

Anatomy Shorts

Occiput to Sacrum

fusionpilatesEDU.com
Never Stop Learning!

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Training to Create Change

▶ Awareness

- ▶ Bring client awareness to exercise, physical sensations and movement quality

▶ Corrective Movement

- ▶ Make appropriate corrections
- ▶ Clients should feel successful and not judged

▶ Strengthening

- ▶ Strengthen new movement pattern

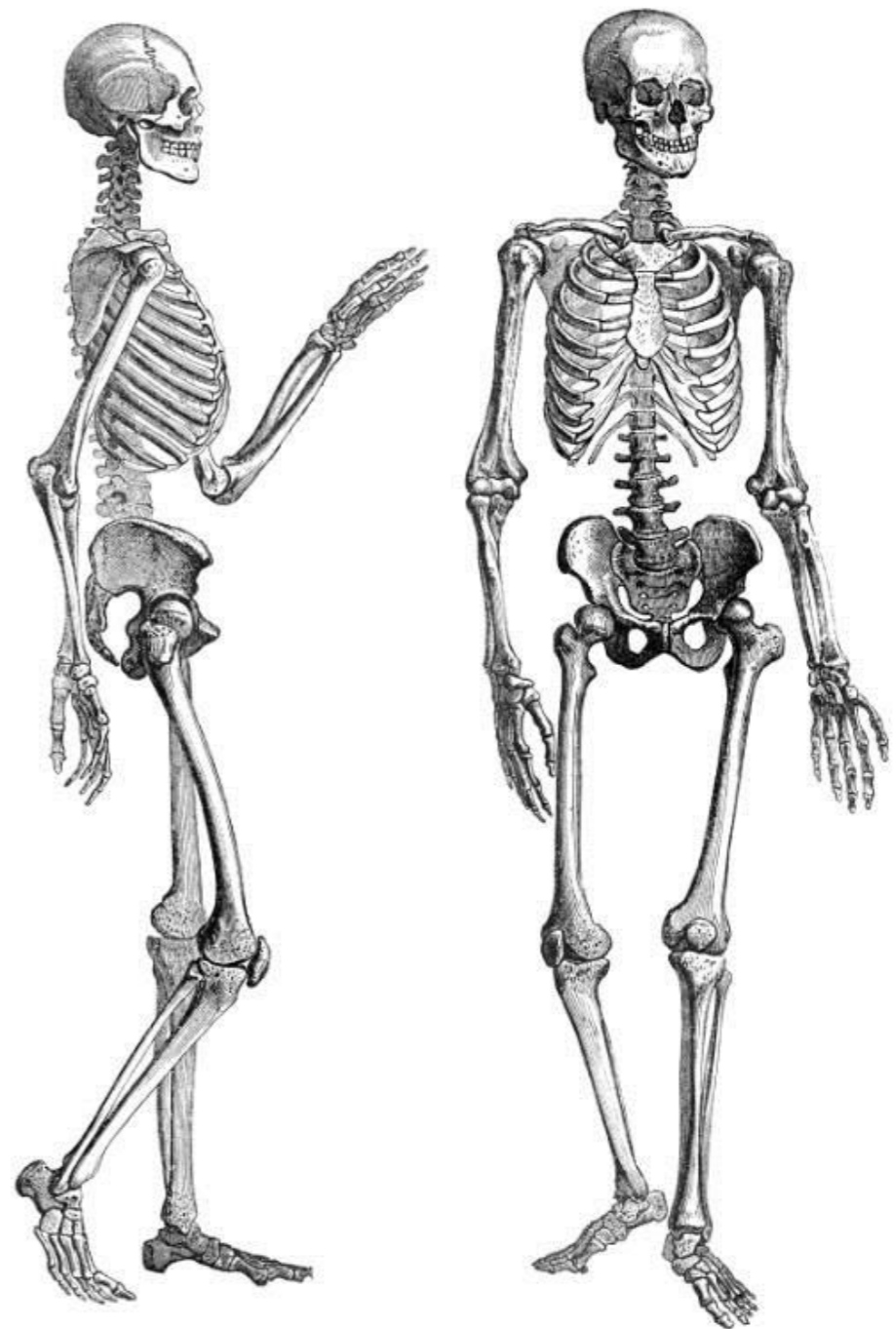
▶ Refined Awareness

- ▶ Bring new awareness to the progress and change

Ease, Economy and Efficiency

When standing in upright the bony alignment creates our vertical infrastructure while the soft tissue including muscles and connective tissue provide support, lift and energy.

The body is primed and idling. Ready for movement!

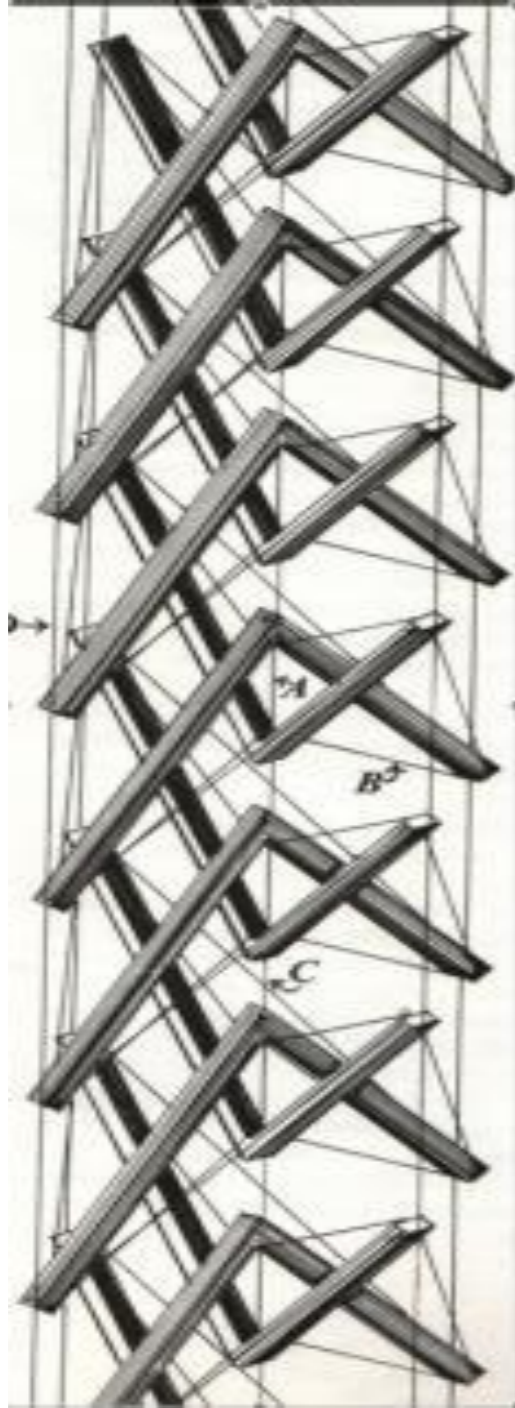


Bone



- ❑ Our bones are the levers by which muscles create movement
- ❑ Our bones are alive: seat of our immune system
- ❑ 206 bones in the human body functions as a scaffold which supports organs, anchors muscles and protects organs.
- ❑ As strong as steel, but lightweight and flexible
- ❑ Bones comprise 30-40% of body weight with half as water

Tensegrity

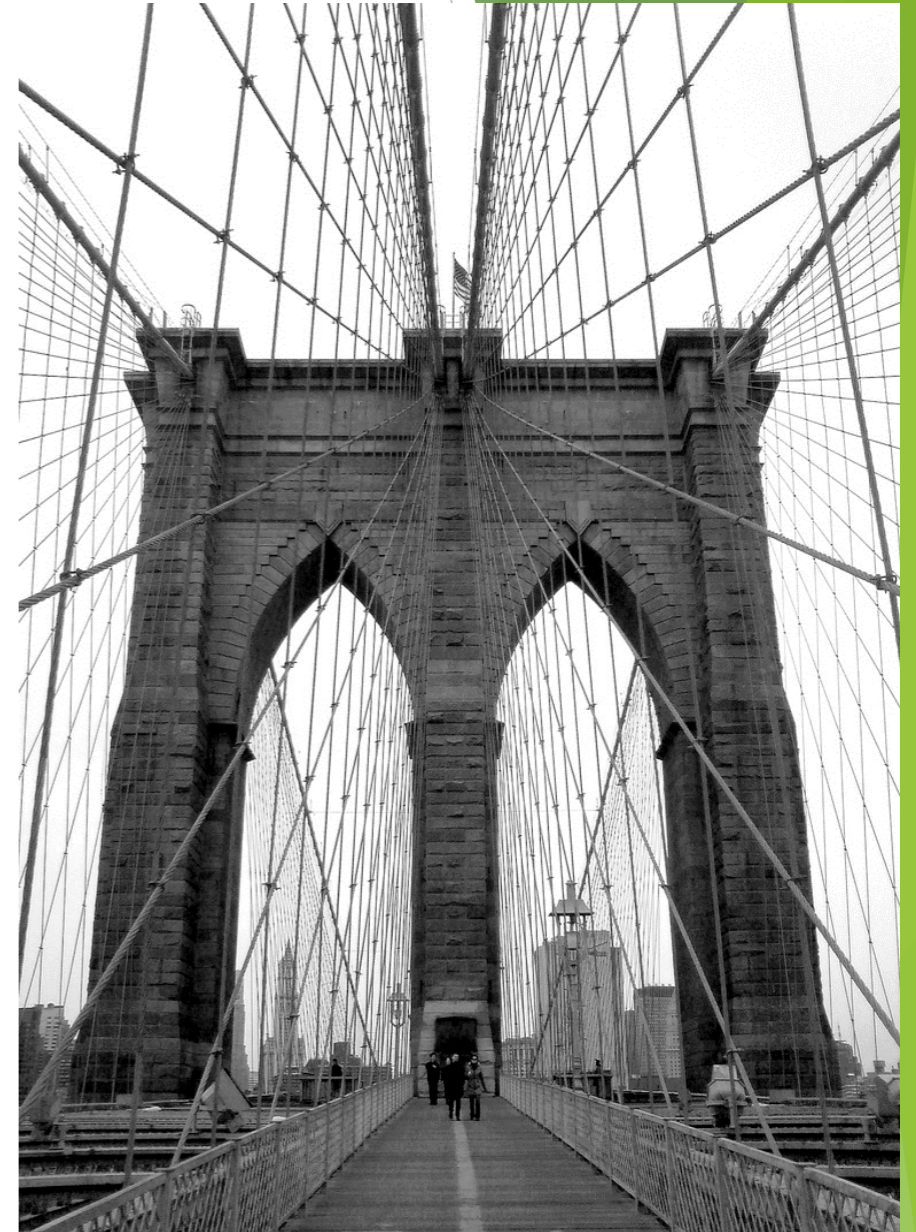


- ❑ Tensegrity = tensional integrity
- ❑ Compressive and tensional forces counterbalance one another
- ❑ Most inanimate objects continuous compression forces
- ❑ Our bones are compressive in nature and our soft tissue components provide are our tensile components
- ❑ In a most simplistic way, bones are our grounding forces, our muscles and soft connective tissues are our lifting forces

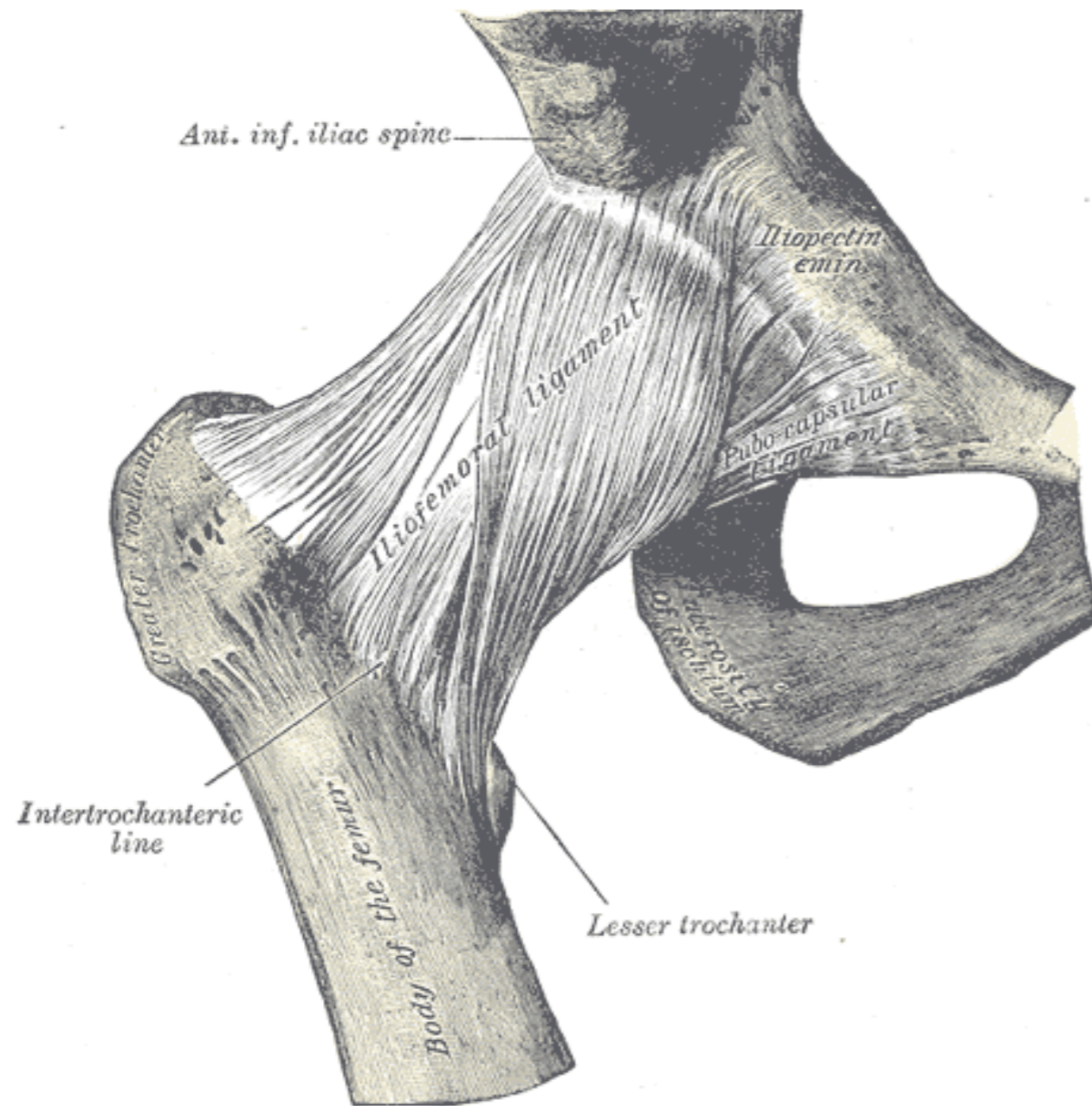
Tensegrity and the Human Form



- Our bones, our framework, deal with the compressive forces of gravity
- Tensile forces, our soft tissue components, include ligaments, tendons, muscles, fascia
- Tensile forces are the suspensory cables which oppose tendency for skeleton to collapse



Ligaments



- ❑ Dense band of fibrous connective tissue connecting bones to bones
- ❑ Ligaments can yield when under tension, but cannot retain their original shape when stretched past their limit for prolonged periods of time

Muscles and Tendons

- ❑ Tendons cross joints and move the levers of the bones
- ❑ Tendons have an elasticity to them and function as springs
- ❑ Muscles are the engines that move bones
- ❑ Muscular activity accounts for much of the energy consumption of the body



Spine

- ▶ Flexible column formed from a series of bones called vertebrae
- ▶ Longitudinal in nature and runs the central axis of the body
- ▶ Symmetry and pyramidal shape give it strength
- ▶ S- Shaped curves give it the power to support and balance the three weight centers of the body: head, thorax and pelvis
- ▶ Absorbs shock as it deals with the forces placed upon it, especially gravity



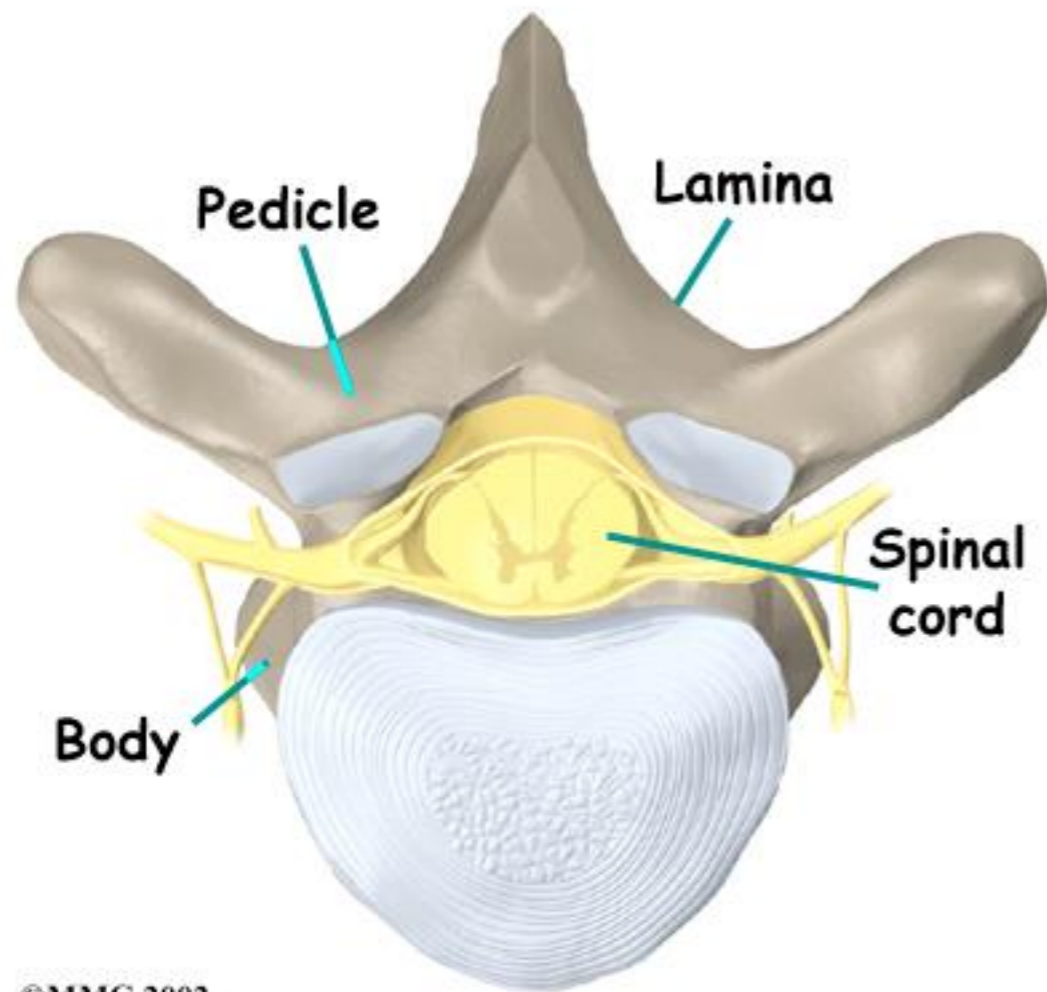
Spinal Mobility



- The flexible spine consists of 24 small, irregular and interlocking vertebra, plus the 5 fused vertebra of the sacrum = 29
- Coccyx an addition 4 or 5 fused vertebra, makes our tail bone

NOTE: In the video I refer several times to the 29 bones of the spine, 24 vertebrae plus the 5 bones that make up the sacrum.

