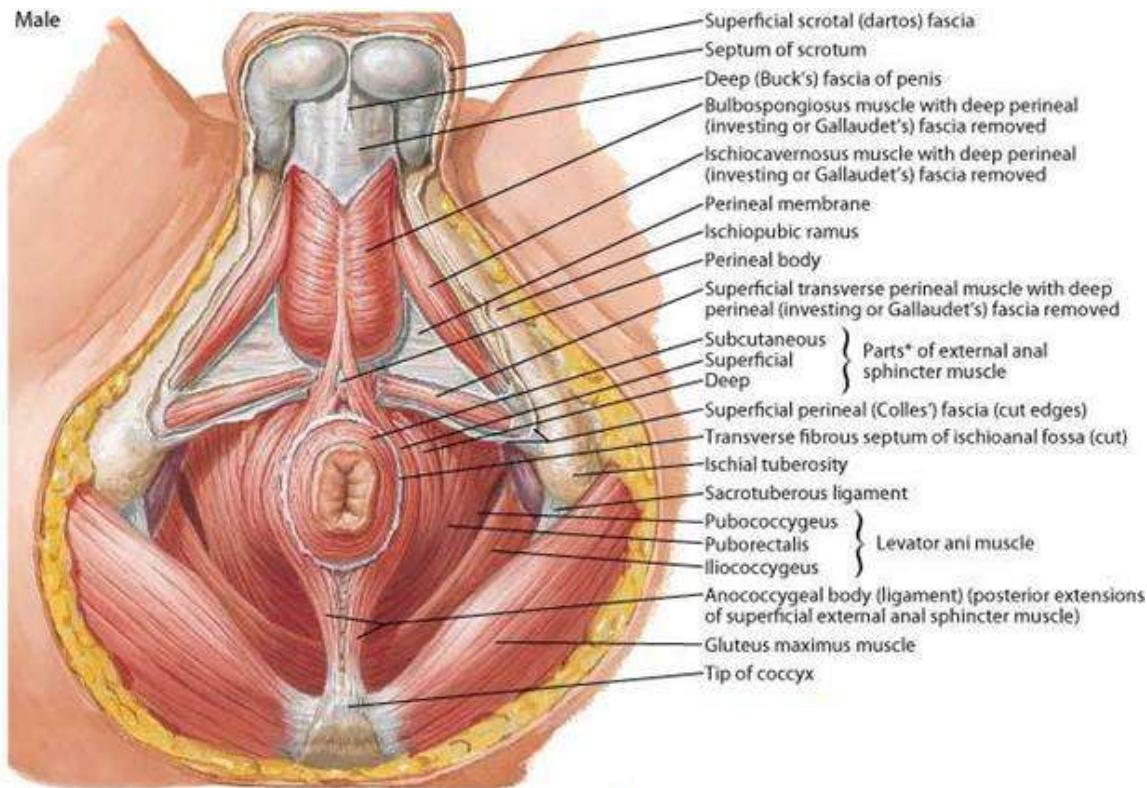


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Pelvic Floor – Superior View



Male Pelvic Floor



Psoas major



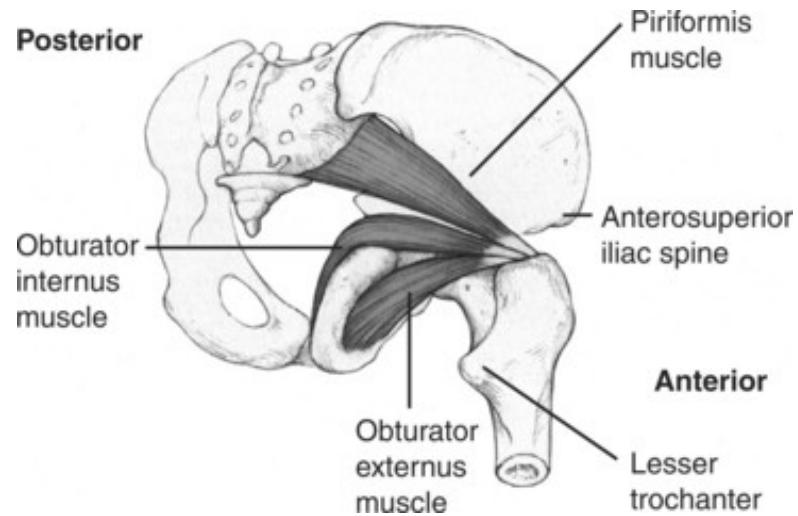
- Fibrous attachments to all lumbar TP's and anteromedial discs and bodies except L5-S1 disc

“Between the **psoas major** and the cranial insertion of the obturator internus, ventral sacroiliac ligament relates closely to the **lumbosacral trunk** (fibers from L4-L5) and the nerve bundle of the obturator nerve. The psoas major is immediately anterior to the SI joint, and **major blood vessels** (e.g. iliac artery and vein) can be found nearby.”

– Vleeming, et. al.

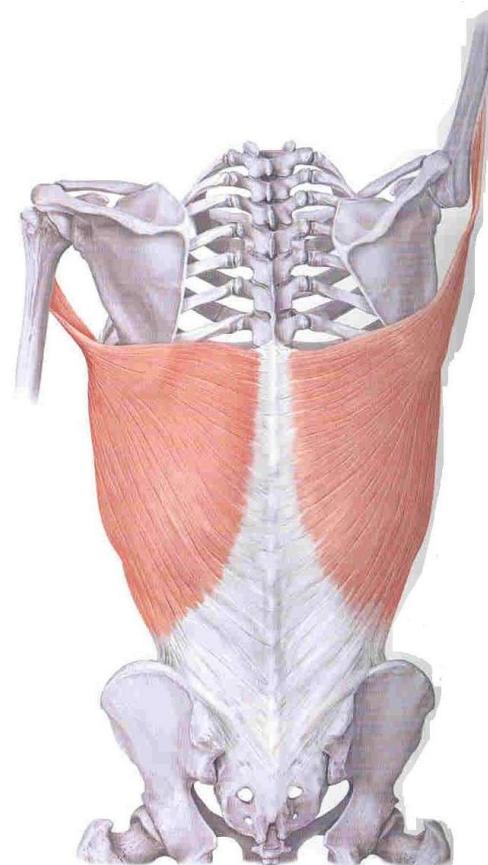
Other muscles to know

- Piriformis
- Obturator internus
- Obturator externus



Thoracolumbar fascia

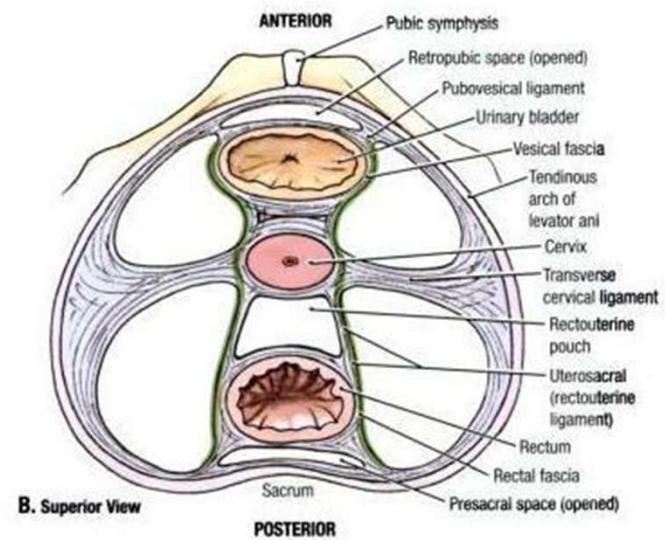
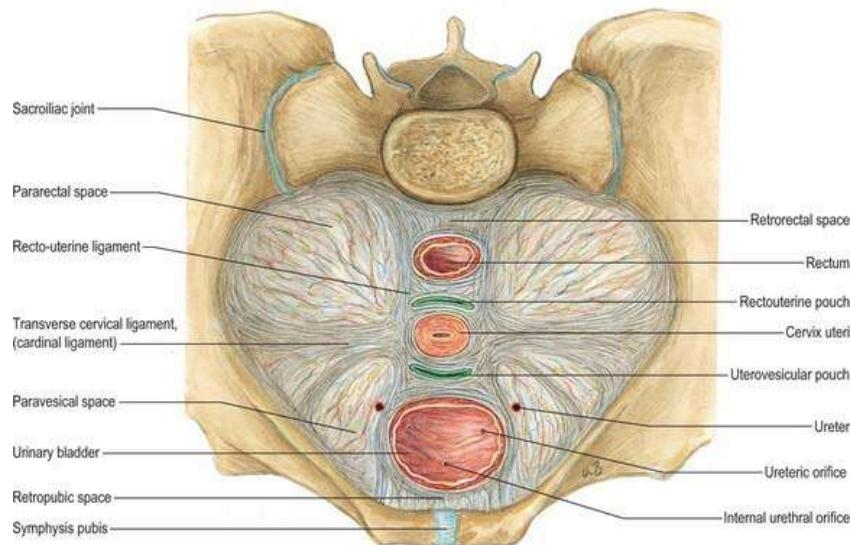
- Strongly fused to the aponeurosis of erector spinae and multifidi at the sacral level



Visceral ligaments/Endopelvic fascia

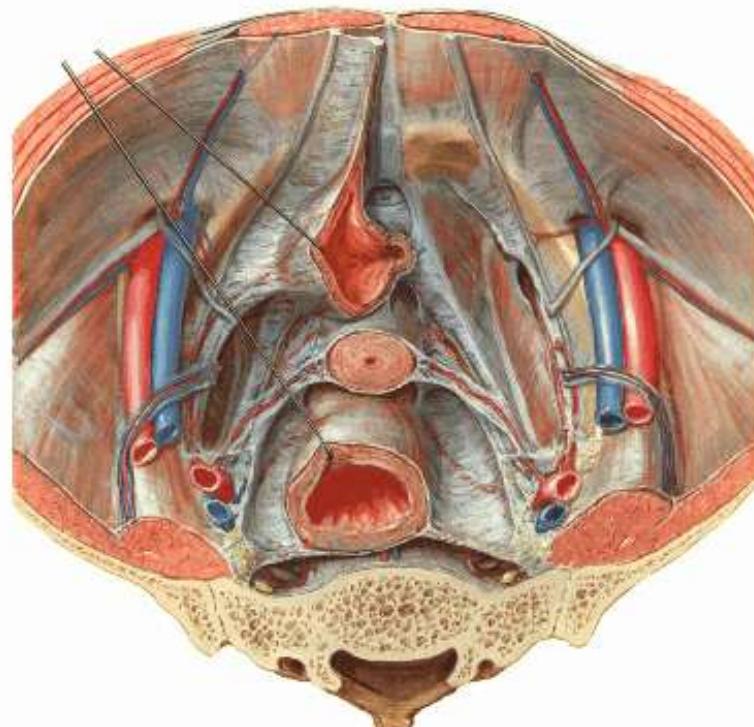
- Arcus tendineus
 - Dense connective tissue that runs from pubic ramus → ischial spine
 - Also courses along the surface of the obturator internus muscle
- Endopelvic fascia
 - Covers pelvic visceral structures

Visceral Pelvic Ligaments



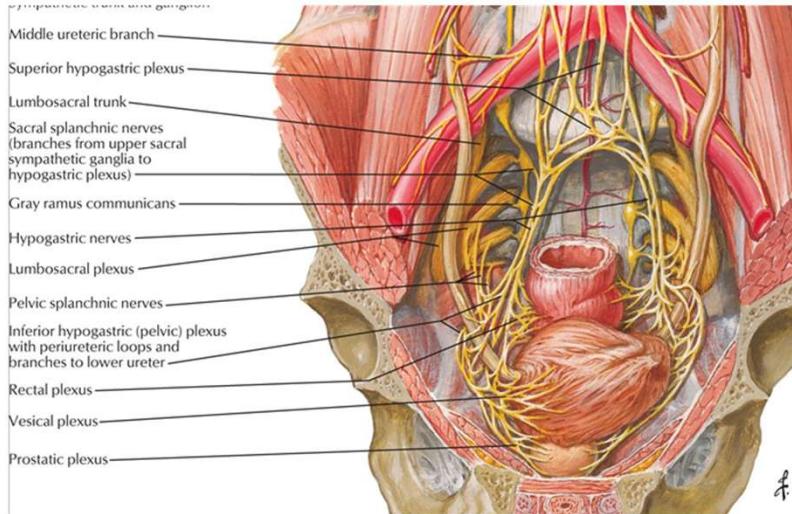
http://clinicalgate.com/wp-content/uploads/2015/03/B9780443066849500858_gr20.jpg
<https://anatomytopics.files.wordpress.com/2008/12/ligaments-of-female-pelvis-ct.jpg?w=490>

Endopelvic Fascia and Spaces of Female
Superior View

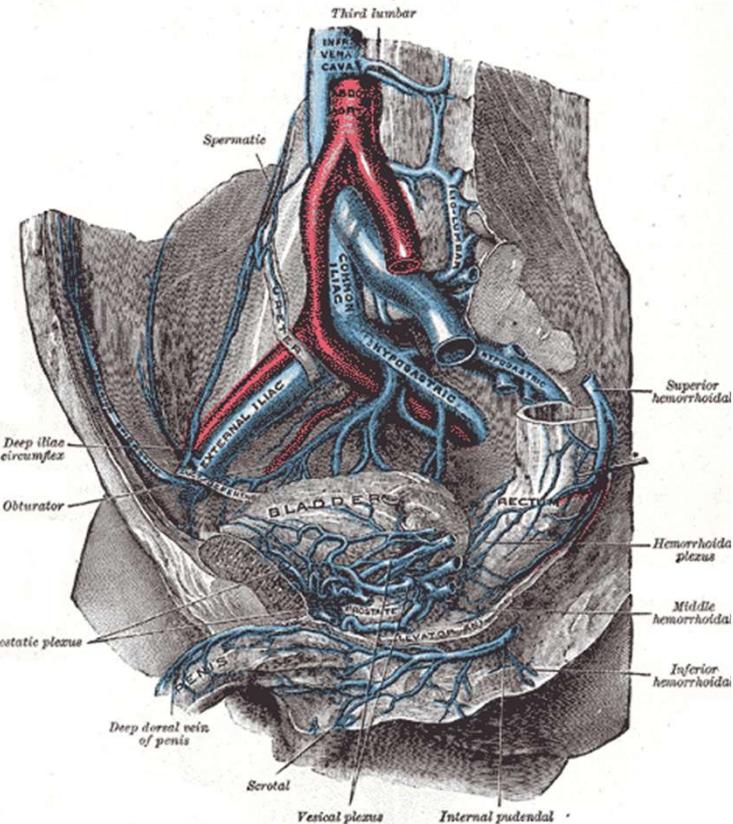


F. Netter M.D.
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Nerves and Vessels



<http://vignette2.wikia.nocookie.net/ranzcrpart1/images/7/77/Capture-1426CFFB96B12E18841.png/revision/latest?cb=20150516234615>



http://www.fpnotebook.com/_media/giPelvicVeinsGrayBB585.gif 23

Fat in the Ischiorectal Fossa

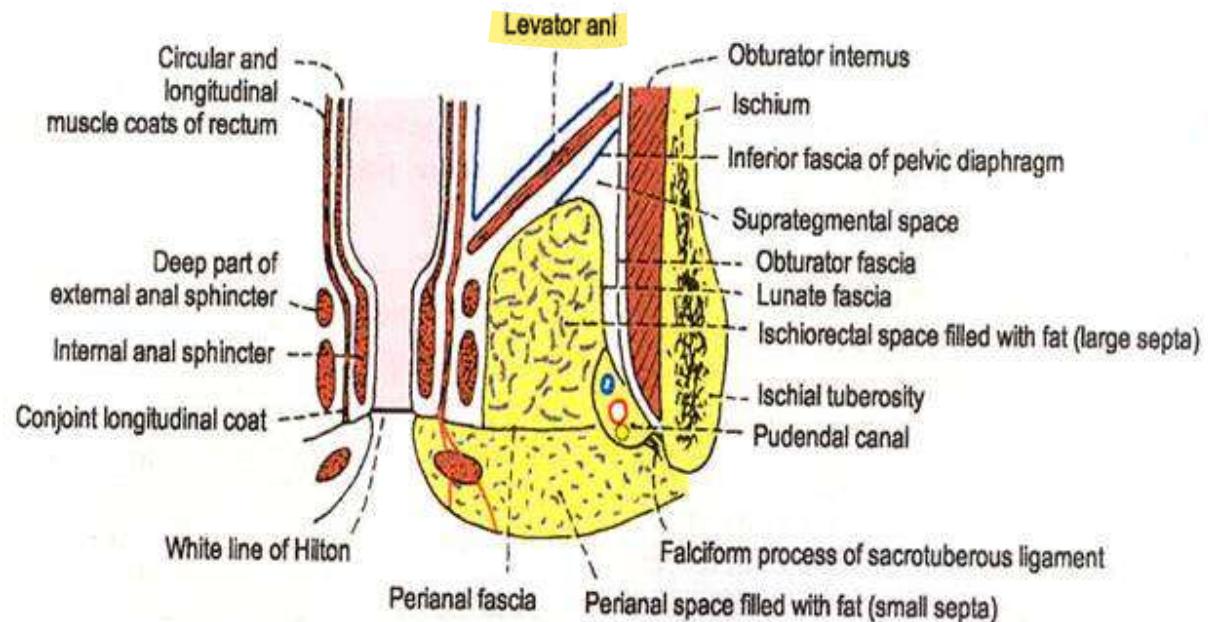
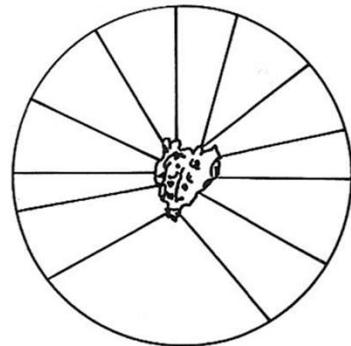


Fig. 28.7: Coronal section through the Ischiorectal fossa.

