“The theory and practice of getting fitter and stronger”

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University of Victoria

- All the presentations are accessible at:

- https://onlineacademiccommunity.uvic.ca/elderacademy/

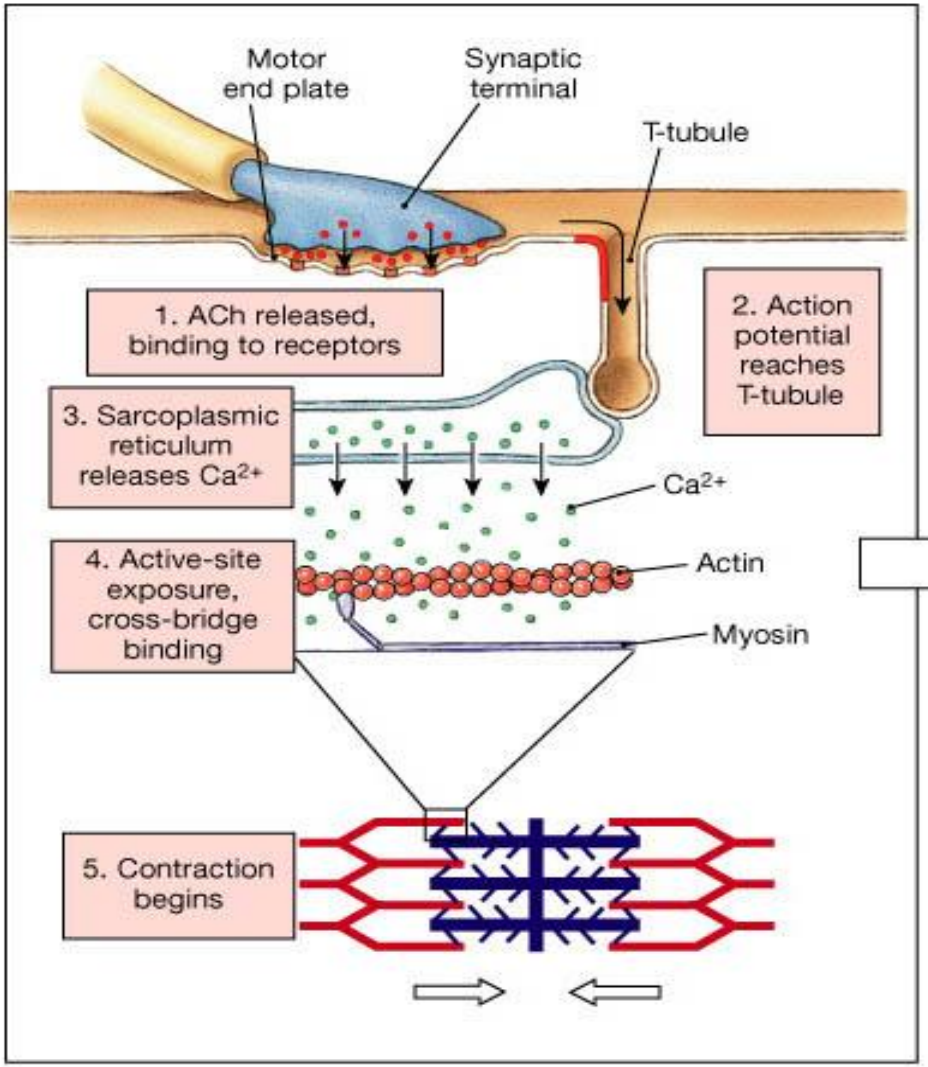
Four part series

1. **Developing aerobic (cardiovascular) fitness (March 3rd)**
2. ***Developing strength and muscular endurance (March 10th)***
3. **Developing the core or back stability (March 17th)**
4. **Effective warm up and developing flexibility (March 24th)**

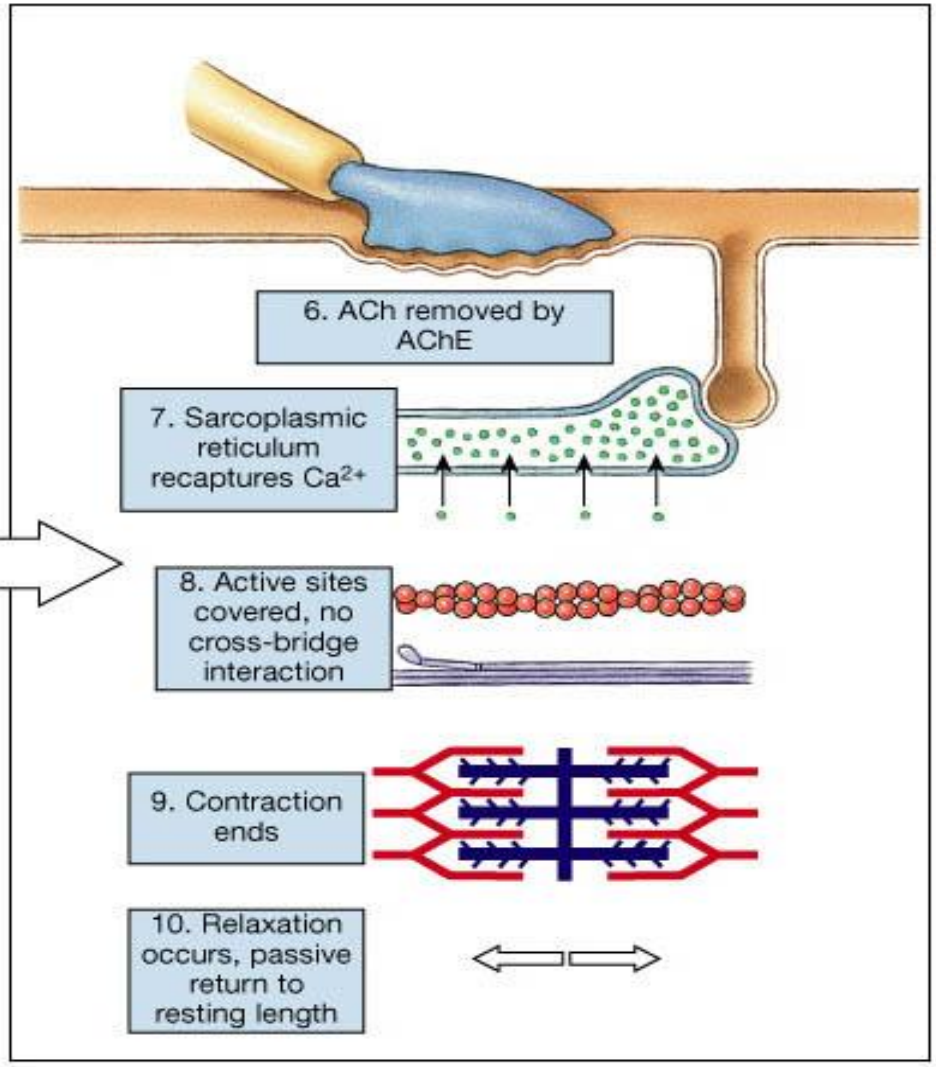
Quick review

- Tension (resistance) on muscle is key to getting stronger.
- Tension should be maintained in both parts of an exercise (concentric and eccentric phases).
- Which muscles work when? Muscles move a limb when shortening.

Motor End Plate & Initiating Contraction



Steps in the initiation of a contraction



Steps that end the contraction

How muscles contract: “The Sliding Filament Theory”

- https://www.youtube.com/watch?v=0kFmbrRJq4w
- https://www.youtube.com/watch?v=tSwls6D1b7Q

Evidence-based resistance training recommendations

Variables:

- Intensity
- Load and repetition
- Resistance mode/type
- Repetition duration
- Volume and frequency

Recommendations:

- Persons should train to momentary muscular failure
- Weight >80% 1RM and perform repetitions to failure (8-12 reps)
- Use either free or stacked weights
- Maintain steady force
- 1 set is adequate; 1X or 2 X per week

From: Fisher et al., 2011

Sample Program

- In general do a program of about 8-10 exercises and try to do at least twice per week.
- A simple program would consist of:
- A. An exercise for biceps (e.g. bicep curl)
  B. An exercise for triceps (e.g. forearm extension, dumbbell press overhead, Arnie press)
- C. An exercise for chest (bench press or push up)
- D. An exercise for back (e.g. lat pull downs, arm pulls, or seated row)

Sample program (continued)

- E. An exercise for quads (leg extension on a machine or front lunge or the single leg squat that Anna showed you. You can do these holding dumbbells)
- F. An exercise for hamstrings (leg curl machine or back lunges or walking lunges. You can also do these with dumbbells).

- G. Side arm lifts
- F. Side arm pull downs

- ***Note: These exercises are in pairs as it is important to work the muscles both sides of a joint. The suggestion is to do them in pairs.***

Hard to change old habits!

- My approach trying to apply the research:
  - Do 8-12 repetitions to muscle failure/fatigue
  - Slow contractions (1-2s both parts)
  - Do two sets
  - Short rest between sets (20-30s)
  - Do as many reps as possible on 2nd set
  - Do 3-4 exercises per session (5 days per week). Some repeat of muscle group

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Disclaimer!

- I am not a physician, trained physiotherapist, or certified to offer professional advice.
- I am an exercise scientist who has studied and researched the effects of physical activity on the human body for nearly 50 years.
- What I will share with you is some information based on my own research, my understanding of exercise and how it impacts the back, as well as extensive reading, attending conferences, and teaching on the subject of Low Back Pain (LBP).
- I was a mentor and master coach for Strength and Conditioning for the National Coaching Institute and Mentor and Presenter for Physical Performance in Advanced Diploma Coaching Program at PISE).

Some facts and figures

- Low back pain is the single leading cause of disability worldwide, according to the Global Burden of Disease 2010.
- Back pain is one of the most common reasons for missed work. In fact, back pain is the second most common reason for visits to the doctor's office, outnumbered only by upper-respiratory infections.
- One-half of all working Americans admit to having back pain symptoms each year.[2]

Some more facts and figures

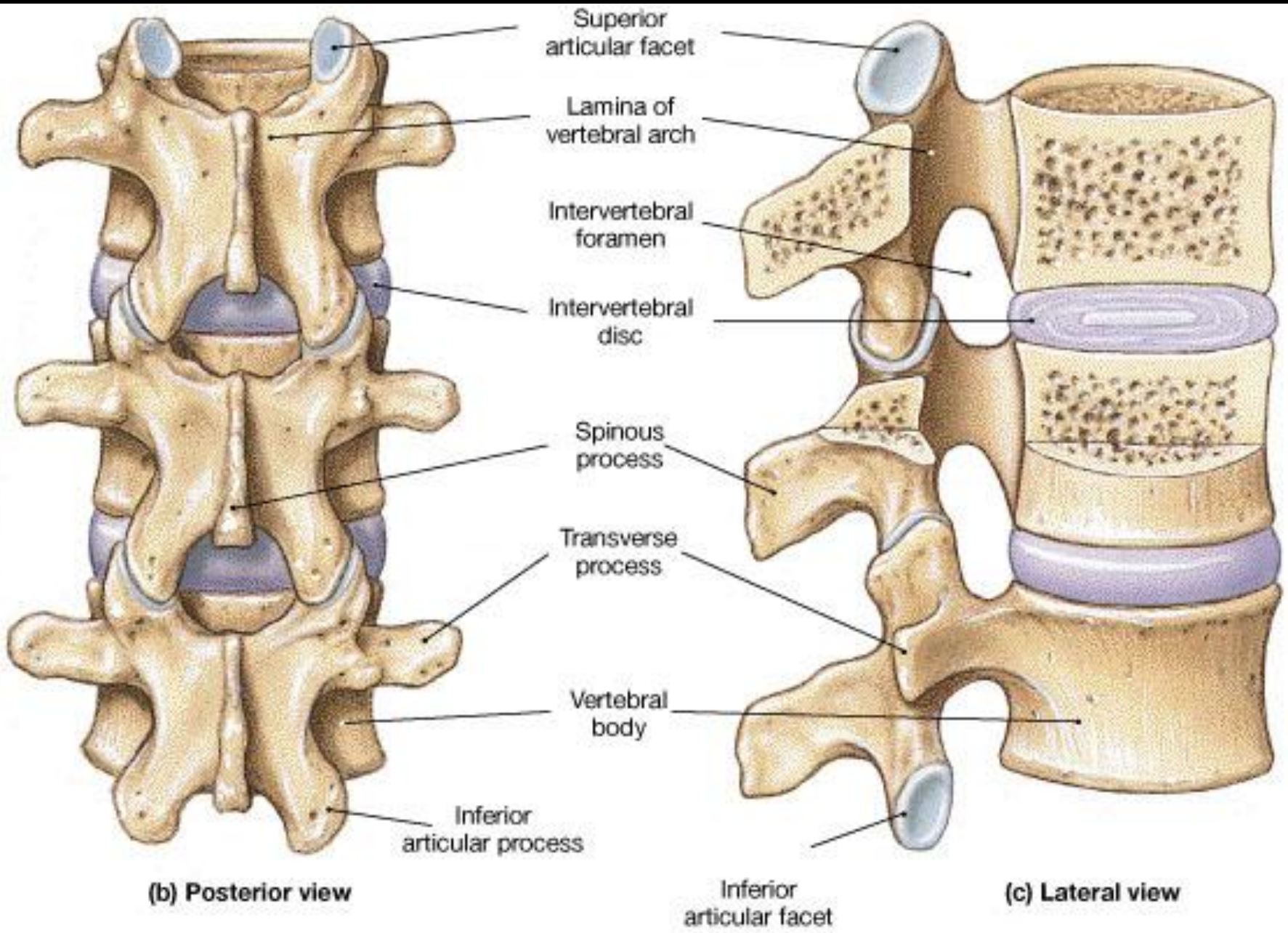
- Experts estimate that as much as 80% of the population will experience a back problem at some time in their lives.
- Most causes of back pain are mechanical or non-organic—meaning they are not caused by serious conditions, such as inflammatory arthritis, infection, fracture or cancer.
- Americans spend at least $50 billion each year on back pain—and that's just for the more easily identified costs.

What Causes Back Pain?

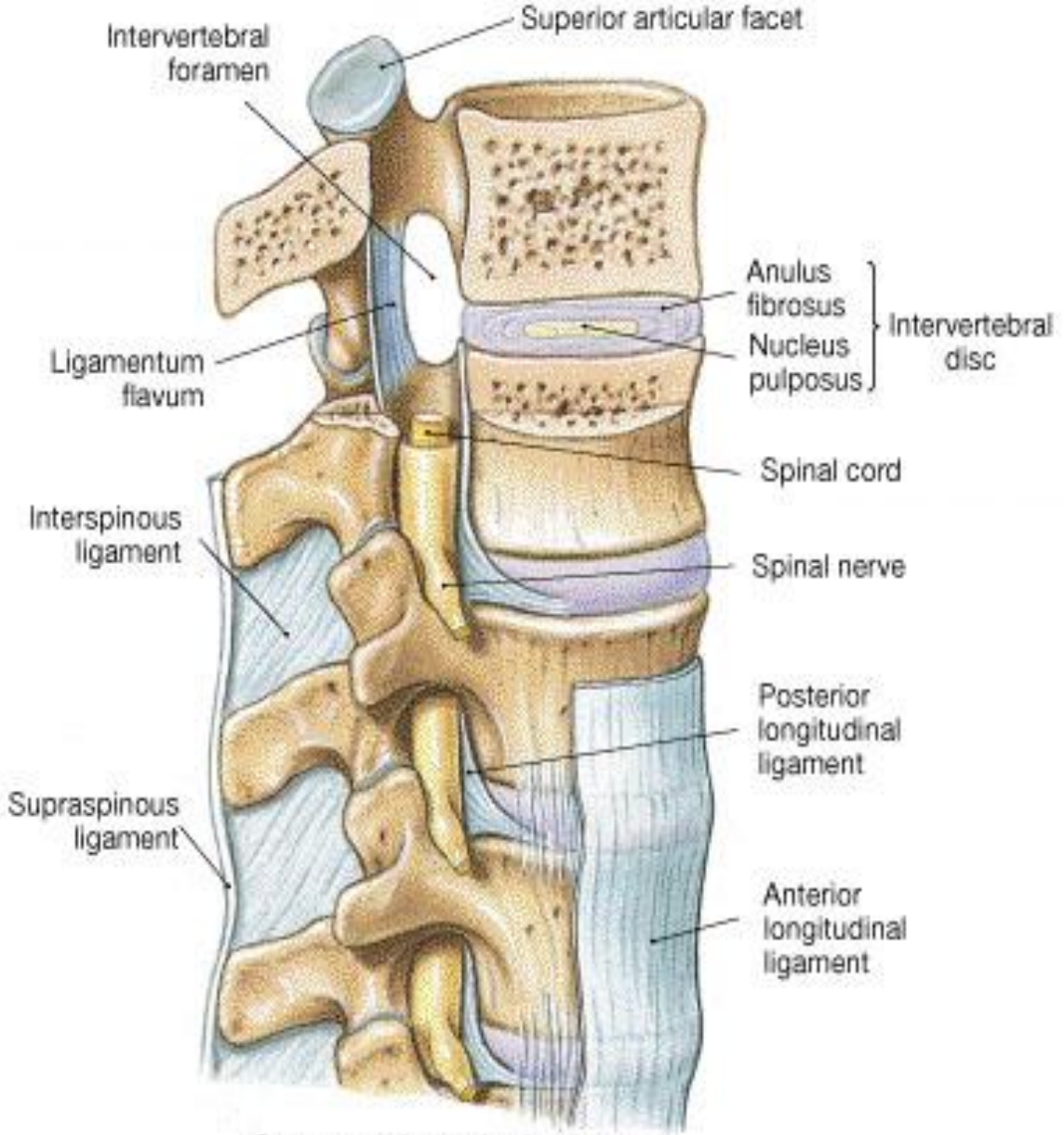
- The back is a complicated structure of bones, joints, ligaments and muscles. You can sprain ligaments, strain muscles, rupture disks, and irritate joints, all of which can lead to back pain. While sports injuries or accidents can cause back pain, sometimes the simplest of movements—for example, picking up a pencil from the floor— can have painful results. In addition, arthritis, poor posture, obesity, and psychological stress can cause or complicate back pain.