Spine as Protection



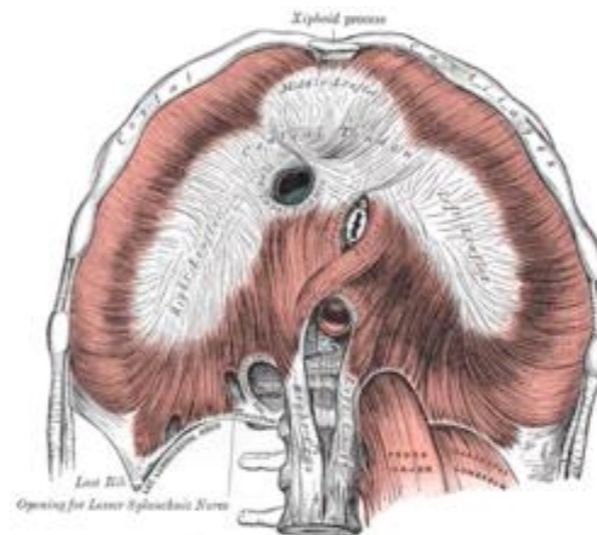
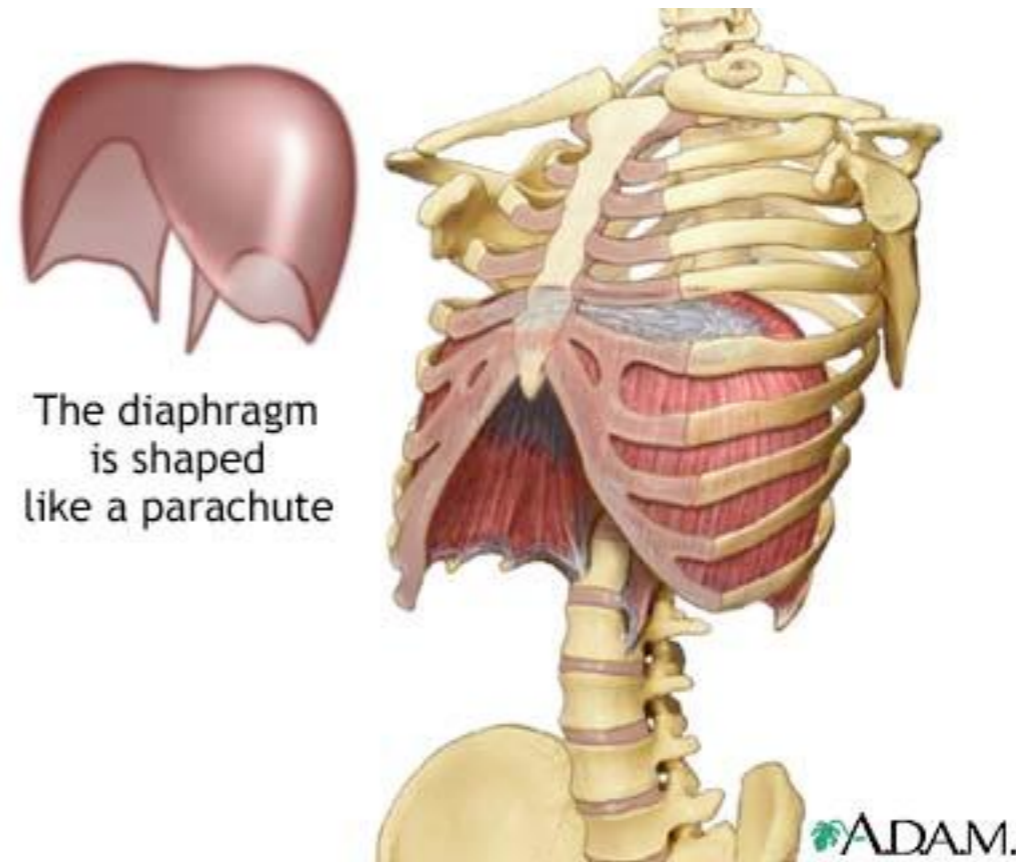
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► Protection

- Ribcage which attaches to thoracic vertebrae protects heart and lungs
- Interlocking vertebrae creates archways which protect the spinal cord and nerve roots (motor and sensory)
- Descending aorta runs along side it

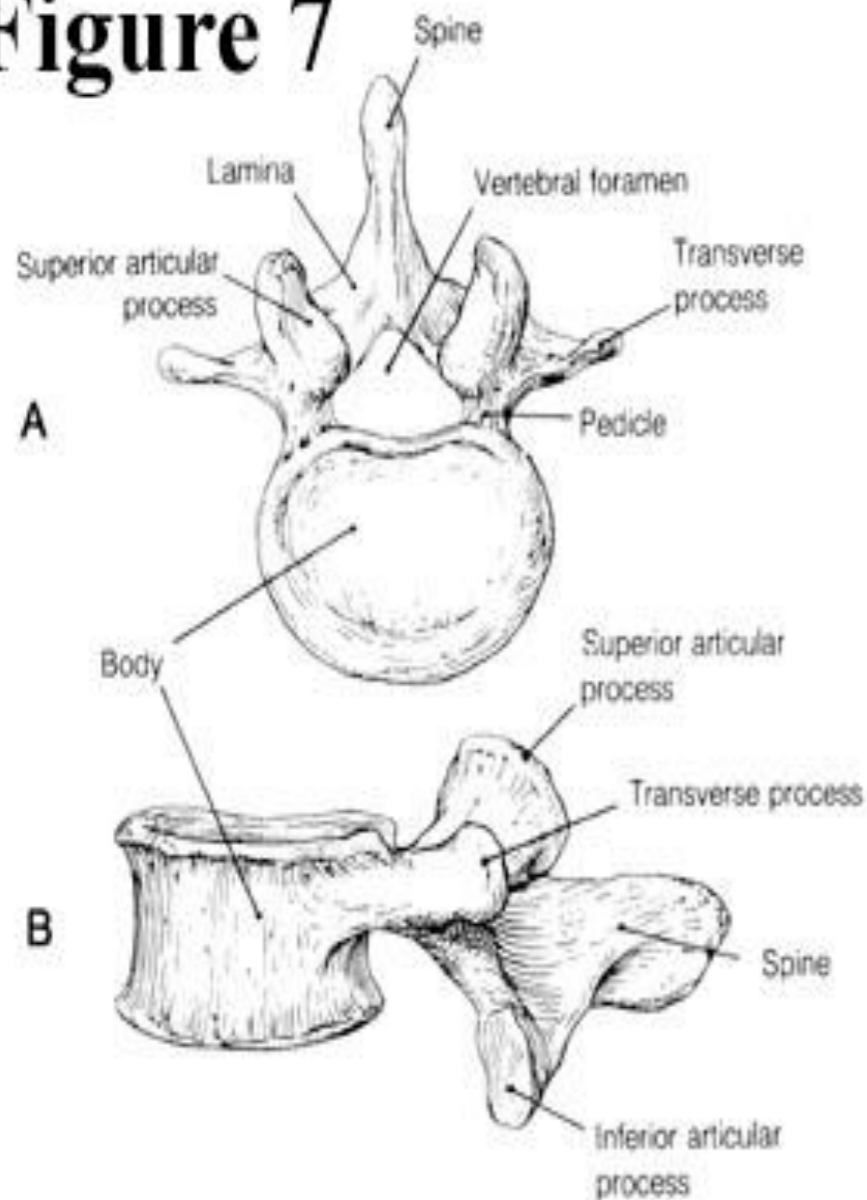
Spine and Breath

- ▶ Diaphragm tucks under ribcage, its movement intimately connected to ribcage as well as spinal mobility, to be explored in depth later
- ▶ Crura, finger like attachments of the diaphragm attach to T12...important junction with multiple muscle interactions



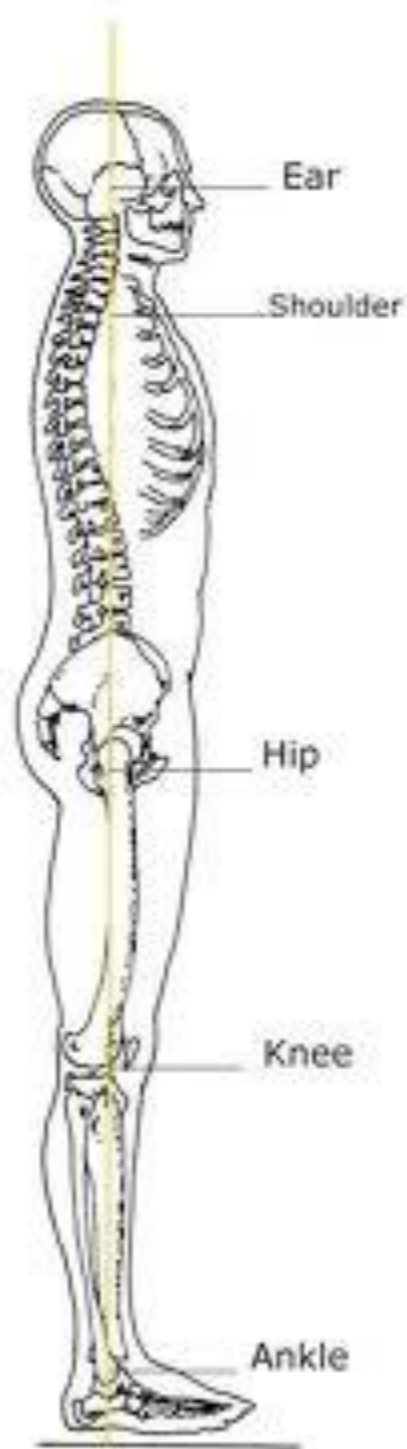
Cost of being upright

Figure 7



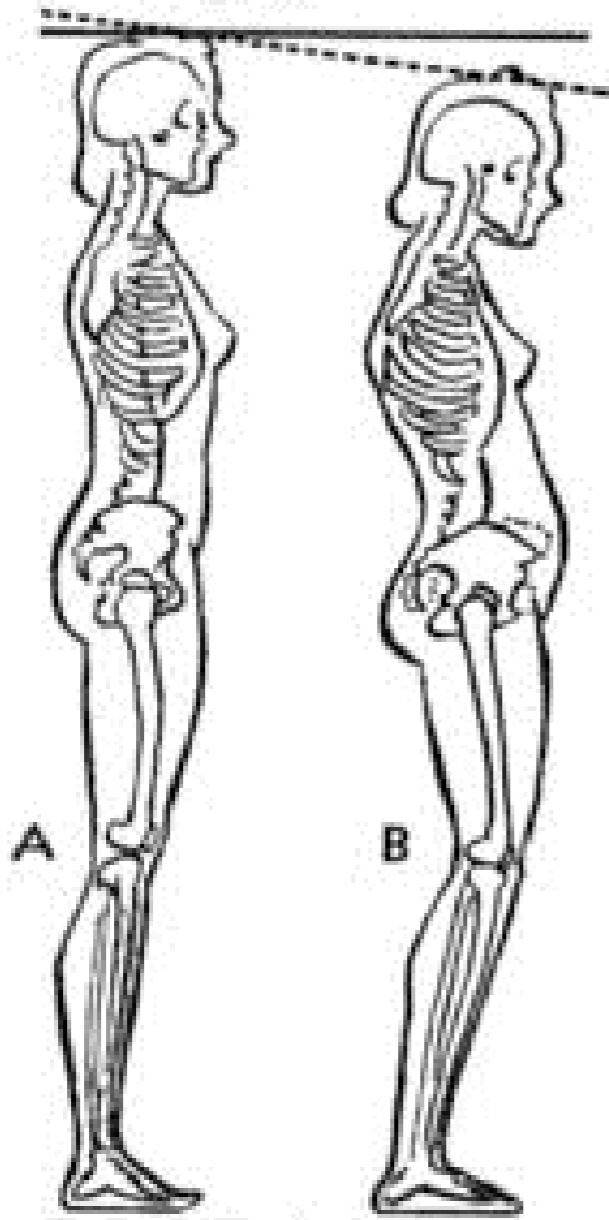
- ▶ Humans are upright and bipedal (two legged)
- ▶ The bony rounded bodies of each vertebra are the principle arbiters of weight receiving
- ▶ The bodies of the vertebra need to enlarge in all directions to support the ever increasing weight distribution
- ▶ Gravity demands that each vertebra take on and support the cumulative weight of the vertebra above as well as translate that weight to the vertebra below

Gravity and the Spine



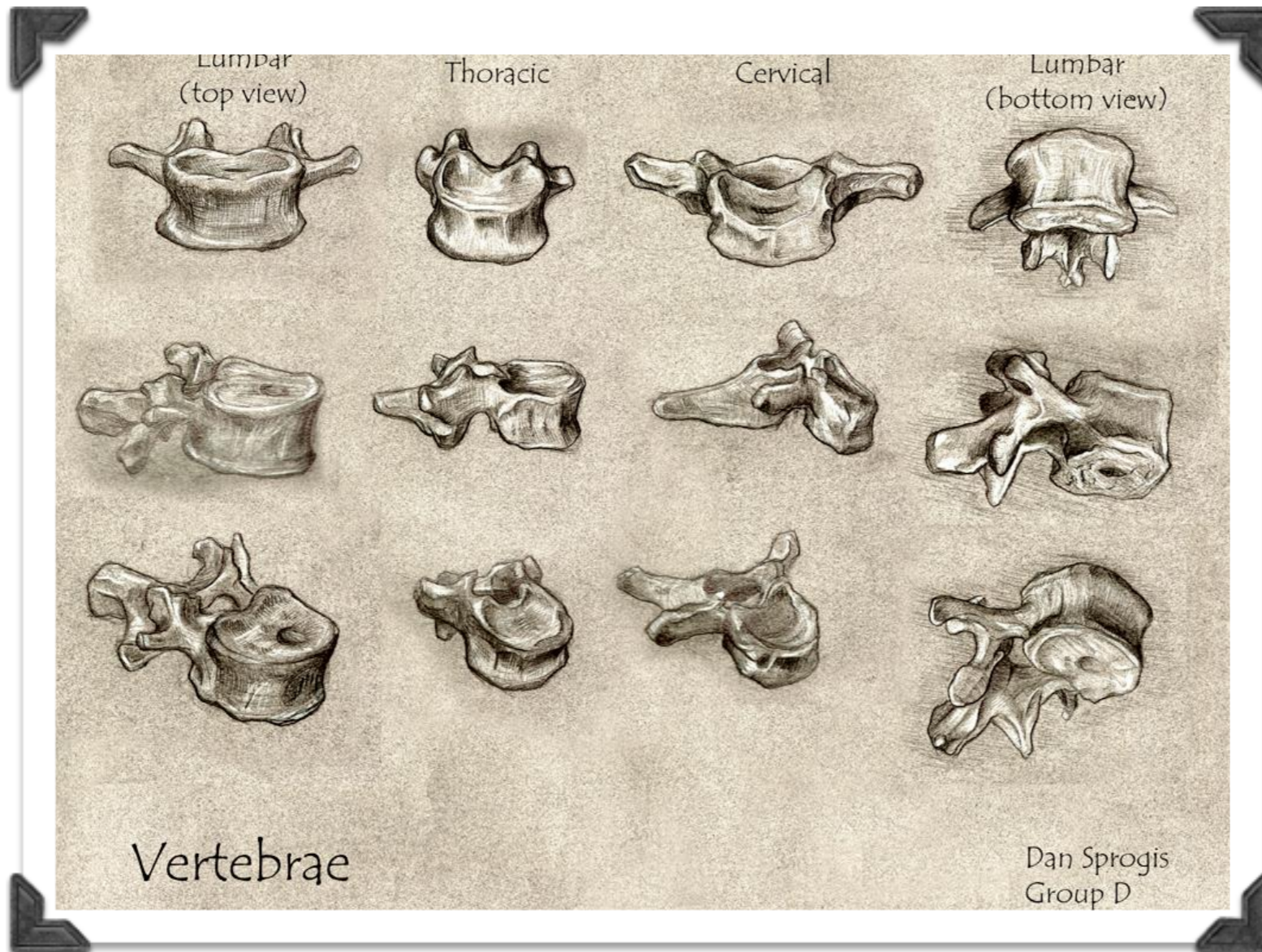
- ❑ Alignment of vertebral bodies important to setting the stage for movement potential.
- ❑ If aligned well, ligaments, muscles and facial stress will be minimized.
- ❑ Center of gravity travels through the inner ear, cervical bodies, soft tissue of heart and lungs, lumbar bodies onto the pedestal of sacrum, through the heads of femora and down the legs to the ground.
- ❑ Ground forces travel up in the reverse direction. Efficient and effective force transference gives movement ease and grace.

Balanced Forces

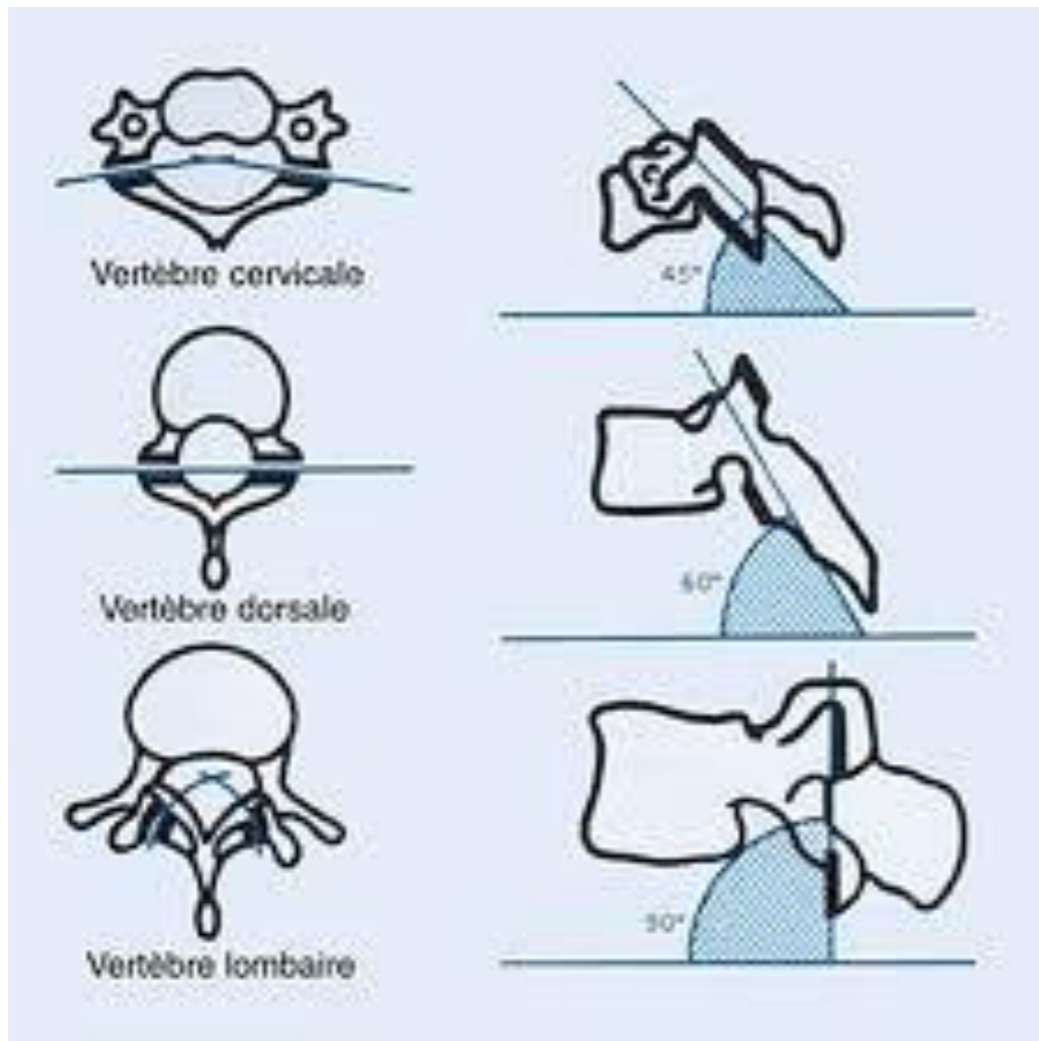


- ❑ 3 principle units of weight include the skull, the thorax and the pelvis
- ❑ If balanced in relation to gravity and one another there will be no unequal strain on ligaments and muscles
- ❑ Tensile forces meet and match gravitational compressive forces