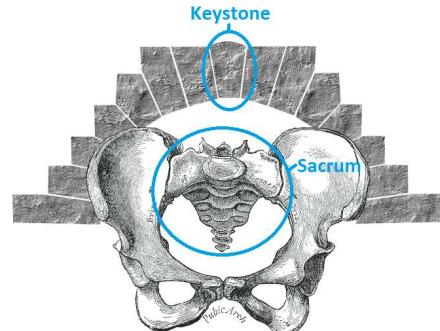
Sacral suspension

The Sacrum as a Hub



Permission granted by Stephen Levin, M.D.

<http://www.serola.net/research-entry/sacrum-as-a-hub/>

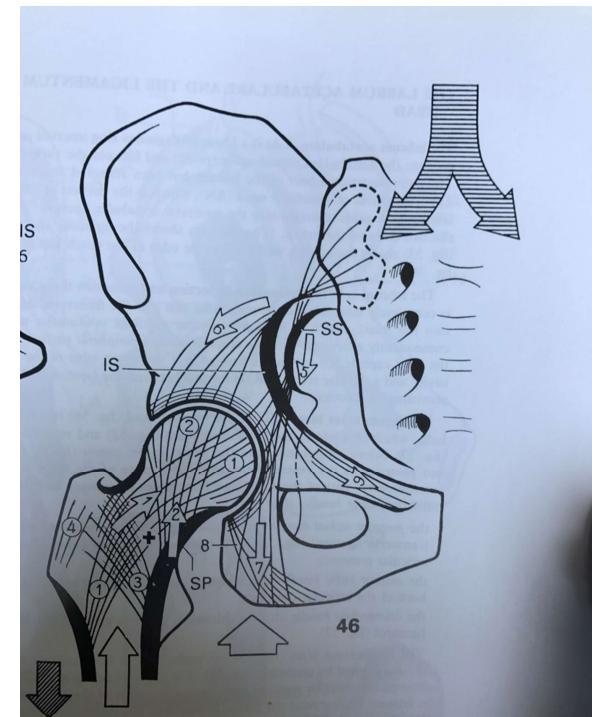


<https://agelesspilates.files.wordpress.com/2013/12/sacrum-keystone1.png>

- A tensegrity structure - suspended from ligaments
- A load applied to any part of the system is equally distributed throughout the fascial system
- Some features similar to a keystone as well

Pelvic Relationships

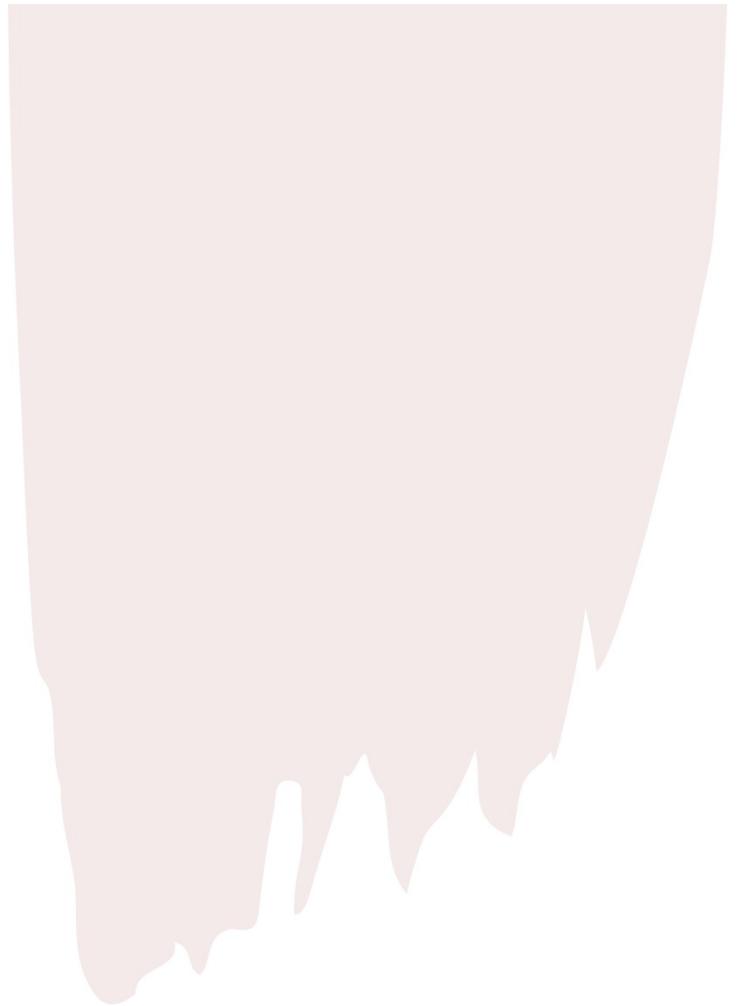
- Sacrum can be referred to as “the integrator” of pelvic relationships
 - Sacroiliac → axial spine and pelvis
 - Iliosacral → pelvis and lower extremity

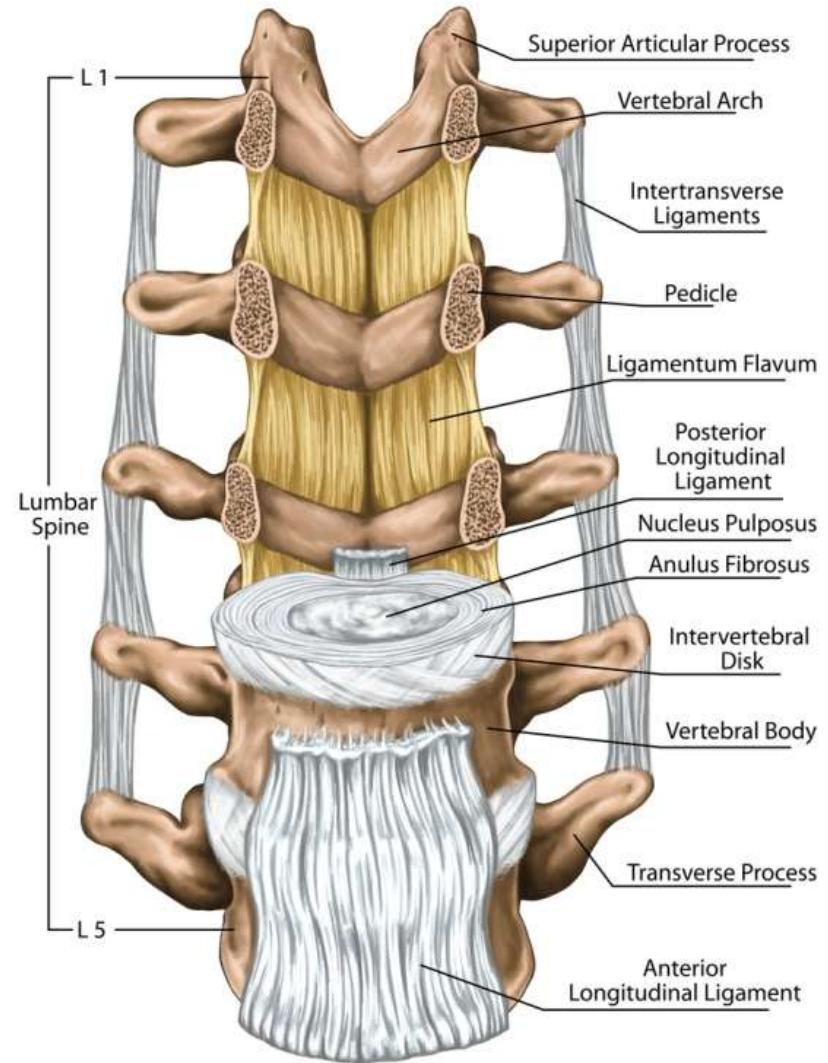


Clinical Indications for Treating the Sacrum/Pelvis

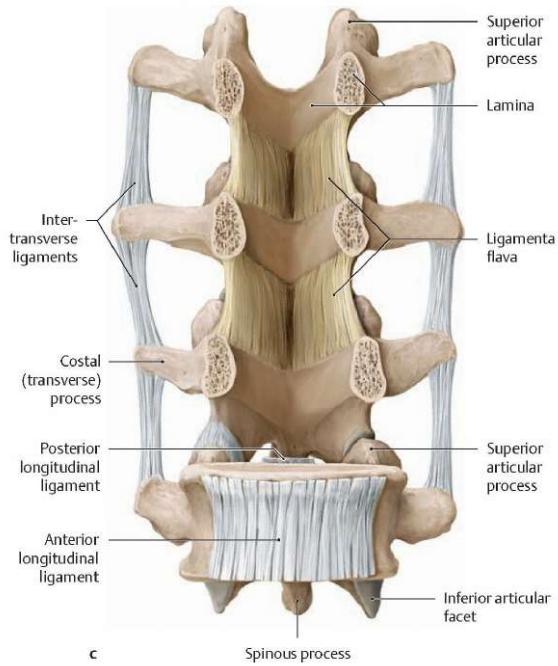
- Urinary incontinence / dysuria
- Constipation
- Coccydynia
- Dyspareunia
- Pelvic pain
- Low back pain
- Infertility
- Pregnancy / delivery
- Benign prostatic hypertrophy
- Erectile dysfunction
- Prostatitis
- Pelvic prolapse
- Pelvic congestion
- Dysmenorrhea
- Headaches (recall dural connections to the cranium)

Spine





<http://ainsworthinstitute.com/wp-content/uploads/2015/07/Spine-ligaments.jpg>



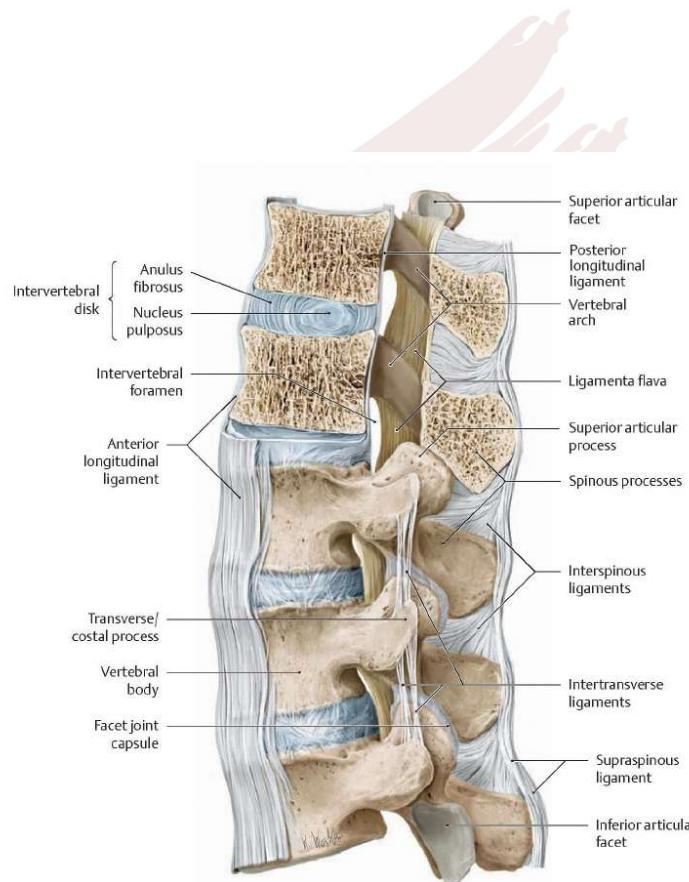
D The ligaments surrounding the lumbar spine

- c Ligamenta flava and intertransverse ligaments, anterior view (after removal of the L2-L4 vertebral bodies).

Illustrator: Karl Wesker

pp. 94-95

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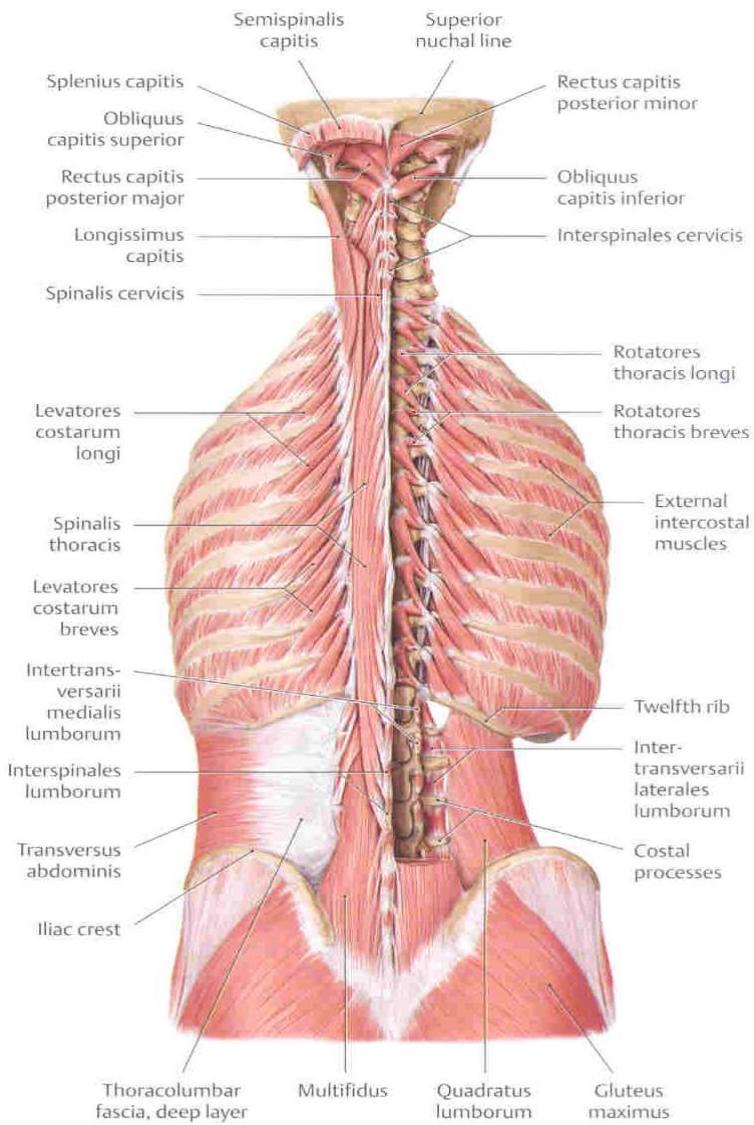
A The ligaments of the spinal column at the level of the thoracolumbar junction (T11-L3)

Left lateral view.