Structure and mechanics of the back

Stacked vertebrae and discs

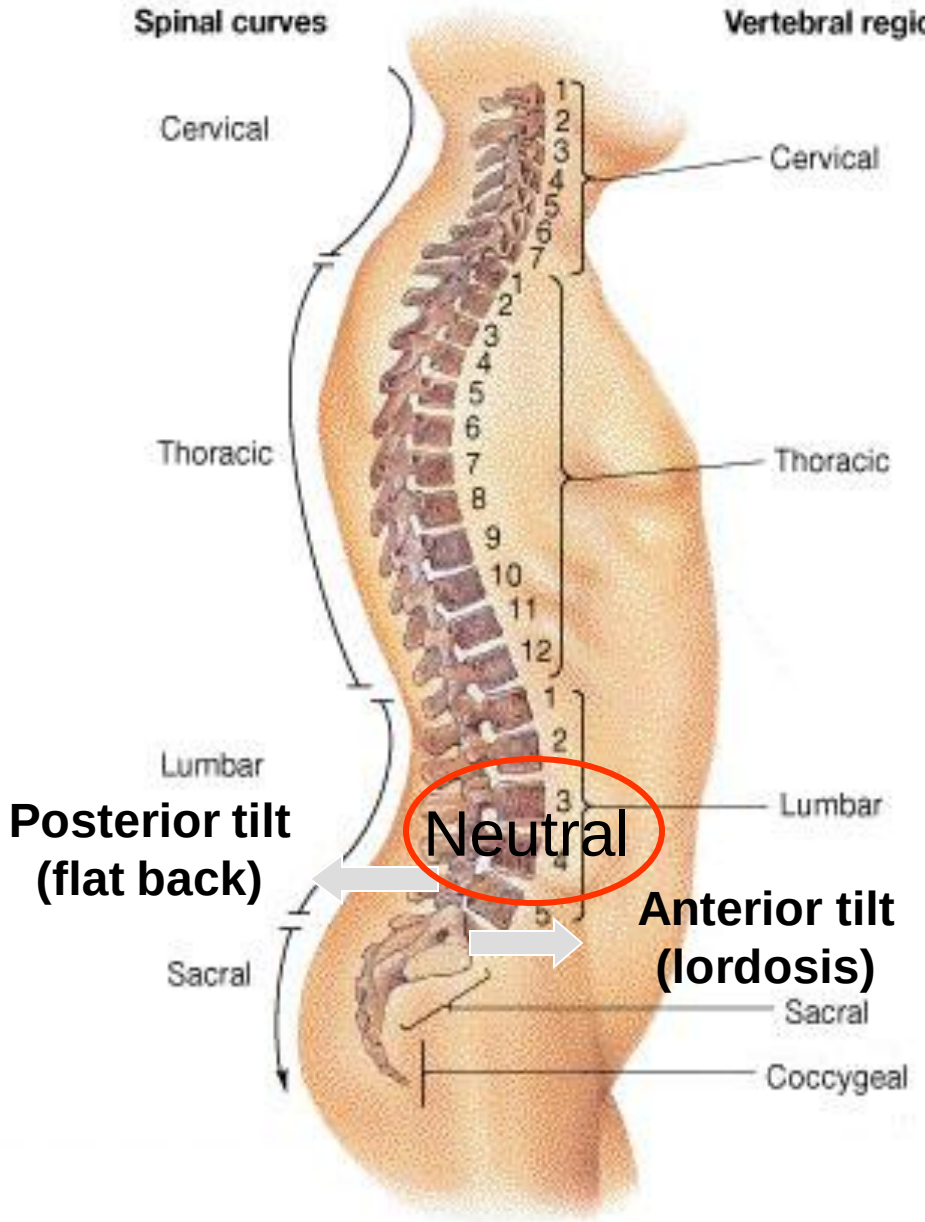


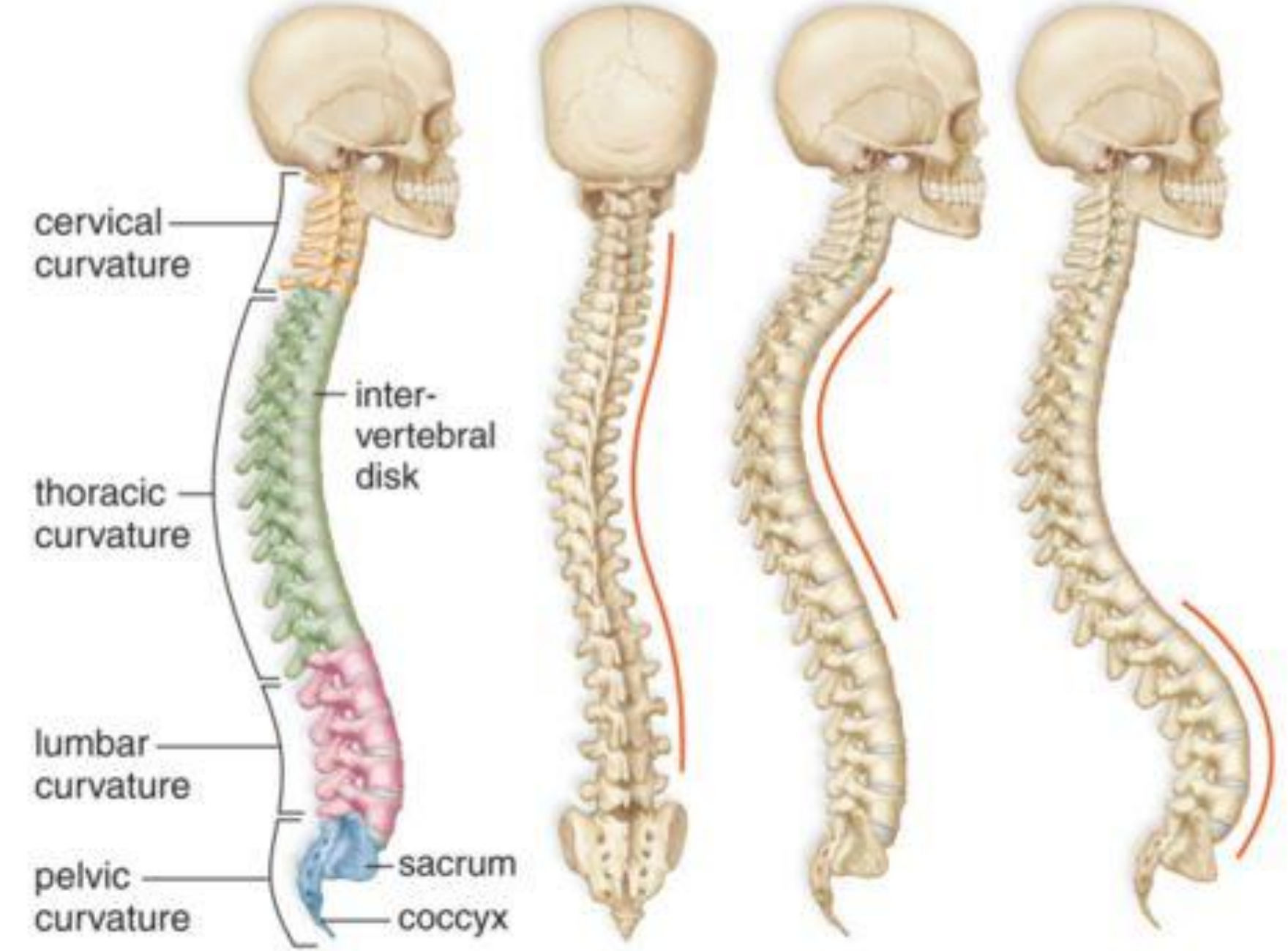
Stacked vertebrae (ligaments)