Vertebrae



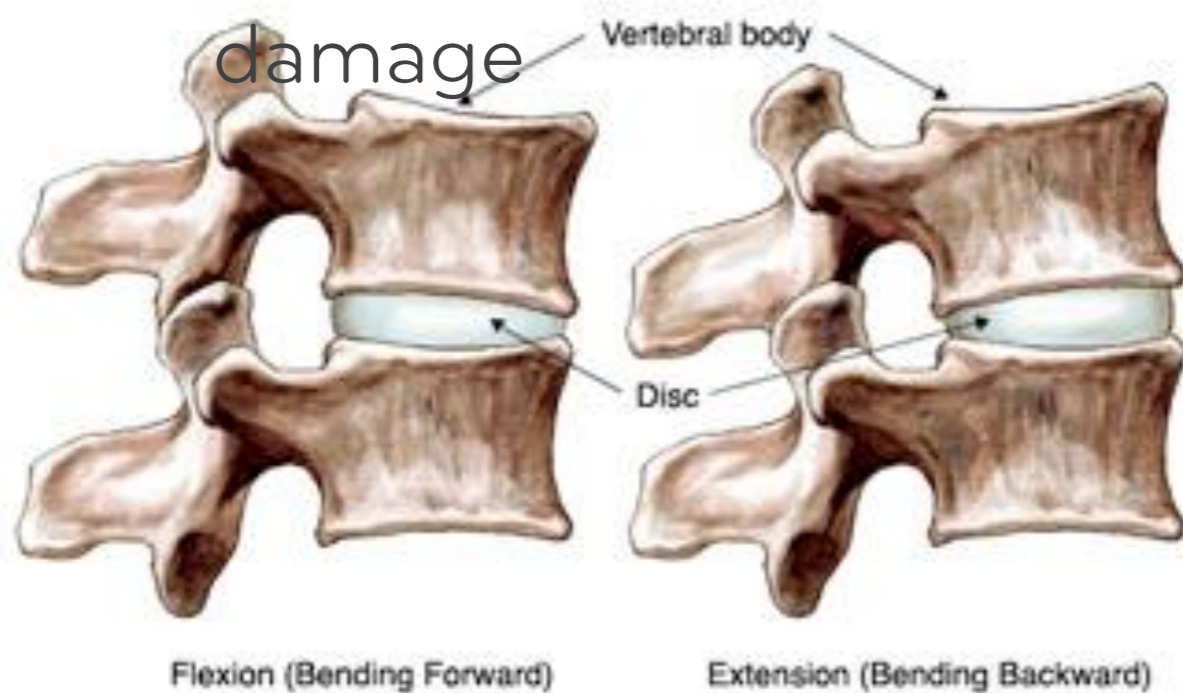
Facet Joints and Spinal Segments



- ▶ Interlocking construction between vertebra
- ▶ Creates joints which provide stability
- ▶ These joint interfaces also allow or dis-allow for movement potential at the joint – these are Facet Joints

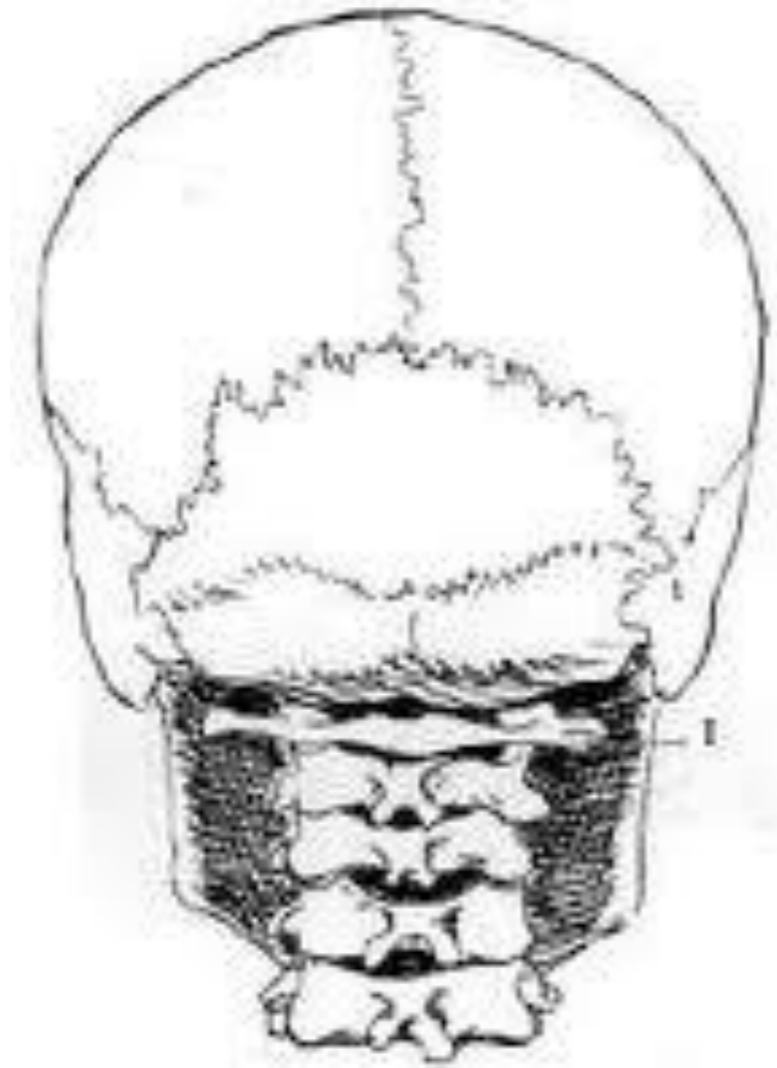
Intervertebral Discs

- ▶ Shock absorbers
- ▶ 20 to 30% of height of spinal column
- ▶ Create connection between bony vertebral bodies
- ▶ Bulges and herniation's most common damage



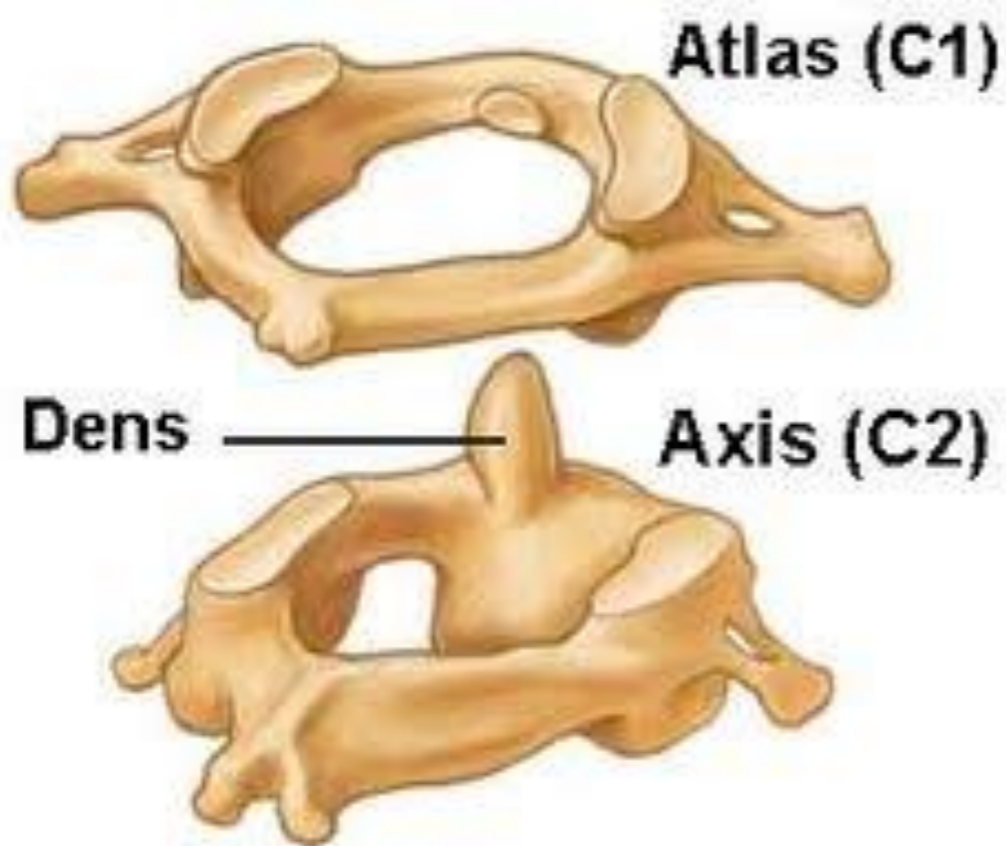
- ▶ Annulus Fibrosis - outermost layer; distributes pressure evenly across the disc
- ▶ Nucleus pulposus - center of annulus fibrosis

Cervical Spine and Facet Joints



- ▶ Cervical spine, 7 small vertebrae, supports weight of the head
- ▶ Convex curve, if observing curve anteriorly
- ▶ Head is an axial load
- ▶ Head sits on the spine at the point just back of the jaw, in line with the inner ear
- ▶ Head sits on top of the spine and rocks, as if on a cradle

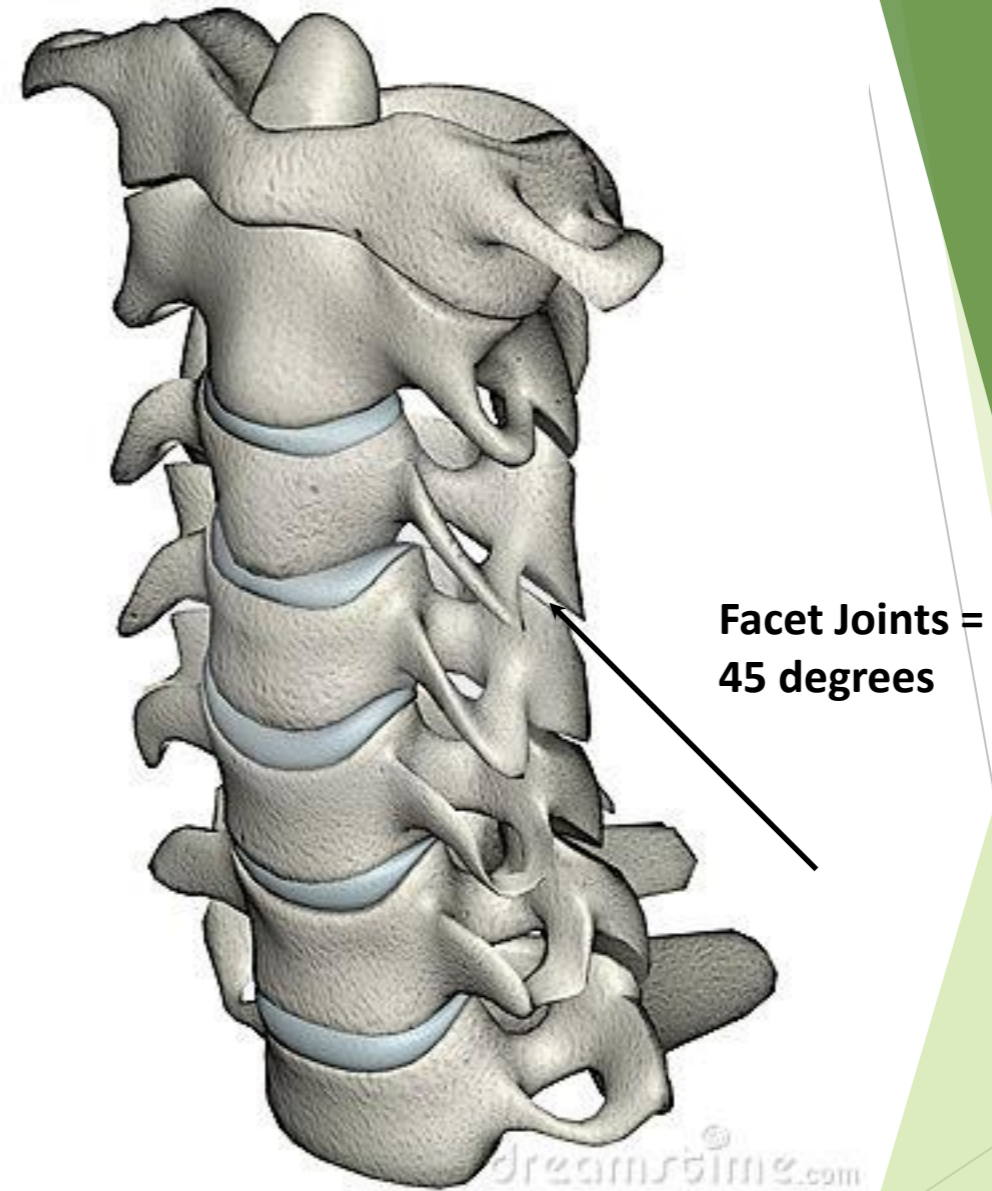
Atlas and Axis



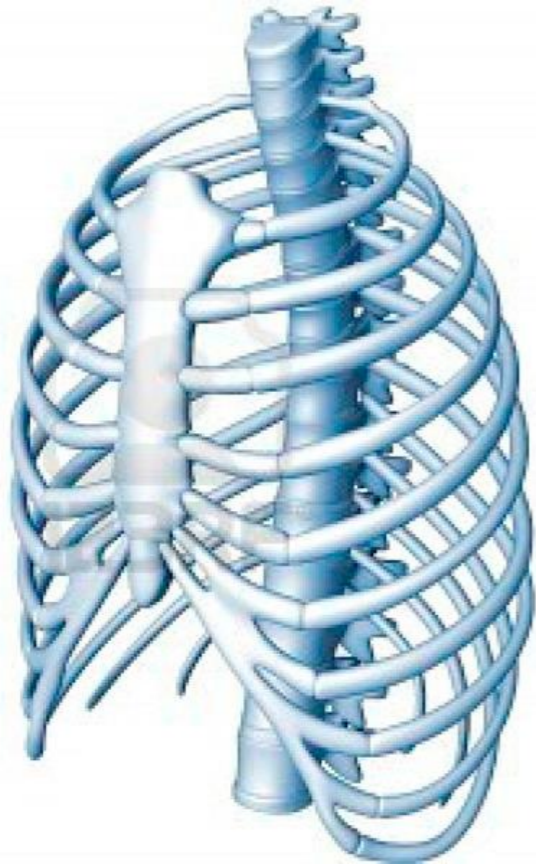
- ▶ The first cervical vertebra, C1, otherwise known as the Atlas articulates with the skull and creates the cradle upon which the head rests
- ▶ C2, the Axis, is the site of cervical rotation
- ▶ Note: tooth like structure called the dens on the Axis fits into Atlas and is where more than half of all cervical rotation occurs.

C3-C7

- ▶ Facet joints C3-C7 at roughly 45 degree angle
- ▶ Allows for support of the head in flexion and extension with limited rotation, side bending
- ▶ Curve, without postural support defaults to either forward head and/or defaults to the curve into extension



Thoracic Spine

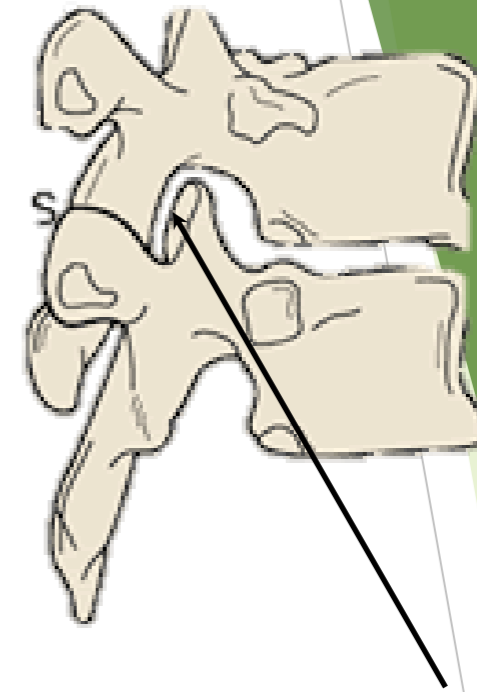
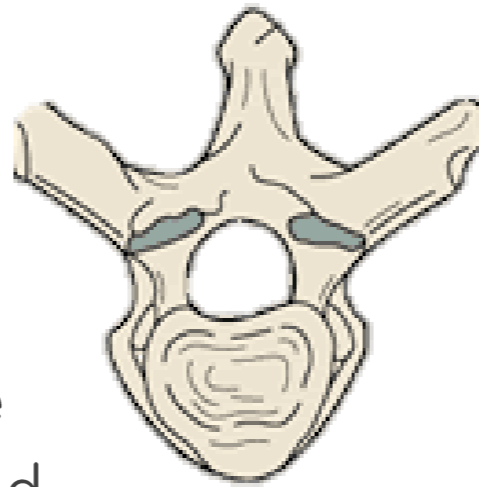


T12 is of particular interest as it has a very strategic transitional position between T12 and L1. Large trapezius muscle attaches to it posteriorly and the psoas rises up along its front of the spine. As a result, this junction is subjected to various pulls and forces

- ▶ Thoracic spine, 12 vertebra, which articulate with ribs to form the ribcage
- ▶ Rib articulation allows for strength and flexibility. Ribcage is capable of expanding in all dimensions
- ▶ Thoracic cavity separates chest and abdomen
- ▶ The diaphragm, like the equator, the floor for the thorax the roof for the abdominal cavity
- ▶ First three pairs of ribs nearly horizontal, important when we discuss Scalenes, SCM and breathing.
- ▶ Joint orientation allows for flexion, rotation and lateral flexion with a minimal amount of extension
- ▶ Curve, without postural support, defaults to the curve toward flexion / kyphosis

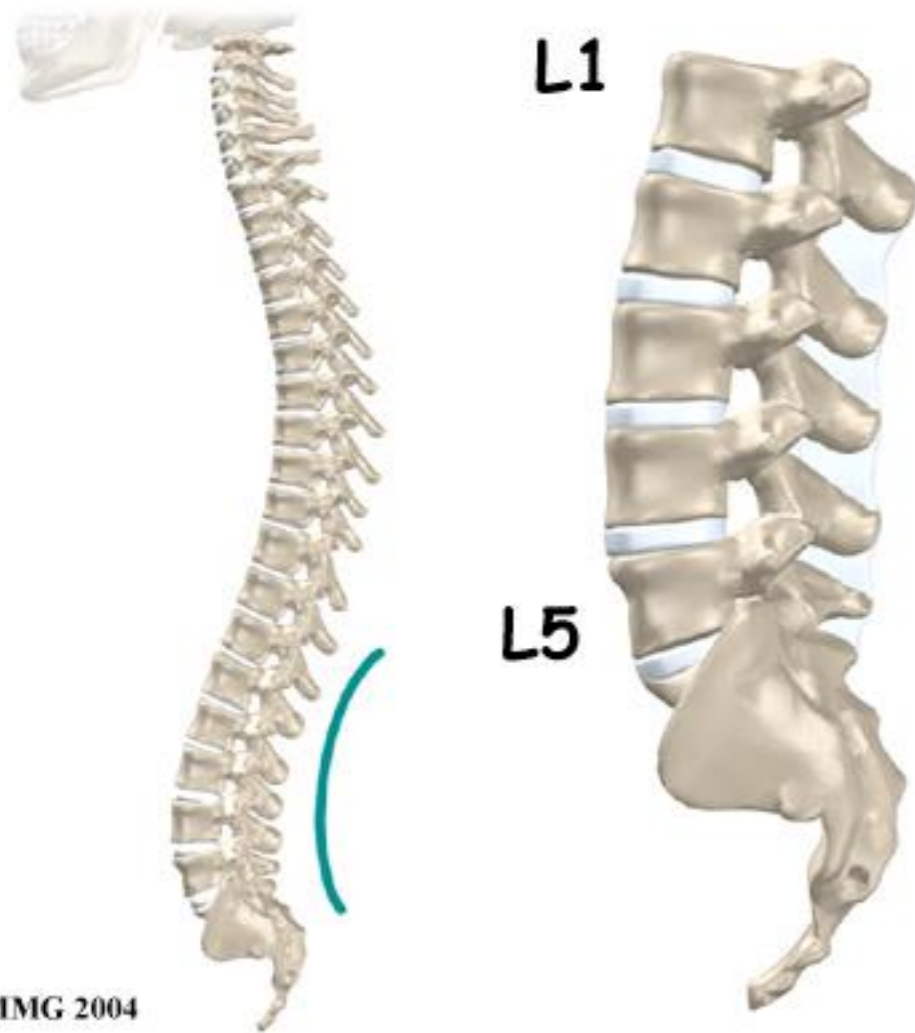
Thoracic Facet Joints

- ▶ The facet orientation of the thoracic spine allows for more freedom in rotation
- ▶ The facet joints face almost parallel to the back allowing for rotation, lateral flexion, some flexion and limited extension.
- ▶ Though extension is limited, the orientation of the facet joints and the downward spinous processes allow the thoracic spine to lengthen/straighten. As it does so the spinous processes lie on top of one another, much like roof tiles



Facet Joint nearly parallel allowing for extension and more rotation.