Illustrator: Karl Wesker

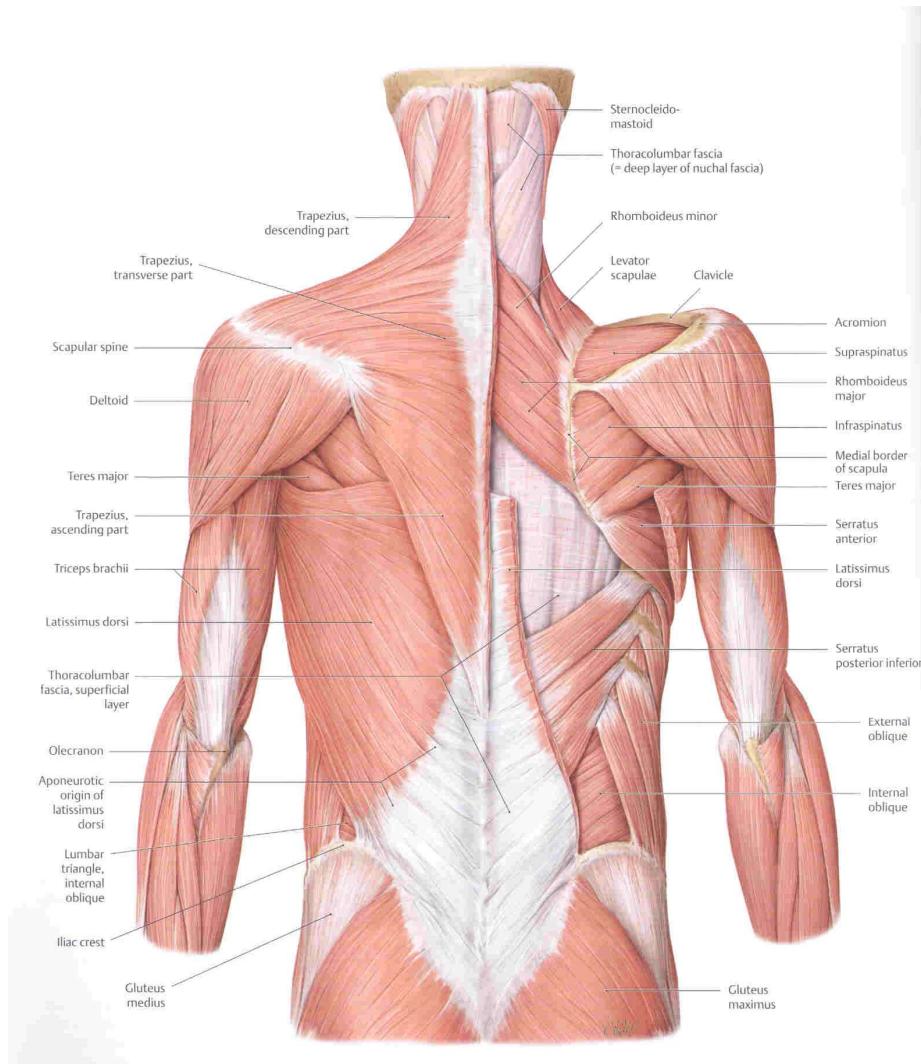
pp. 94-95

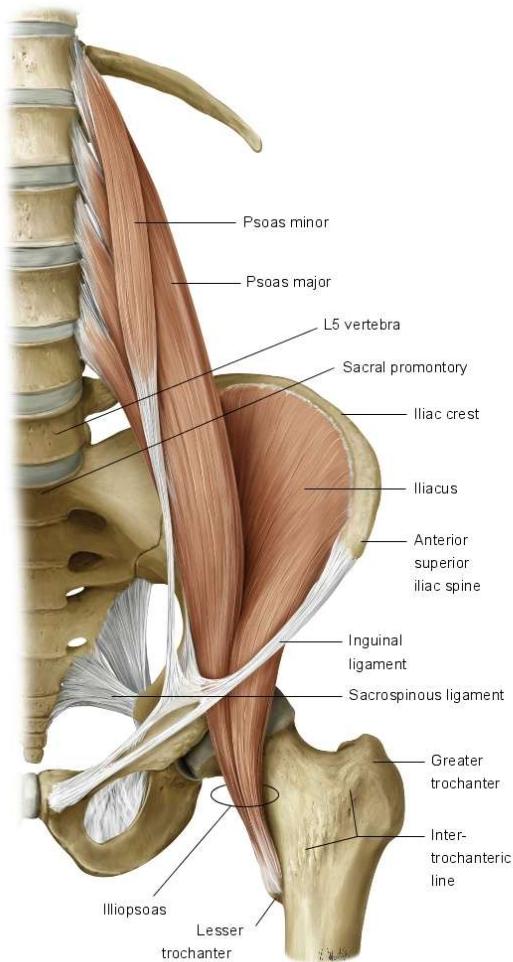
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Thieme anatomy

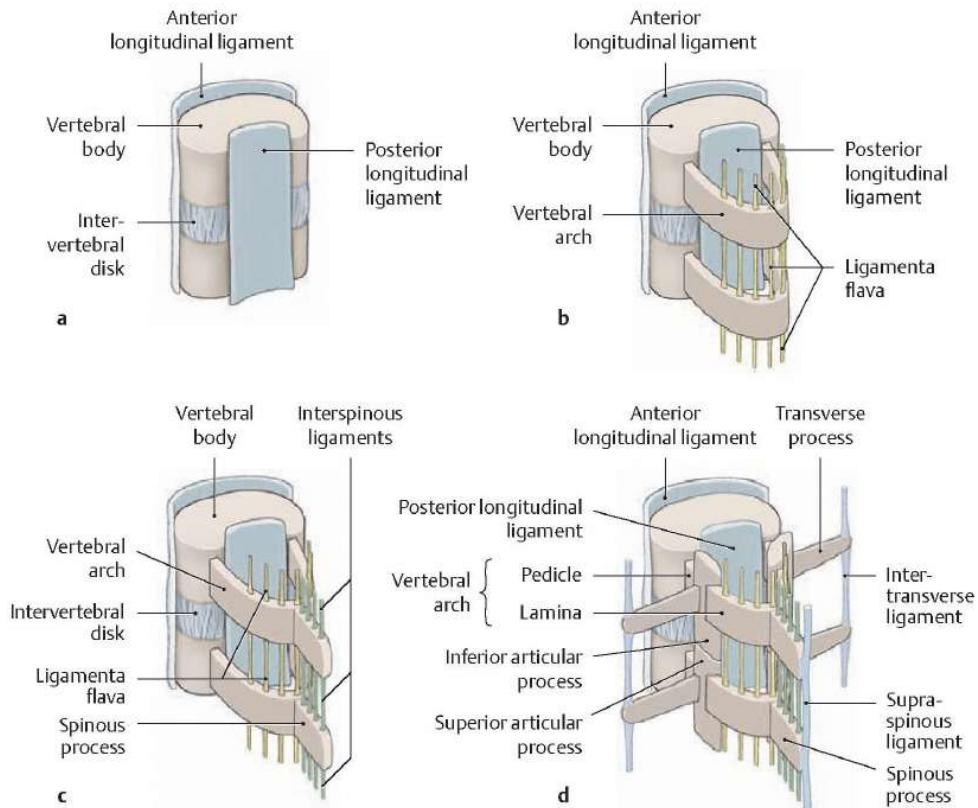
Thieme anatomy





Illustrator: Karl Wesker





C Schematic representation of the vertebral body and vertebral arch ligaments
Viewed obliquely from the left posterior view.

- a Vertebral body ligaments.
b-d Vertebral arch ligaments.

Illustrator: Karl Wesker

pp. 94-95

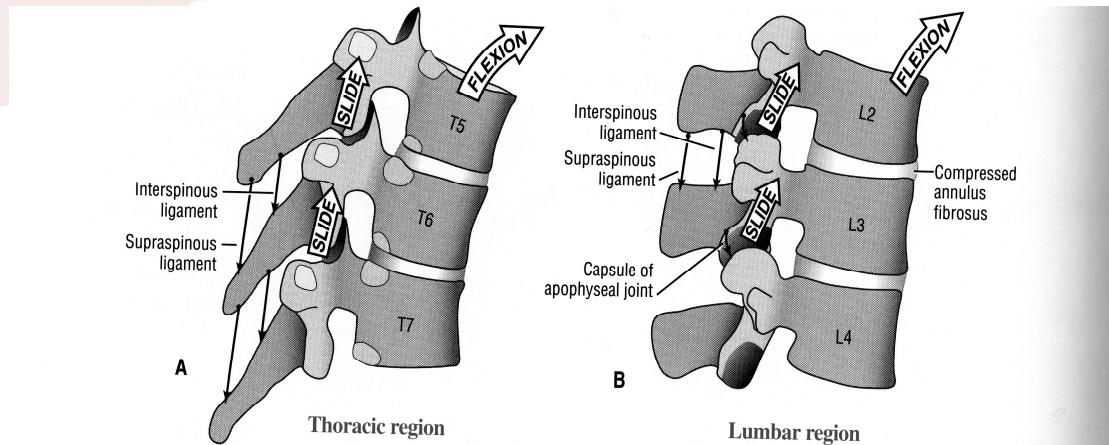
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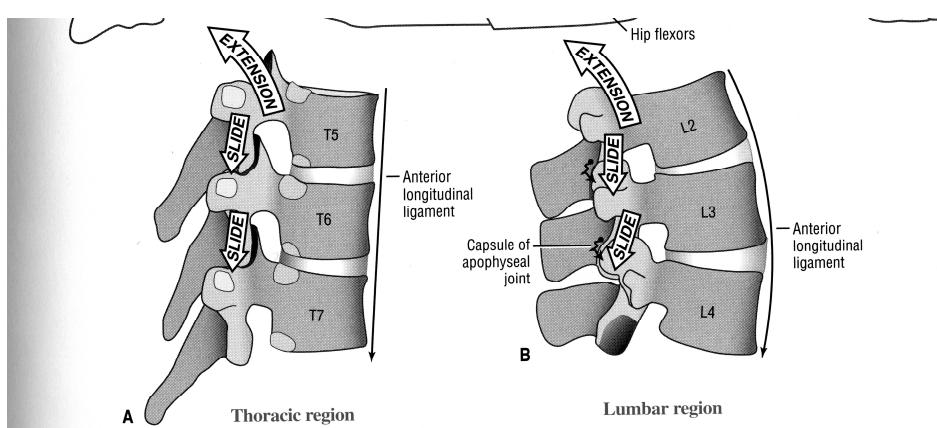


***Balance the
Tension in the
Ligaments of
T-L Spine
using Short
Lever***

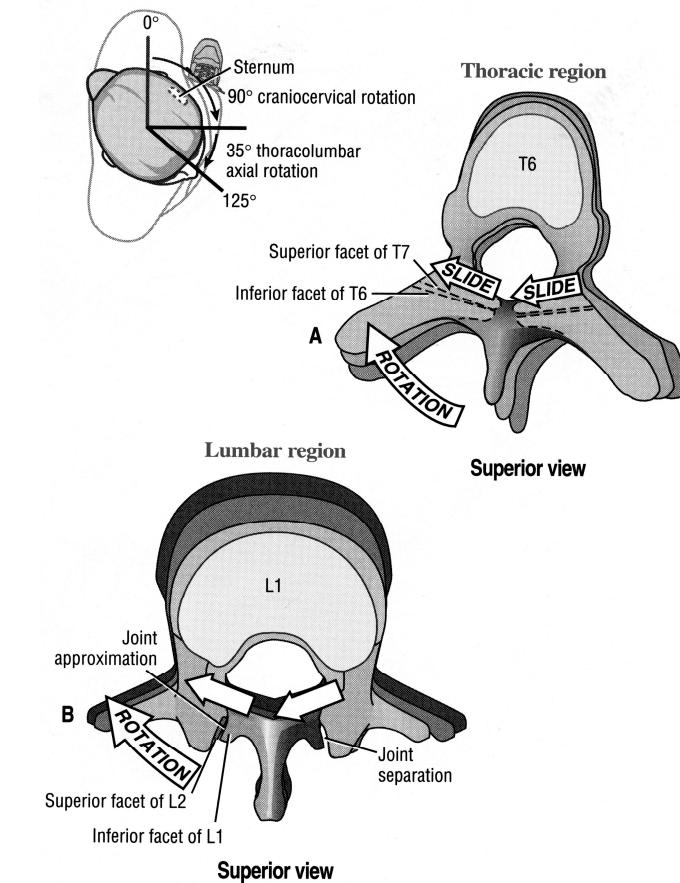
Create Thoracolumbar Flexion/Extension via Short Lever



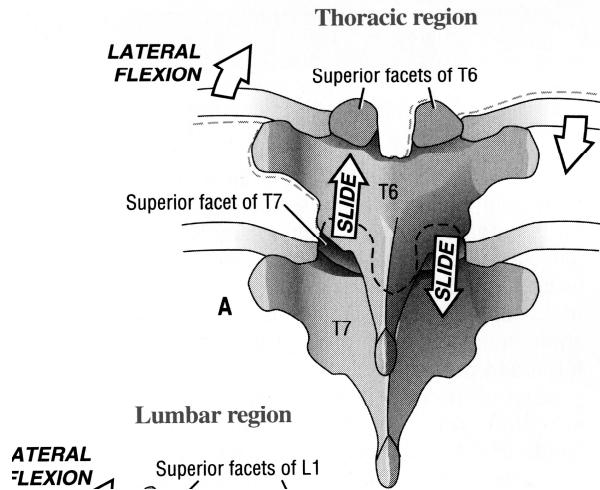
Kinesiology of the
Musculoskeletal System
pp. 286-91



Create Vertebral Rotation via Pressure on Spinous Processes- Short Lever

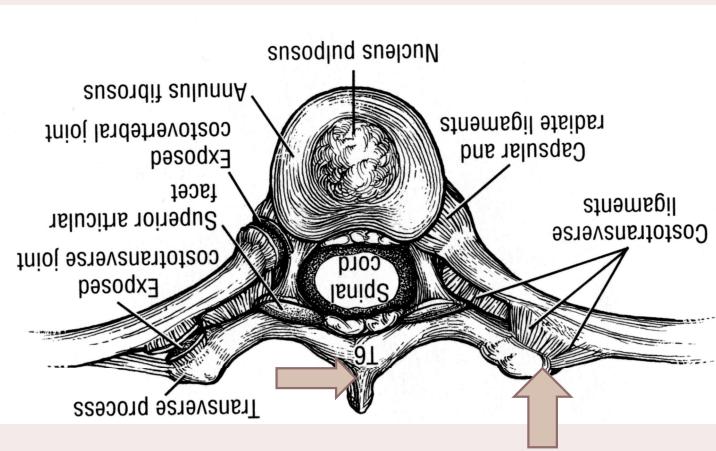


Diagnosis & Treatment of T1-5 using Short Lever Ligamentous Release

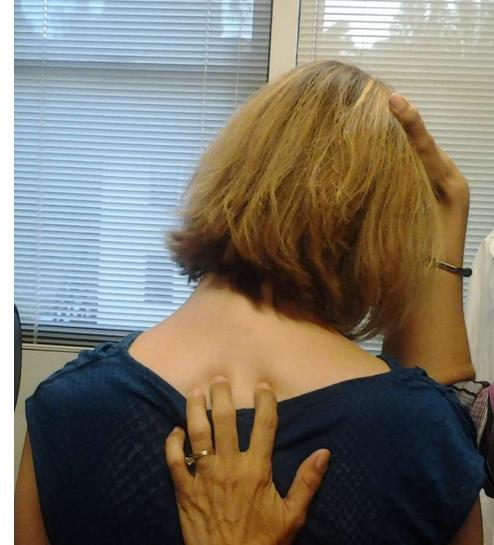
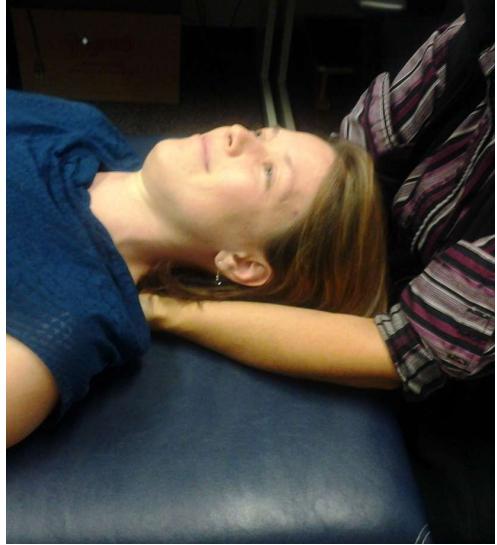


Sidebending can be accomplished by either:

1. Superior pressure on one side of transverse process and inferior pressure on the other
2. Translation



Rotation can be accomplished by lateral pressure on spinous process or anterior pressure on transverse processes



Diagnosis & Treatment of Upper T Spine Short Lever vs Long Lever



Diagnosis: Scanning T-L spine in a supine patient

Scan for most dysfunctional segment(s) by reaching behind patient and palpate over transverse processes for increased tension.