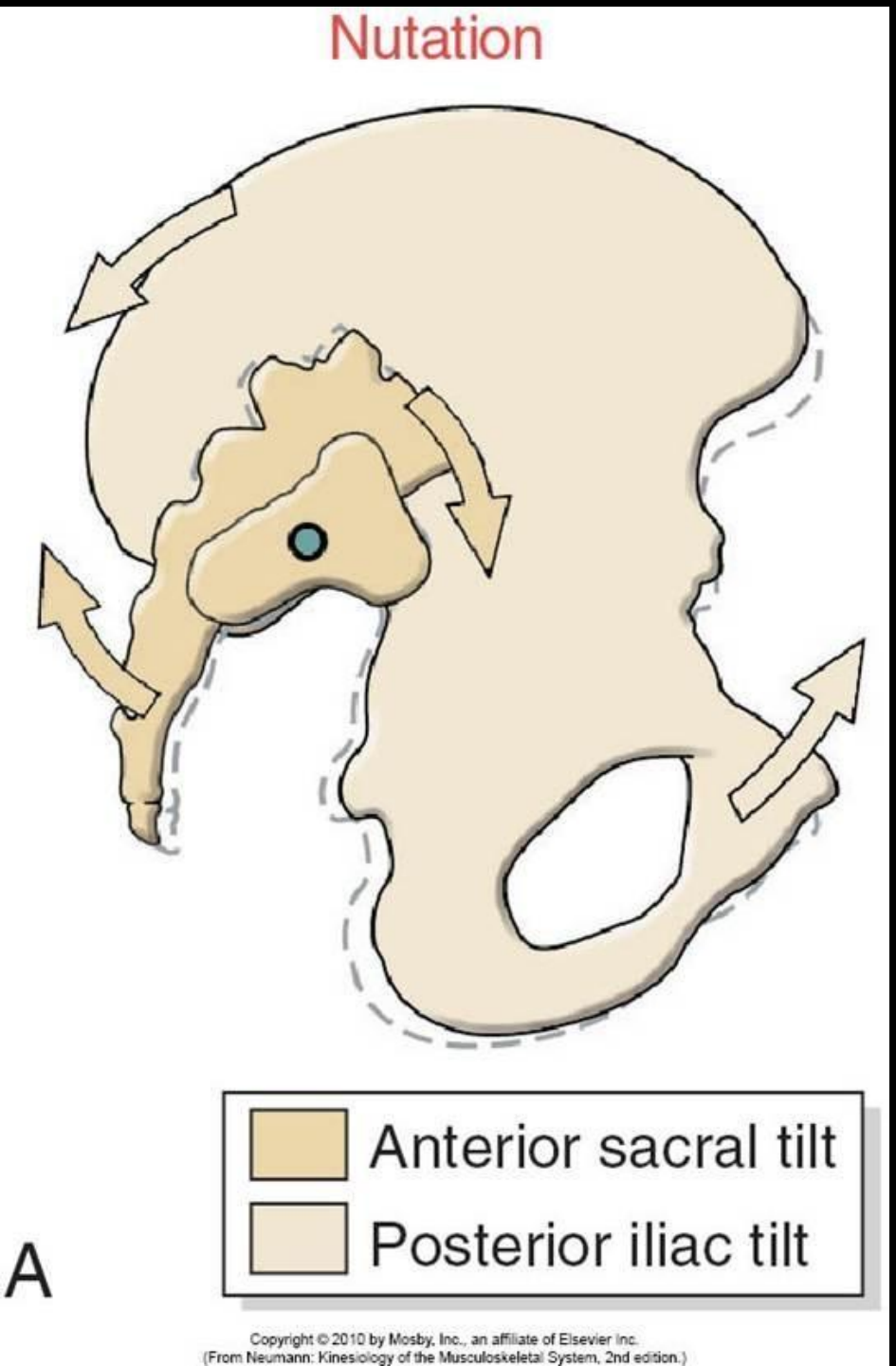


Segment of vertebral column, lateral and sectional view

Curvatures of the spine

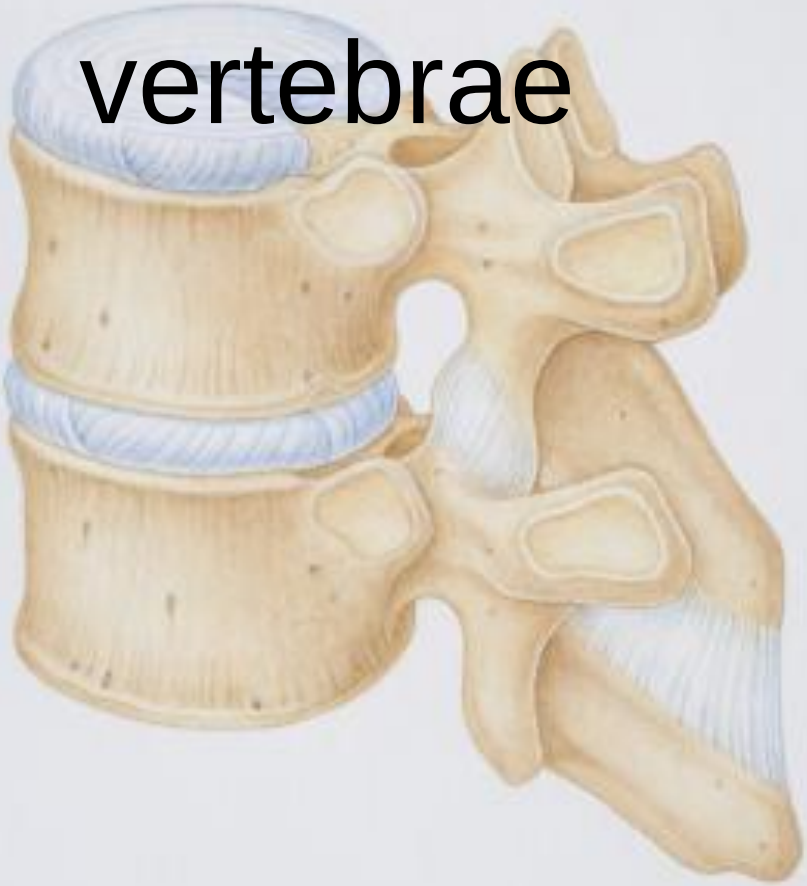




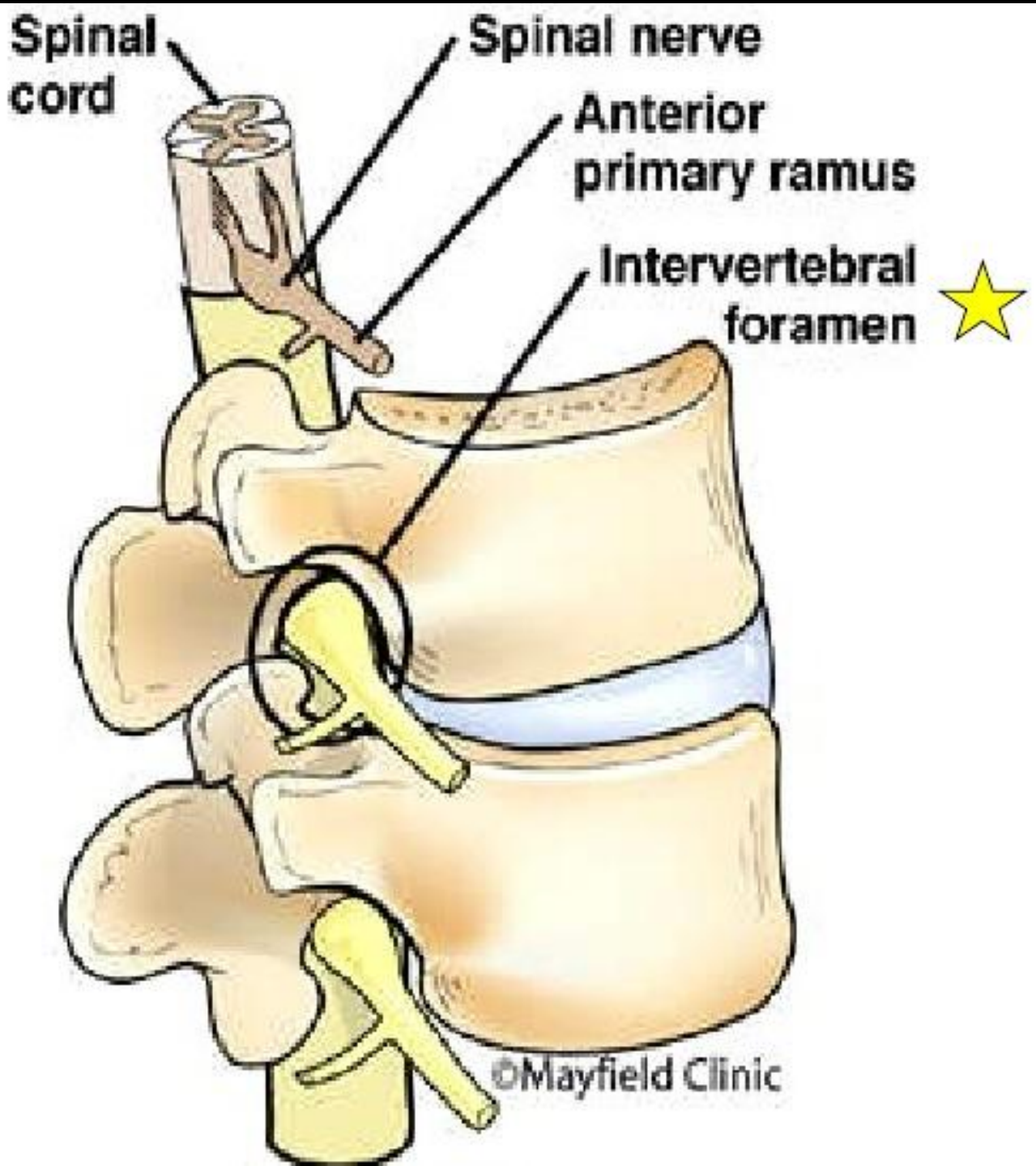


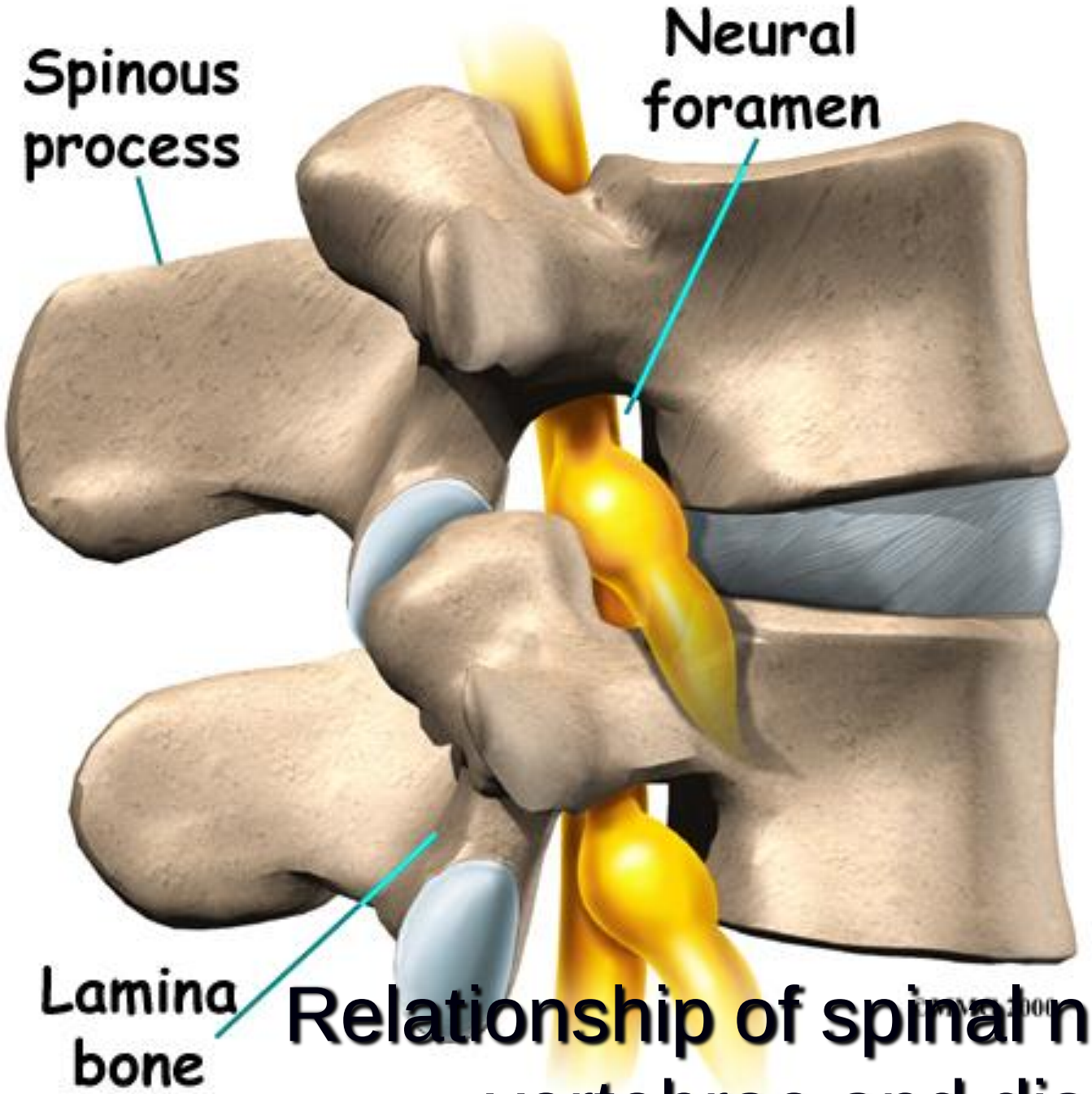
Pelvic Tilt:
Anterior
Posterior

Stacking of the vertebrae

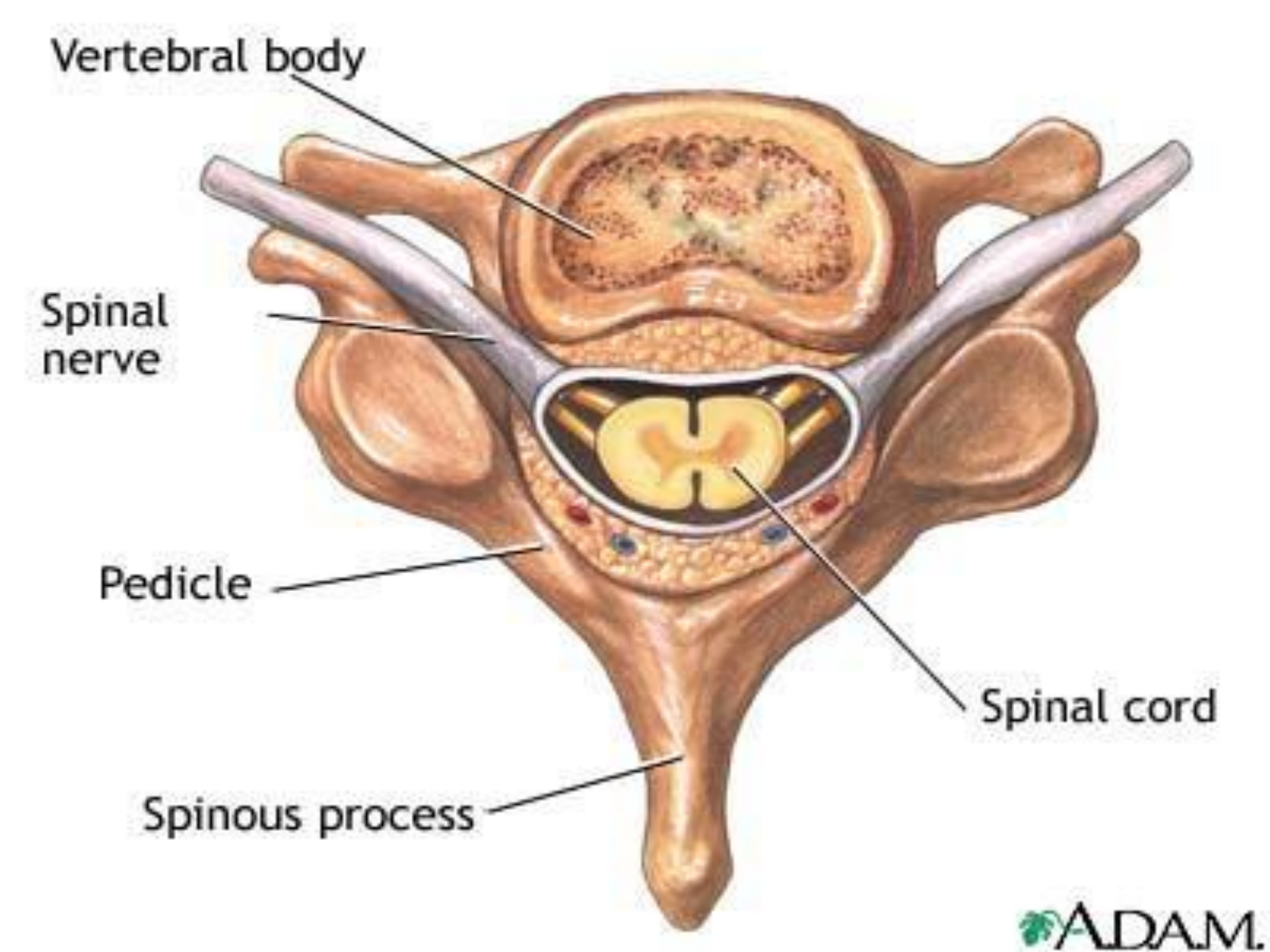


Intervertebral foraminae allow for lateral exit of spinal nerves





Relationship of spinal nerves to vertebrae and discs

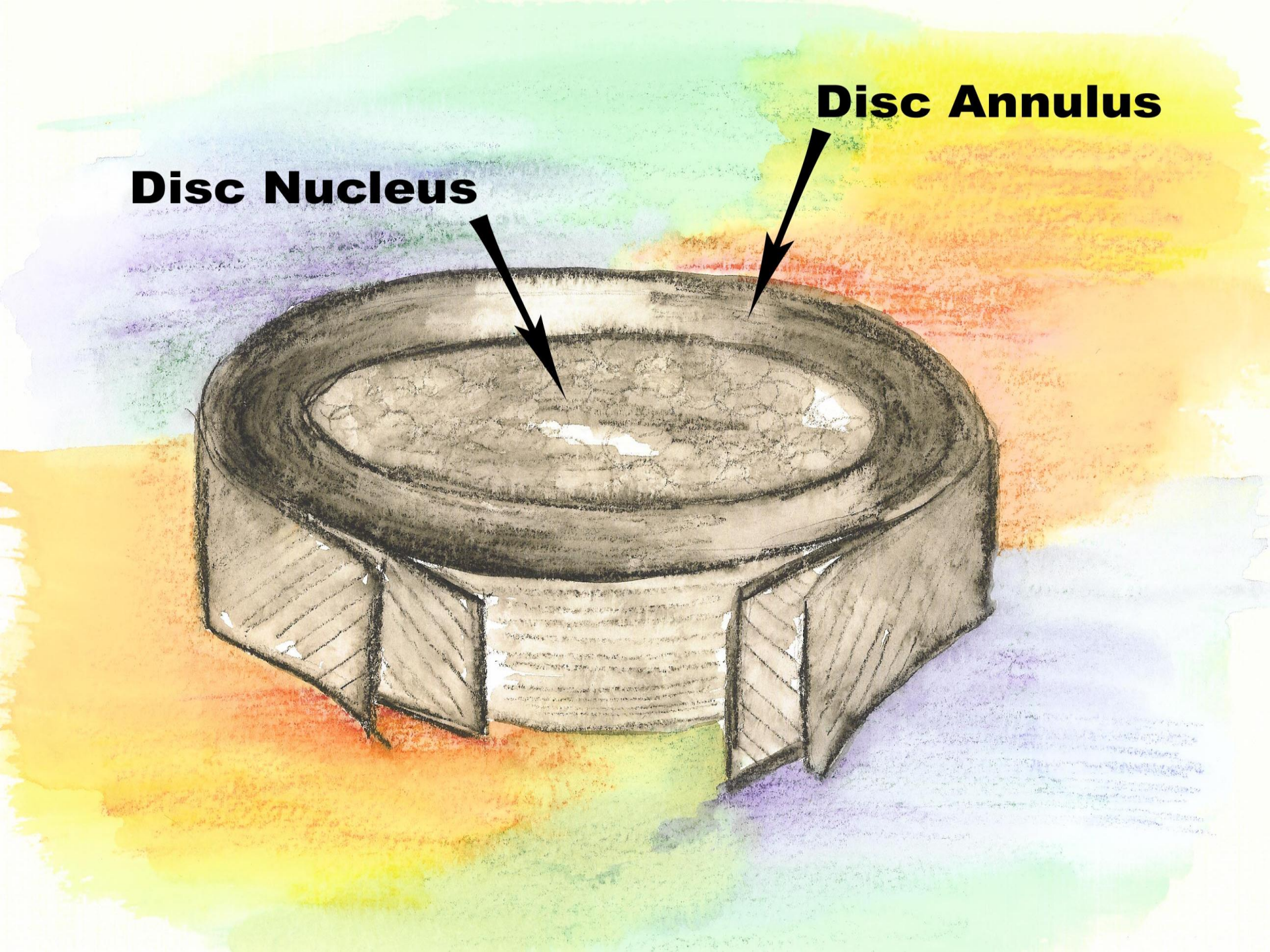

Vertebral body
Spinal nerve
Pedicle
Spinal cord
Spinous process
A.D.A.M.

Intervertebral Disc

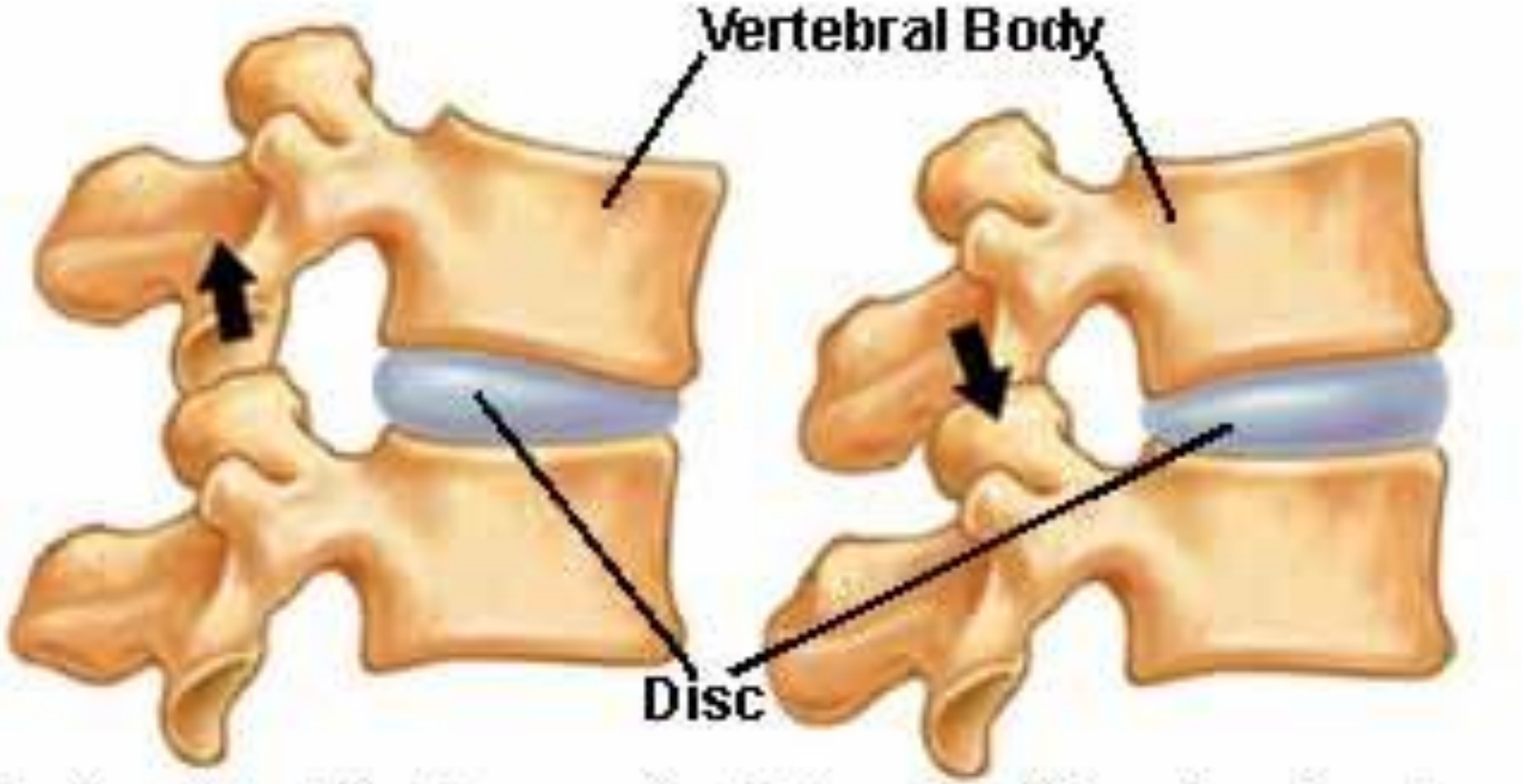
- Fibrocartilaginous joi
  motion segment
- Make up ¼ the lengt
  spinal column
- Present at levels C2-(
  S1
- Allows compressive,
  and rotational motio
- Largest avascular structures
  in the body