Lumbar Spine



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- ▶ Responsible for taking on cumulative weight of the body and transferring weight down on the sacrum to be dealt with via the pelvis
- ▶ The lumbar facet joints align at almost 90 degrees limiting the rotational capacity and encouraging stability and support
- ▶ Orientation of facet joints also prevent forward sheering of vertebrae.
- ▶ Postural defaults to curve is toward extension / lordosis

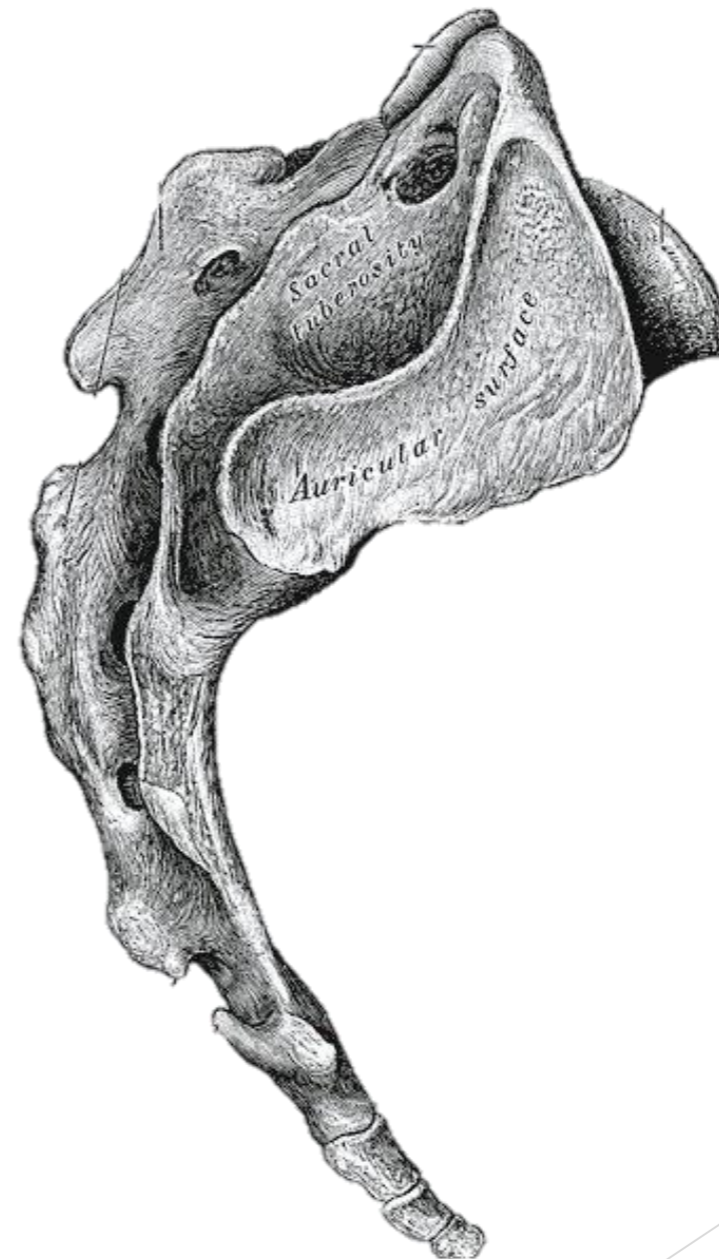
Sacrum and Coccyx

▶ Sacrum

- ▶ Sacrum = 5 fused vertebra (S1-S5)
- ▶ Designed to support the spine and to transfer forces from spine through pelvis to legs and from the legs through the pelvis to the spine

▶ Coccyx

- ▶ 3 to 4 fused vertebra
- ▶ Attachment point for the pelvic floor muscles



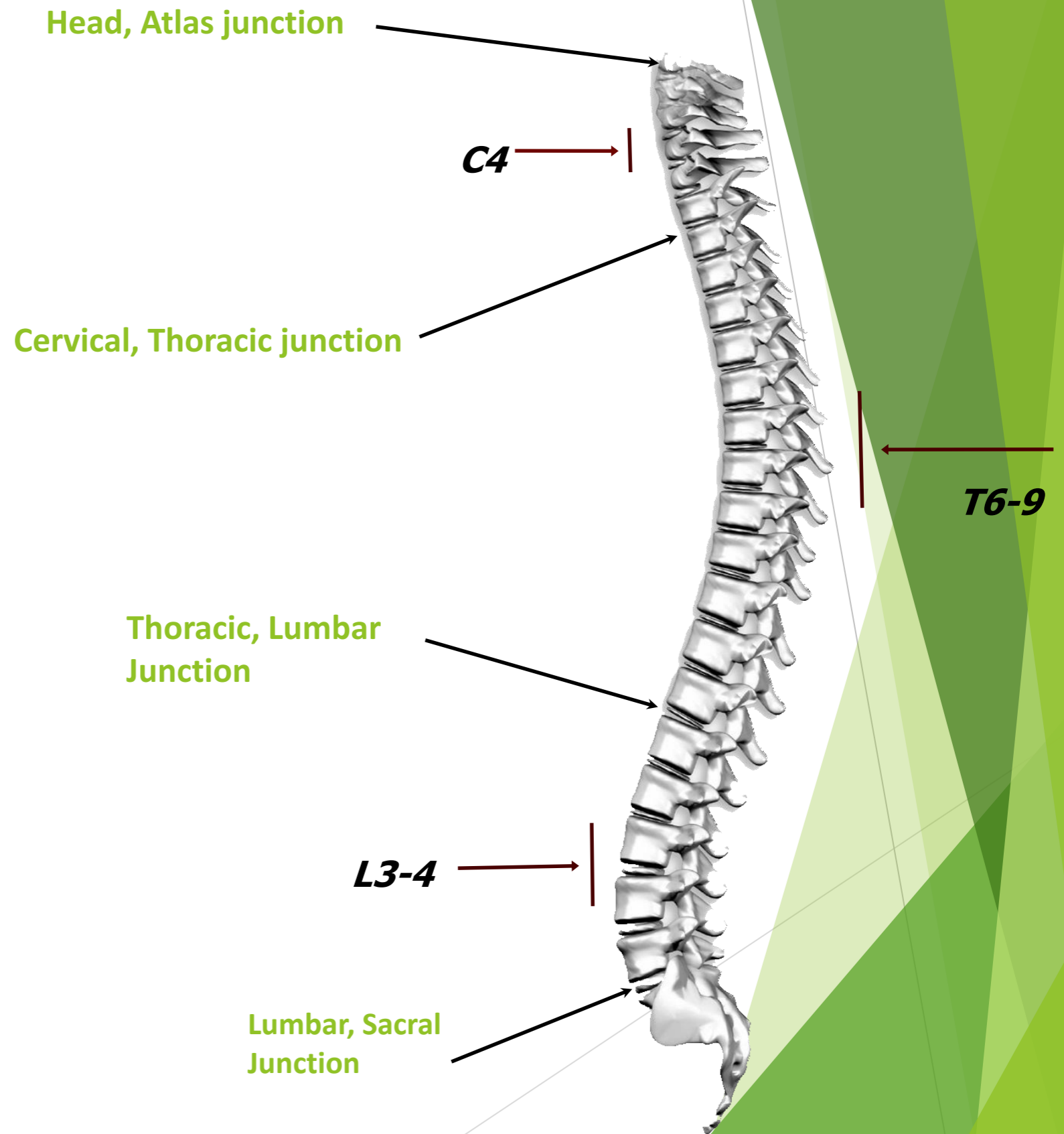
Spinal Curves, Dynamic Equilibrium and the Symmetrical Bow

Spinal junctions

- sites where weight transference occurs
- these junctions are where muscles cross and have oppositional lines of pull
- Vulnerable to forces of gravity.

Symmetrical Bow = the flexible spine

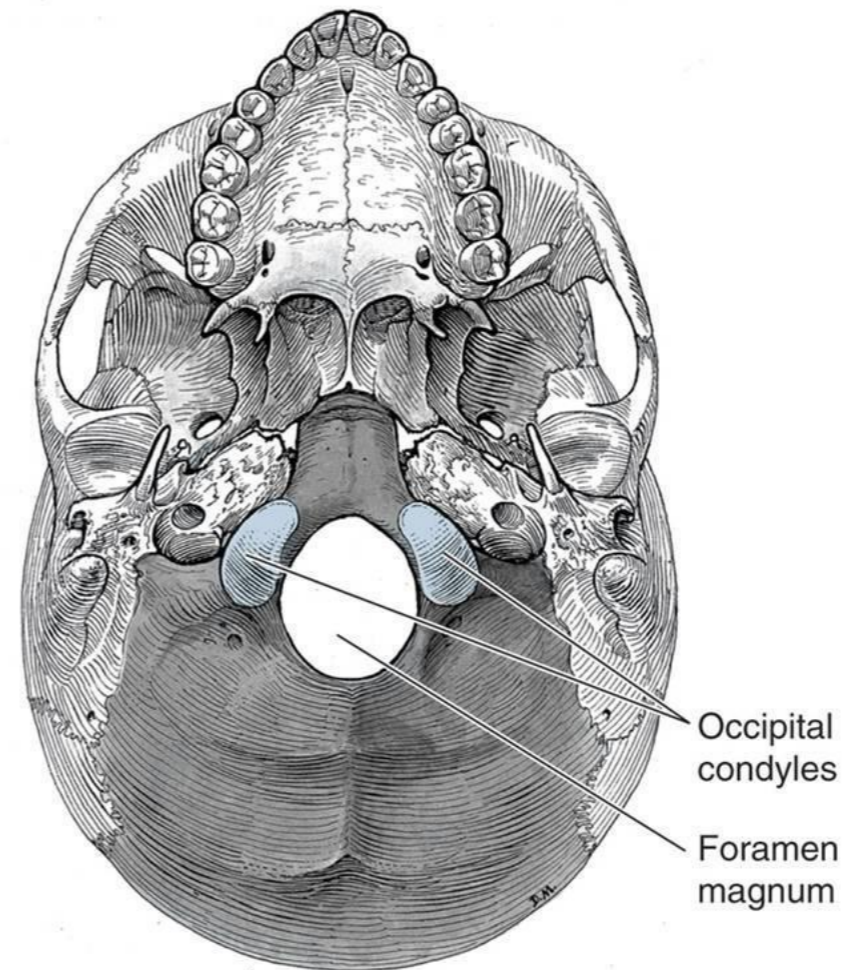
- The segments between the junctions, which, if supported, will bolster the curves of the spine and if not supported will yield to the burden of gravity.



Practical Cervical Movements

- ❑ Occiput sits on C1 (Atlas), allows for nodding as a cradle rocking
- ❑ Articulation between C1 and C2 = rotation
 - ❑ Head Rocking
 - ❑ No, No, No
 - ❑ 180 degrees (rotation)
- ❑ C3-C7 cervical spine mobilization with w/ C4 being apex of cervical curve
 - ❑ Ear to shoulder
 - ❑ Ear to sternum

Exercises can be done seated, against a wall, lying on wedge, flat or roller



Cranial base, external surface (inferior view)

Observe movement quality. If there are restrictions, where are they coming from?

Practical - Thoracic Mobility

- ▶ Childs Pose - extension (floor, arc, reformer)
- ▶ Childs Pose - rotation (floor, arc, reformer)
- ▶ Ball or Roller - extension through to flexion
- ▶ Thoracic mobilization - Lateral (arc, ball)
- ▶ Telescope arms, Pinwheel and Mermaid



Practical - Lumbopelvic stability

- ▶ Knee Folds – “finding the crease” feeling the weight of the femur down and back in the hip
 - ▶ Sagittal
 - ▶ Coronal
- ▶ Toe Taps – find the inner support
- ▶ Marching – anchoring/imprinting for stability
- ▶ Knee Sways – feel the diagonals
- ▶ Neutral Bridge



The Symmetrical Bow - Cat

Neutral Support

- ✓ First – drop into spinal defaults and observe the curves
- ✓ Next – draw the abdominals in to support lumbar spine, pelvis moves to neutral, lengthening the tail
- ✓ Finally, bring the brain back, lengthen the back of the neck
- ✓ Spine is neutral



Symmetrical Bow

- ✓ From neutral, continue to draw abdominals in and up sending tail away from head.
- ✓ Thoracic rounds, but remains long
- ✓ Head and eyes follow.

The Moving Bow: Spinal Integration

Flexion: Supine



Bridge, articulating
"Length and Width"

The Moving Bow: Spinal Integration

Flexion seated, Lateral seated
and Extension prone

- ▶ Spine Stretch forward
- ▶ Seated Side Stretch/Mermaid – follow the dials
- ▶ Rockets



The Moving Bow: Spinal Integration Reformer and Trap

▶ Reformer Short Box

- ▶ Full Bow – Round back to seated extension
- ▶ Lateral side bend – Spear a fish

▶ Reformer Knee Stretches and Elephant

- ▶ Round Back
- ▶ Neutral
- ▶ Extension

▶ Reformer

- ▶ Overhead Press
- ▶ Swan
- ▶ Pulling Straps
- ▶ Mermaid
- ▶ Hawk

▶ Trap

- ▶ Seated push through flexion to seated extension
- ▶ Mermaid
- ▶ Hawk

Most Common Spinal Anomalies

▶ Degeneration and Disc Issues

- ▶ Arthritis, bulging or herniated discs
- ▶ Rules of Thumb
 - ▶ Flexion increases disc pressure
 - ▶ Neutral and extension decreases disk pressure

▶ Spondylolisthesis

- ▶ One vertebra slides forward of the vertebra below
- ▶ Rules of Thumb
 - ▶ Neutral and lumbopelvic stabilization key to finding internal abdominal support
 - ▶ Bracing and training of inner unit
 - ▶ Imprinting often helpful or working with posterior pelvic tilt
 - ▶ Avoid extension
 - ▶ Avoid unsupported chain loading of the front of the spine when supine in hip flexion (i.e. hundreds, doubles leg lowers)

Most Common Spinal Anomalies

▶ Spondylolysis

- ▶ Vertebrae fractures, may degenerate with advancing age and become unstable. The change in the bone is not only unstable, but may impinge upon the spinal nerves that run through the spinal canal

- ▶ Rules of Thumb – same as Spondylolisthesis

▶ Stenosis

- ▶ Narrowing of the spinal canal
- ▶ May cause neurological deficit
- ▶ Symptoms include pain, numbness, paraesthesia and loss of motor control

- ▶ Rules of Thumb – same as Spondylolisthesis

Up the Front and Down the Back

Tensegrity in posture

In upright posture, if you can imagine the symmetry of the spinal curves and in keeping with the idea of our bow, to bolster the curves, think of the musculature lifting up from the ground

- ✓ Front of shins, thighs, abdominals
- ✓ Lift the ribcage off the pelvis and lengthen through the crown, feeling the muscles of the neck support the cervical spine
- ✓ Grounding forces of our bones reaching down the back
 - ✓ Scapulae, spine, sacrum and heels



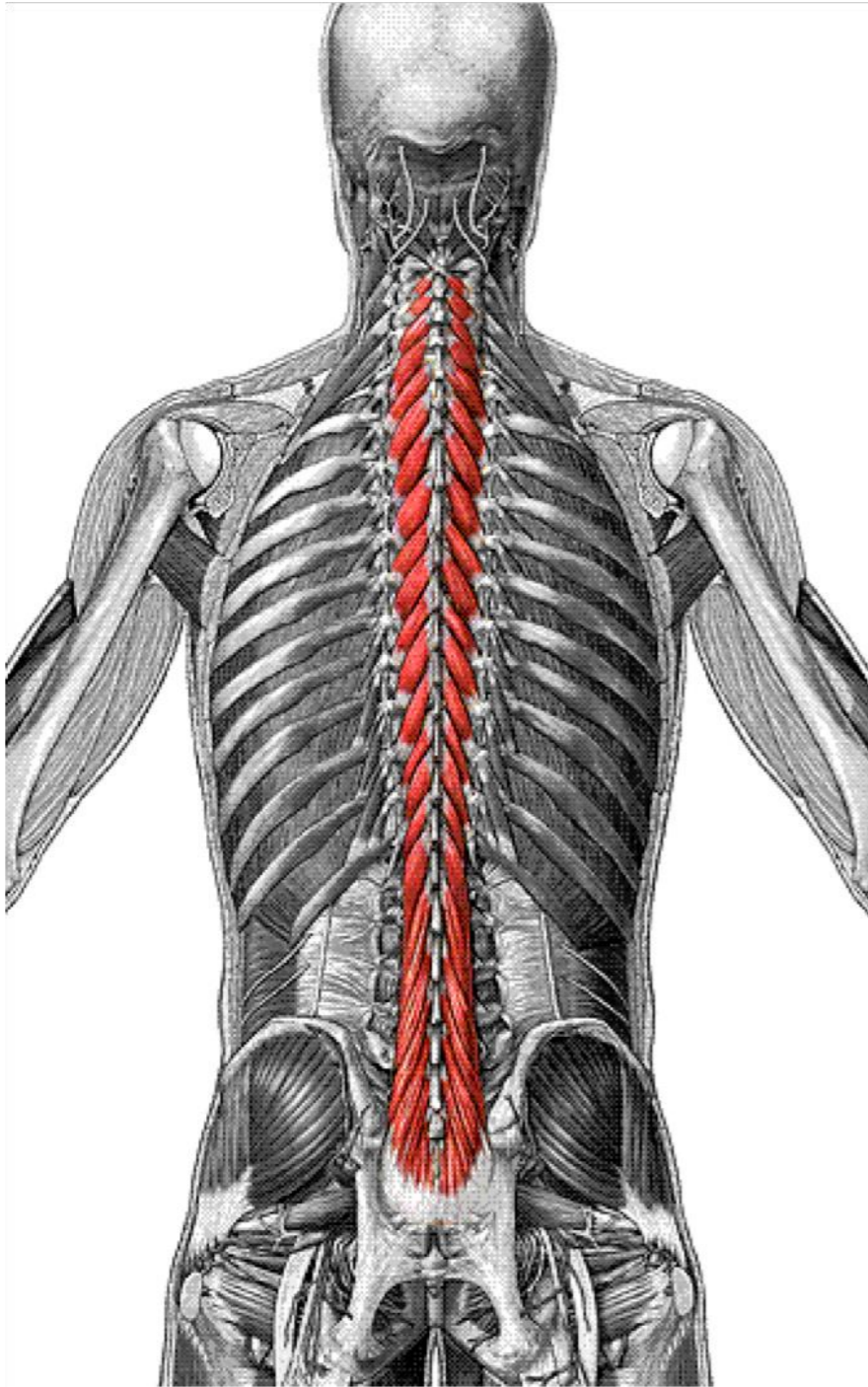
Longitudinal Back Support

The muscles of the back which support upright posture include:

- ▶ Multifidi
- ▶ Quadratus Lumborum
- ▶ Erector Spinae

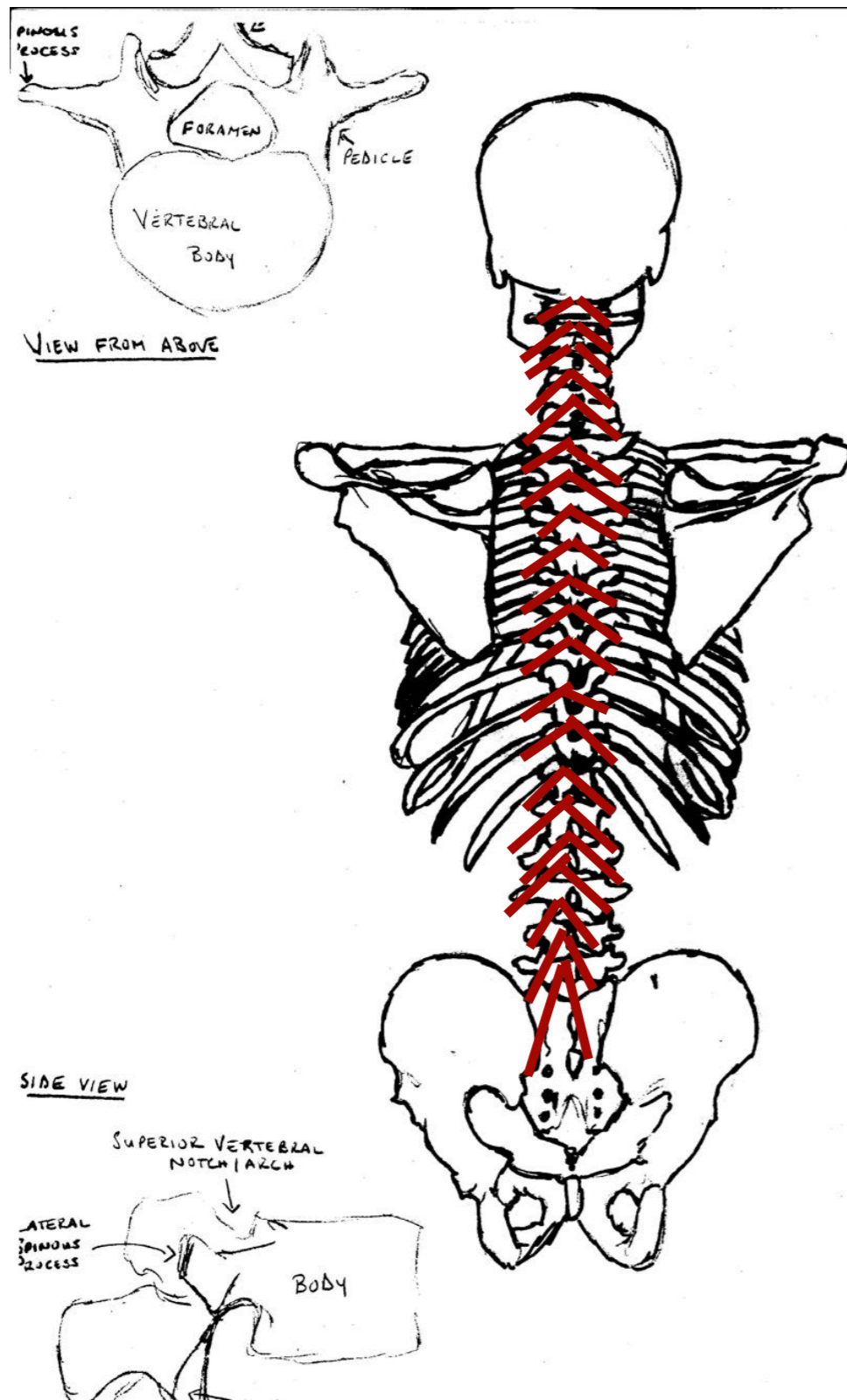


Longitudinal back Support: Multifidi



- ▶ Works to stabilize the joints at the level of the individual vertebra
- ▶ Intervertebral support
- ▶ Functions as a structural muscle supporting each bony segment creating stiffness (in a protective way) and stability
- ▶ Runs from Axis to Sacrum
- ▶ Fleshy and tendinous
- ▶ Fills up the groove on either side of spinous processes
- ▶ Works to stabilize joints at each segmental level
- ▶ The stiffness and stability makes each vertebrae work more effectively and reduces the degeneration of the joint structure

Multifidus



Multifidi run from C2-
Sacrum

Span from spinous
process down
3, 4, 5 and sometimes 6
segments

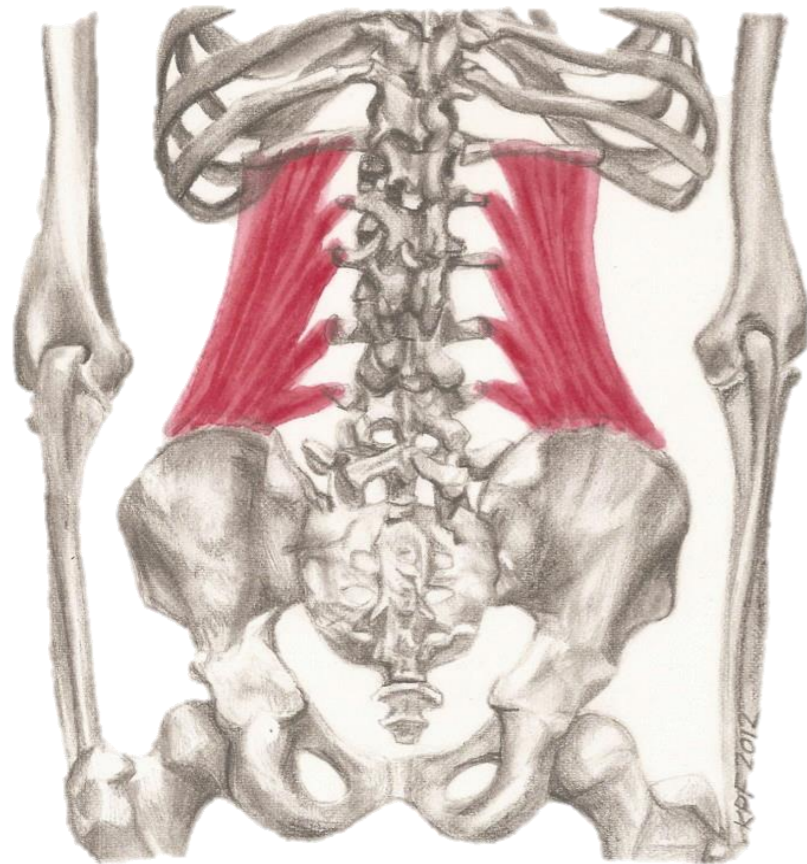
Creates chevron
patterning
which acts much the
same
way the cabling on a
bridge
giving stabilization to each
spinal segment

Multifidi

- ❑ Standing upright or one leg forward in front lunge
- ❑ Kneeling – All Fours
- ❑ Prone – Swan, Swimming



Longitudinal back Support: Quadratus Lumborum

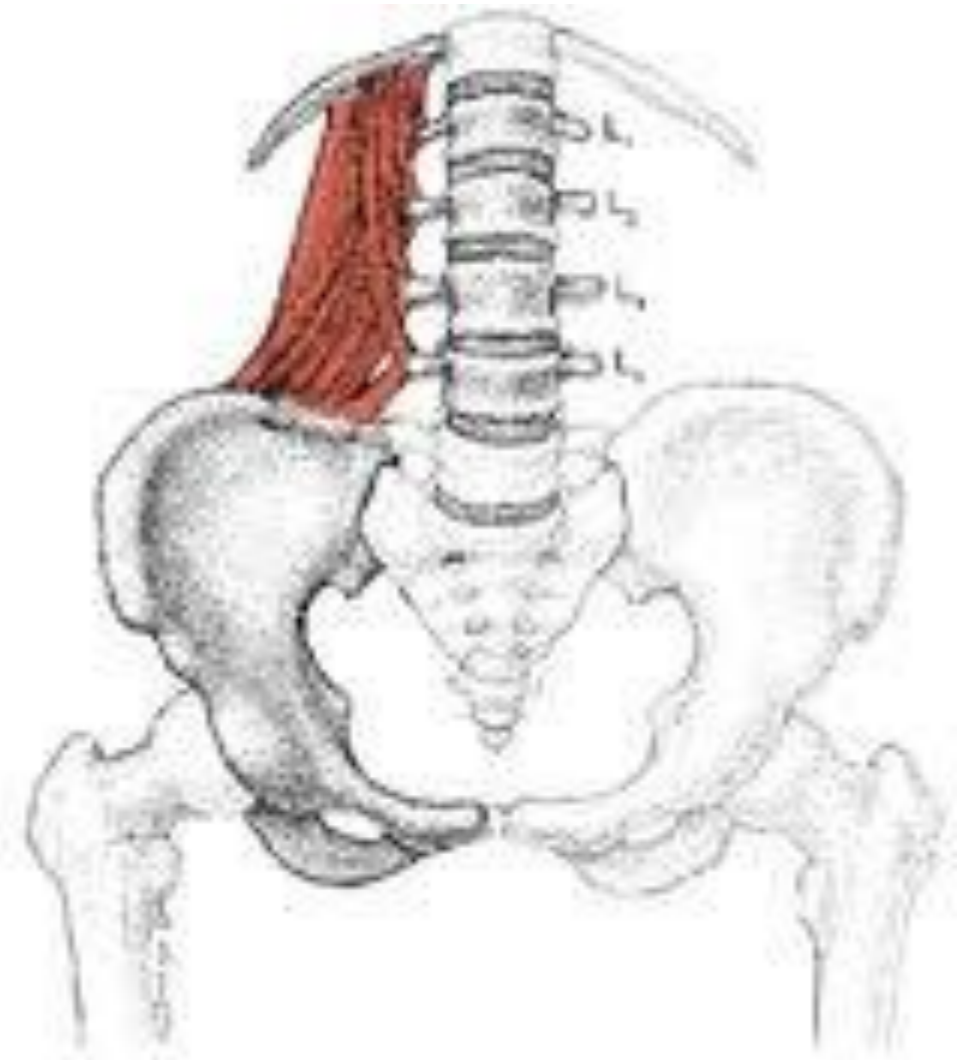


Performs (4) actions:

1. Lateral Flexion of vertebral column
2. Extension of lumbar w/ bilateral contraction
3. Fixes 12th rib during forced expiration
4. Elevates ilium, with ipsilateral contraction

*Anterior to the QL lies the colon,
the kidneys and the Psoas, important to
keep in mind, no?*

Quadratus Lumborum continued



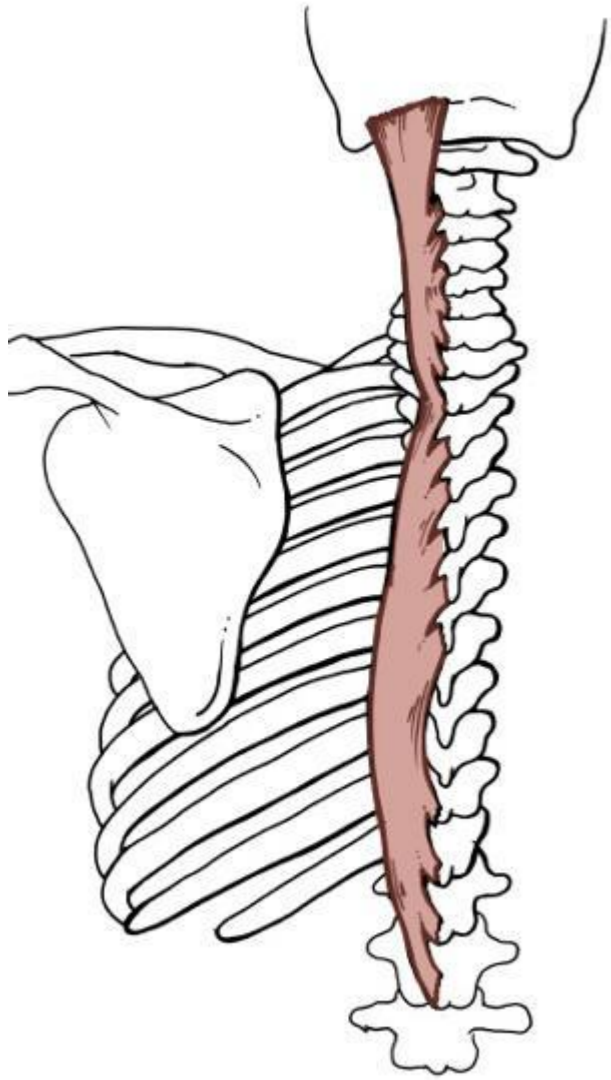
QL forms prominent part of the lower back and abdominal wall.

Connects pelvis to the spine.

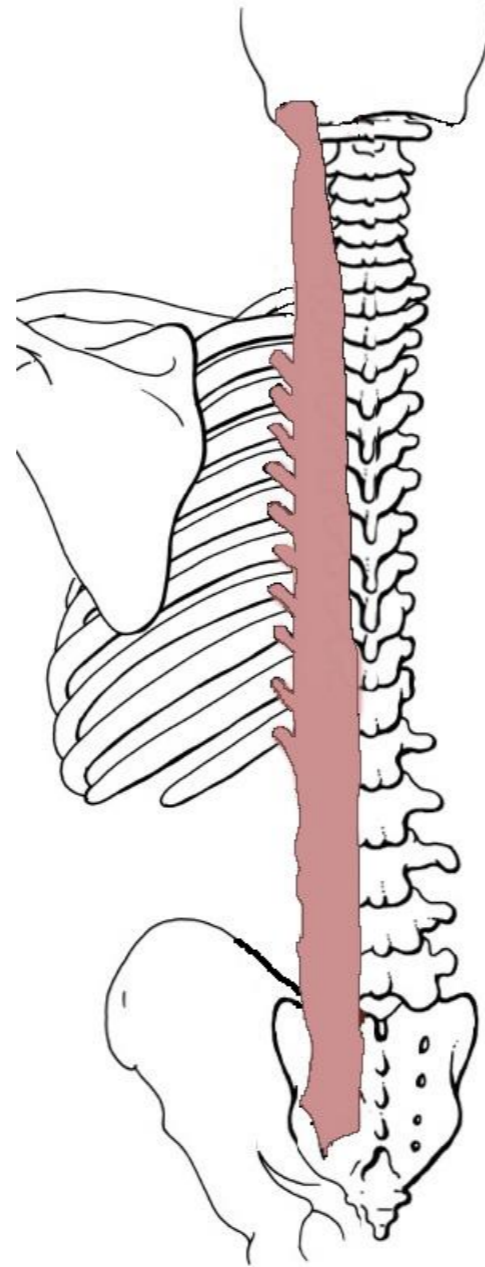
Irregular quadrangle shape arises from lowest rib to transverse processes of L1-L4

Common source of low back pain as they pick up slack when lower fibers of erector spinae are weak