Spring anteriorly for restricted rotation

Sidebending can be accomplished by translation

Breath or moving the spinous process inferiorly/superiorly can be used to determine flexion/extension



Clinical Indications for Treating Spine

Back pain

Neck pain

Viscerosomatic reflexes

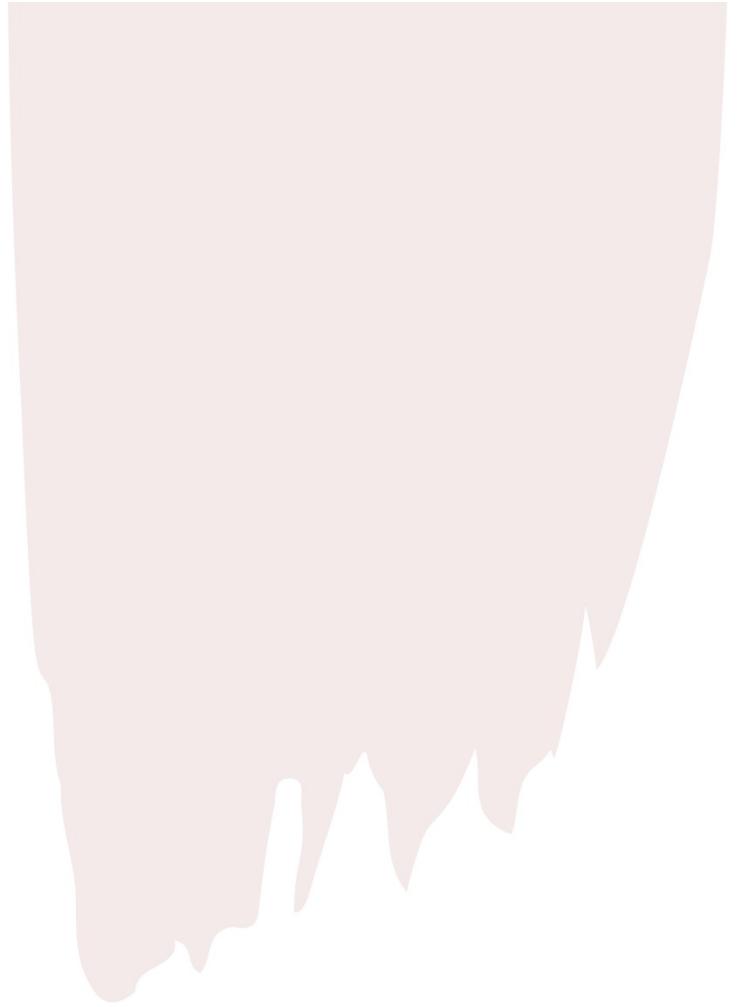
Whiplash

Headaches

Posture or mobility issues

Injuries/trauma

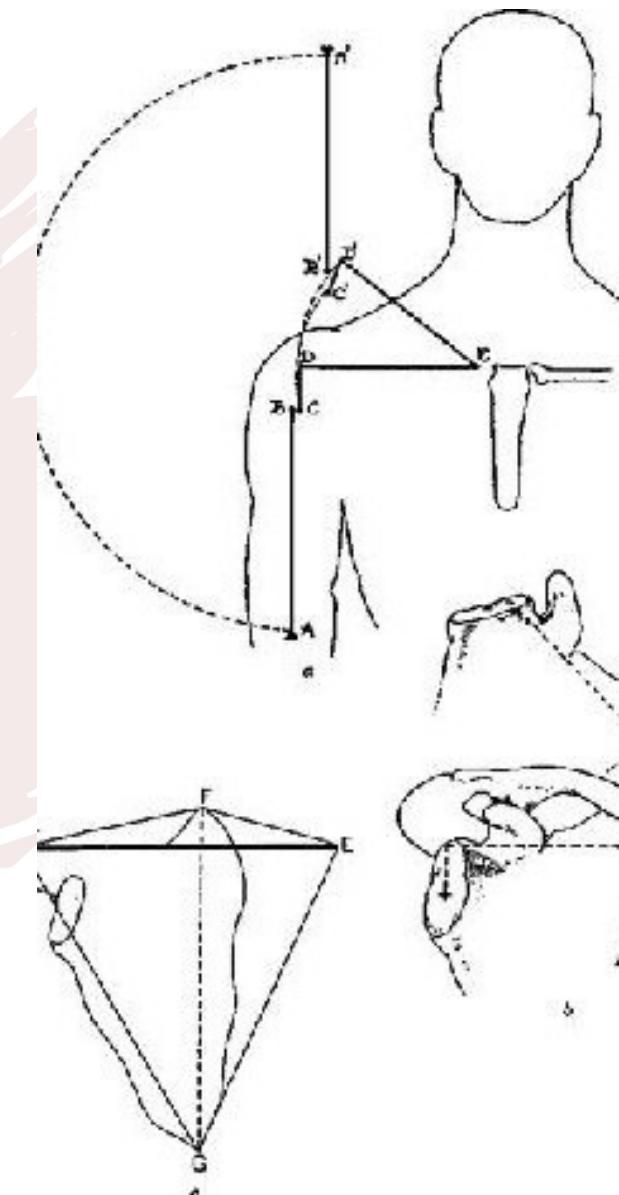
***BLT/MFR for
Sternum & Ribs***



HOW ARE THINGS MOVING AT THE THORAX, CERVICAL SPINE, STERNUM, RIBS, CLAVICLE?

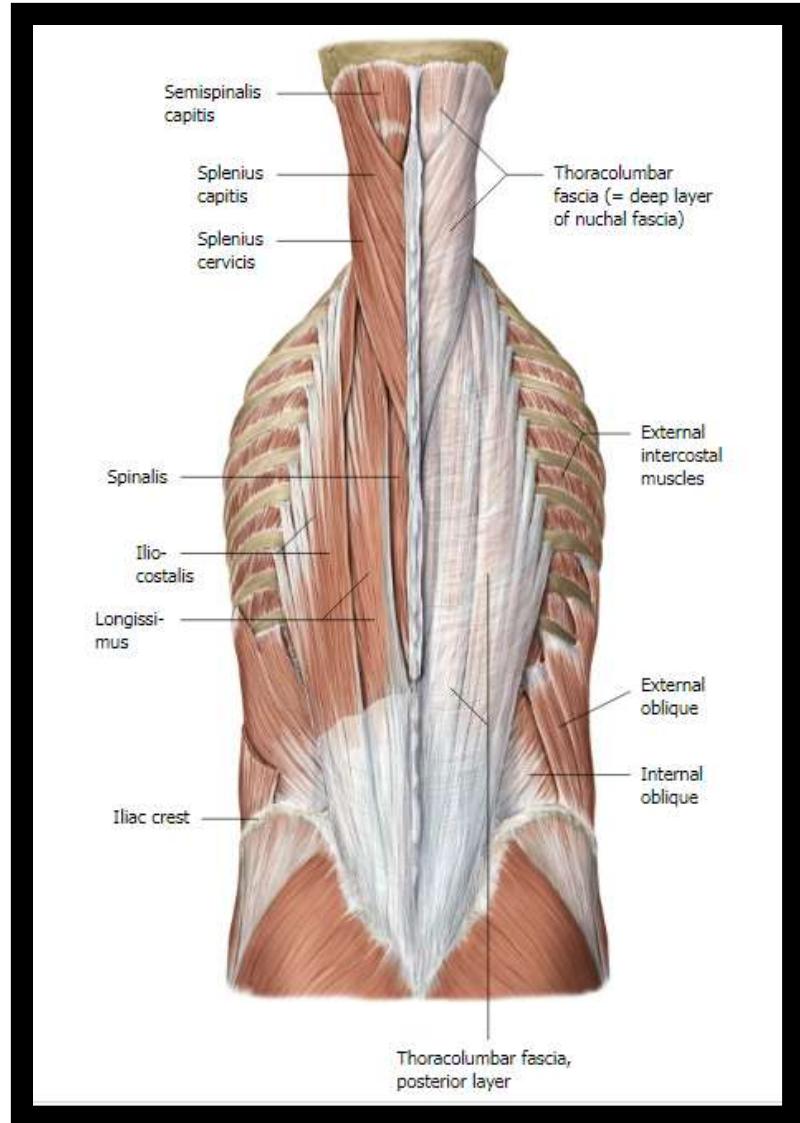
THINK OF THE THORAX AS A CYLINDER- ANY PART OF THE RING CAN BECOME RESTRICTED AND IMPEDE OTHER PARTS

HOW CAN YOU ADDRESS DIFFERENT TISSUES, FASCIA, MUSCLES, JOINT MECHANICS?



Cervical / Thoracic Spine

- Thoracic spine motion limited by
 - Long fascial connections (thoracolumbar fascia)
 - Muscles (linking cervical, thoracic, lumbar regions)
 - Innervated by dorsal rami
 - Rib motion alterations via attachments of muscles
 - Respiratory ribs
 - Mechanical ribs
 - Spinal motion restrictions
 - Type I, Type II, bilaterally flexed, bilaterally extended
 - Alterations in mechanics such as prior trauma, degenerative changes, scoliosis, chronic disease (COPD or asthma)
-
- Superficial and Intermediate Intrinsic Back Muscles
 - Erector spinae and splenius muscles



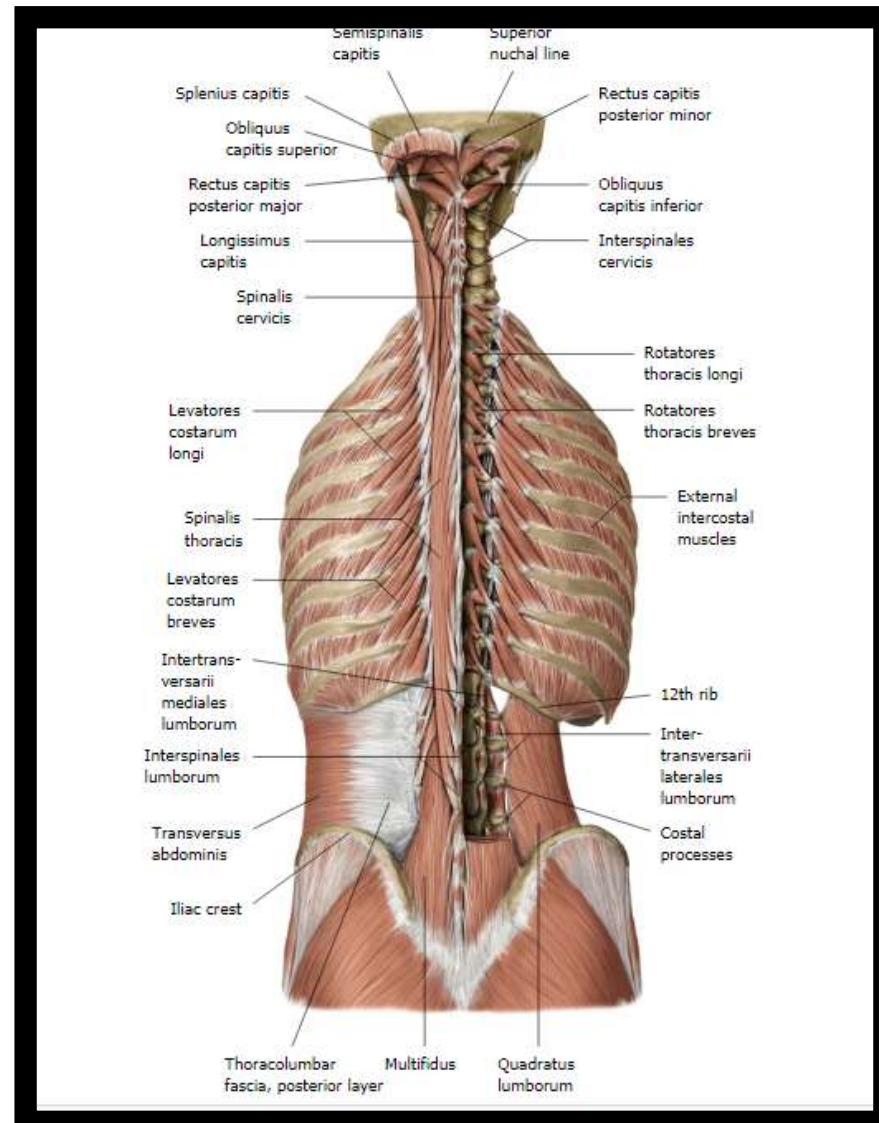
Cervical/Thoracic Spine Muscles

Transversospinalis muscles

- Rotatores (Longi/breves)
 - TP- SP
- Multifidus
 - Sacrum, ilium, mamillary processes of L1-5, TP of T1-4 and C4-7 attaches to sp skipping 2-4 vertebra
- Semispinalis
 - Semi-spinalis capitus-C7-T6/7 TP origin- insertion- occipital bone
 - Semi-spinalis cervices- T1-T6 TP and C4-C7 articular process origin- insertion C2-C5 SP

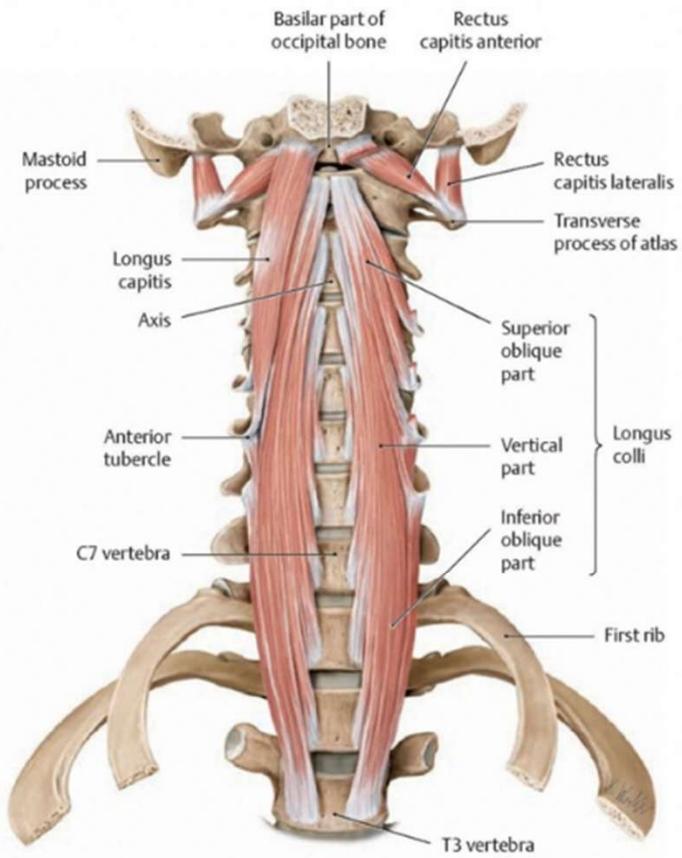
Deep segmental back muscles

- Interspinals
- Intertransversarii
 - Cervical C2-C7 between posterior tubercles of adjacent vertebra
 - Mediales lumborum L1-5 between mamillary process
 - Laterales lumborum L1-5 between TP
- Levatores costarum (longi/breves)
 - Attaches to TP and ribs



Other Cervical/Thoracic/Rib Muscular Connections

- **Longus colli** attaches superiorly to bodies C1-3 and TPs C3-6 and inferiorly to bodies of C5-T3 to TPs of C3-5. (C2-6 innervation). Flexes and rotates head
- **Longus capitus** attaches to basilar portion of occipital bone to anterior TPs C3-C6. (C1-3 innervation). Flexes head
- **Scalenes: anterior**: attaches from anterior TPs of C4-6 to 1st rib. (C4-6 innervation). Flexes head. **Middle and posterior** attach from posterior TPs C4-6 to 1st and 2nd rib respectively. (C4-6?, C7 innervation). Side bend neck and lift ribs 1&2. **Minimus** (Anterior primary rami of C7)



- D The prevertebral muscles: longus capitis, longus colli, and recti capitis anterior and lateralis
Anterior view after removal of the cervical viscera.