ANATOMY OF SPINE

Dr Pankaj N Surange
MBBS, MD, FIPP
Interventional Pain and Spine specialis


Disc Annulus
Disc Nucleus

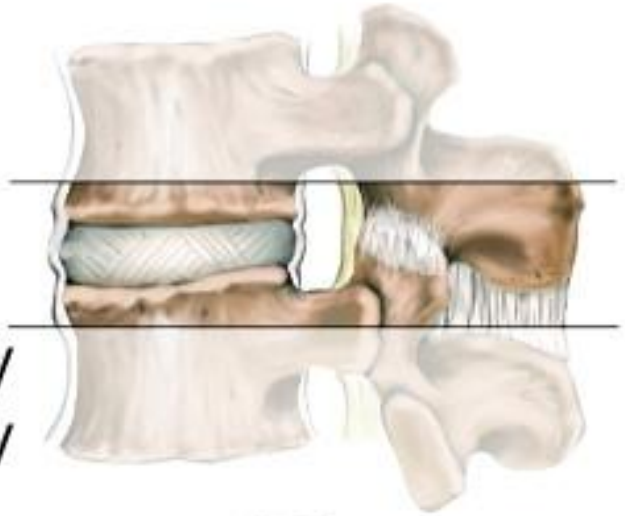
Facet Joints in Motion



https://www.spine-health.com/video/lumbar-spine-anatomy-video

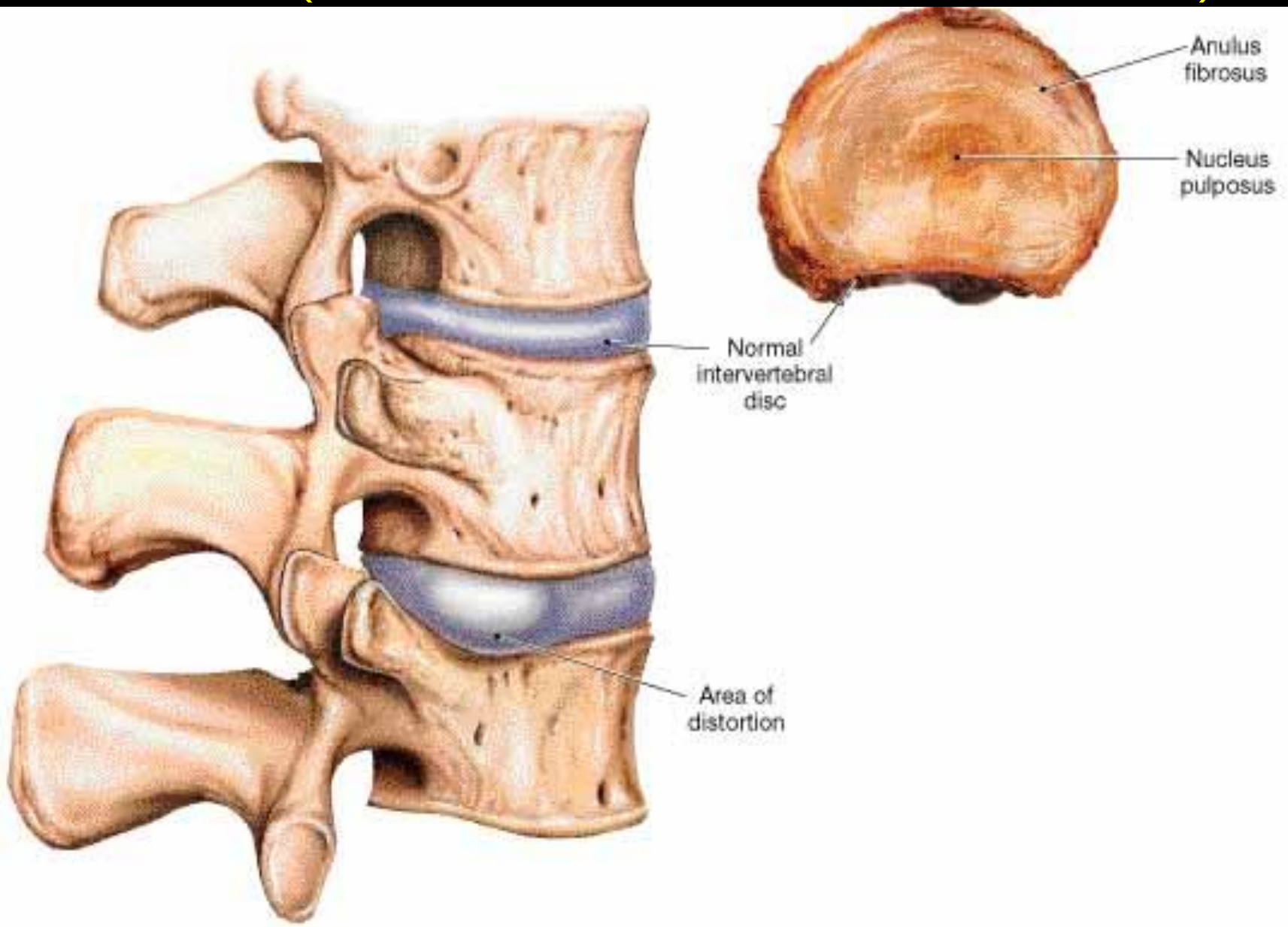
Intervertebral Disc

Blood Supply



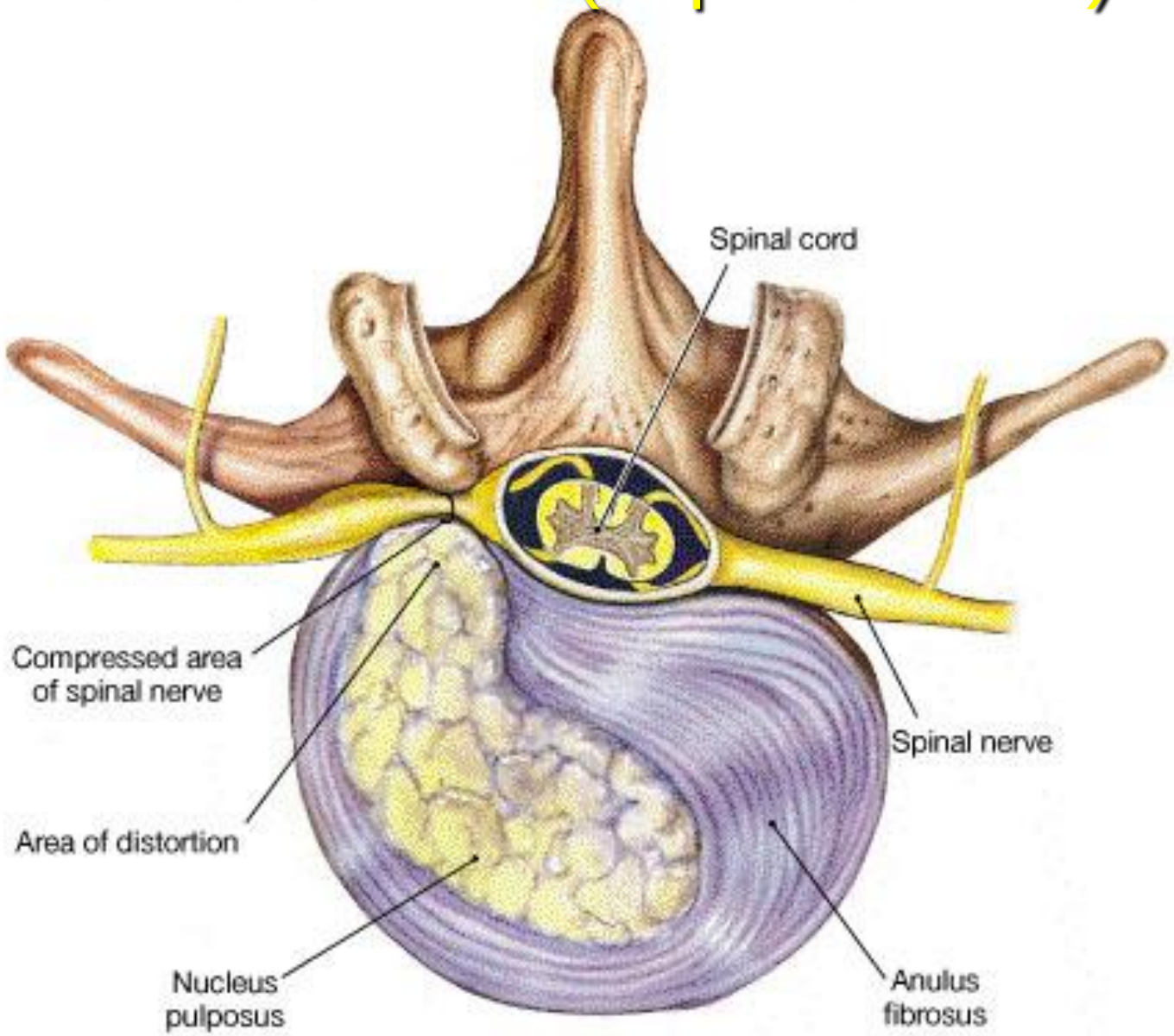
- Intervertebral discs have no significant vascular structures.
- They receive their blood supply by diffusion through the vertebral body endplates.
- A network of vessels located centrally in the endplate allows nutrients to diffuse into the nucleus pulposus and annulus fibrosus.

Vertebrae (lateral view of distorted intervertebral disc)



(a) Lateral view of distorted intervertebral disc

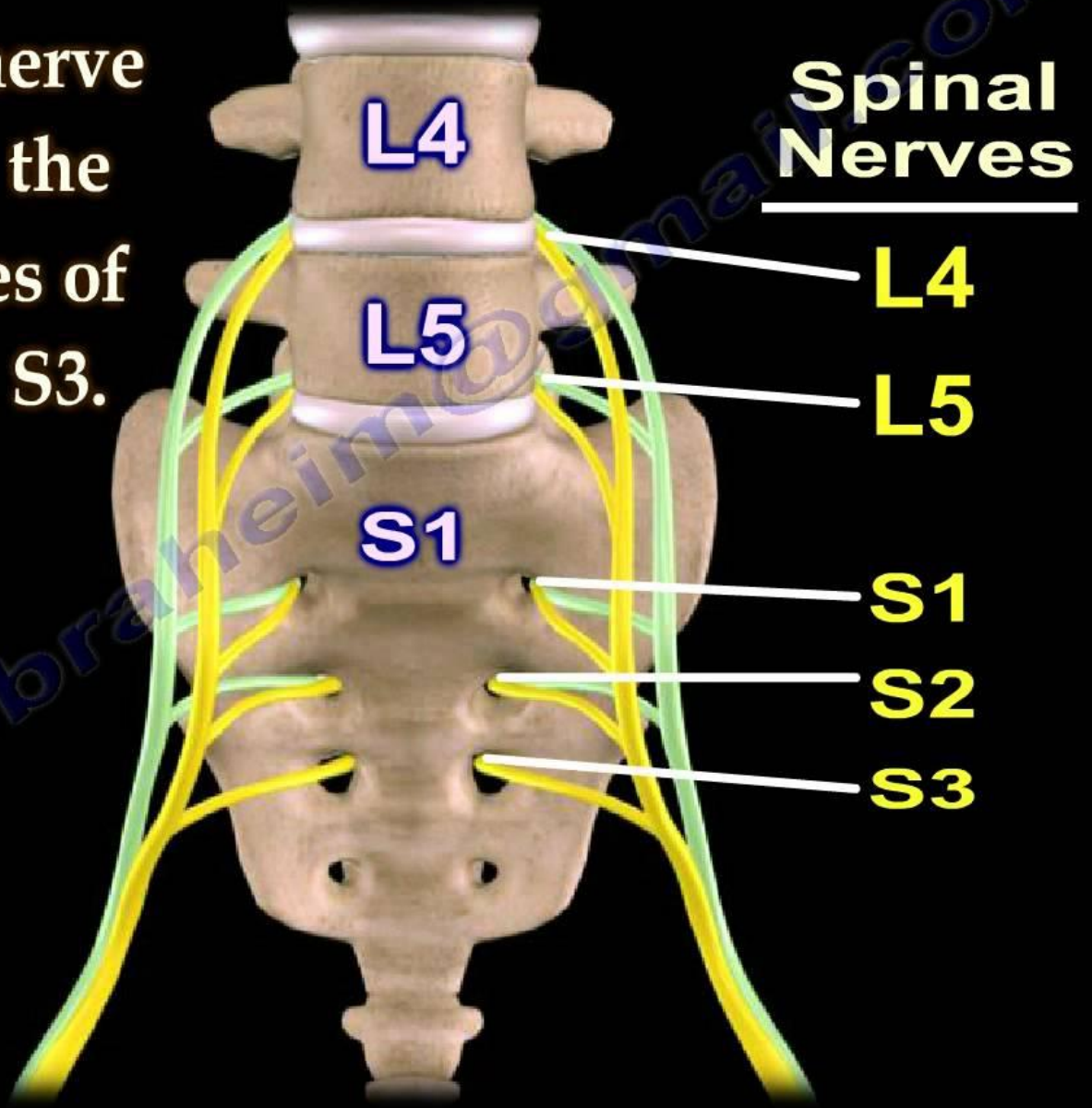
Herniated disc (superior view)

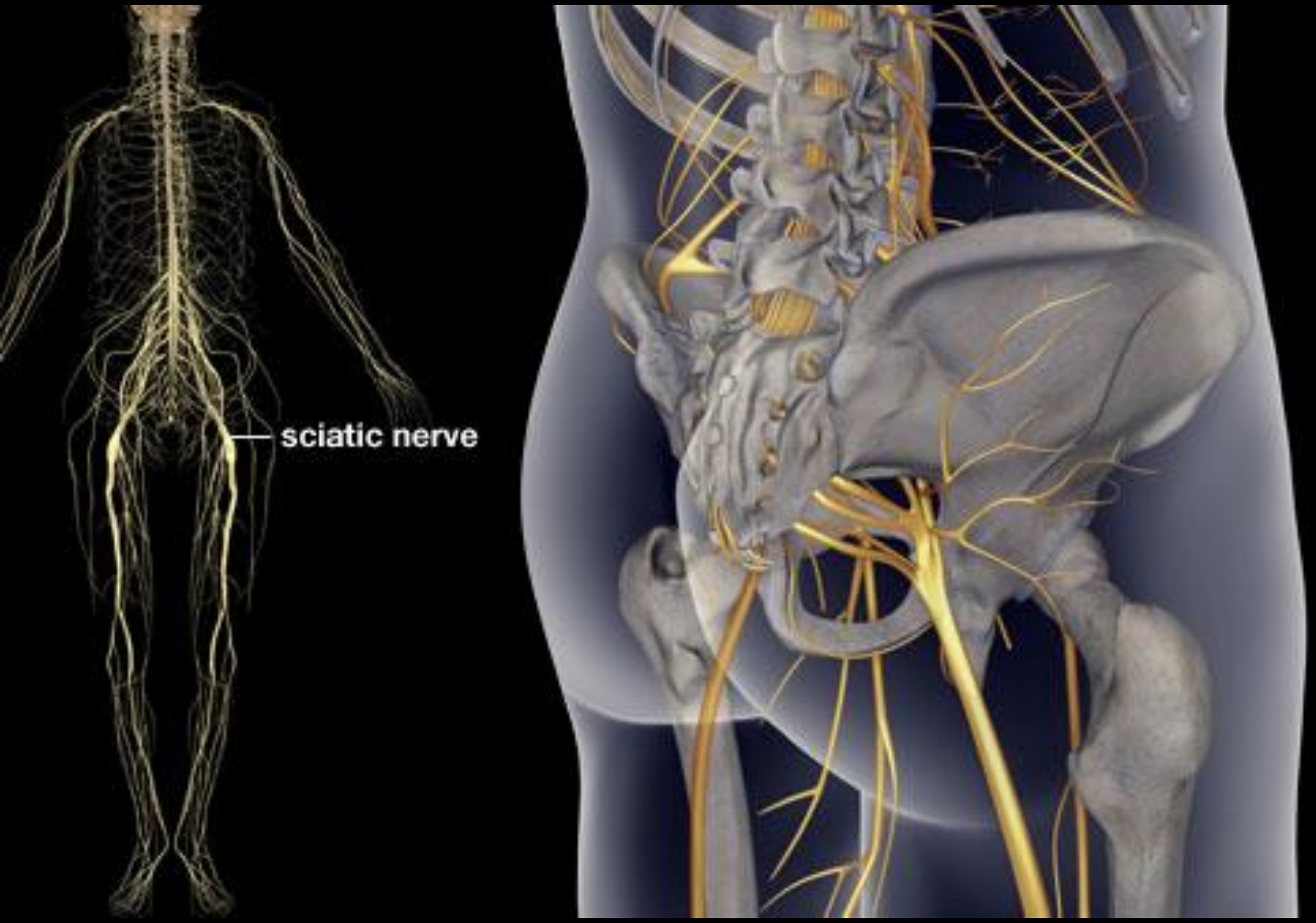


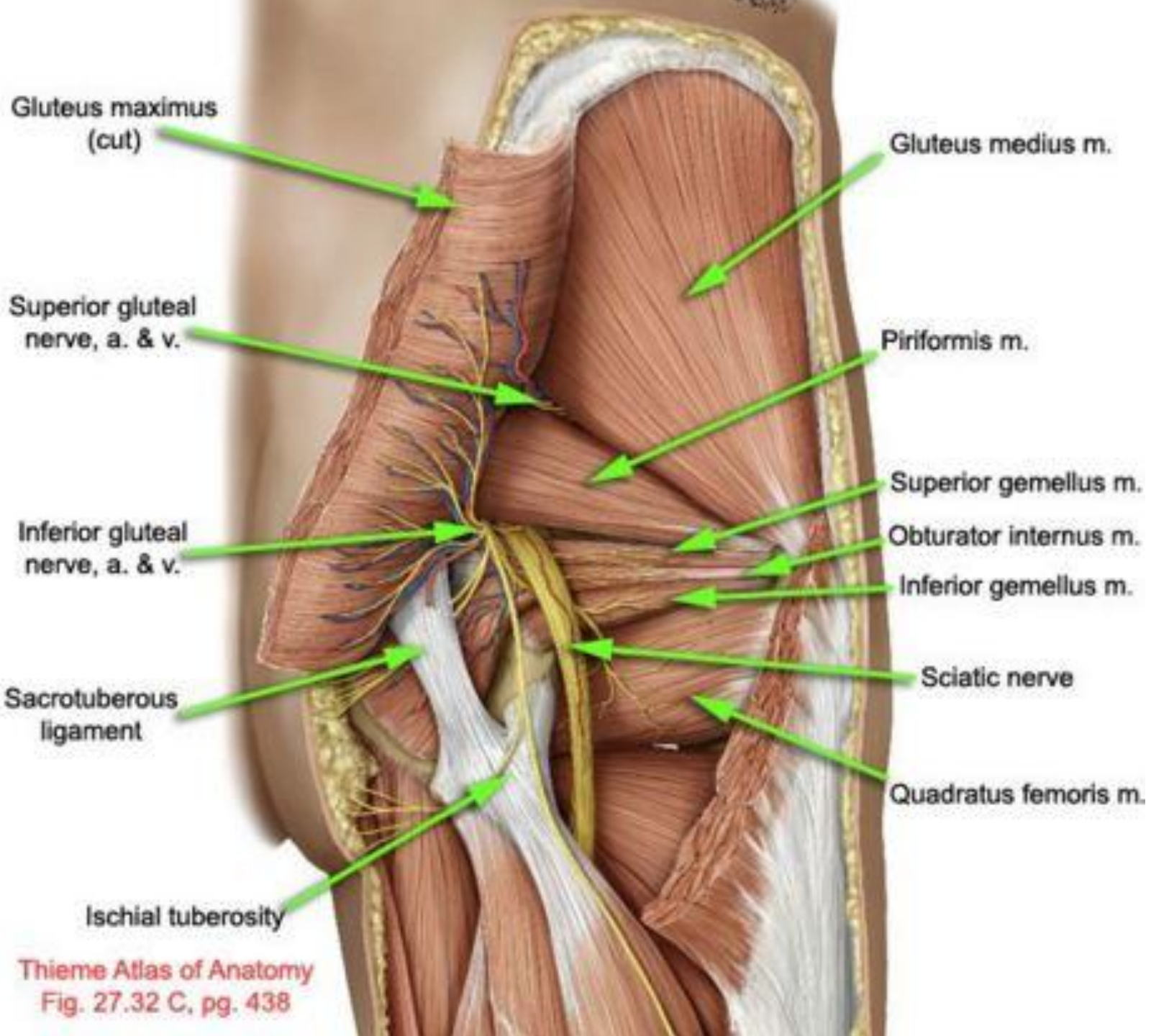
(b) Herniated disc, superior view

Sciatic Nerve Origin - Anatomy 3D

The sciatic nerve arises from the spinal nerves of L4 through S3.