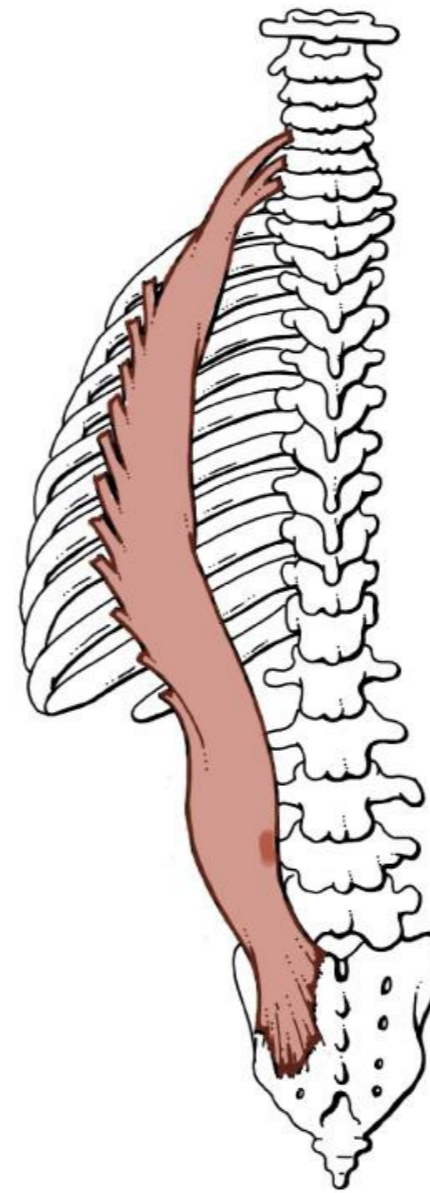
Longitudinal Support: Erector Spinae



Spinalis

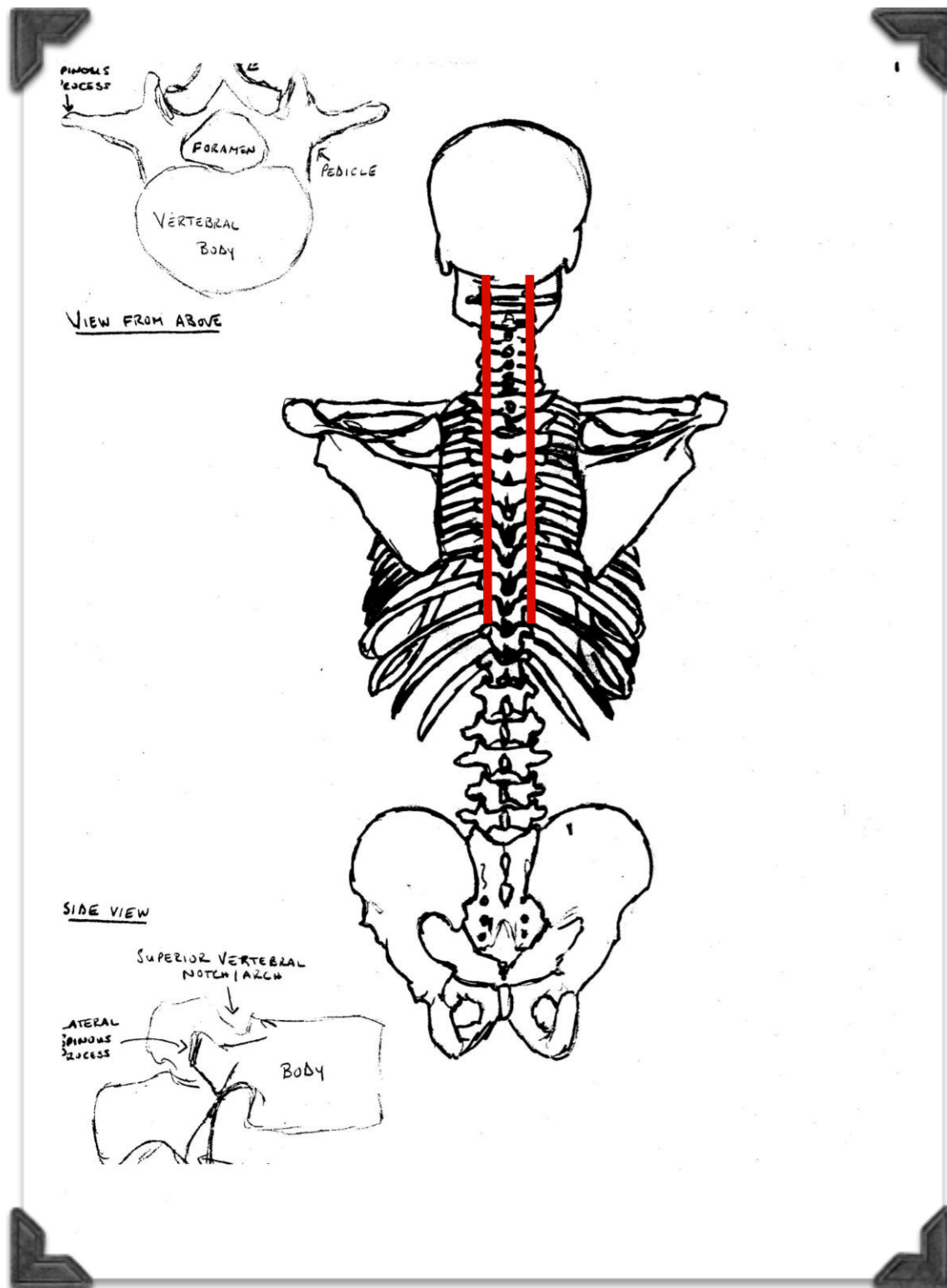


Longissimus



Iliocostalis

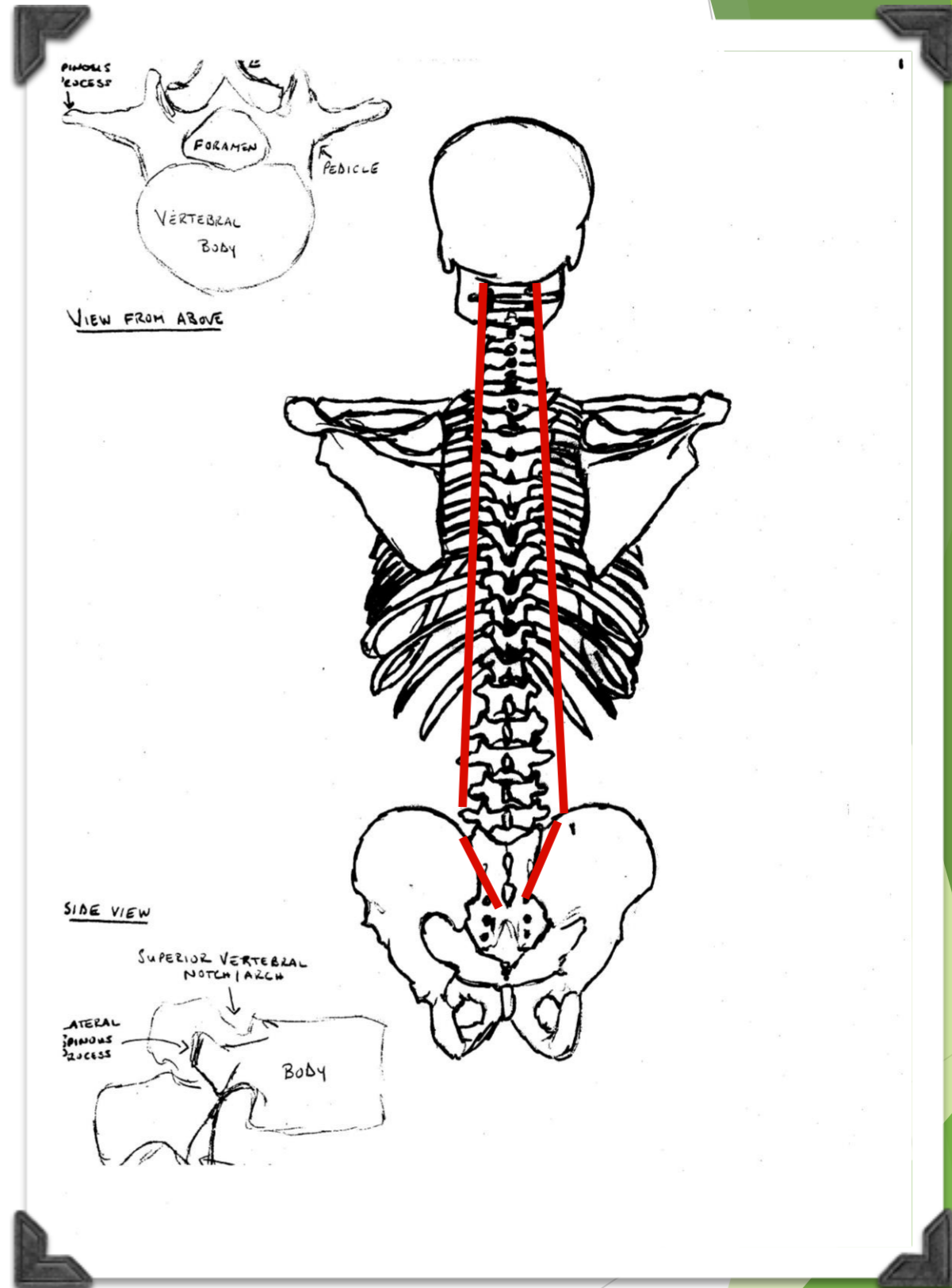
Spinalis



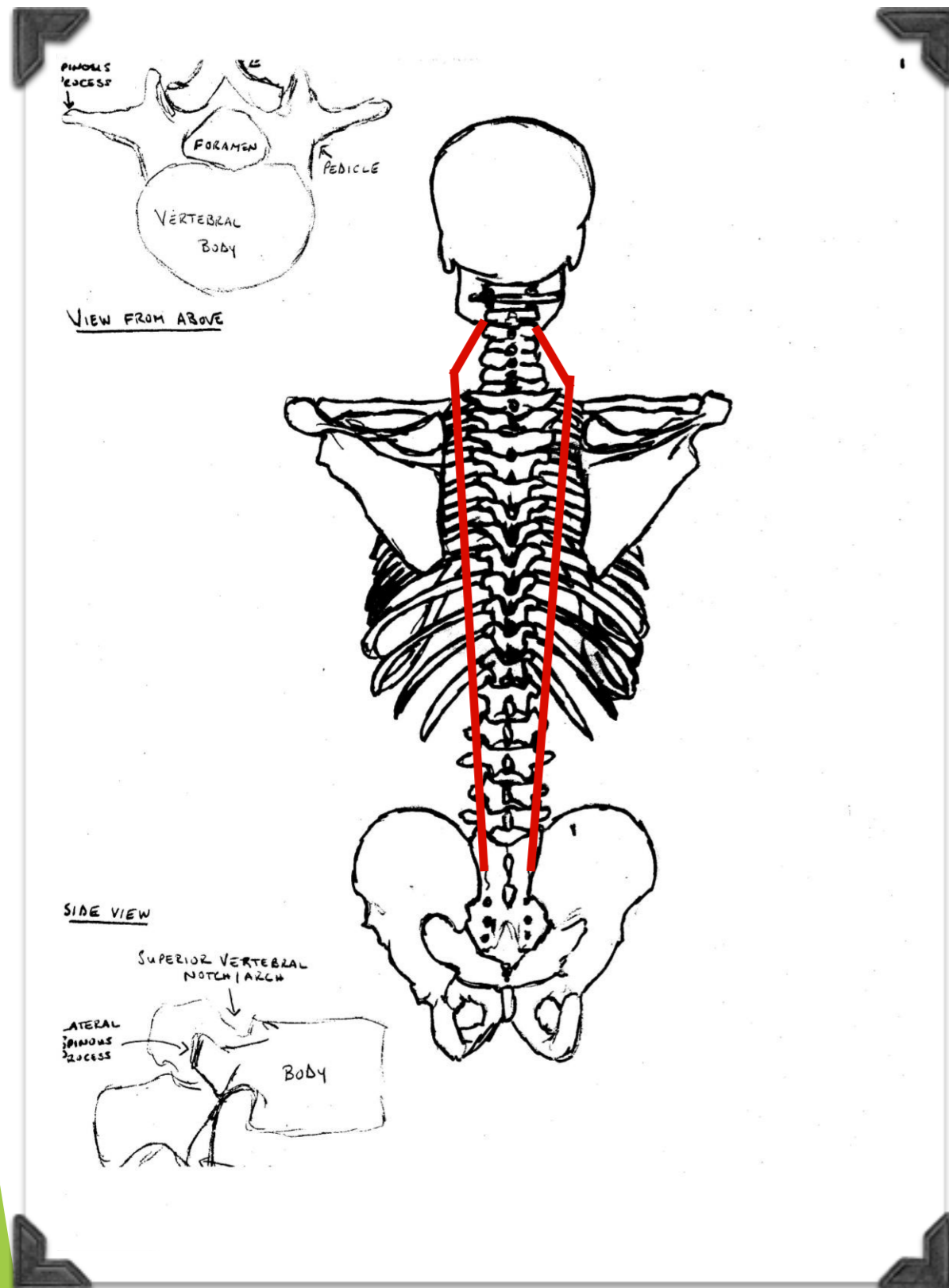
- One of the erector groups
- Bundle of muscles and tendons located nearest to the spine
- Runs spinous process to spinous process. Occipital bone to T10
- Divided into (3) parts
 - Thoracics - L3-T10; T8-T2
 - Cervicis - T2-C6; C4-C2
 - Capitis - from cervical and upper thoracic to external occipital protuberance

Longissimus

- Also divided into (3) segments
 - Thoracics - originates from the sacrum transverse processes where it blends with iliocostalis lumborum
 - Cervicis - Transverse processes of T6-T1 and inserts on transverse processes of C7-C2
 - Capitis - originates from the transverse processes of T3-T1, runs through C7-C3 to mastoid process, beneath SCM



Iliocostalis

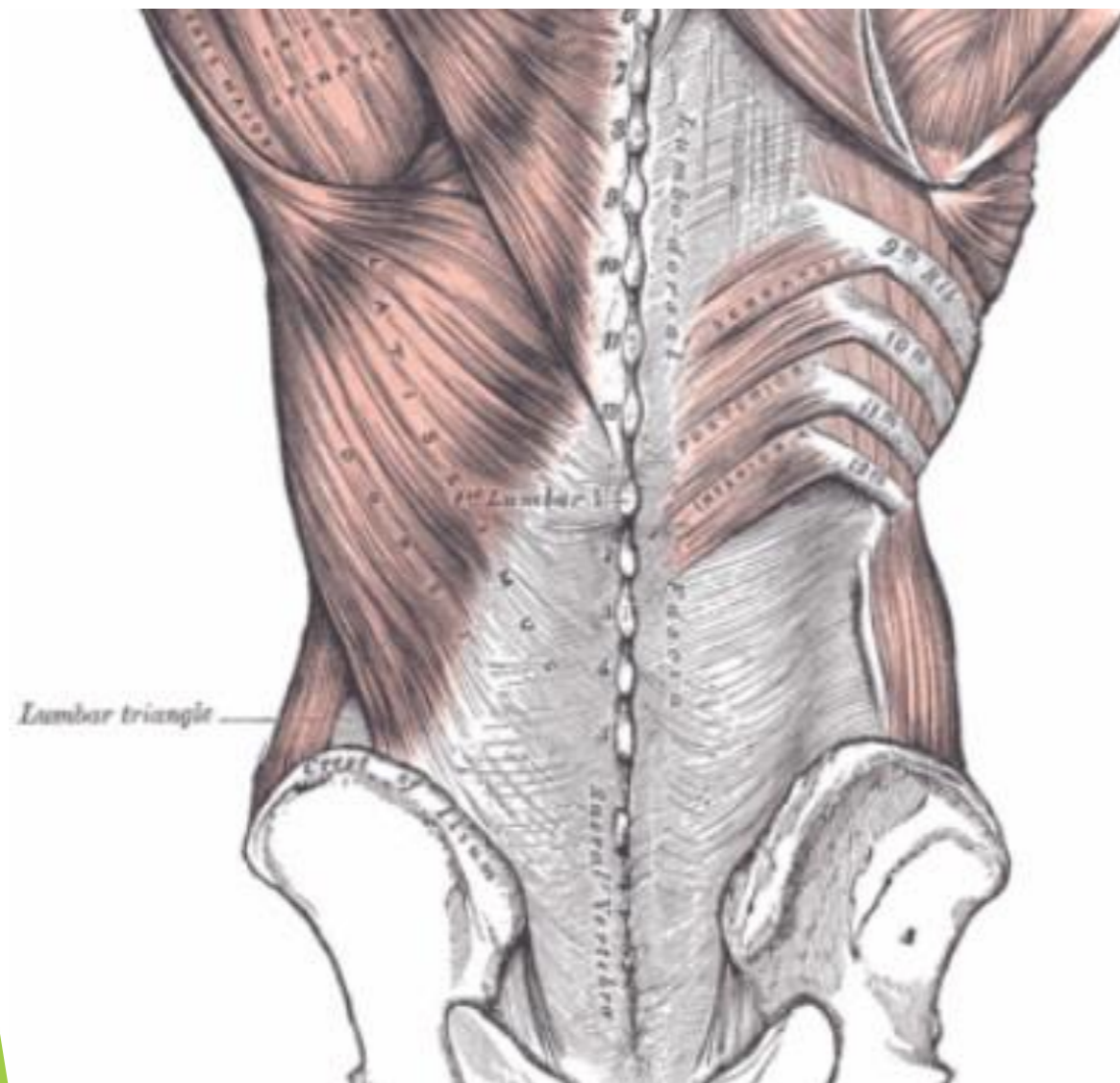


- The three sections of the iliocostalis lumborum include:
 - Lumborum - sacrum to last (6) ribs
 - Thoracic - Last (6) ribs to (1st) 6 ribs
 - Cervicis - 1st (6) ribs to transverse processes of C6-C4

Erector Spinae Imagery

Like rings of a tree, erectors spinae start central to the spine and work their way out to the body, reaching up to cervical, out to the ribs, and down to the pelvis

Thoracolumbar Fascia

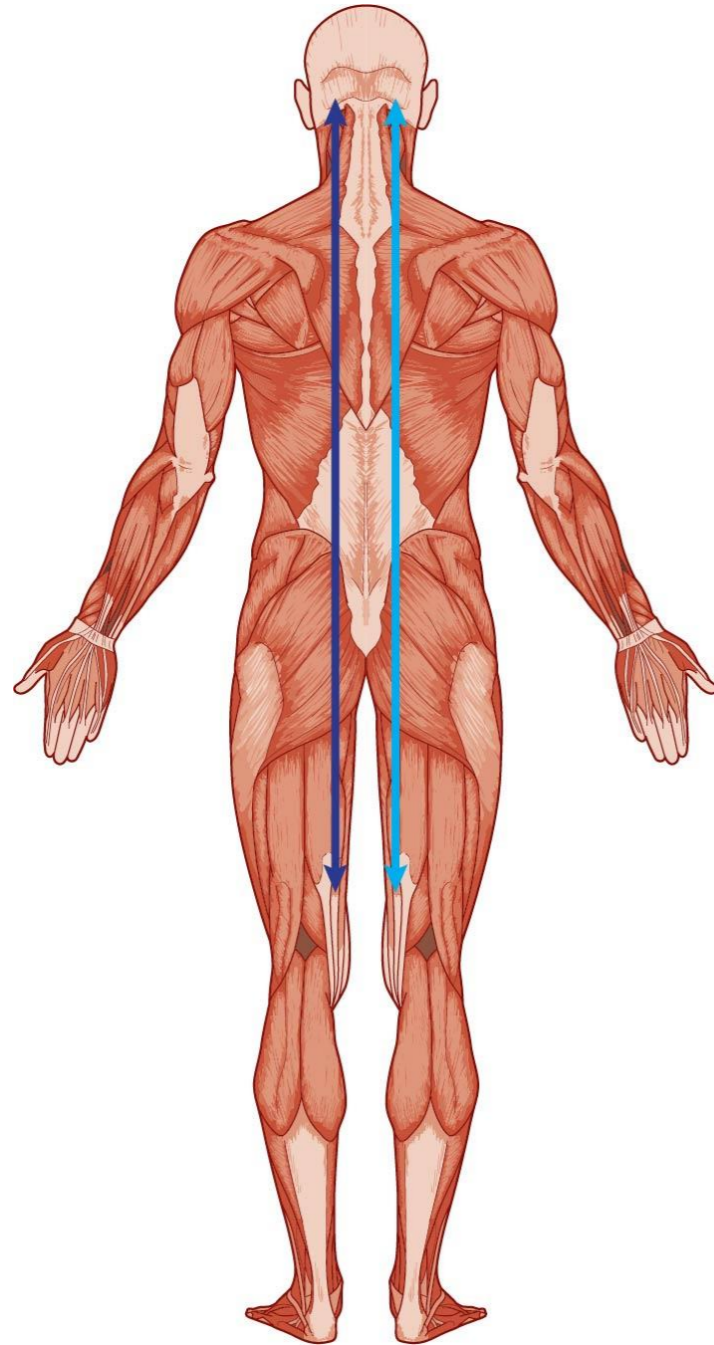


- Deep connective tissue membrane which covers the deep muscles of the back. Three layers which form 2 spaces where muscles are enclosed
 - Quadratus lumborum lies between the anterior and middle layers
 - Erector Spinae lies between middle and posterior layers

Fascia

- ▶ Uninterrupted, three-dimensional web of tissue that extends from head to toe, from front to back and from interior to exterior. (Thomas Meyers)
- ▶ Muscle = elasticity and recoils back to resting length
- ▶ Fascia = plasticity, more like molding clay; if stretched too fast it can tear. Has postural implications as fascia can fix around strained muscle
- ▶ If stretched slowly, fascia will remold over time
- ▶ Fascial tissue should glide and slide with mobility of musculature

Deep Longitudinal System



Muscular Chain Includes

- Erector spinae
- Quadratus lumborum
- Thoracolumbar fascia
- Sacrotuberous ligament
- Biceps femoris

Anatomy Trains system includes

- Gastrocnemius
- Plantar Fascia and Toe Flexors

Function

- Supports upright posture
- Creates spinal extension

Practical – The Mobile Bow

Wringing out the spine

▶ Reformer Short Box

- ▶ Full mobile bow - Round back to seated extension

▶ Reformer

- ▶ Childs pose
- ▶ Scapulae Glides
- ▶ Extension
- ▶ Flexion to Extension
- ▶ Thread the needle
 - ▶ Add circle saw

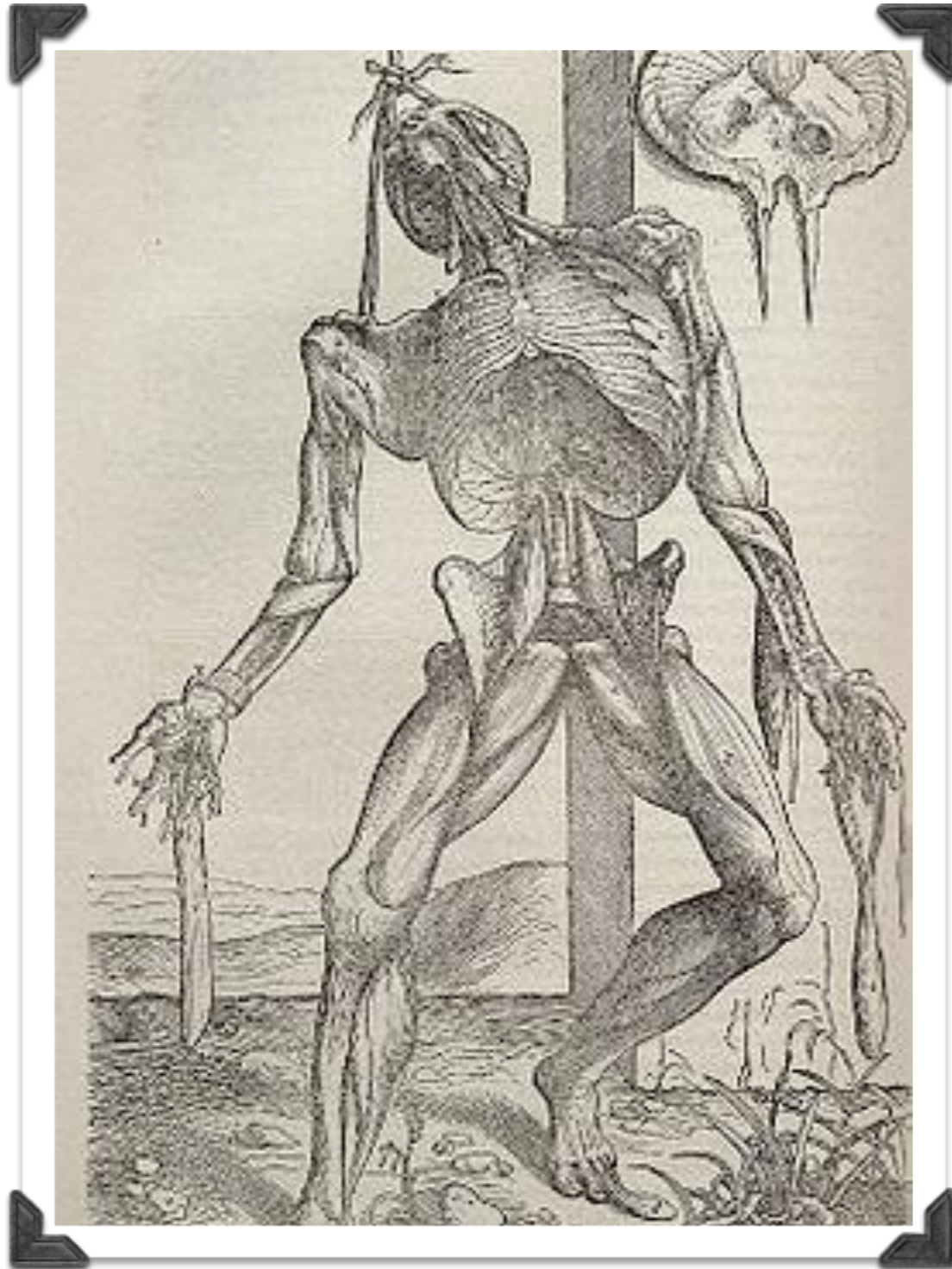
▶ Trap

- ▶ Seated push through
- ▶ Thread the needle
- ▶ Kneeling push through
 - ▶ Add circle saw
- ▶ Cat Add circle saw