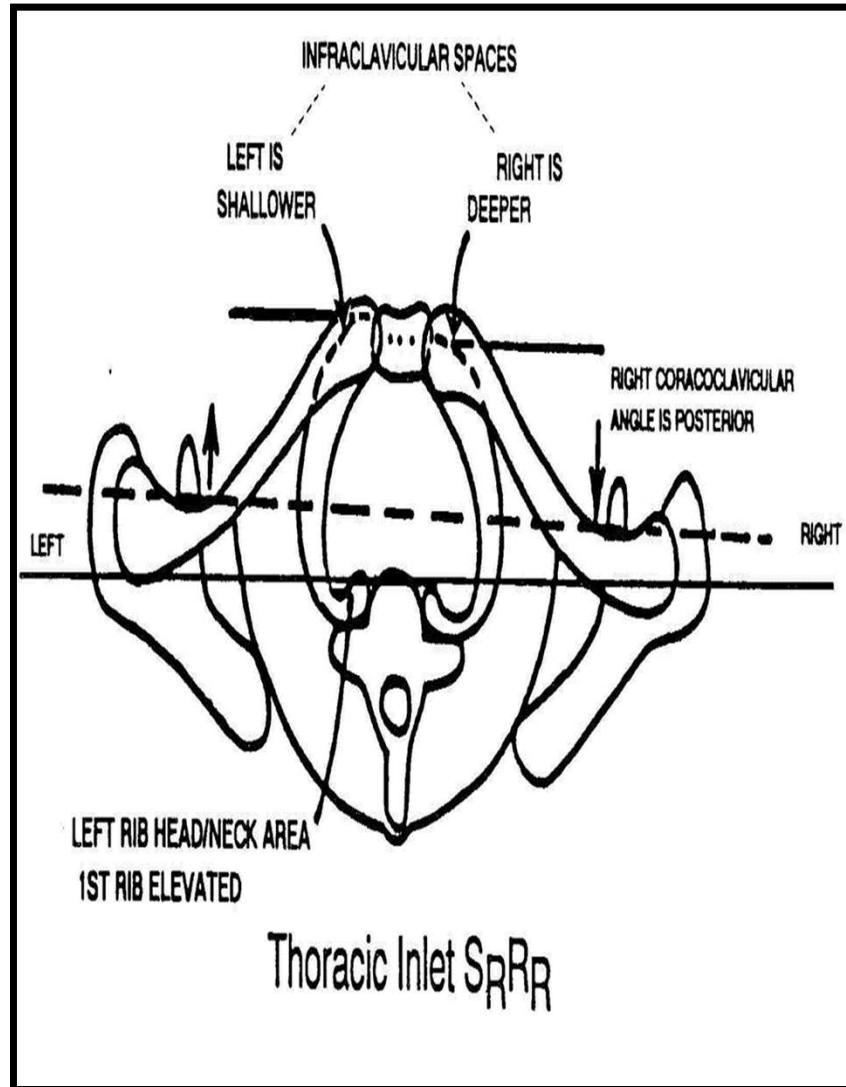
Illustrator: Karl Wesker

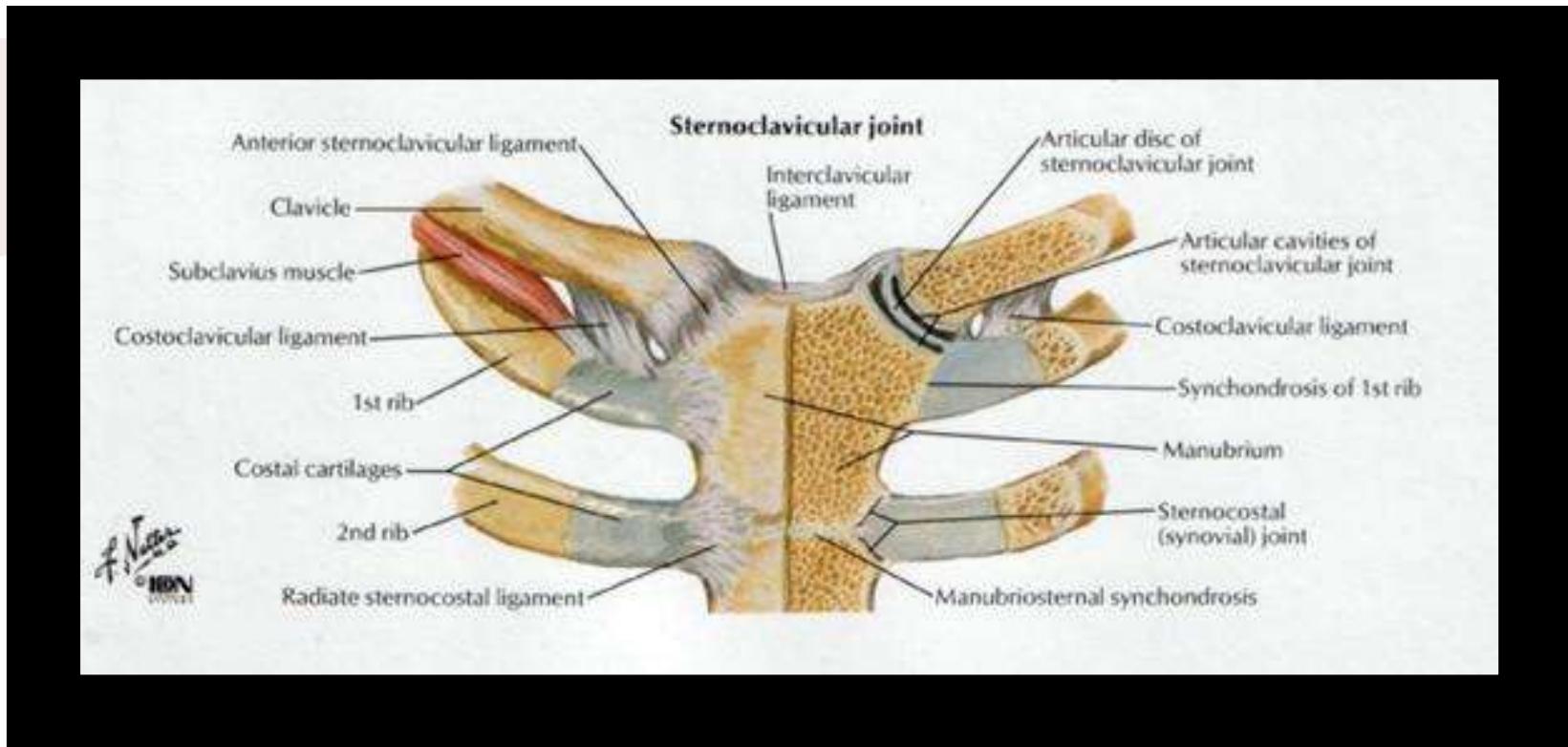
pp. 124-125

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Thoracic Inlet Assessment

- Palpate under the clavicle at the first rib
 - Whichever one is deeper names the side of rotation
 - Right side deep- thoracic inlet is rotated right
 - Left side deep- thoracic inlet is rotated left
- Palpate at the top of the first rib (over the trapezius)
 - Whichever side is higher- opposite side is sidebending
 - Right side high = left sidebending
 - Left side high = right sidebending
- Not to be confused with an elevated Right first rib from a T1SIRr



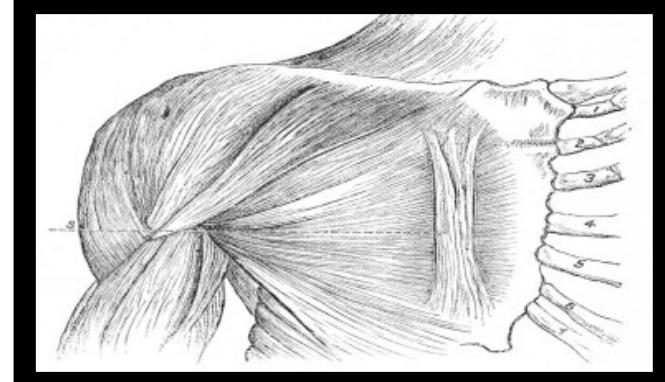
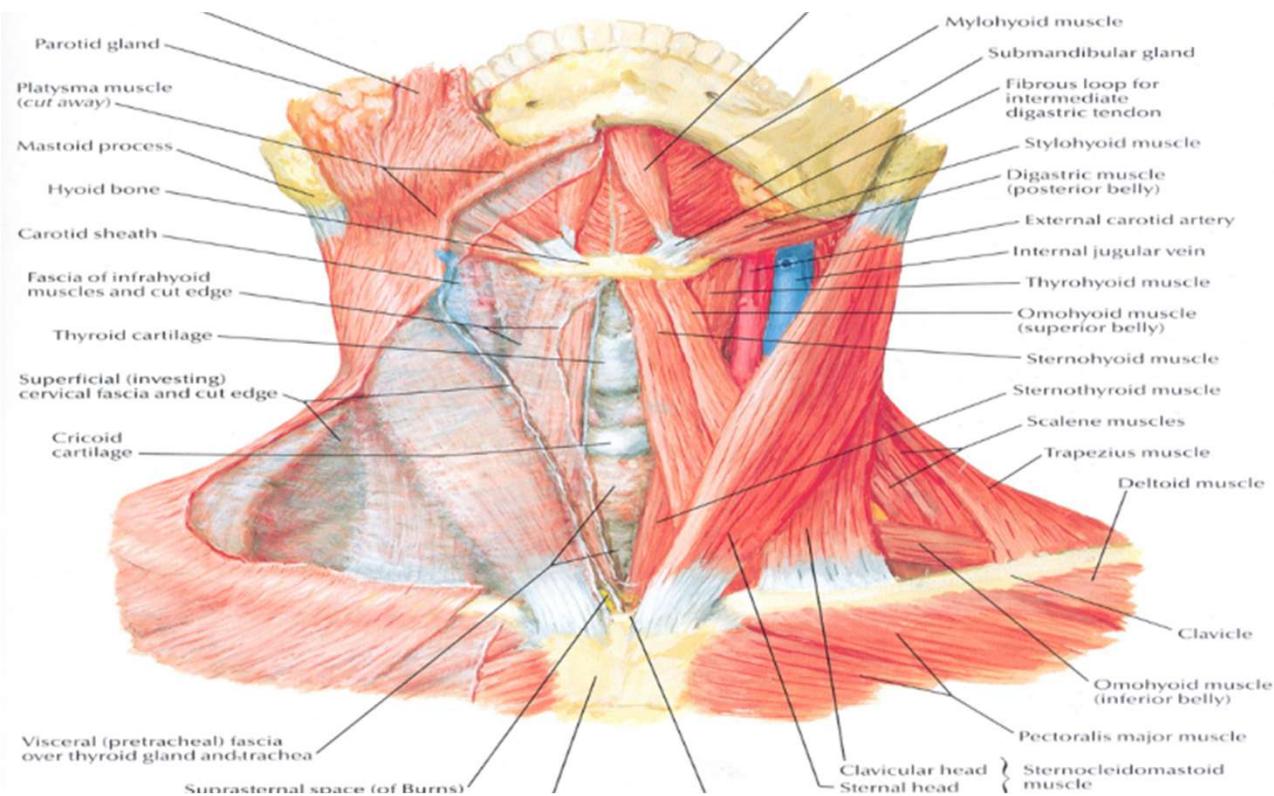


- **Muscular Attachments to the clavicles**
 - SCM, Subclavius, Omohyoid, Trapezius, Pectoralis Major, Deltoid
- **Clavicles** • **Ligamentous Attachments to the clavicles**
 - Costoclavicular ligament, sternoclavicular, interclavicular, acromioclavicular

Sternum

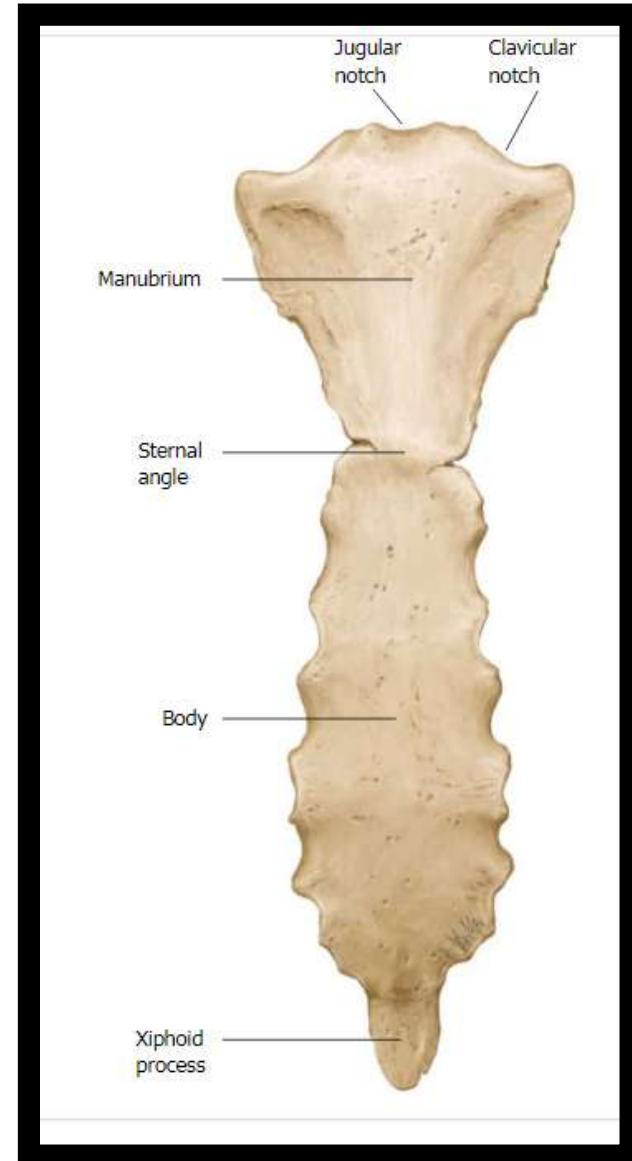
Muscular attachments with innervation

- Sterno-cleido-mastoid (CNXI and C2,3)
- Sterno-hyoid (C2-3)
- Sterno-thyroid (C2-3)
- Pectoralis major (C5-T1)
- Internal intercostals (segmental intercostal nerves)
- Transversus thoracis (T2-6)
- Diaphragm-xiphoid portion (phrenic n.)
- Transversus abdominis (xiphoid portion)
- Rectus abdominis (intercostals, iliohypogastric)
- Sternalis muscle



Sternebrae

- Fuse from the bottom- up
- Fusion usually happens by various ages
 - 3rd/ 4th sternebrae- 15-17 years old with 100% fusion
 - 2nd/ 3rd sternebrae- males over 25 females over 30 100% fusion
 - 1st/ 2nd sternebrae- earlies age 16-18- 100% males over 60 females over 30
 - Some of you may have upper sternebrae that are not yet fused!



Sternum Evaluation: Observe/Palpate Sternal Motion with Respiration

- Observe

- Scalene muscles stabilize or elevate the first rib
- Manubrium lifts outward
- Sternal angle up and out
- Notice how rib restriction, muscular restriction or clavicular restriction may affect this motion

- Palpate

- Active
 - Monitor as the patient breaths
 - Inhalation- increased prominence
 - Exhalation- decreased prominence
- Passive
 - Apply a posterior motion to the sternomanubrial joint and assess for compliance
 - Rock the manubrium and see if there is compliance at the sternomanubrial joint

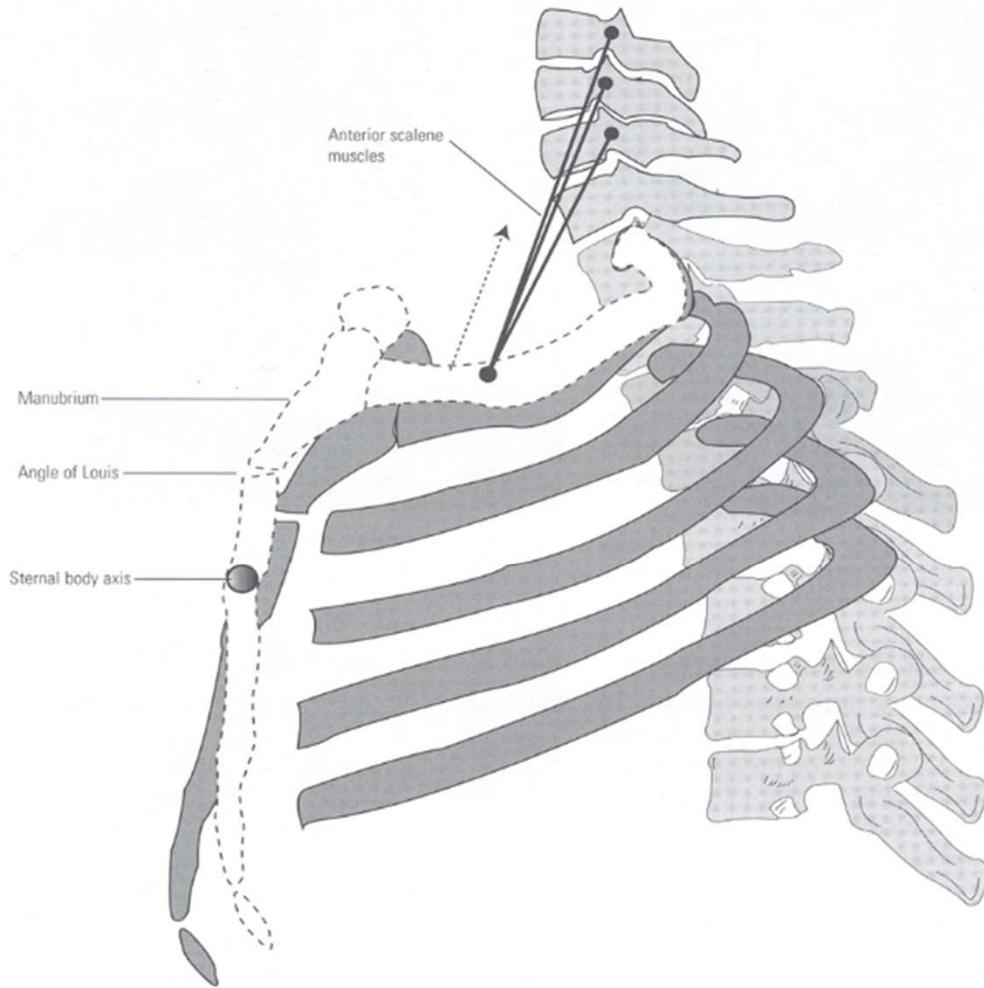


Figure 6.6 Lateral view showing actions of the scalenes and tilting of the manubrium with forced inhalation. As the scalene muscles elevate the first rib, the manubrium tilts outward, hinging at the clavicle heads. The sternal angle moves up and out. Normally the body of the sternum pivots at the third costal cartilage, and the xyphoid process moves up and posteriorly. Obesity may modify this aspect of sternal movement.