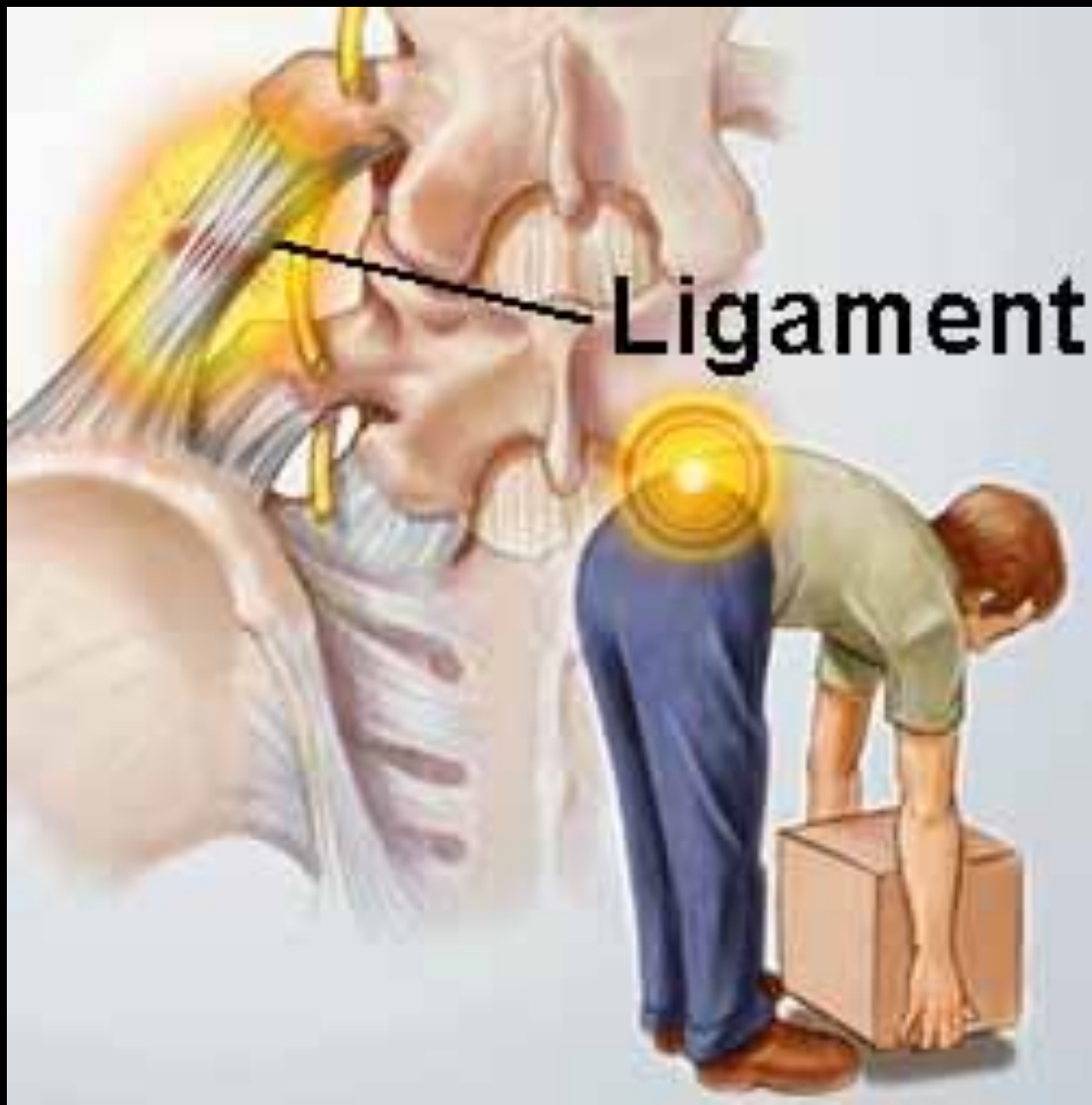

sciatic nerve

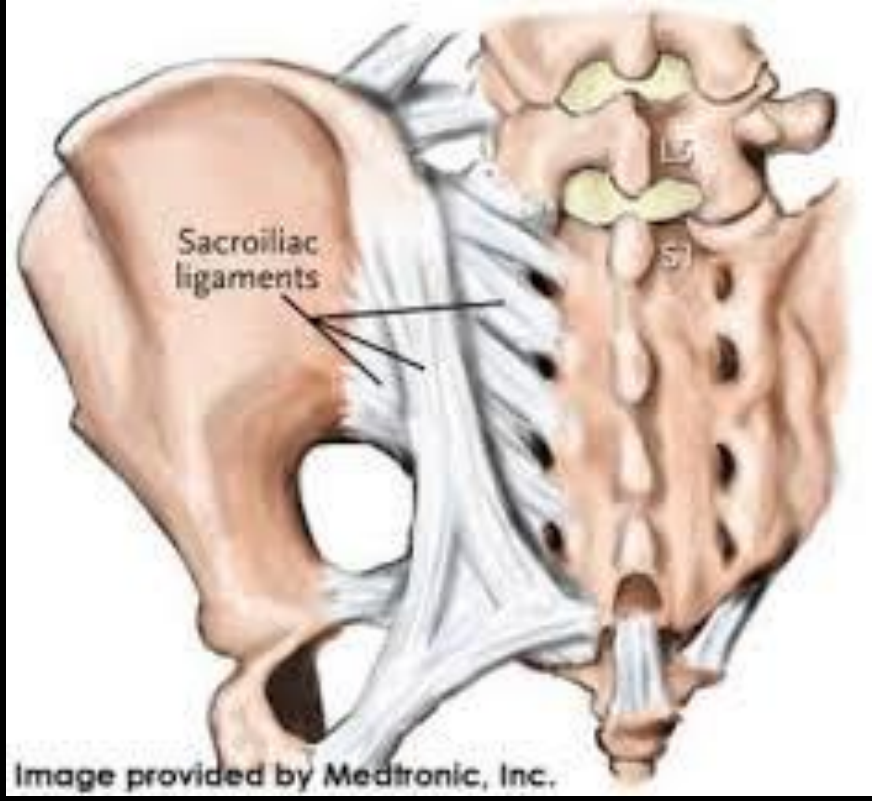


Thieme Atlas of Anatomy
Fig. 27.32 C, pg. 438

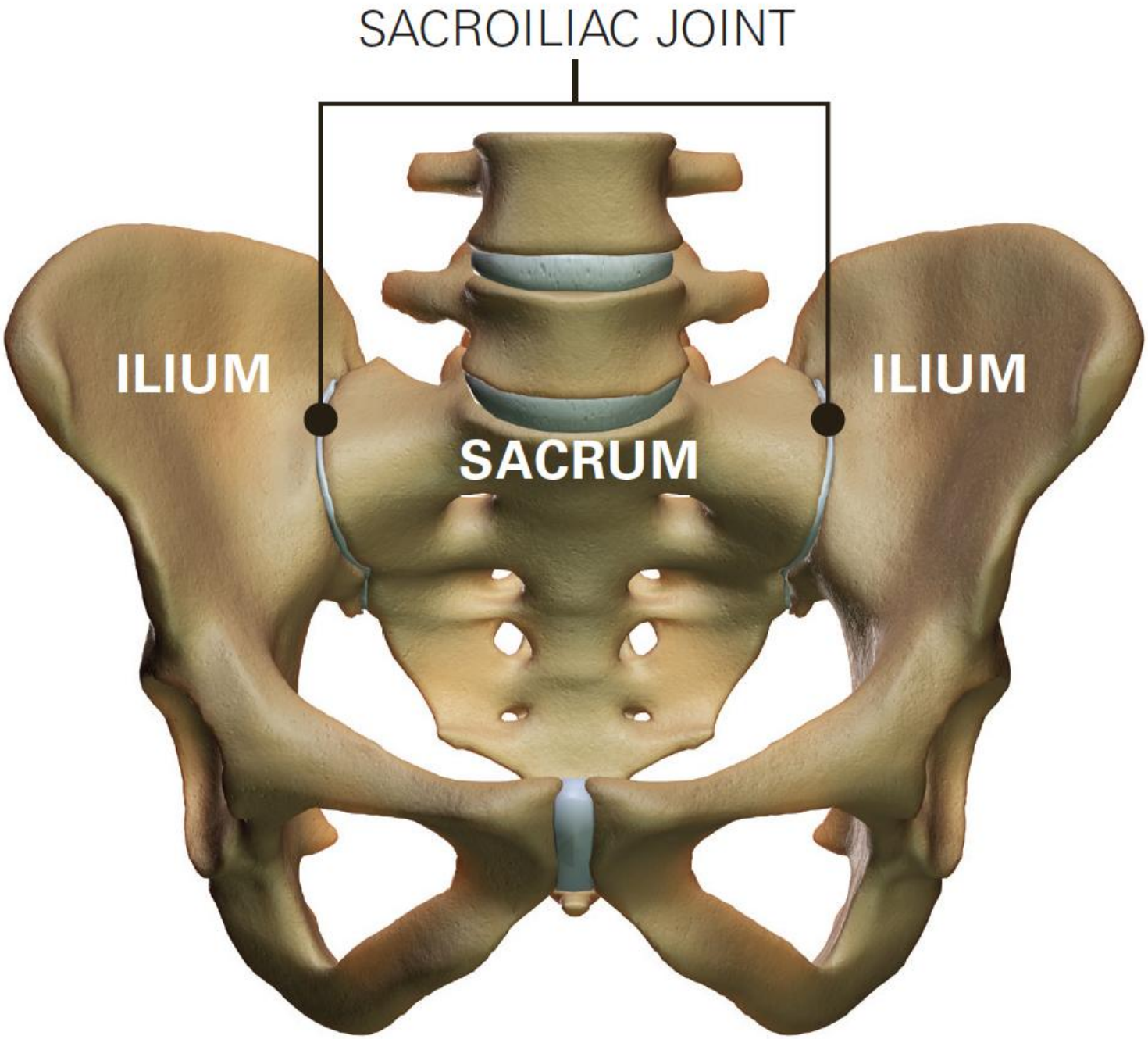
Lifting mechanics

Stress, strain and inappropriate forces influence not only muscle and tendons, but also connective tissues!





The Sacroiliac (SI) joint


SACROILIAC JOINT
ILIUM
ILIUM
SACRUM

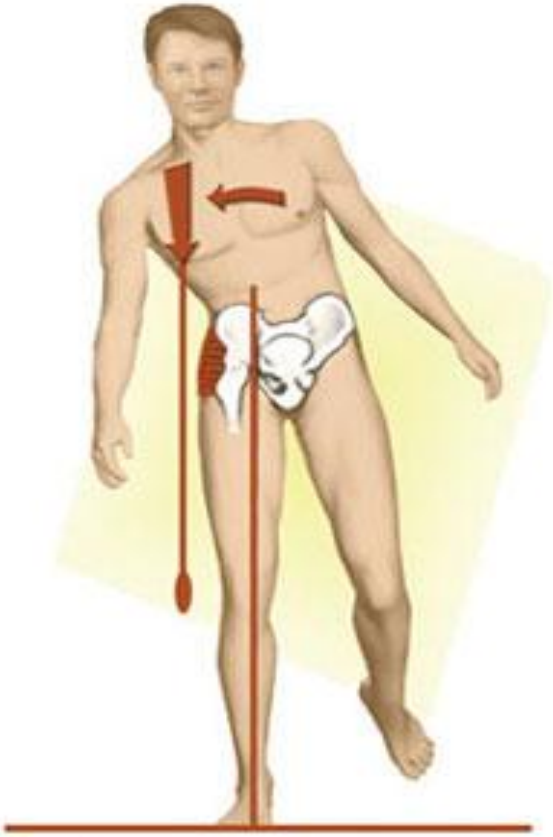


Fig. 3

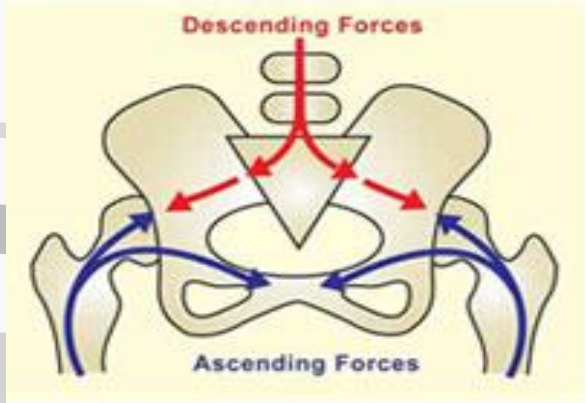
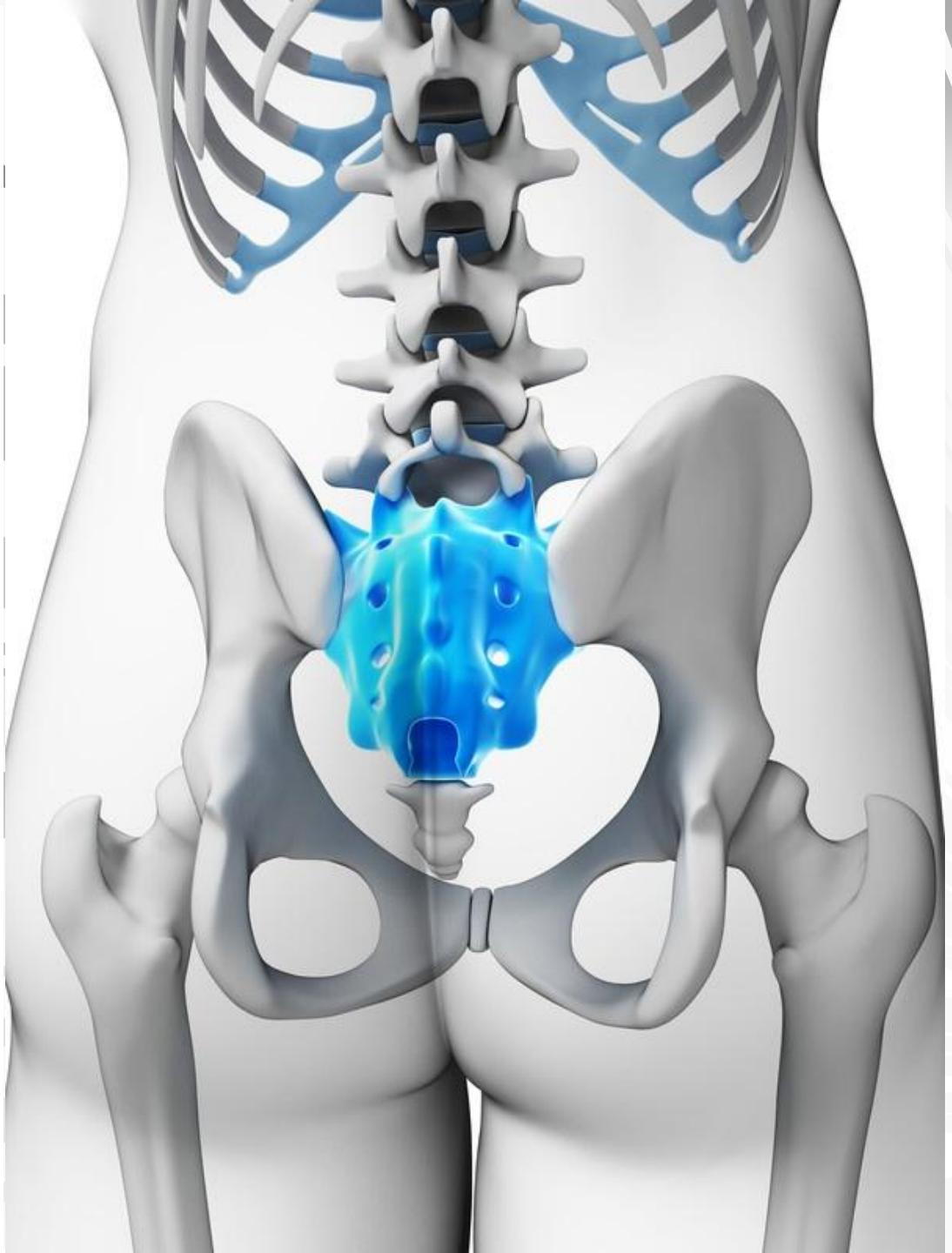
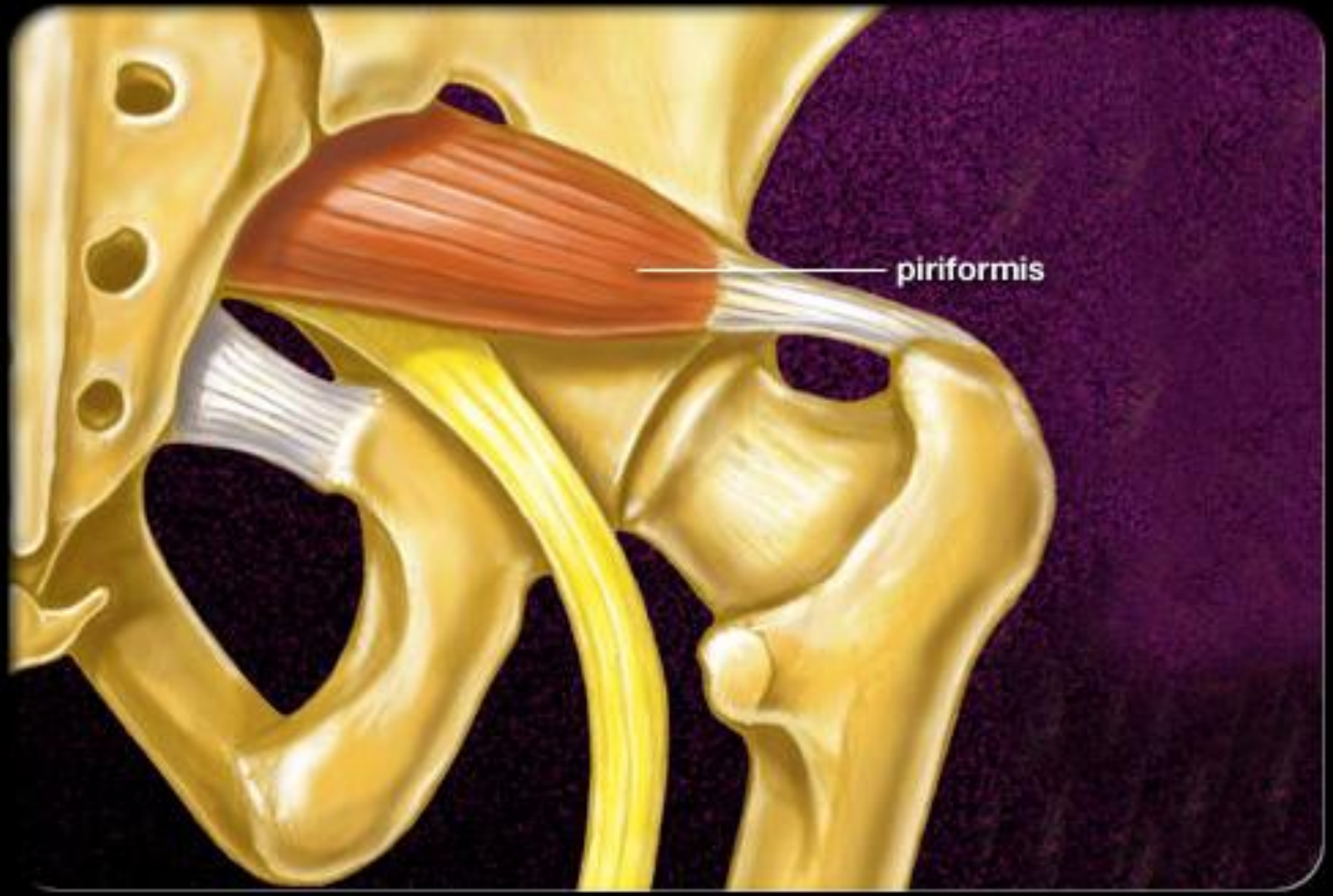