▶ Roll Down

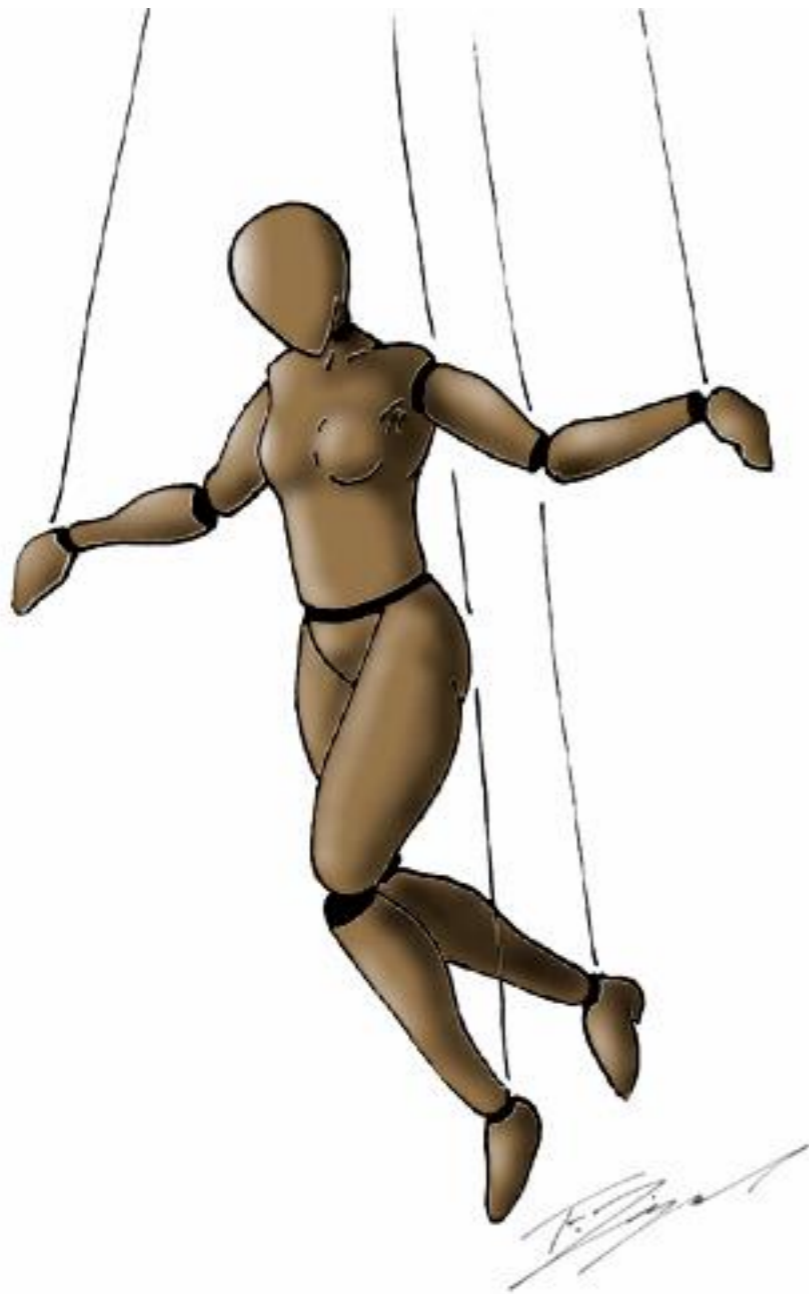
- ▶ Flexion
- ▶ Flexion to Extension
- ▶ Adding lateral and rotation
- ▶ Agitation

Longitudinal Front Support Suspensory Muscles



Andreas Vesalius

Spine the Puppeteer of Suspensory Muscles



Like a puppet on a string, the longitudinal front support provides sense of suspension and lift.

If, however, these strings have slack or are released, the suspensory quality is lost to gravity

The spine is the puppeteer

Pectineus

- ❑ Adductor of the thigh
- ❑ Plays a role in supporting health femur/pelvis coordination
- ❑ Pectineus and psoas center the upward force from the femur
- ❑ Other adductors of import, adductor brevis and magnus
- ❑ Action: Hip Flexion, adduction and medial rotation
- ❑ Pectineal line of the femur to superior pubic ramus



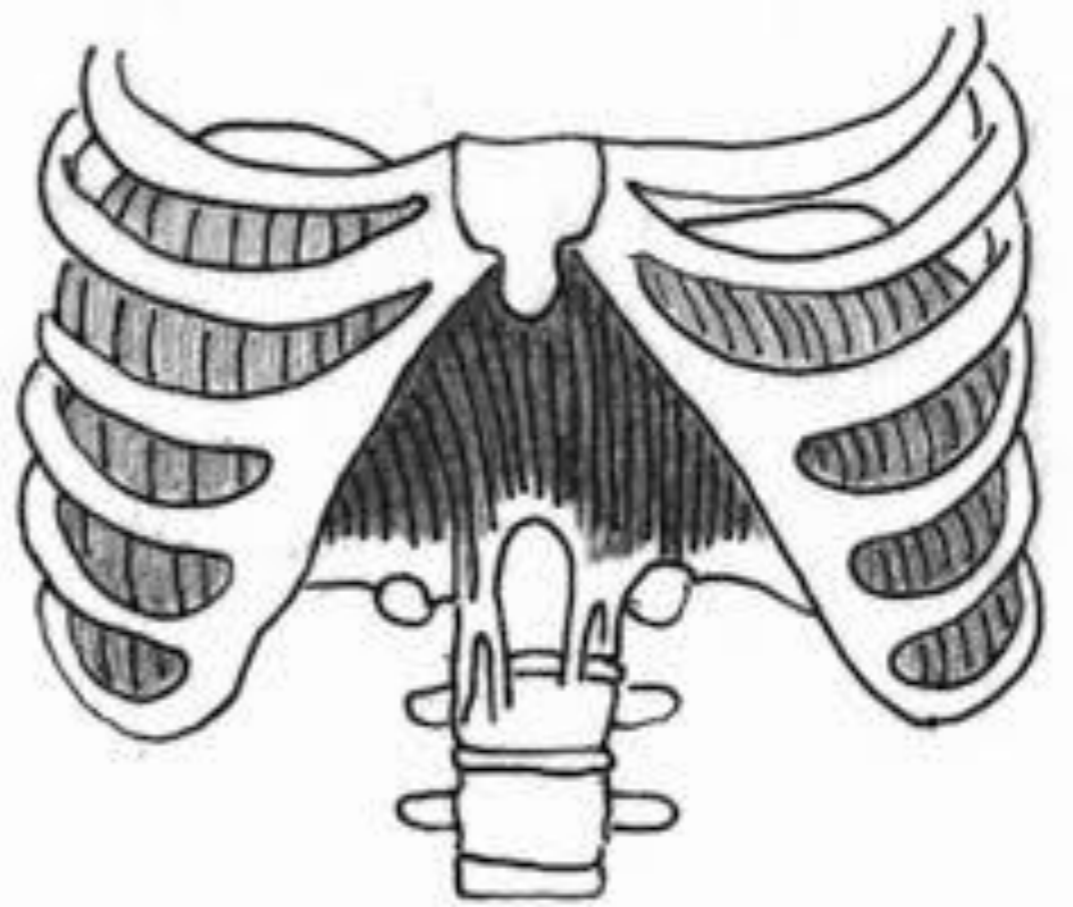
Psoas

- Long and lean, up to 16 inches long
- Runs from 12th thoracic, attaches to the transverse processes of the lumbar vertebrae to lesser trochanter of the femur
- Meets iliacus and joins via a common tendon and attach to femur



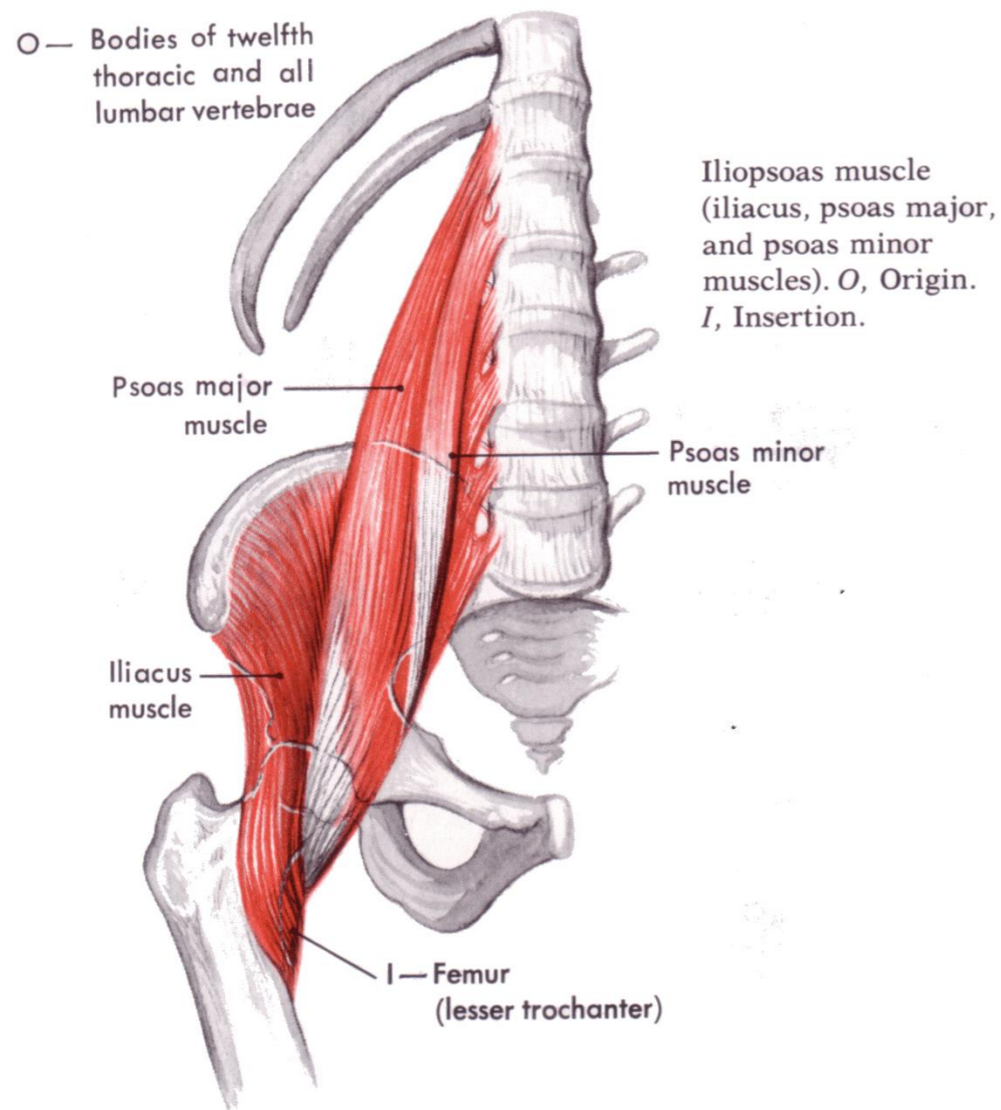
Psoas and Breath

- ❑ Top most fingers of the psoas interdigitate with crura of the diaphragm
- ❑ Can literally breath into our legs!
- ❑ Breath brings in oxygen and releases toxins...primary principle in Joe's work



The relationship between the TA, the thoracolumbar fascia and the diaphragm all have mutual interests where function, strength and pliability are concerned

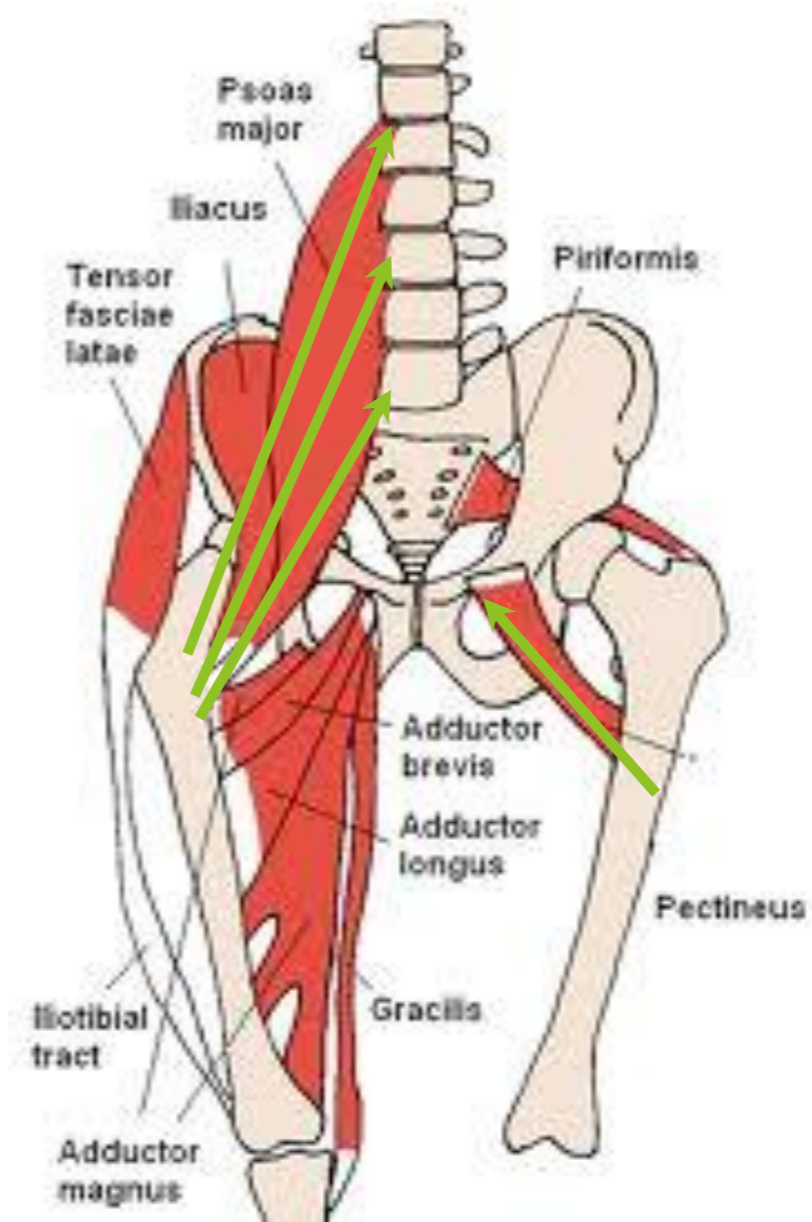
Other functions of the Psoas



- ❑ Psoas sits back and up into our spine as it rises toward T12
- ❑ Forms the “psoatic shelf” (Liz Koch, The Psoas Book)
- ❑ Shelf is support and source of circulation for viscera