Passive Range of Motion of the Manubrium

- Place a finger on either side of the manubrium
 - Superior/inferior- and rock looking for asymmetry and motion restriction
 - This helps to test compliance of the sternomanubrial joint
- Other descriptions of manubrial diagnosis exists
 - Right and left- and rock looking for asymmetry and motion restriction
 - At a diagonal on opposite sides and rock- looking for asymmetry and motion restriction
 - And one hand stabilizing on the sternum and one on the manubrium rocking it

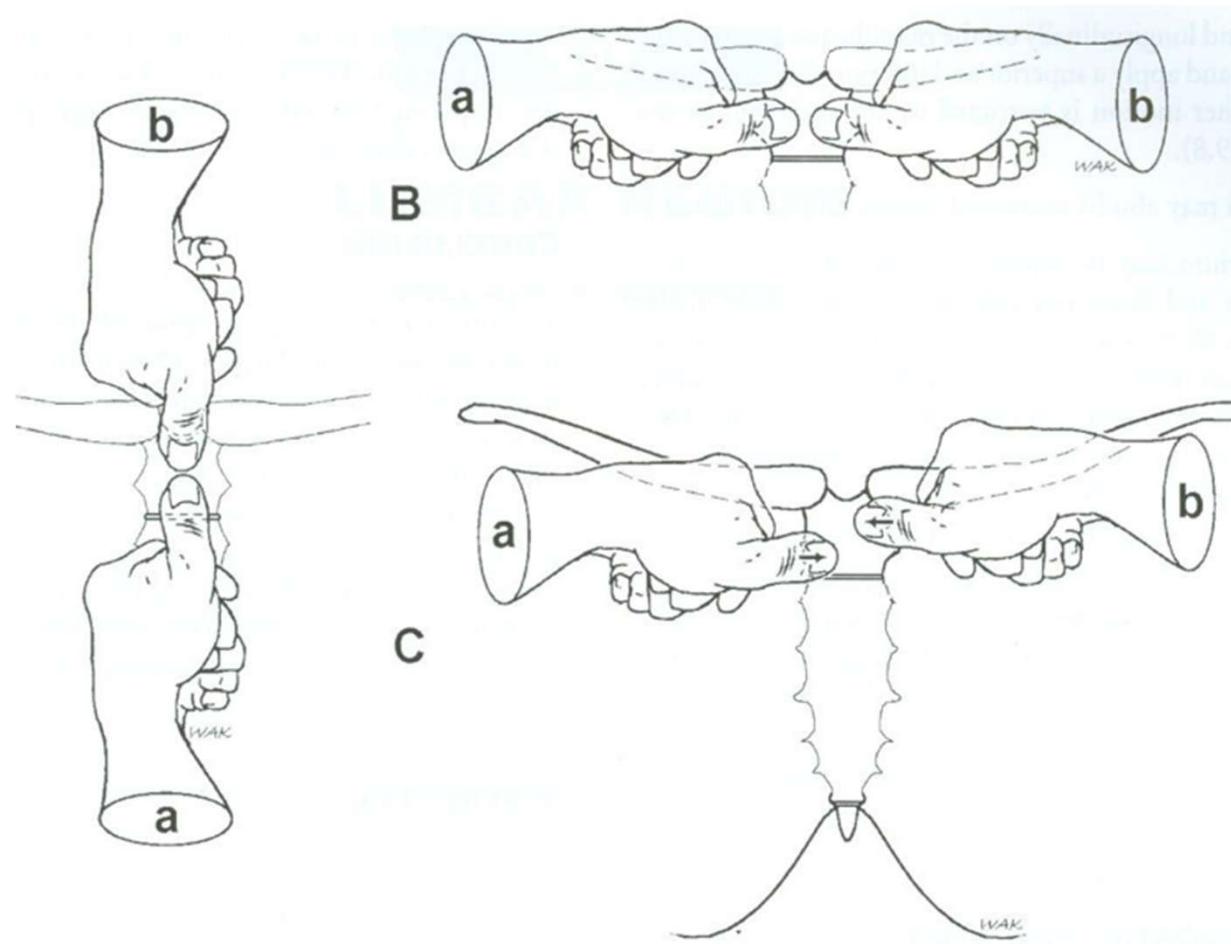


FIGURE 49.9. Segmental evaluation of the manubrium of the sternum.

Sternum Evaluation: Sternum Compression and Glide

- Compress the sternum
 - You are looking for springiness or stiffness
- With a little compression, glide the sternum
 - Inferior and superior
 - Left and Right
 - Rocking anterior and posterior (Flexion and extension)
 - Clockwise & counterclockwise
- Name for position of ease

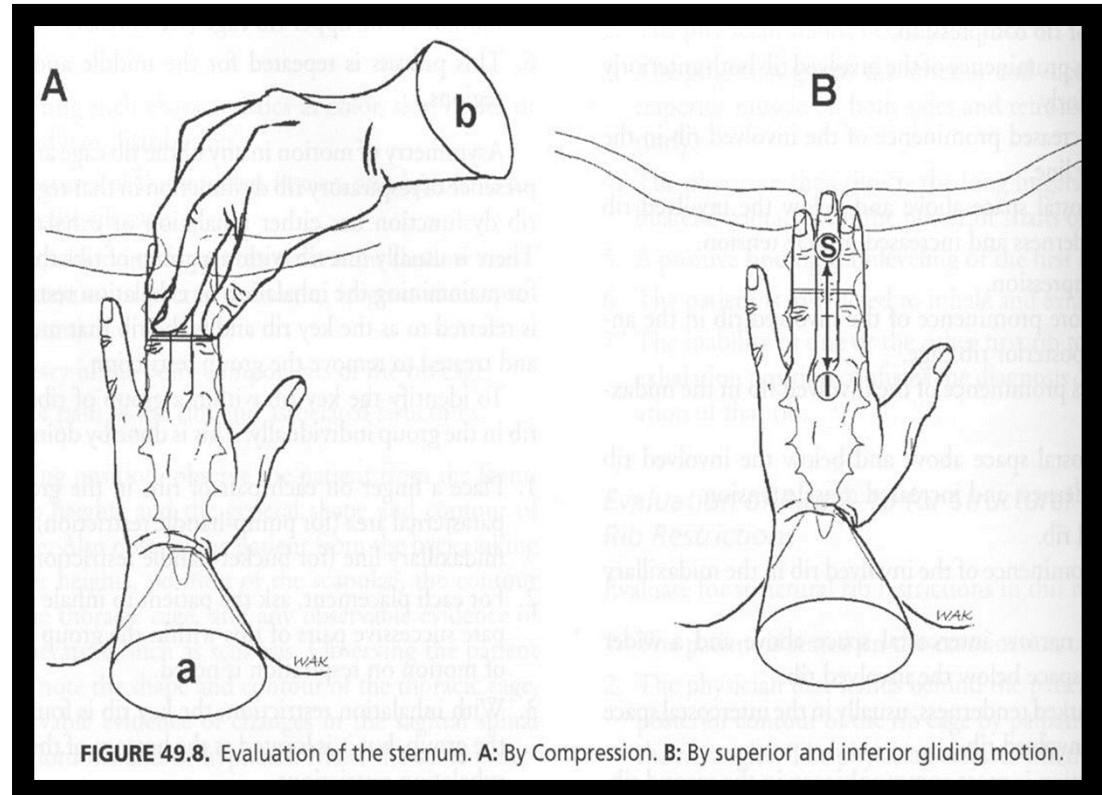
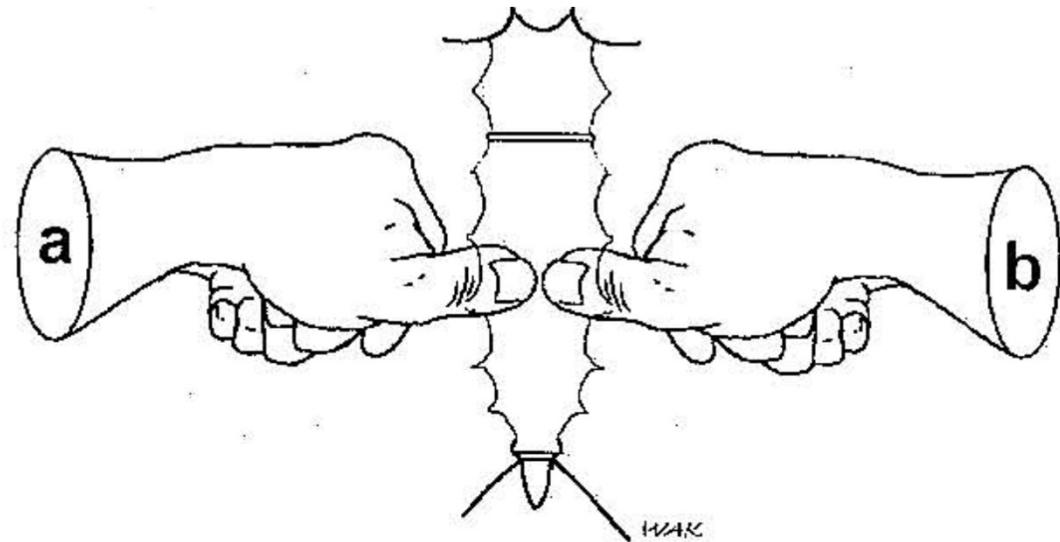


FIGURE 49.8. Evaluation of the sternum. A: By Compression. B: By superior and inferior gliding motion.

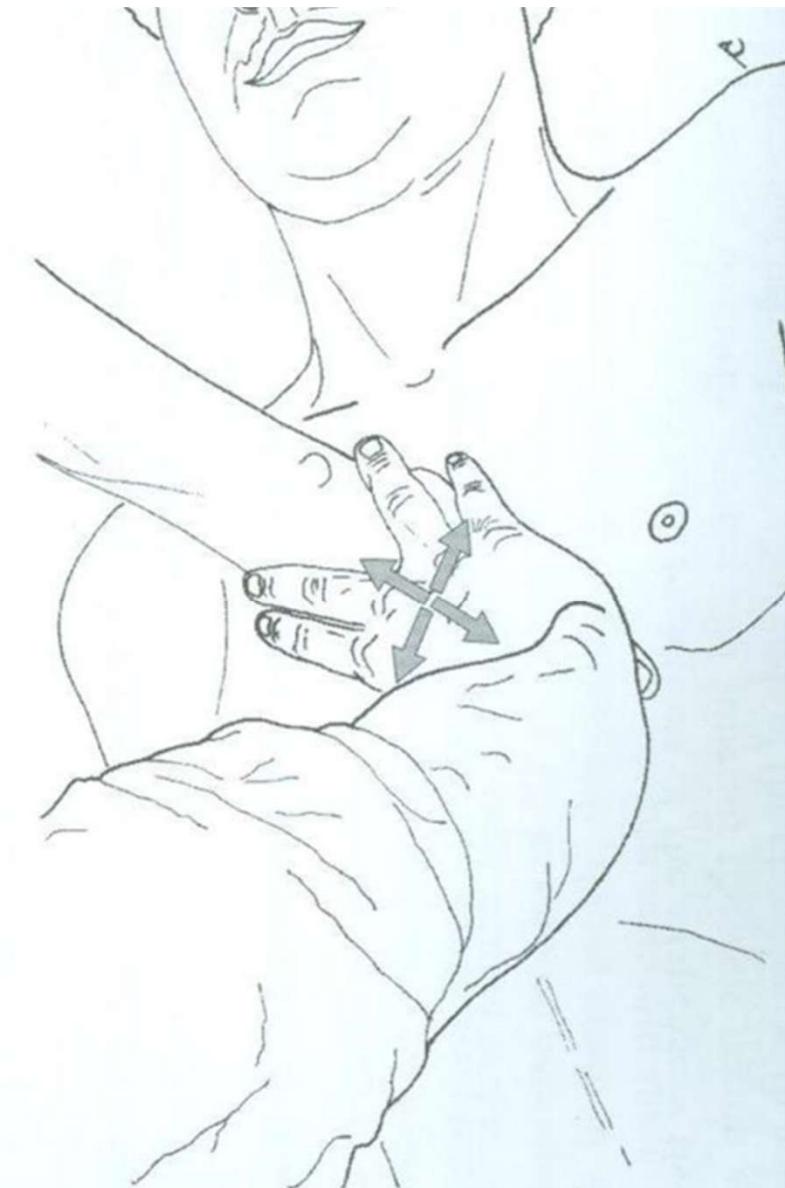
***Evaluate the Sternum:
Palpate for bumps/divots
signaling non-physiologic
rib dysfunction***

- Palpate at
 - Sternal chondral
 - Costochondral
- For
 - Divots
 - Which may indicate a posterior non-physiologic rib
 - Bumps
 - Which may indicate an anterior non-physiologic rib



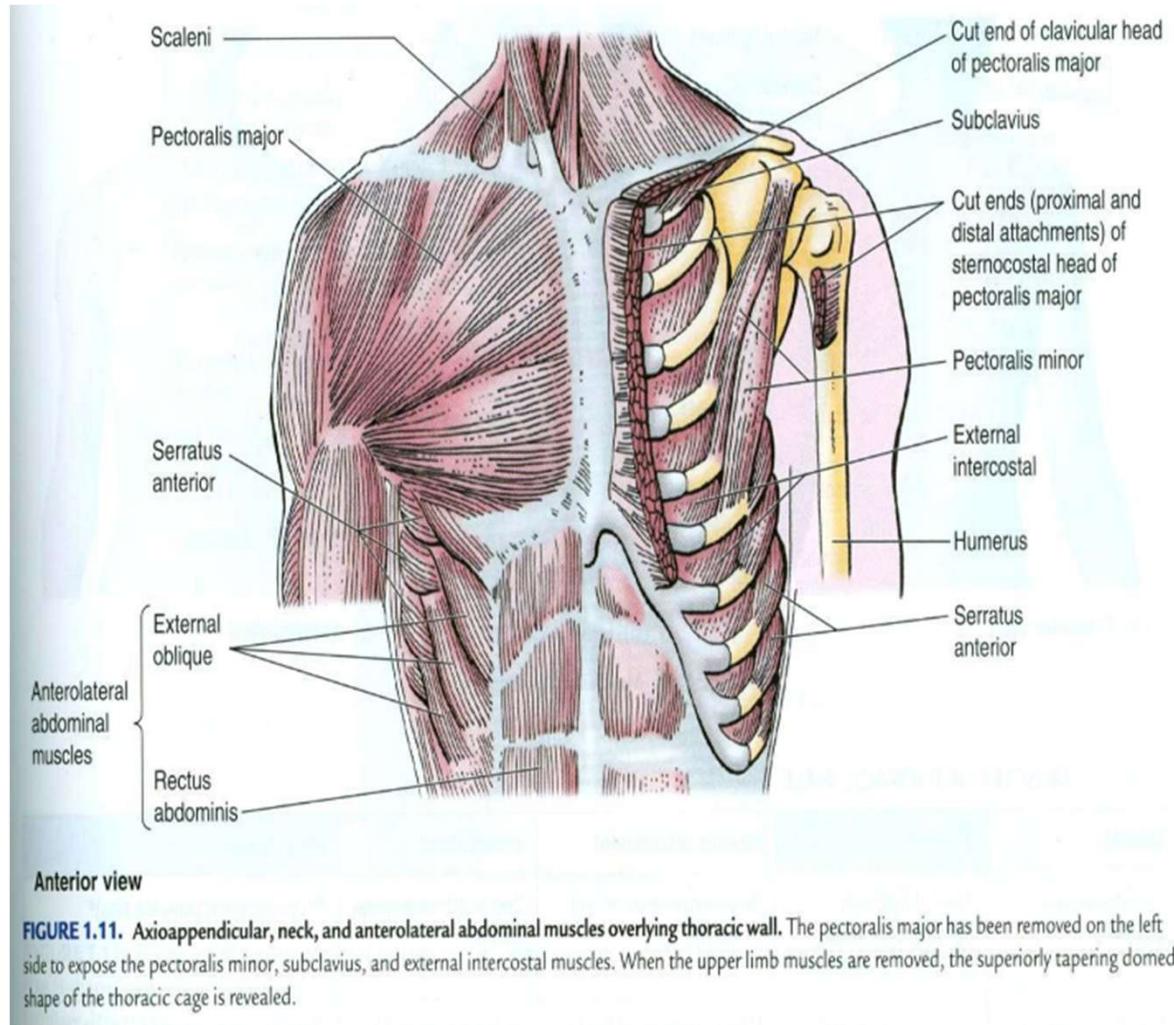
Crossed Mediastinum Test & Treatment

- Stand on the patient's right side
- Cephalad (Left) hand on a diagonal, thenar and hypothenar aspects of palm of hand lateral to sternum on right at 2nd ICS
- Caudal (Right) hand overlapping left hand on a diagonal thenar and hypothenar aspects of palm of hand on left 5-6th ICS
- Check the motion superior/inferior/left / right/twisting
- Be aware that your patient may be sensitive physically as well as emotionally to this test and treatment
 - Trauma, An Osteopathic Approach, Barral and Croibier