Fig. 4

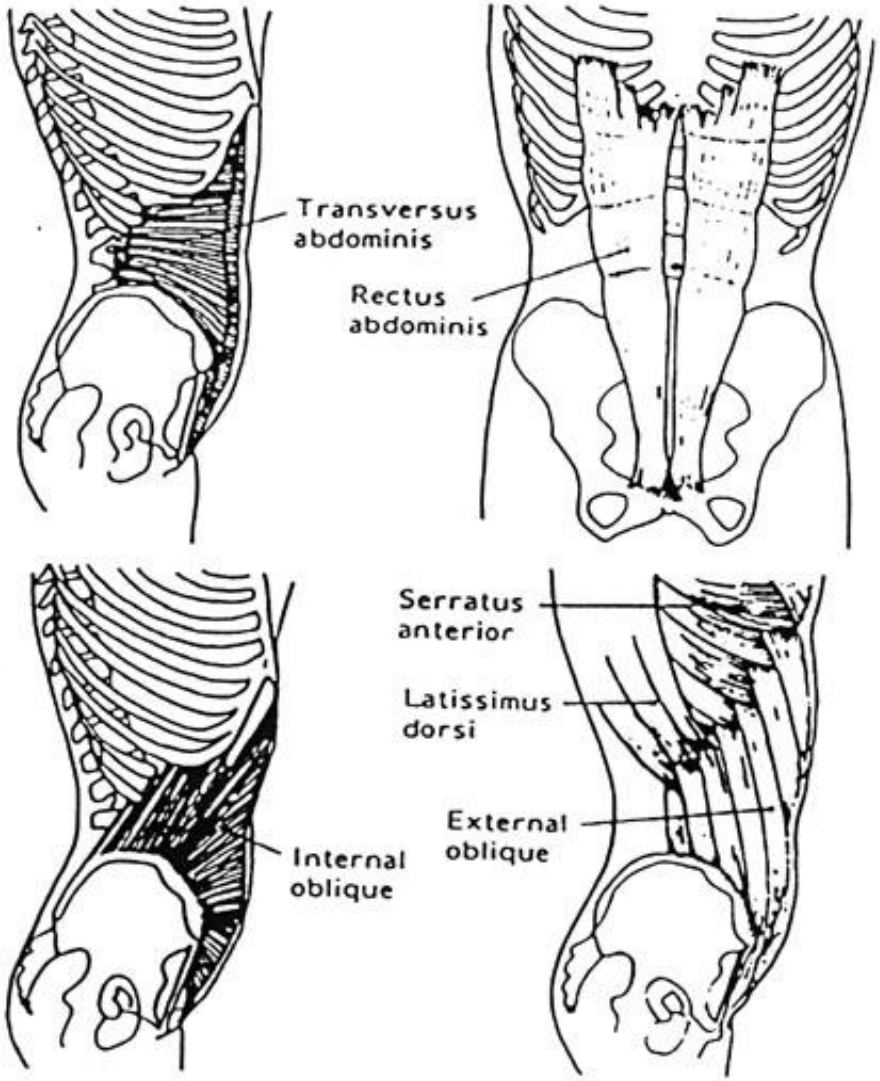


Sacroiliac Joint problems




© Spine-health.com

Anatomy of anterior trunk (or abdominals)



The iliopsoas

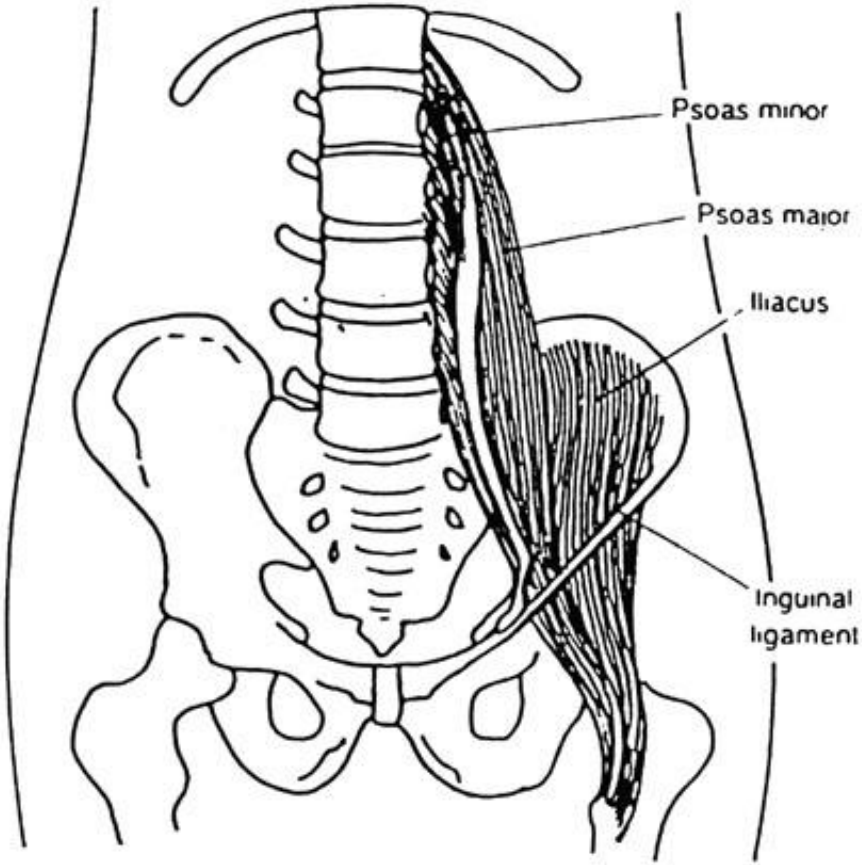
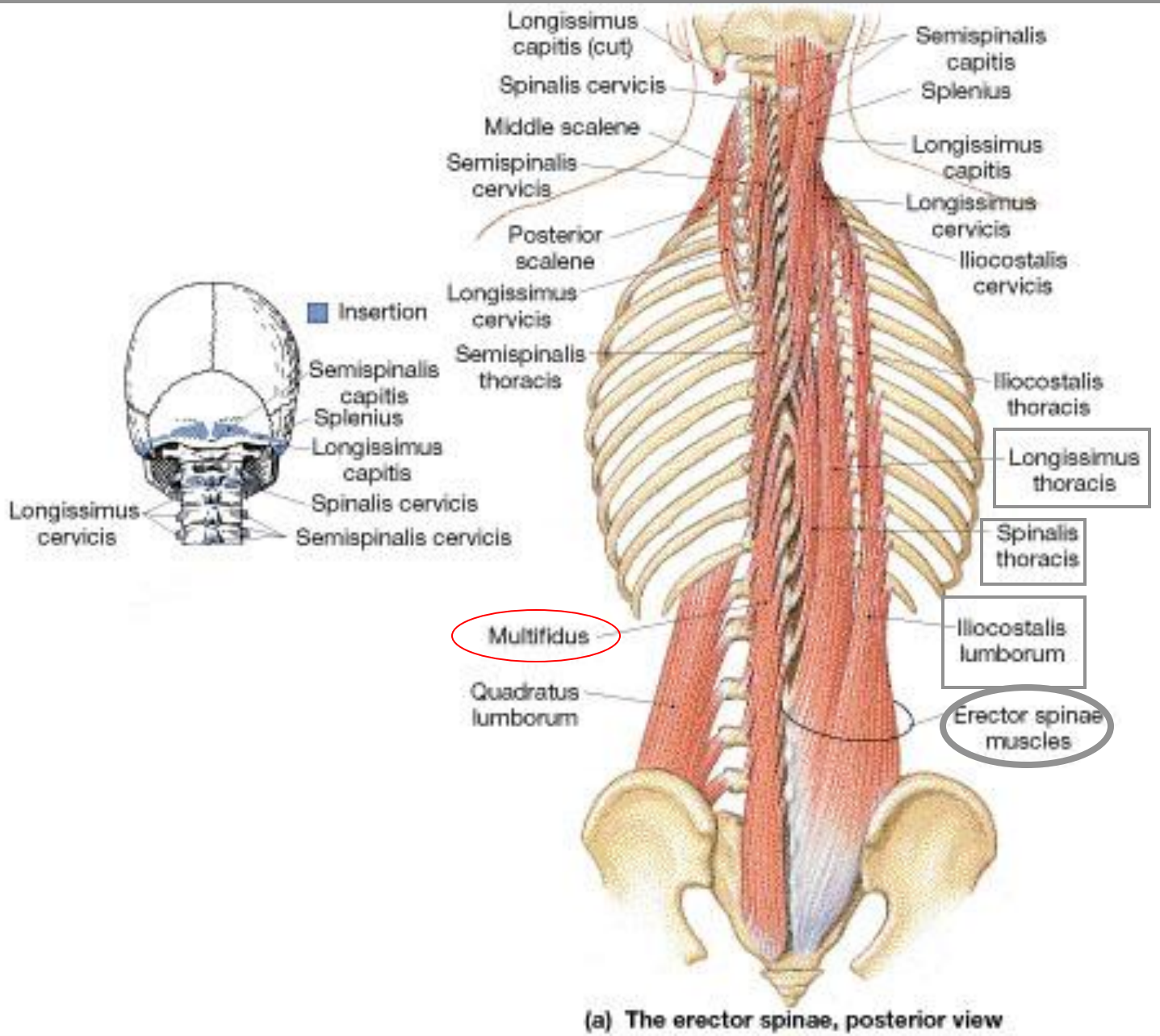


Figure 1. The anterior abdominal wall. Reproduced with the permission of the publishers from: Oliver J. Middleditch A. *Functional Anatomy of the Spine*. Oxford, UK: Butterworth-Heinemann, 1991

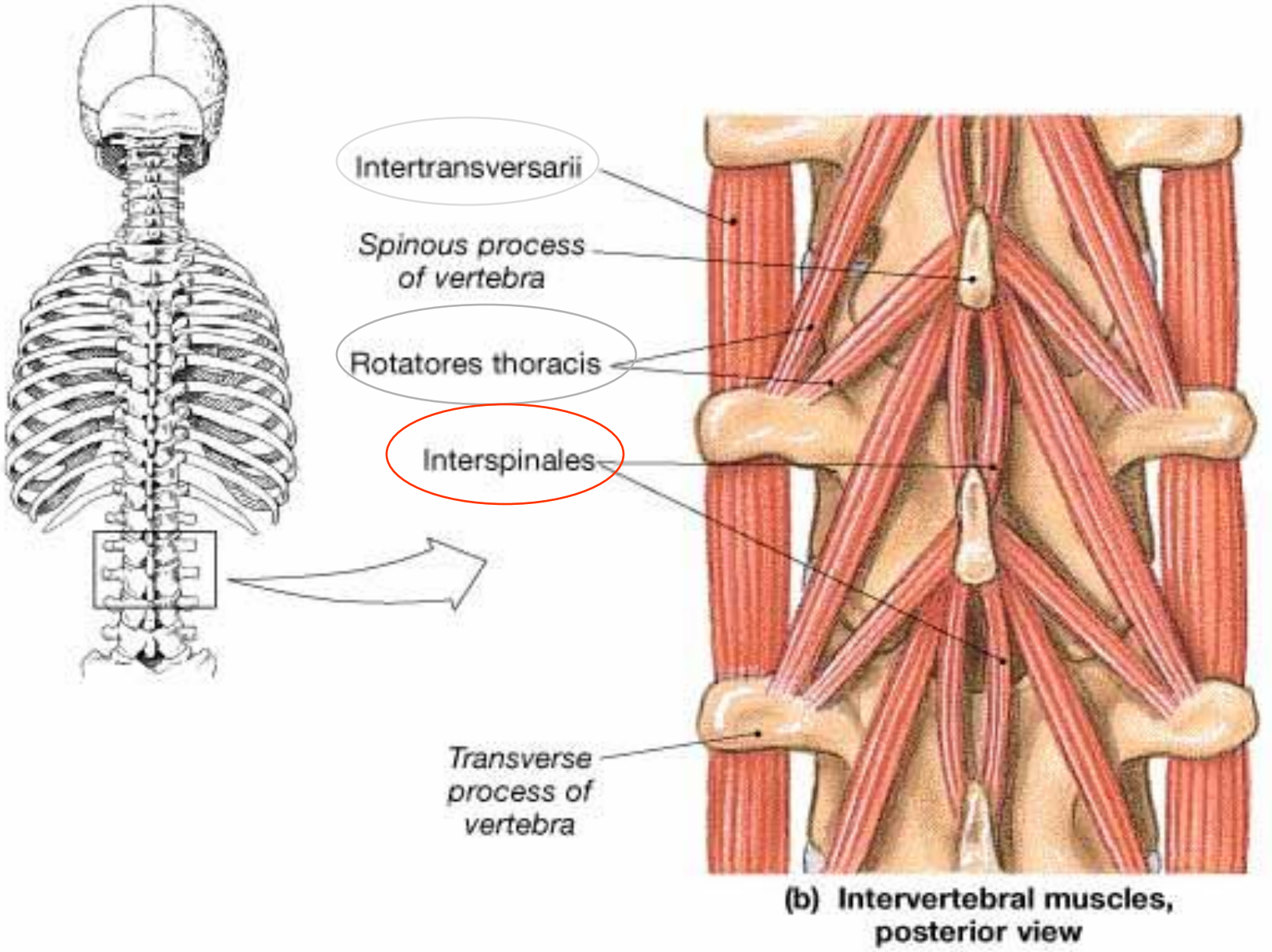
From Norris (1993)

Anatomy of the posterior trunk (or back)



(a) The erector spinae, posterior view

Intervertebral (deep) muscles



The abdominal corset

(Transverse abdominis)

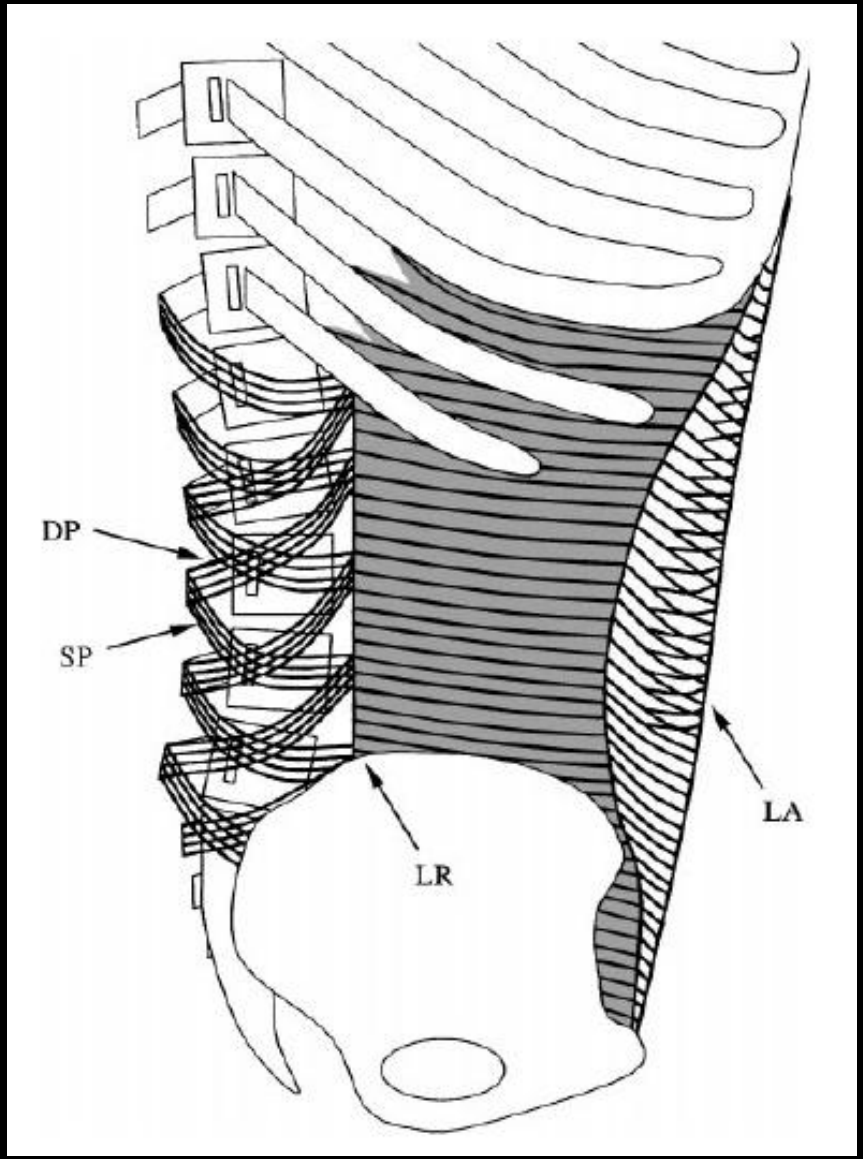


Fig. 1—Anatomy of transversus abdominis. The attachments of tranversus abdominis to the lumbar vertebrae via middle and anterior layers of the thoracolumbar fascia are not shown. To demonstrate the bilaminar fascial attachment of the posterior layer of the thoracolumbar fascia it is shown connecting only to the spinous processes. LR – lateral raphe, LA – linae alba, SP – superficial lamina of the posterior layer of the thoracolumbar fasica, DP – deep lamina of the posterior layer of the thoracolumbar fascia.