Relevance

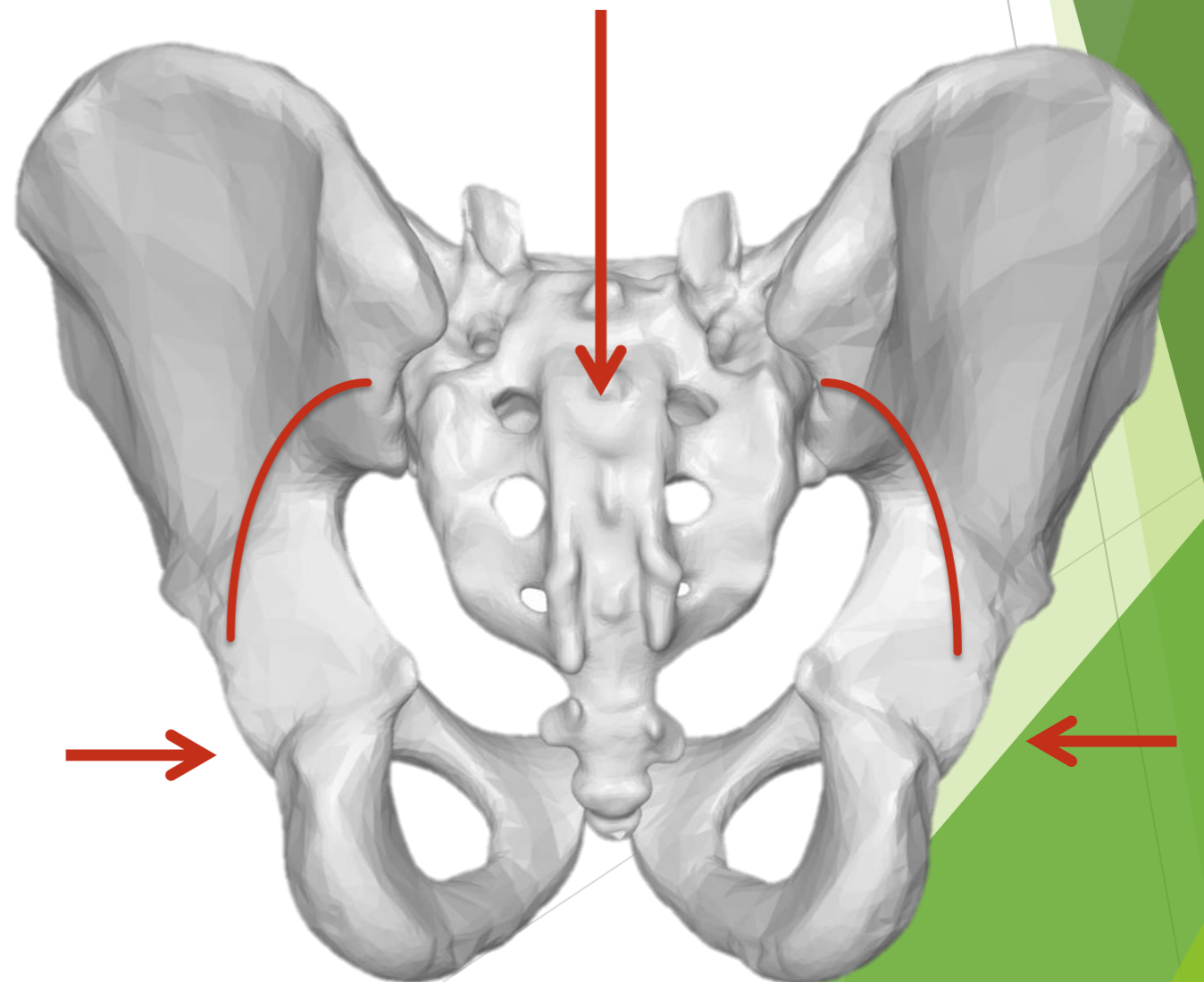
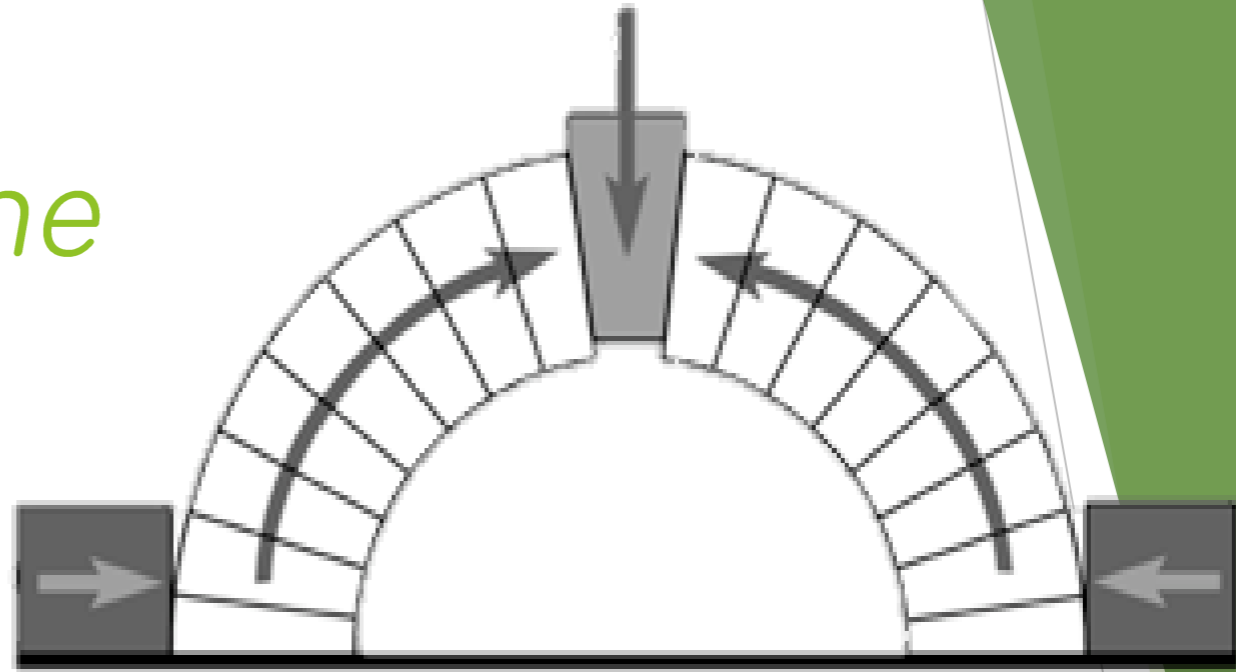
Pectineus and psoas centers upward force from the femur through the hip joint toward the keystone of the sacrum through the sacroiliac and lumbosacral joints



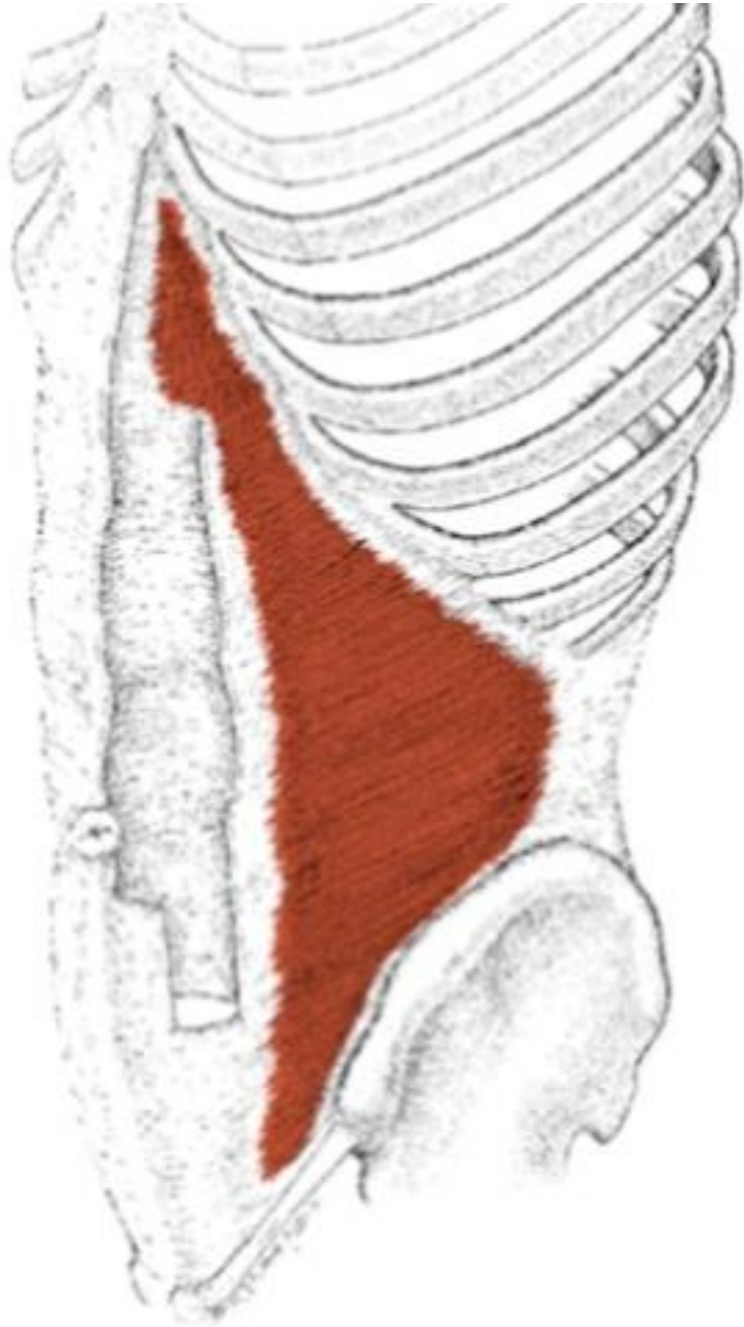
Sacrum as Keystone

Definitions:

- **Architectural definition:** A central stone at the summit of an arch, locking the whole together
- **General definition:** The central principle of part of a policy, system etc. on which all else depends



Transverse Abdominis

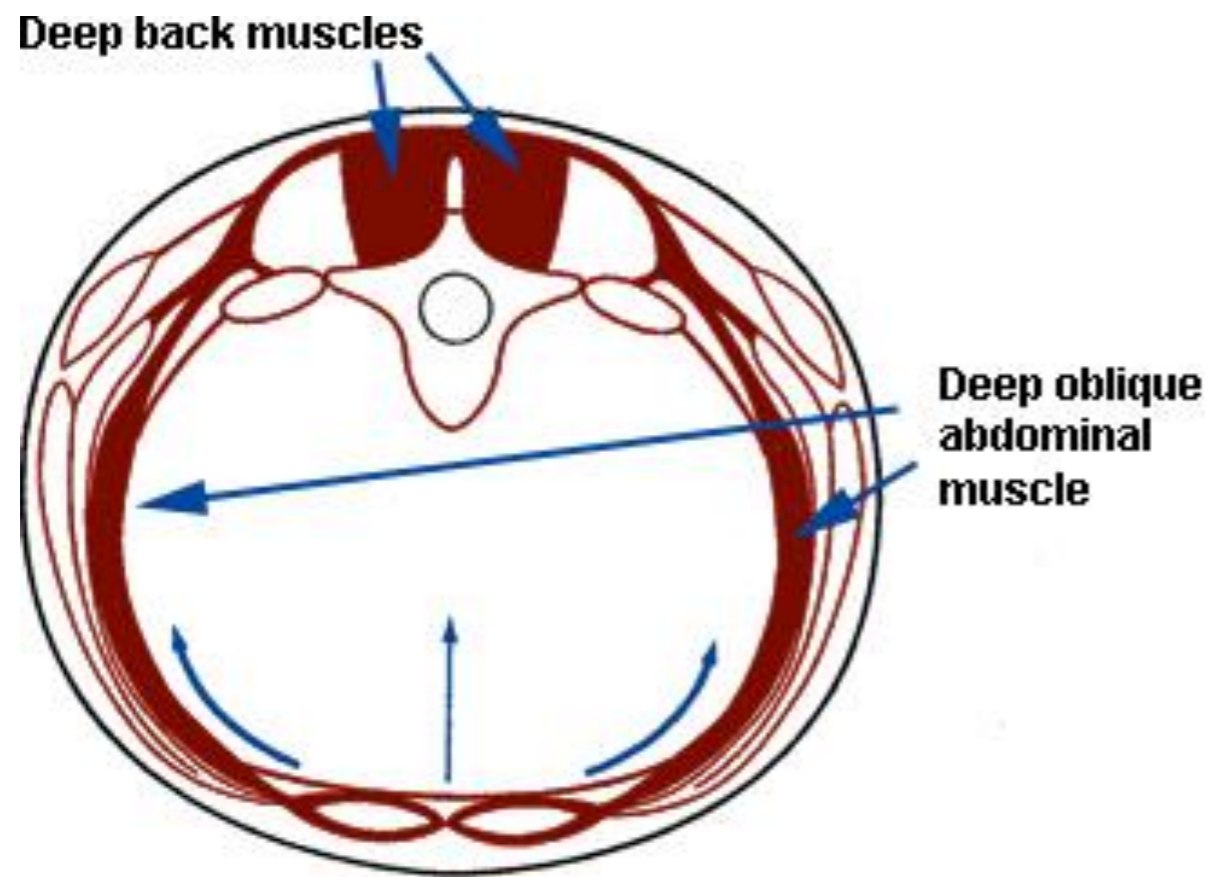


- ▶ TA creates the lateral and anterior abdominal wall
- ▶ Emanates from lumbar fascia and wraps, like a girdle, around the cylinder of the abdominal cavity
- ▶ TA fibers run horizontally and itself attached in the front via connective tissue. Muscle elasticity therefore along its sides
- ▶ Lower TA rides the iliac crest and the inguinal ligament while upper fibers attach to intercostals of ribs 7-12

The background features a detailed anatomical drawing of the human torso. On the left, the Transversus Abdominis muscle is shown in cross-section, with its fibers running horizontally. On the right, a dark-colored corset with multiple rows of laces is depicted, illustrating how it would compress the abdominal wall. The text is overlaid on the central part of the image, where the muscle and corset overlap.

Transversus
Abdominus Corset
creating hoop like
tension and support

Thoracolumbar, Fascia, Multifidus and Spinal Stability – Creating Hoop Tension



- ▶ Increase intra-abdominal pressure =
- ▶ TA contracting like a hoop = Pulling on Thoracolumbar fascia =
- ▶ Multifidi pressing into spine decompressing joints

Fascia and Force Transmission

- ▶ Fascia and muscle work together to support and transmit forces to the moving body
 - ▶ Plantar fascia, tension rod which supports body weight and springs us forward, gait is example of this
- ▶ Fascial cabling more than assists and supports but assists muscles in decreasing energy consumption and allowing muscles and fascia to interface. This interface allows for muscle power to rejuvenate while the cabling provides a spring board for exertion.
- ▶ Note: TCLF extends deep into the gluteals...keep this in mind.

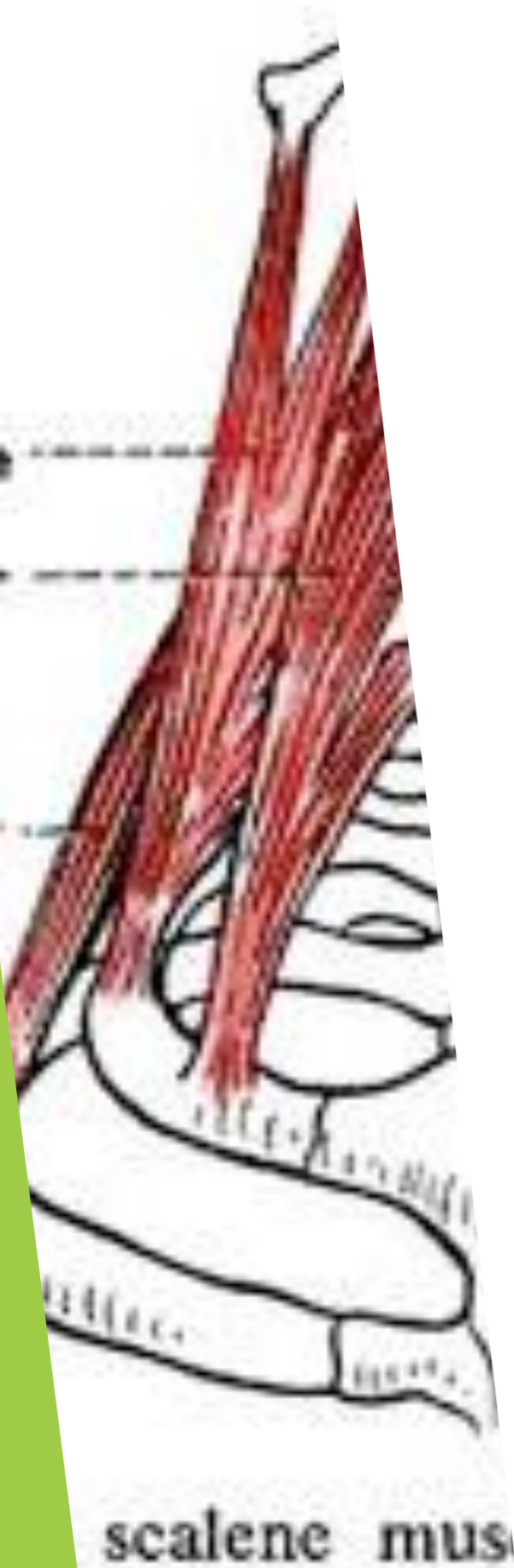
TA/Multifidi Sandwich

- ❑ Standing upright tilt body forward of plumb line
- ❑ Kneeling – All Fours
- ❑ Reformer
 - ❑ Reverse knee stretches
- ❑ Trap
 - ❑ Cat



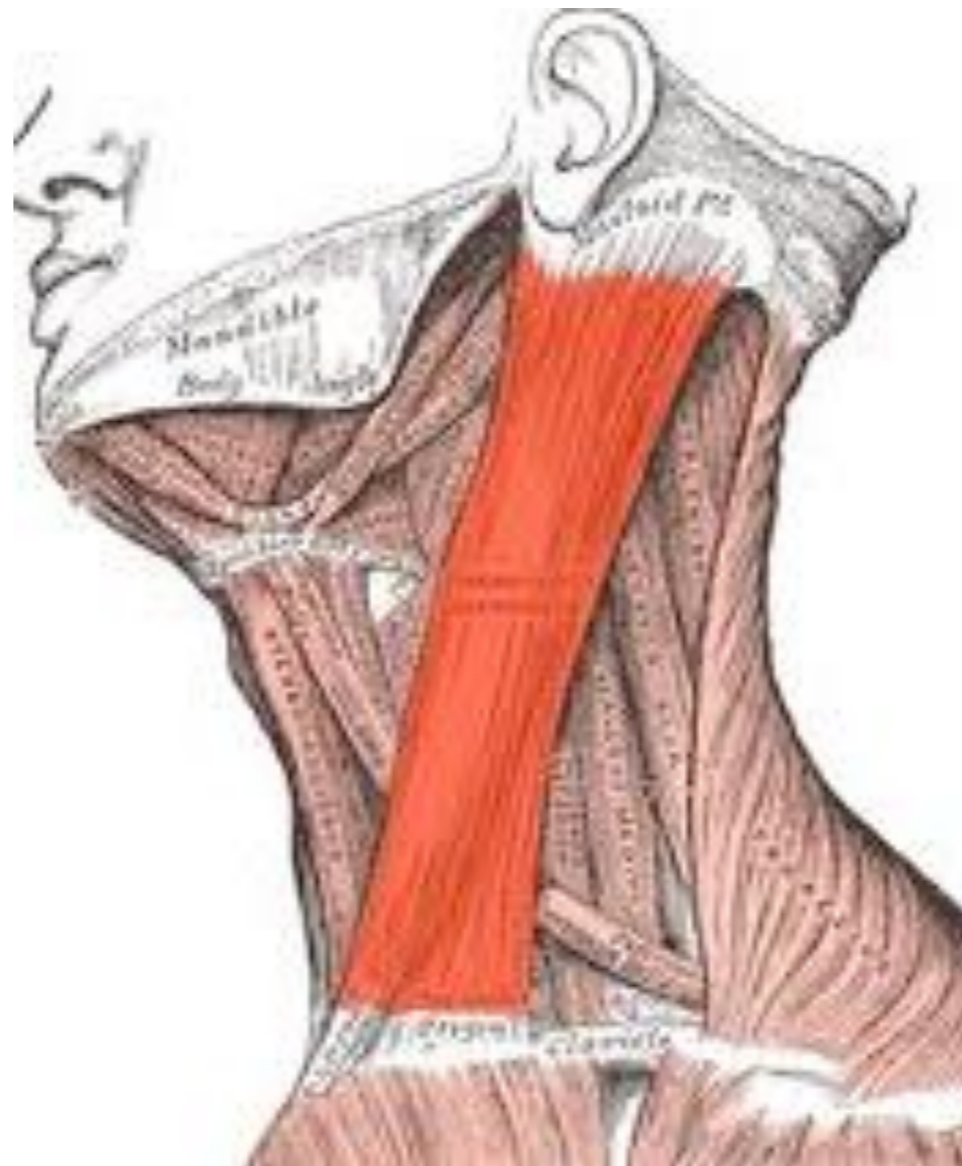
Cervical Longitudinal Support Hanging by a head

- ❑ What the psoas is to the pelvis and lumbar spine, the scalenes are to the cervical and ribcage.
- ❑ If scalenes pull on cervical vertebrae, c-spine falls into its arch.
- ❑ However, if scalenes draw in and up, with c-spine lengthens allowing for proper head placement on c-1 and assisting in lifting first two ribs.
- ❑ Assists in inspiration.
- ❑ Transverse process of C1-6 to ribs 1, 2 and sometimes 3



Sternocleidomastoid

- Acts to flex and rotate the head
- Accessory muscle of inspiration
- Medial 3rd of clavicle to mastoid process



Longitudinal Support Suspensory Muscles *Up the Front*

- ▶ Cradle – maintaining the bow and the front support
 - ▶ Cradle toe taps
 - ▶ Cradle roll down
- ▶ Spine Stretch Forward
- ▶ 100s
- ▶ Revisit extension

Diaphragms

Pelvic and Thoracic



Both these domes, (diaphragm and pelvic floor) need pliability and flexibility to do their intended jobs. Restriction in motility and support of the spine will ultimately lead to decrease in function

Rollin', Rollin', Rollin' Practical

Some of the best exercises to massage the back, create mobility in thoracolumbar fascia, increase circulation, and relax tight structures are rolling exercises.

- ▶ Having a ball with Rolling Like a Ball

Remold and Reshape - Go Fetal



Fetal position has developmental, spiritual and mental elements associated with it.

Specifically to this conversation, moving in and out of fetal, from front to back, side to side, into long diagonal slings and back again serve to release, activate, release again the fascial tissues throughout the body.

It disarms the musculature and the fascia, a sort of control, alt, delete. To move in and out and about, from closed to open will also open the CV and nervous systems of the body.

In doing so we can remold and reshape!