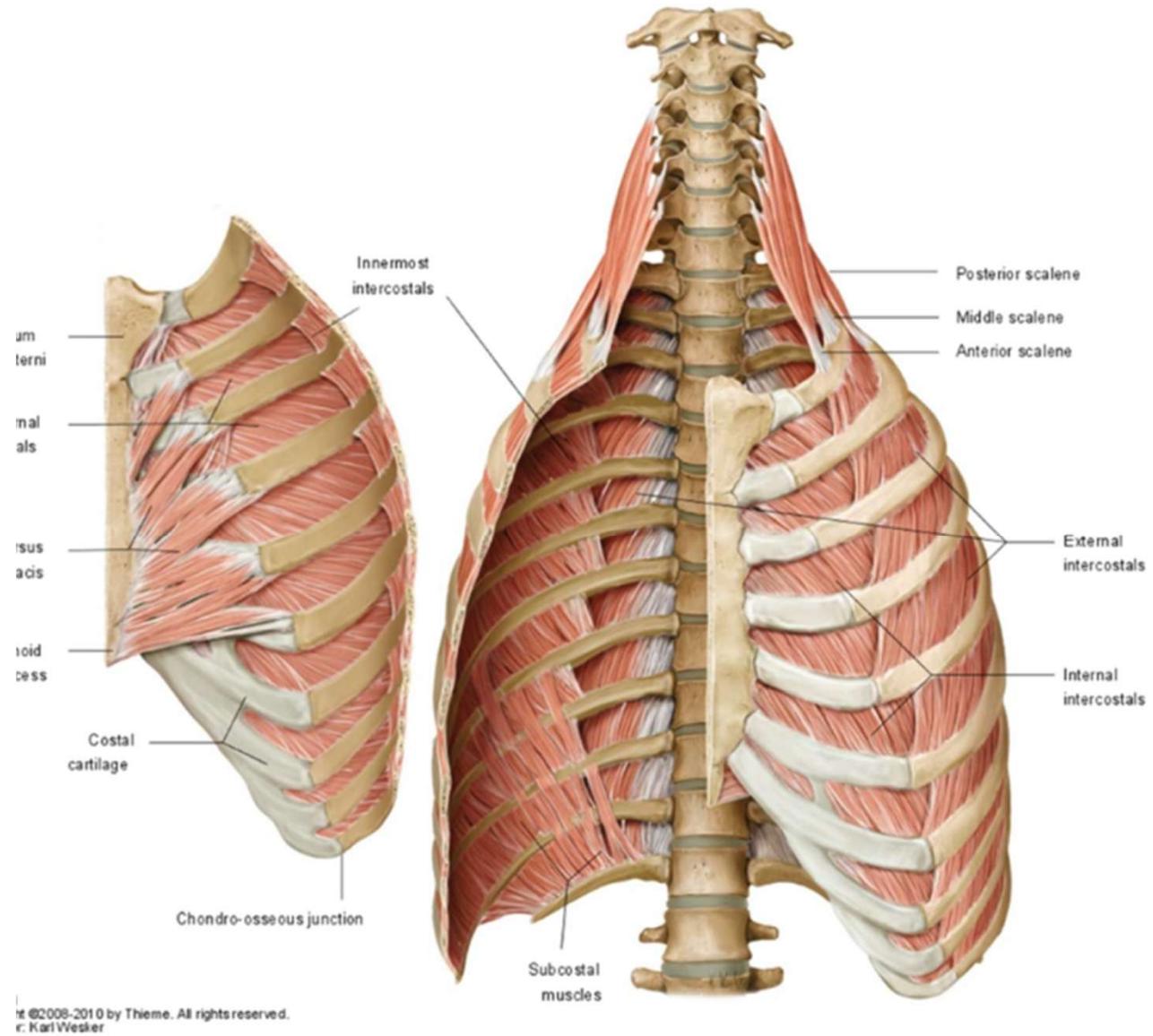
Ribs

- Recall muscular connections that may affect rib motion or maintain rib somatic dysfunction
- Scalenies
- Pectoralis major
- Pectoralis minor
- Subclavius
- Rectus abdominus
- Serratus anterior
- Latissimus dorsi



Deeper muscles that may affect rib motion

- Intercostals
 - External intercostals
 - Raise ribs
 - Lower margin of rib to upper margin of the next rib
 - Internal intercostals
 - Lower ribs
 - Innermost intercostals
 - Lower ribs
- Subcostals
 - Lower margin of lower ribs to inner surface of ribs 2-3 ribs below
 - Lower ribs
- Transversus Thoracis
 - Sternum/xiphoid to 2nd-6th ribs
 - Lowers ribs
- Consider these muscles and the intercostal nerves with rib pain



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Karl Wesker

Thoracoabdominal Diaphragm

Attachments

Xyphoid process

Ribs 6-12

Left crus to L_{1,2,(3)}

Right crus to L_{1,2,3,(4)}

Arcuate ligaments

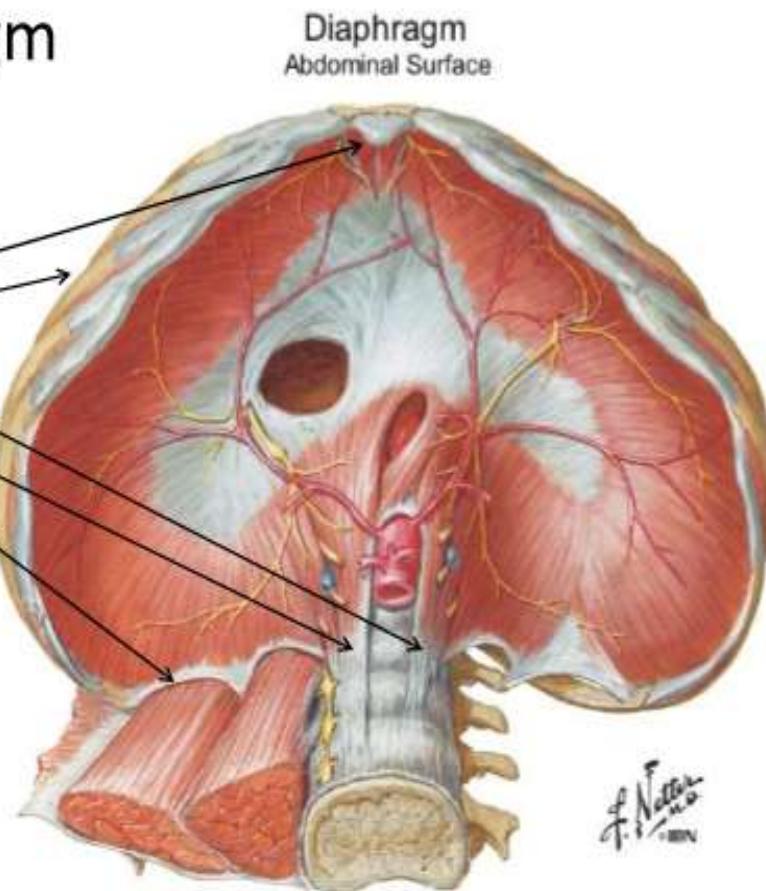
Openings/penetrations

Esophageal hiatus

Vena caval foramen

Azygos/homozygous v.

Aortic foramen

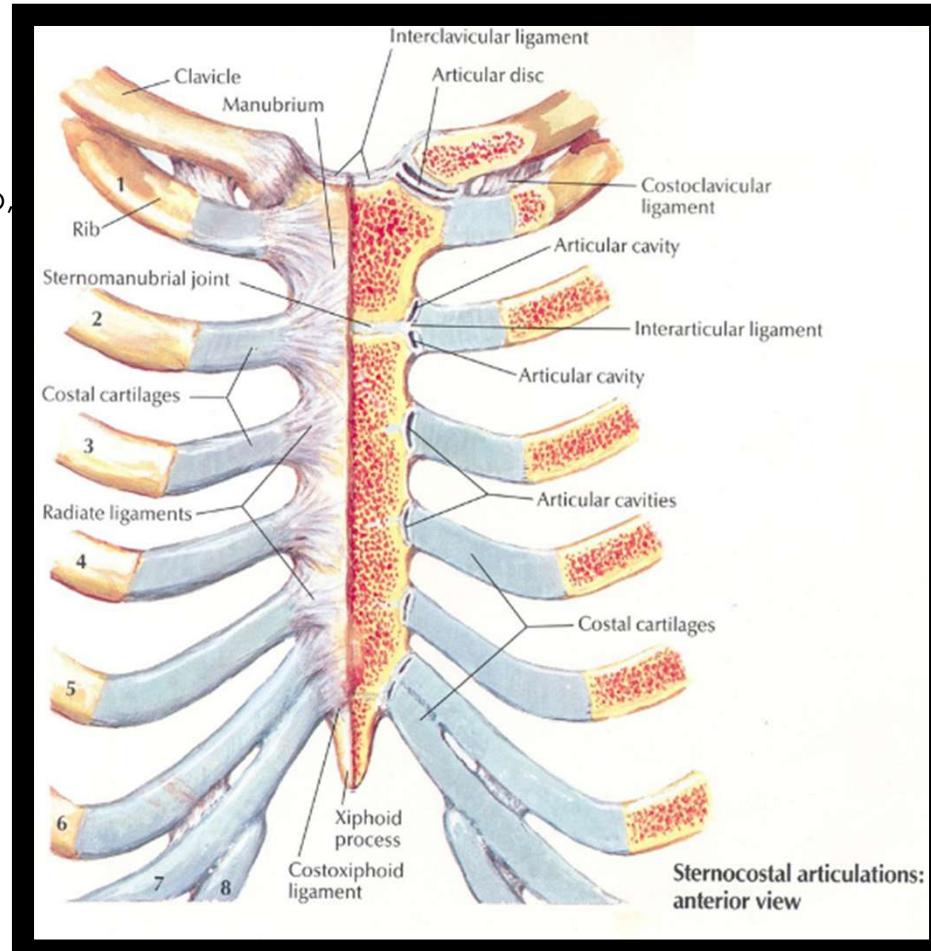


Diaphragm Attachments

- Diaphragm restriction can cause:
 - Rib restriction
 - Lumbar restriction
 - Xiphoid (sternal) restriction
- Be sure you consider this large muscular connection

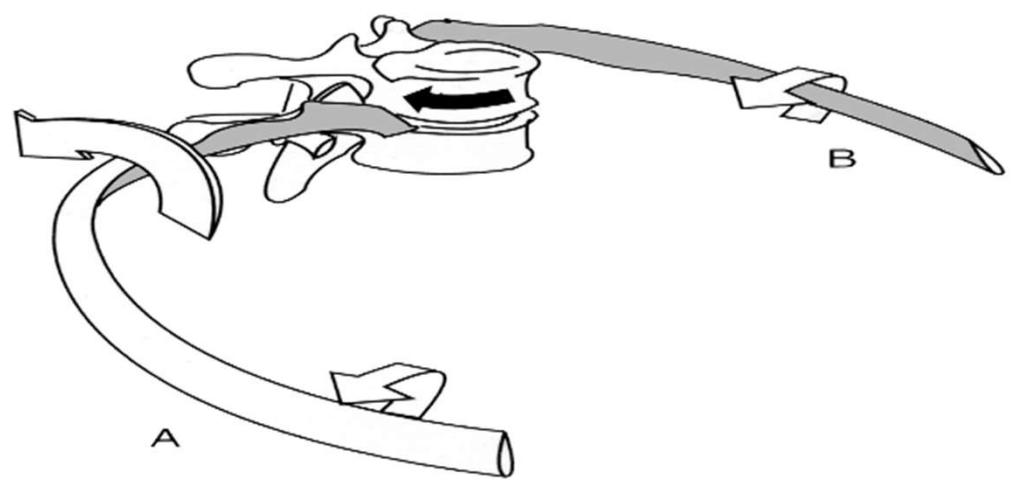
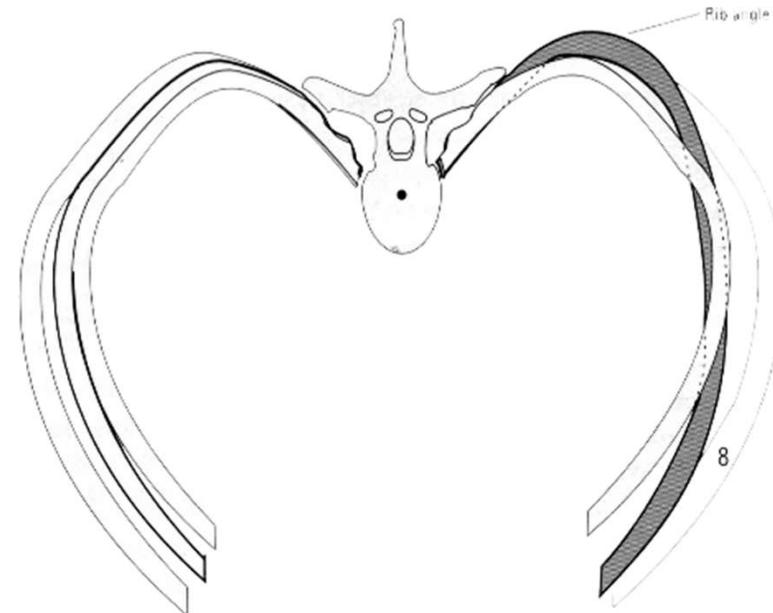
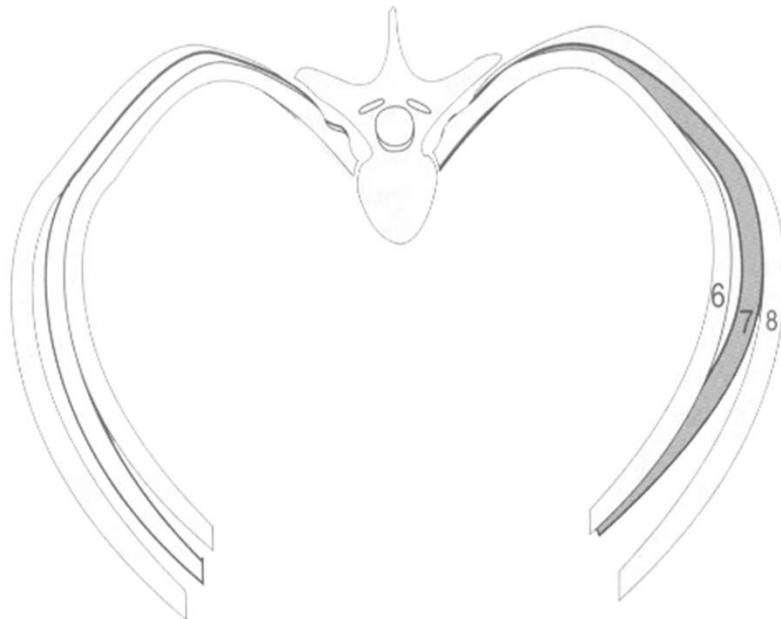
Ribs and Sternum- Non-physiologic ribs

- Physiologic ribs- move with respiration
 - Inhaled or exhaled ribs
- Non-physiologic ribs
 - Often due to trauma, joints not in proper physiologic relationship, rib does not move well with respiration, usually painful
 - Named for position of ease
 - Medial displacement (lateral rib compression)
 - Trauma from lateral to medial
 - Medial- mid axillary less prominent (pothole)
 - Lateral- mid axillary more prominent (speed bump)
 - Anterior rib (anterior subluxation)
 - Anterior bump at the chondro-costal articulation
 - Posterior divot at the rib angle
 - Posterior rib (posterior subluxation)
 - Anterior divot at the chondro-costal articulation
 - Posterior bump at the rib angle
 - Torsions
 - Twisting of the rib at it's attachment points
 - Frequently accompany a non neutral thoracic dysfunction (ERS)
 - Bumps and divots can be found at the chondro-costal articulation, rib angle or mid axillary line depending on the mechanism of injury



Netter Image

Non-Physiologic Ribs



Rib Diagnosis

- Integrated Exam

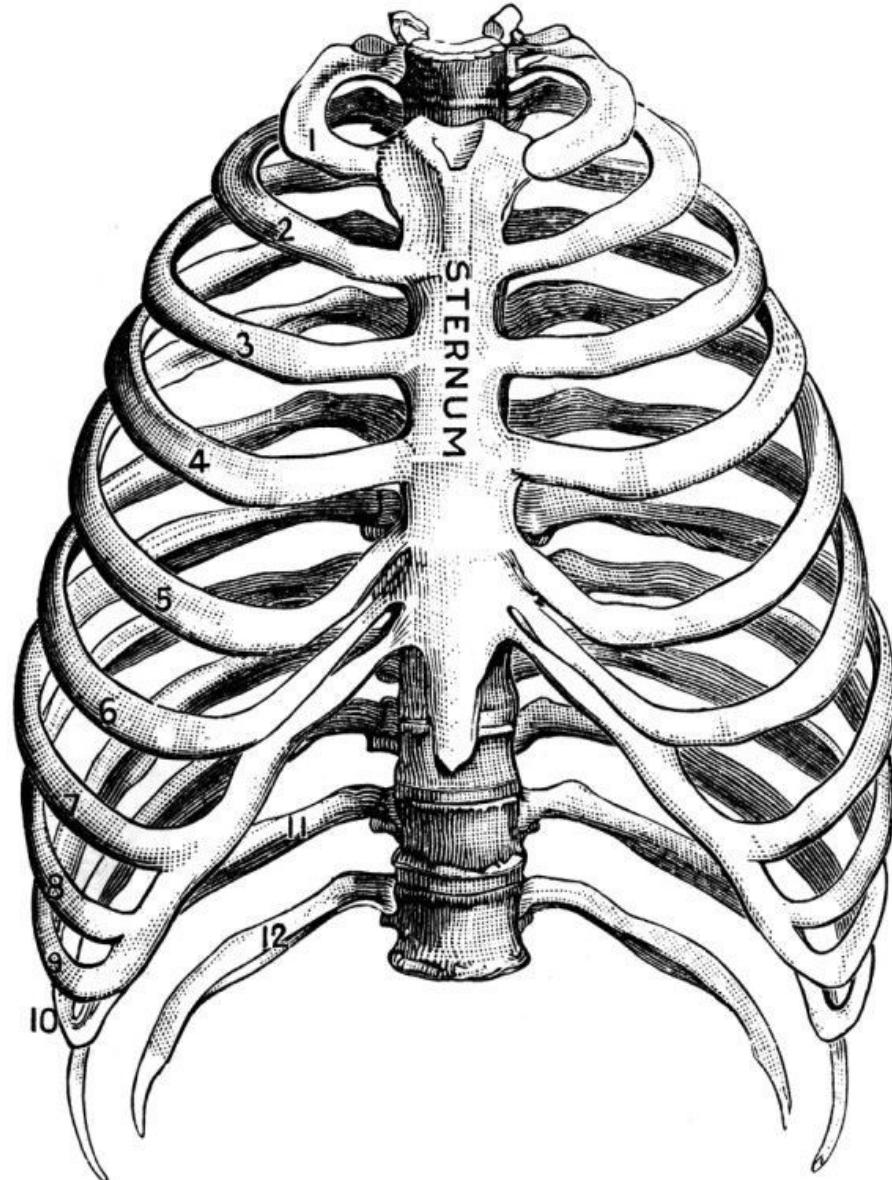
- Integrate your rib evaluation into your cardiac and respiratory evaluation