From Hodges, 1999

Spine stabilization is dependent on:

- The structure of the bone and the articulations (joints)
- The intervertebral discs
- The articular capsule and the accessary ligaments that surround the joint
  - These structures are considered passive
- The musculature and neural control
  - These structures are considered active

However……..

- The *musculature* is considered the most important of the structures in maintaining core stability under various conditions

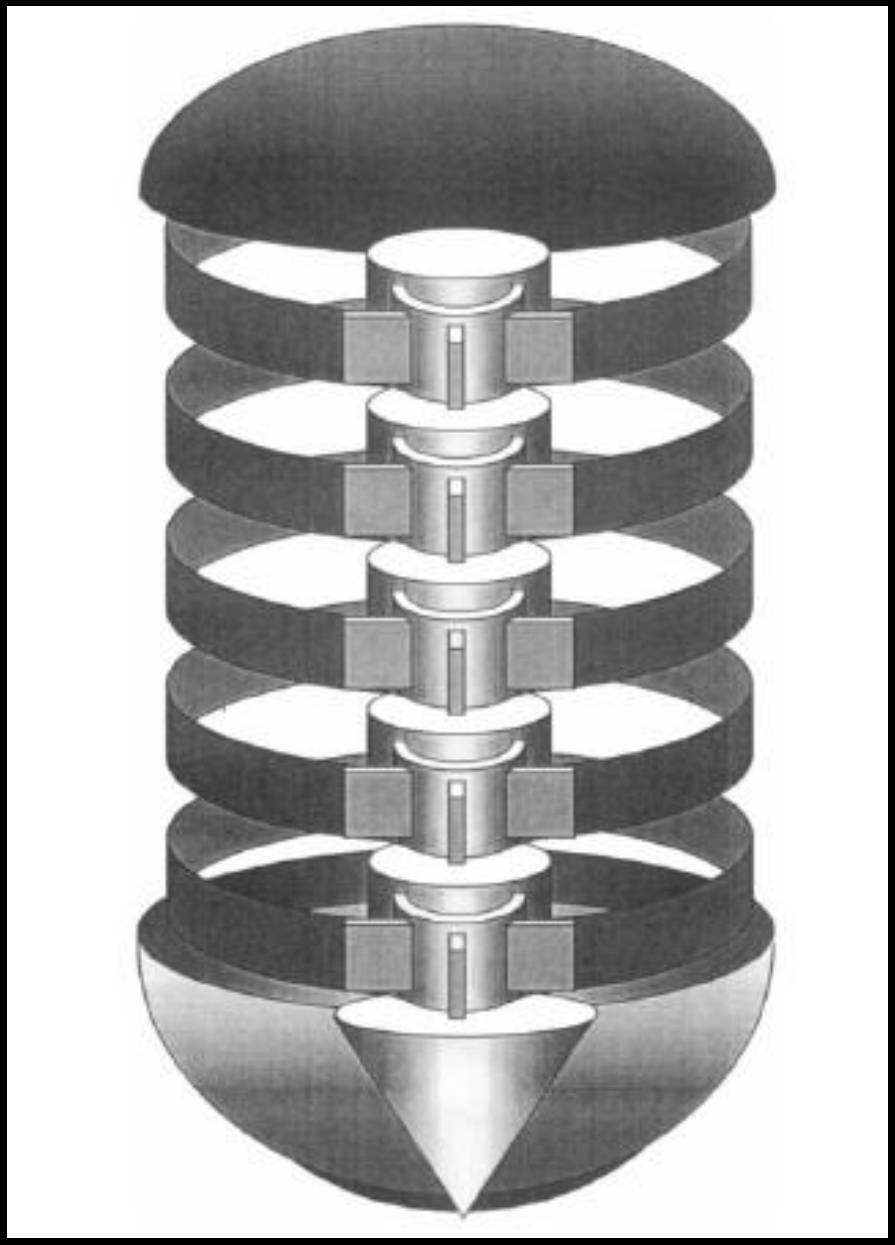


Fig. 6—Diagrammatic representation of the abdominal 'canister' formed by co-activation of the diaphragm, transversus abdominis and the pelvic floor. Activation of all muscles of this canister is required in order for abdominal contents to be controlled and for contraction of transversus abdominis to increase the pressure in the abdominal cavity and increase the tension in the thoracolumbar fascia.

From Hodges, 1999

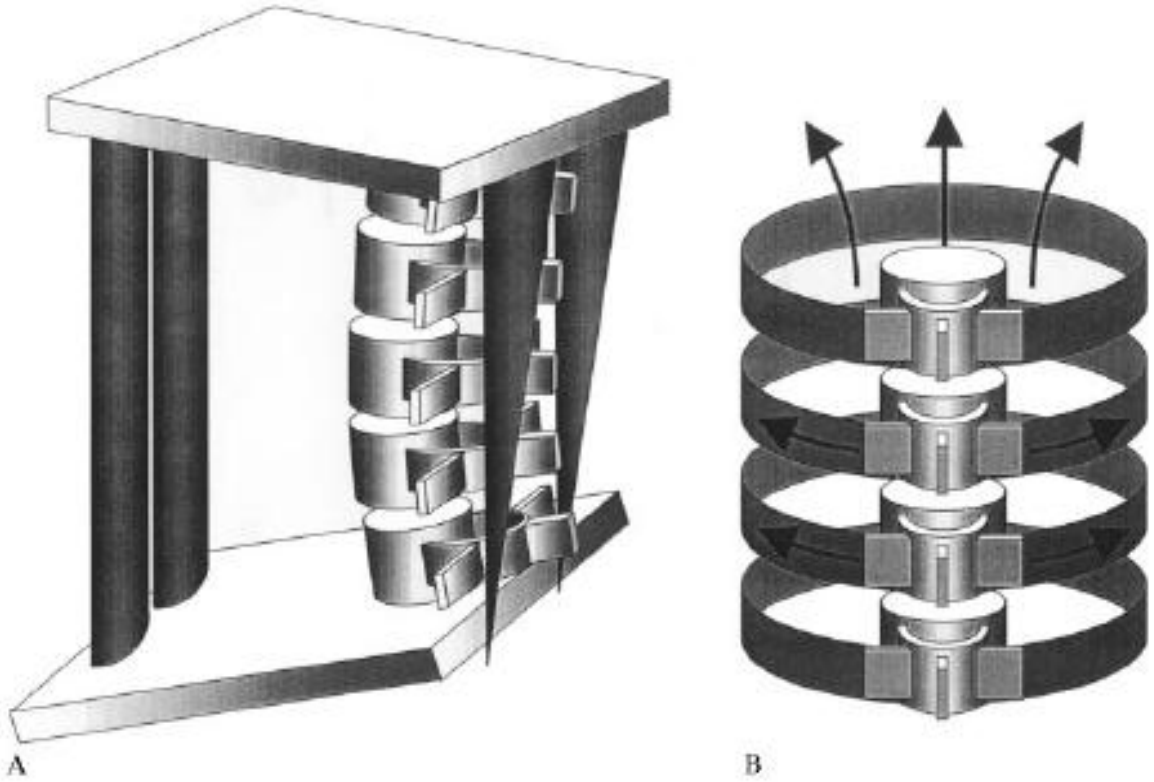
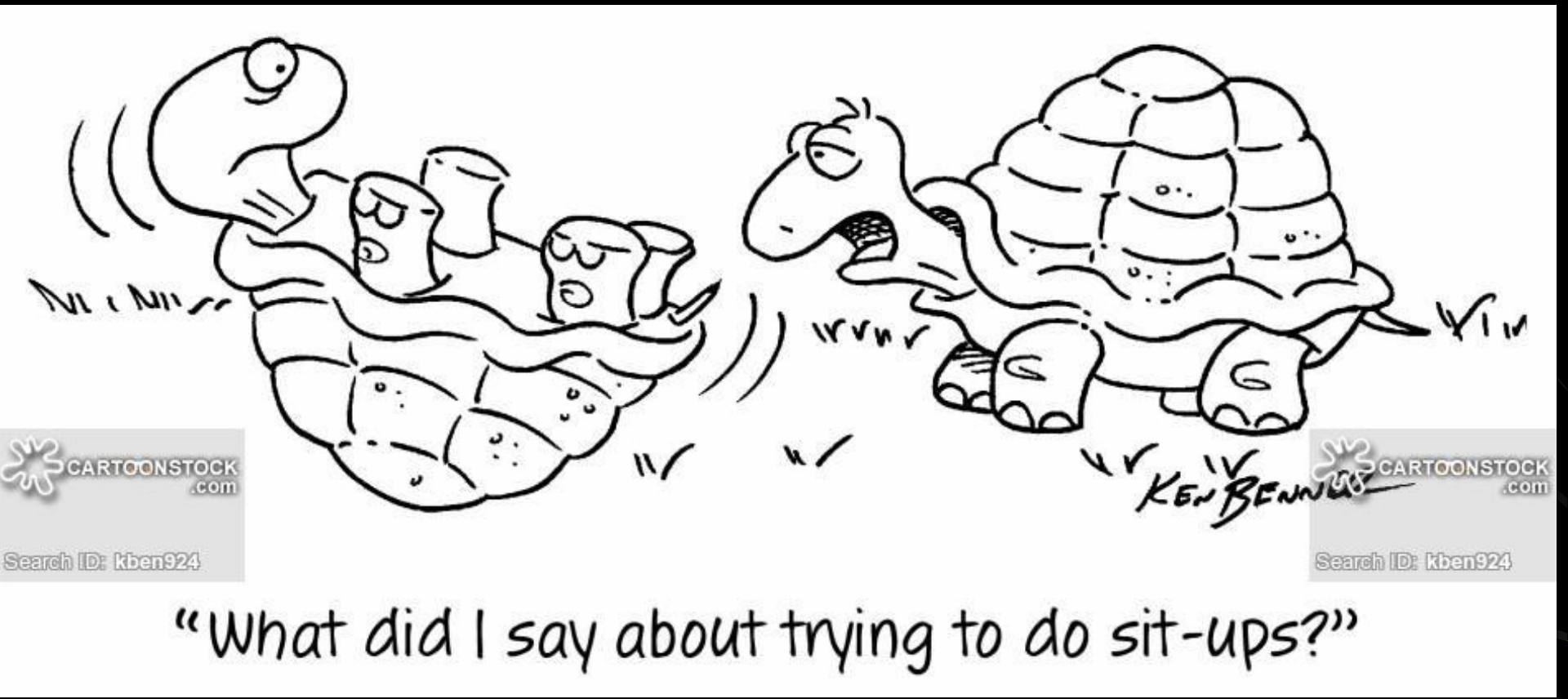


Fig. 7—Model for the differential contribution of the trunk muscles to spinal stability. (A) The superficial trunk muscles (rectus abdominis, obliquus externus abdominis, obliquus internus abdominis and erector spinae) have the mechanical advantage to control the overall orientation or posture of the spine. (B) In contrast, transversus abdominis is unable to directly control external forces and may control intersegmental motion in a general manner by increasing the pressure in the abdominal cavity and tension in the thoracolumbar fascia.

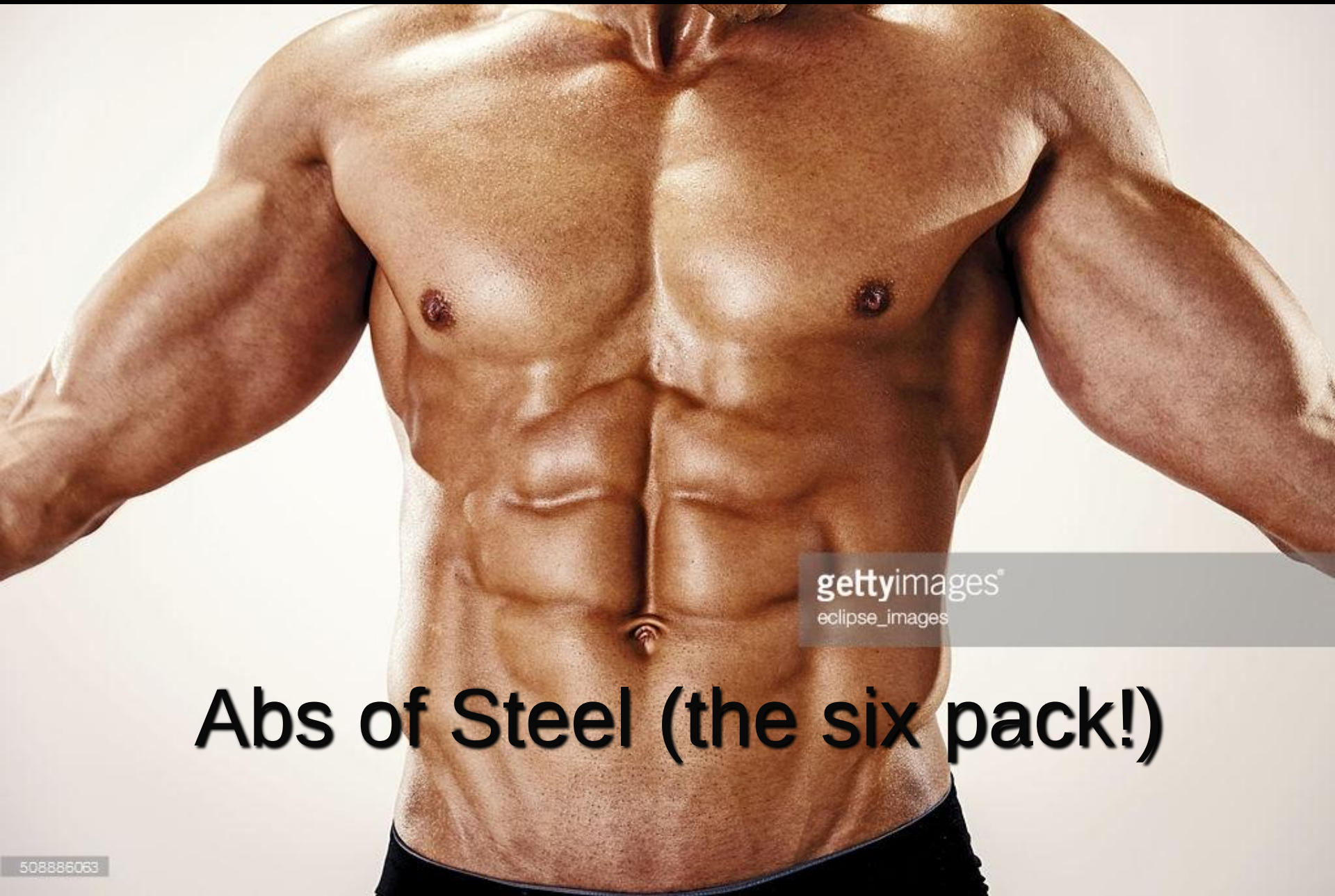
From Hodges, 1999



"What did I say about trying to do sit-ups?"

From this.....