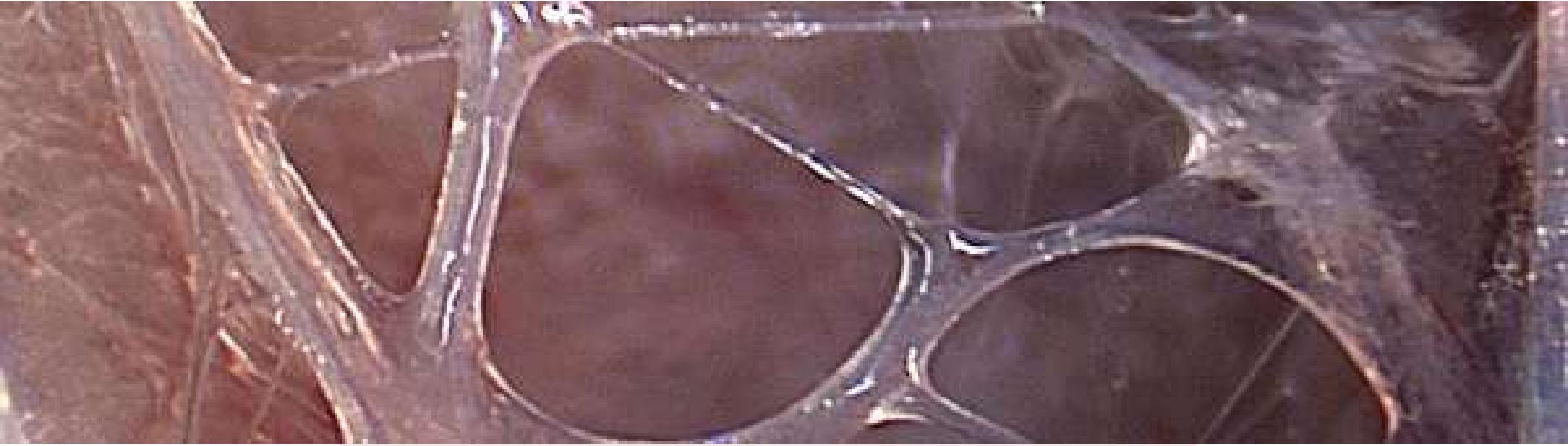
- Screen – Observe ribcage for presence of SD

- Asymmetry-static/dynamic
- Restriction to motion of breathing

- Scan / Segmental Dx

- Restriction to Springing
- Restriction to Inhalation/ Exhalation
- Dx single rib dysfunctions or group dysfunctions
- Identify boundaries of a group dysfunction
 - Identify Key Rib in a group dysfunction
- Note structural clues for Non-physiologic rib SD
 - "Speed bumps & potholes" anteriorly and at angles
 - Mid axillary depression or prominence
 - Do not move well in either inhalation or exhalation



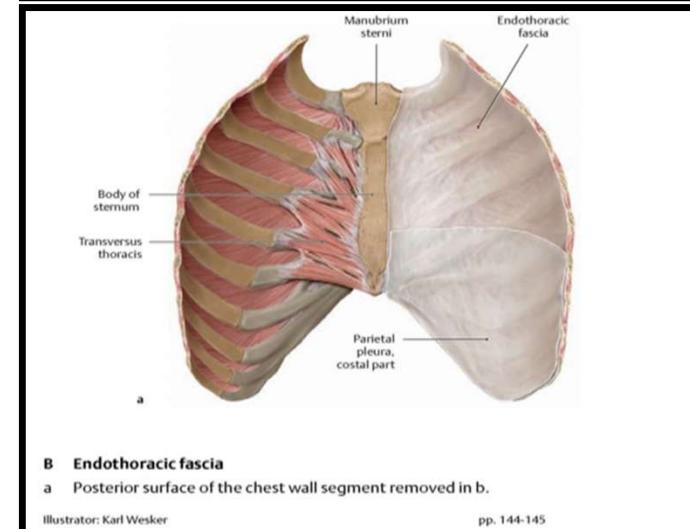
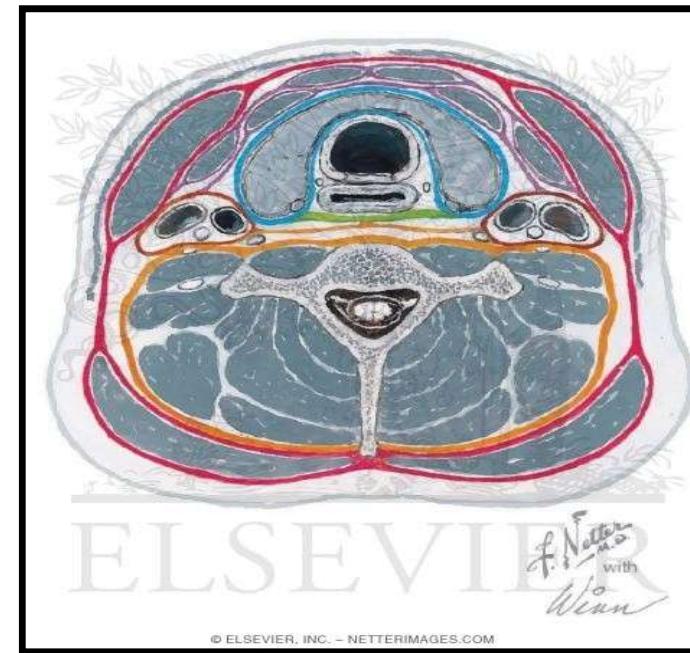


THE LONG LINK BETWEEN THE CRANIAL BASE AND THE PELVIC FLOOR

Fascial Connections

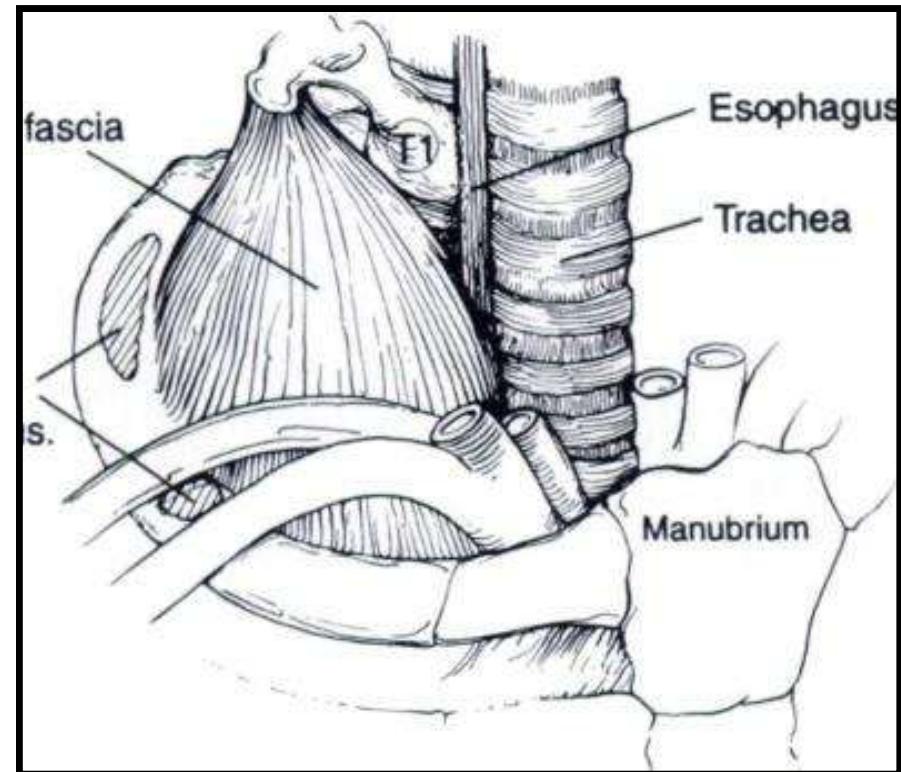
Deep Cervical Fascia

- Superficial- (dark red in picture)
 - Covers SCM and trapezius
- Middle (purple in picture)
 - Hyoid muscles
- Deep (orange in the picture)
 - Anterior neck muscles and paraspinal muscles
 - The anterior portion becomes fascia of the mediastinum
 - The posterior portion becomes thoracolumbar fascia
- Visceral layer (blue/green in picture)
 - Covers the thyroid, trachea and esophagus
 - Alar fascia- carotid sheath
 - Connects from the cranial base (occiput) goes through the neck and becomes endothoracic fascia- later becomes endoabdominal fascia and endopelvic fascia
 - LONG FASCIAL CONTINUITY!



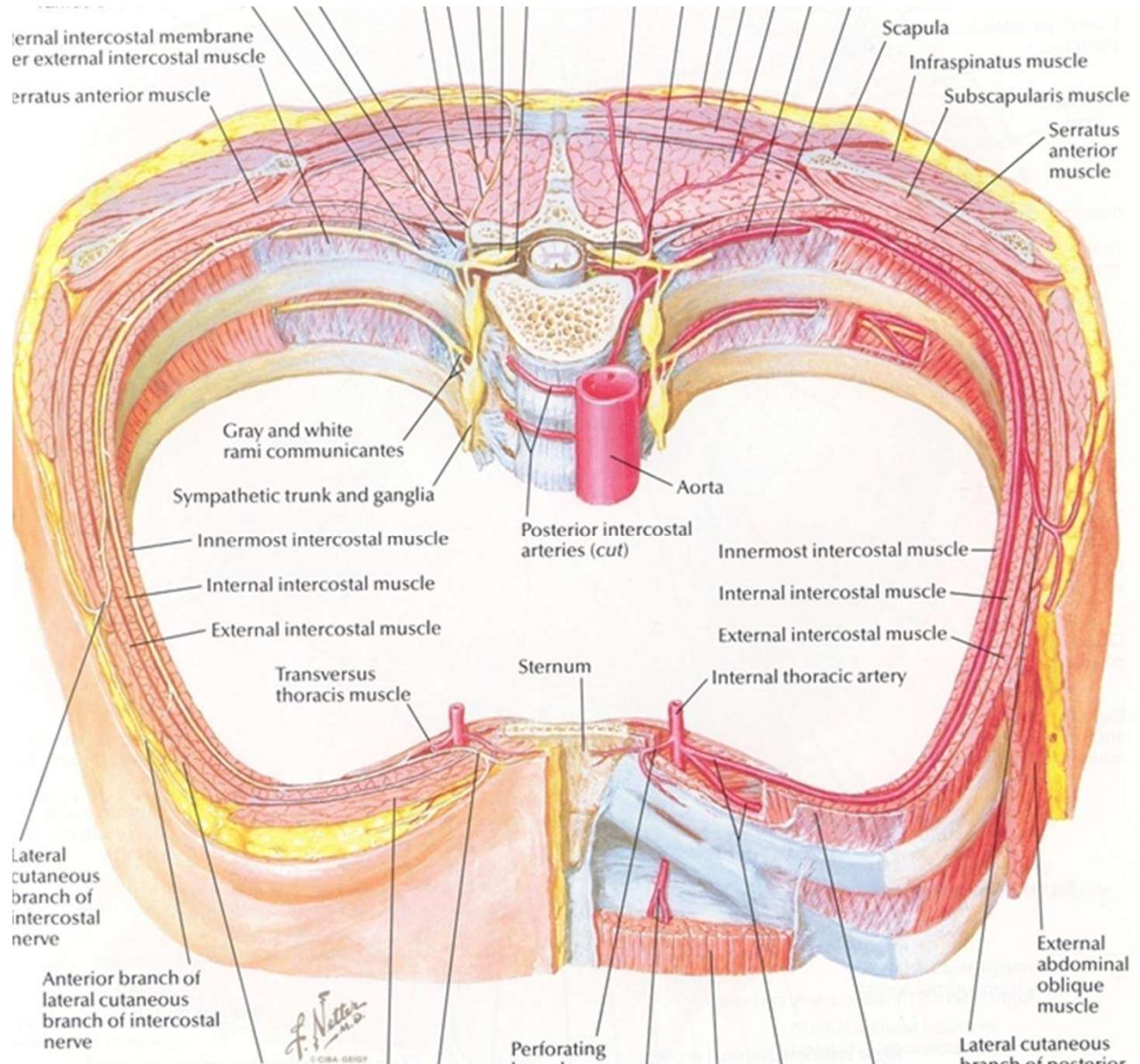
Sibson's Fascia- Pleural Dome

- “The thickened portion of endothoracic fascia extending over the cupola of the pleura and reinforcing it; it attaches to the inner border of the first rib and to the transverse process of the seventh cervical vertebra.”



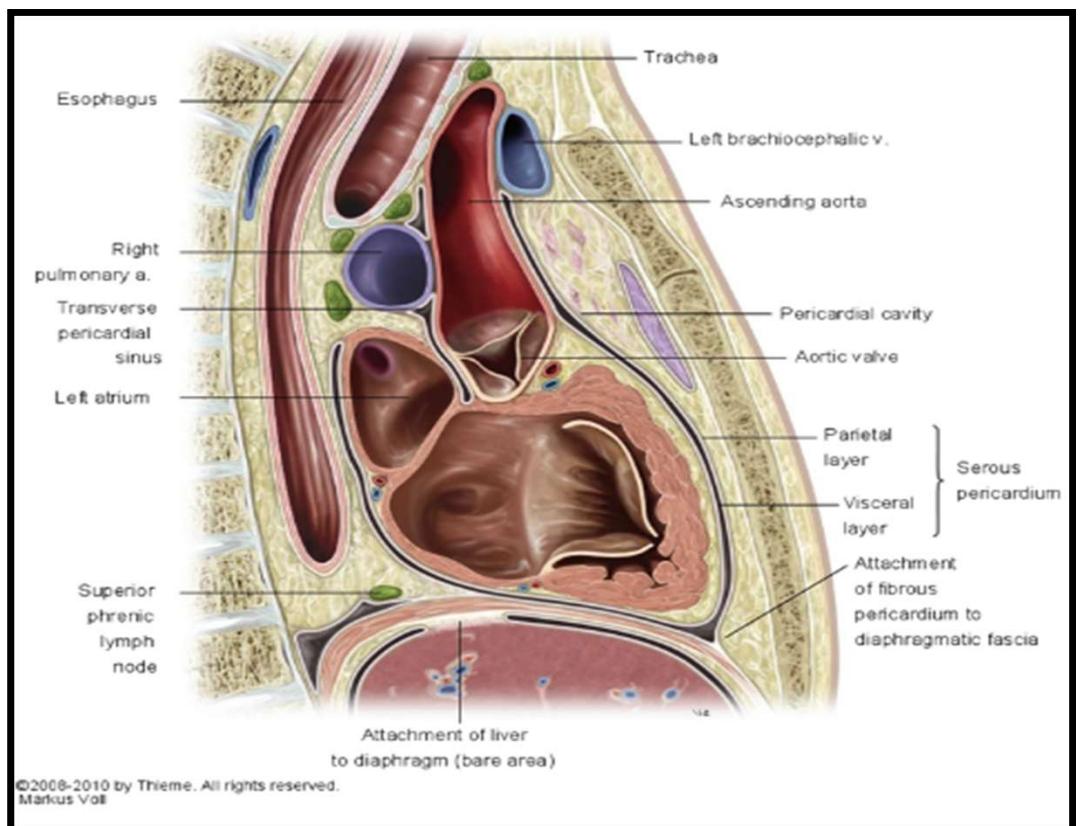
Chest Trauma

- Distributed to about 150 joints
- Tissues store the energy of trauma
 - How is the energy released?
 - Compensation
 - Central facilitation
- Emotional memory
- Prolonged nociceptive input
 - Sensitization
 - Loss of inhibitory neurons and growth of excitatory neurons
 - Pre-frontal loss of inhibitory neurons in response to pain
 - We look to stop this cascade



- Visceral courses will advance your palpatory skills of the mediastinum, lungs, heart
- Their fascial attachments can also cause restrictions within the thorax and ribs
- Try to get a feel of what is under your hands
- Sometimes when what seems to be a mechanical issue won't go away with good treatment- there may be an underlying visceral issue which needs to be addressed.

Visceral Consideration



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5. Raikos, A. et al. Sternalis muscle: an underestimated anterior chest wall anatomical variant. J Cardiothorac Surg 2011;6:73
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