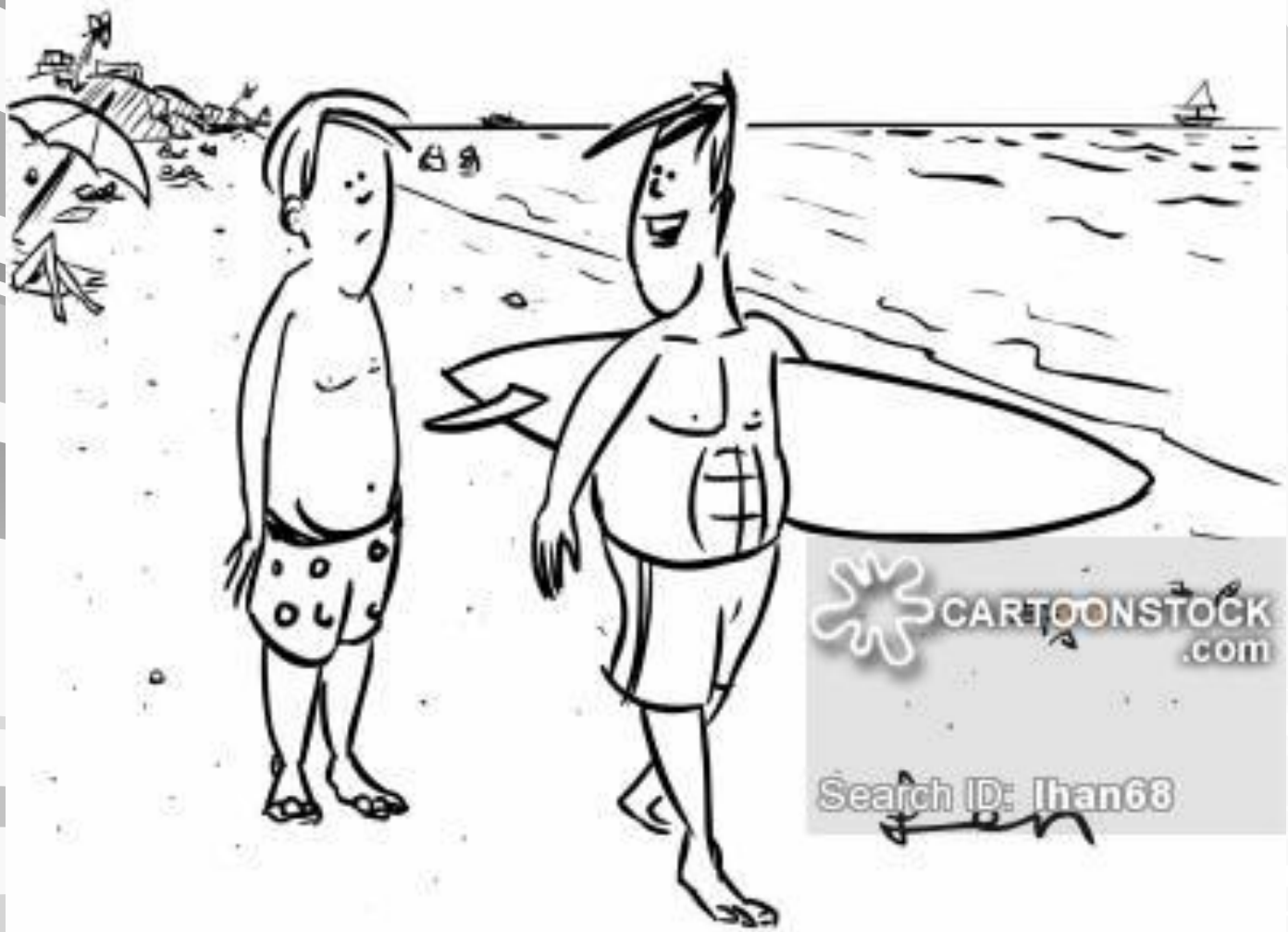
To this.....



Abs of Steel (the six pack!)

OR.....

OR.....



"The secret to great abs? Marker pen."

Exercising for core stability! What about sit ups?

Some key points about core exercises

(Stuart McGill and David Docherty)

- Do not “brace” the feet
- Do not go to full flexion
- Tighten (pre-activate) the stomach muscles before moving
- Lift with the stomach muscles and not the shoulders and neck.
  - *Pivot on the hips (pelvis) and not the upper back.*
- Try and keep a neutral pelvis (DO NOT arch the back)

Progressions

- Chair exercises (video)
- Progressing bridge exercises
  - Start easy and build
  - Increase the time of the held positions
  - “The Big Three” or maybe four! (video)
- More advance/challenging exercises!

https://www.youtube.com/watch?v=SOQCA3RsHH0

https://www.youtube.com/watch?v=d2-B-BPmlPA

Progressions

- Chair exercises (demonstrations)
- https://www.youtube.com/watch?v=d2-B-BPmlPA
- The Big Three/Four
- https://www.youtube.com/watch?v=033ogPH6NNE
- Progressing bridge exercises
  - Start easy and build
  - Increase the time of the held positions
  - “The Big Three or Four”
- More advance/challenging exercises!

Beginners program sequence

- Cat-camel warm up and cool down (5-6 cycles)
- Activating the core muscles
- Anterior abdominal exercise (curl up with one knee extended and one knee flexed)
- Lateral musculature (side bridge)
- Roll-overs (side-front-side bridges)
- [extensor program]
- [raise hand held weight while bracing]

McGill, 2001

- Shoulder (back) bridge

The curl-up is performed by raising the head and the upper shoulders off the floor. The motion takes place in the thoracic spine – not the lumbar or cervical region. To begin, the hands are placed under the lumbar region to support a neutral curvature. The exercise is made more challenging by raising the elbows off the floor. Even more challenging is first performing an abdominal brace (activating the abdominal muscles), and then curling up against the brace. Hold the posture for 7-8 seconds. Do not hold the breath but breath deeply. Do not increase the challenge by increasing the intensity of the abdominal brace. This will groove desirable motor patterns. Choose the most appropriate level of challenge.

Side bridge

Front (prone) bridge/plank

An advanced level side bridge involves holding the posture on one side for 7-8 seconds and the “rolling” over to the other, and repeating as endurance is increased. It is critical to lock the pelvis to the rib cage, via an abdominal brace, so that the spine remains rigid during the rolling. Finally, add deep breathing while in this posture. The rolling action with the breathing will prepare many people to meet any challenge with a stable spine.

The back extensors (both the lumbar and thoracic are important) are challenged with the birddog. But only one half of these muscles are challenged at a time by lifting the alternate arm and leg. This reduces the spine load to about a half of that produced during traditional spine extension exercises such as roman chair extensions. Begin on the hands and knees and hold the posture for 7-8 seconds. Then lower the hand and knee, and "sweep" the floor with them and raise them again for the next repetition. This motion will enhance the stabilizing patterns. Switch sides as appropriate. The abdominal muscle are braced throughout.

The Big Three!

https://www.youtube.com/watch?v=033ogPH6NNE


how many more sit ups?
ICANHASCHEEZBURGER.COM

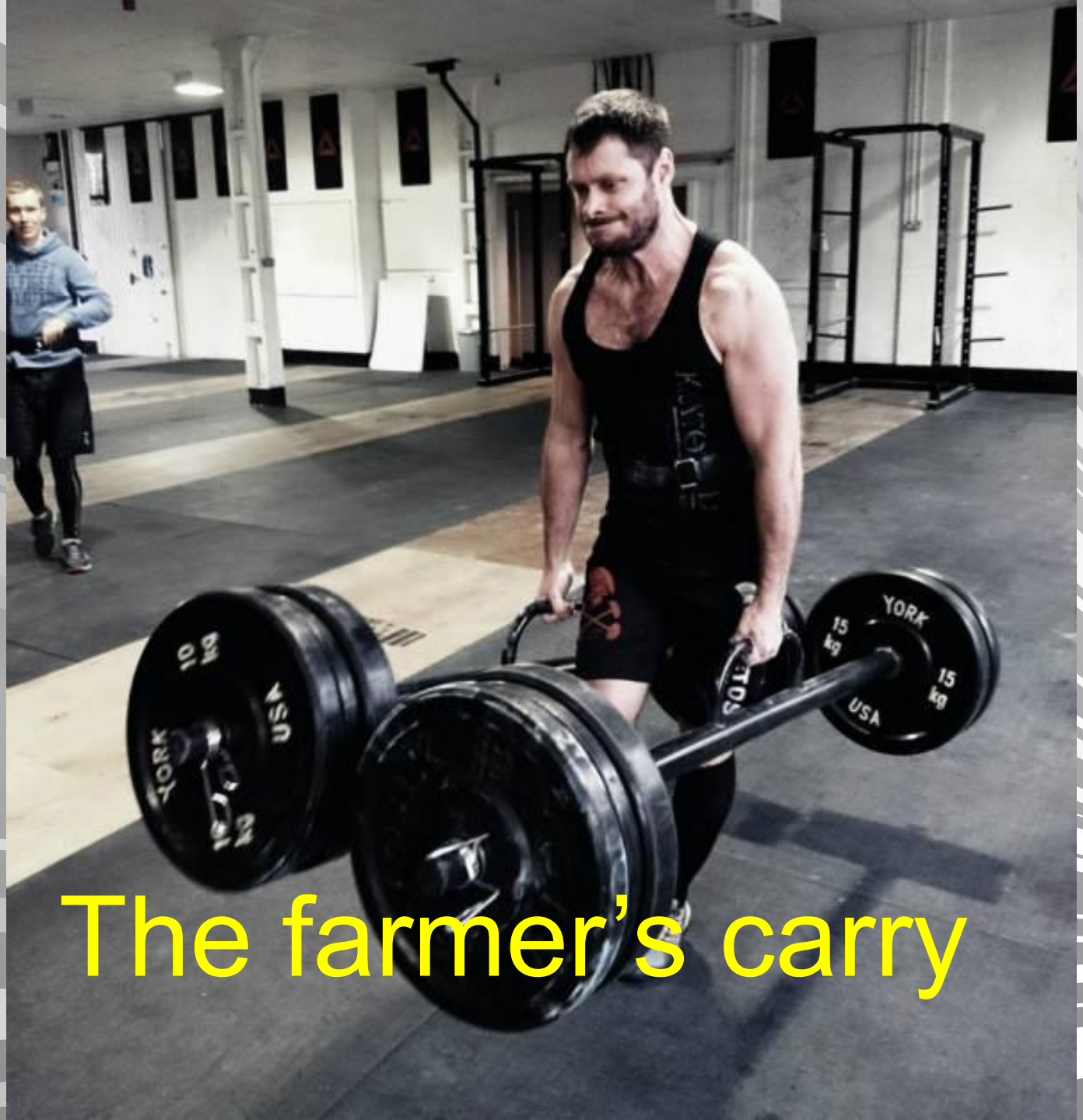
A word of caution!

Exercises for the Glutes

And one more.....

A note of caution!

More advanced exercises



The farmer’s carry

A real farmer’s carry!


Start


2.


Finish

Figure 4. Prone bridge—hip extension.

Faries and Greenwood (2007)

Figure 6. Side bridge abduction.

Faries and Greenwood (2007)

Figure 8. T rotation.

Faries and Greenwood (2007)

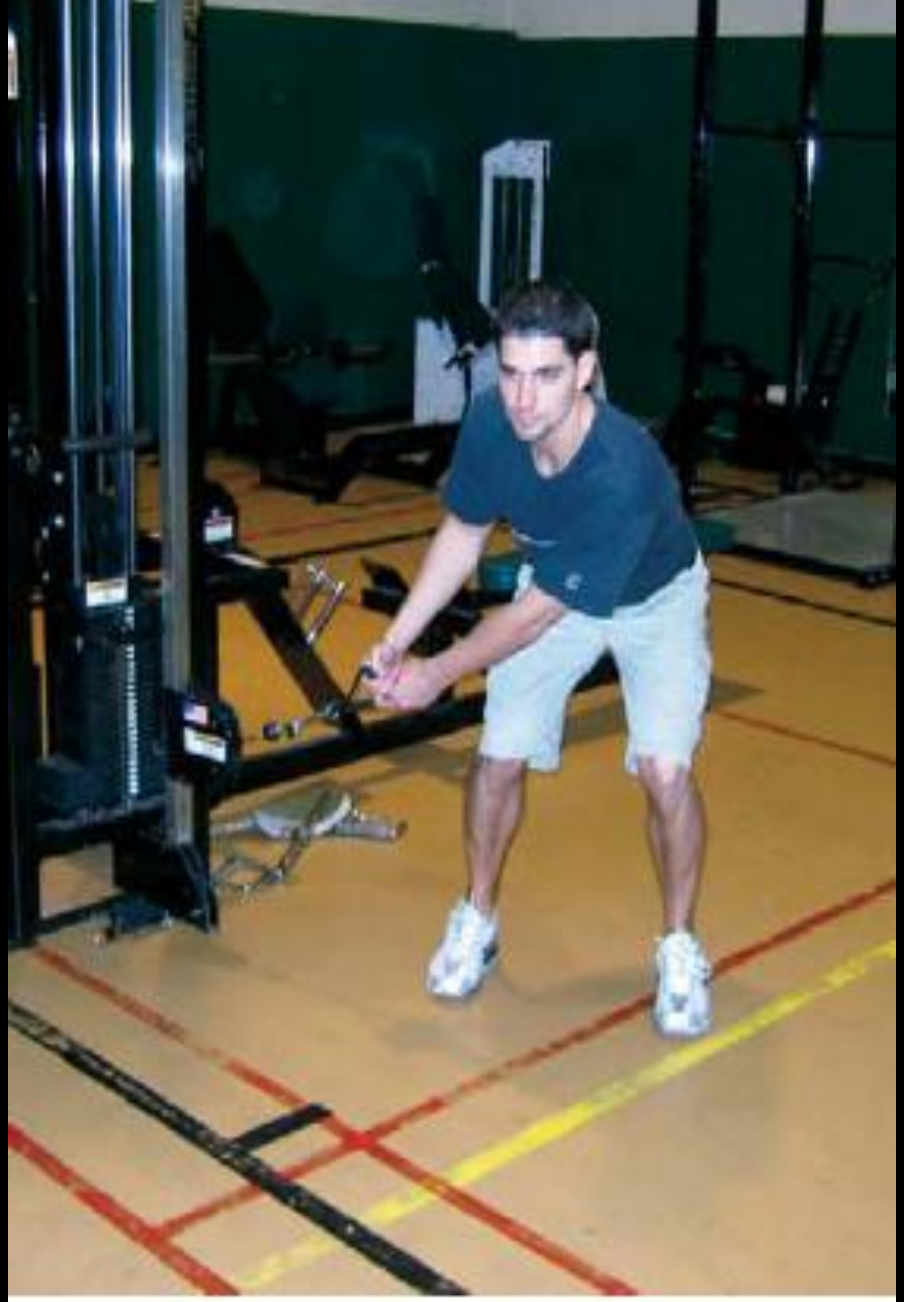
Figure 9. Twist on ball.

Faries and Greenwood (2007)

Figure 10. Cable wood chop.

Faries and Greenwood (2007)

Faries and Greenwood (2007)



Cable reverse wood chop.

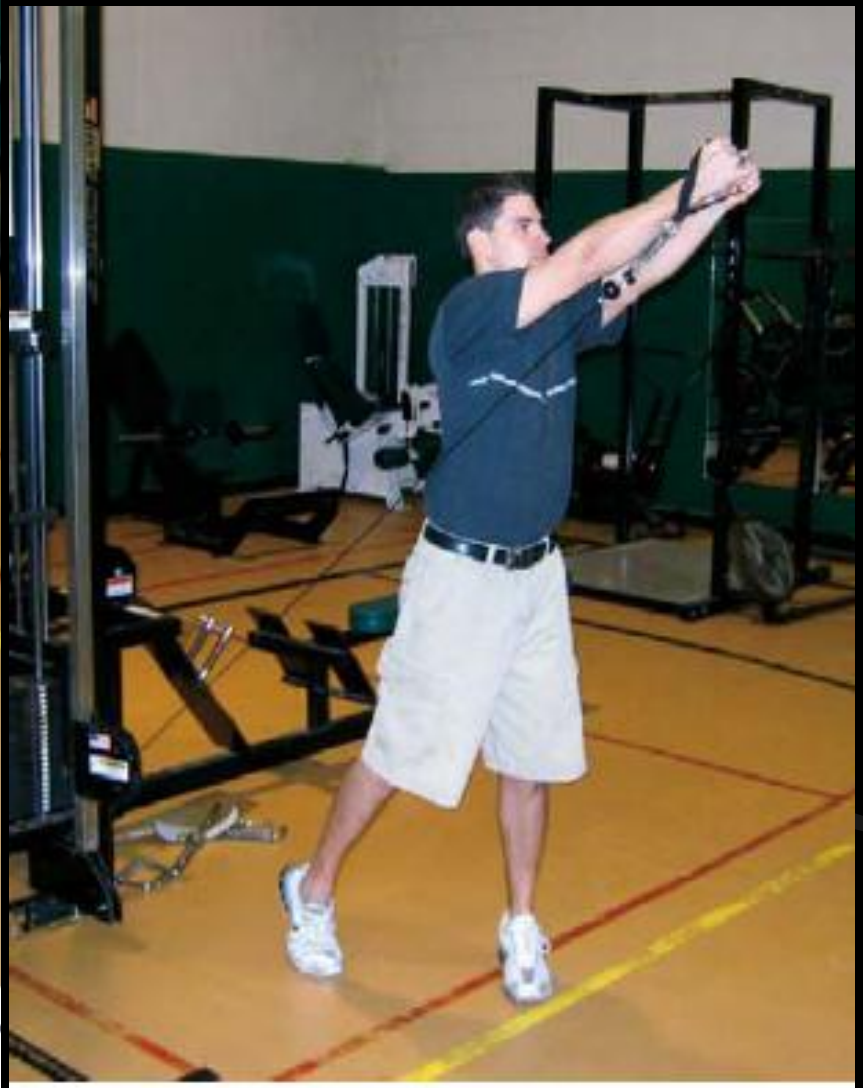


Figure 14. Two arm/single arm chest press functional progression.

Faries and Greenwood (2007)

Cooling down

The cat and camel exercise is a motion exercise and not a stretch. Good form includes the integration of the cervical spine with the lumbar and thoracic spine. All three sections of the spine should be flexed and extended together.

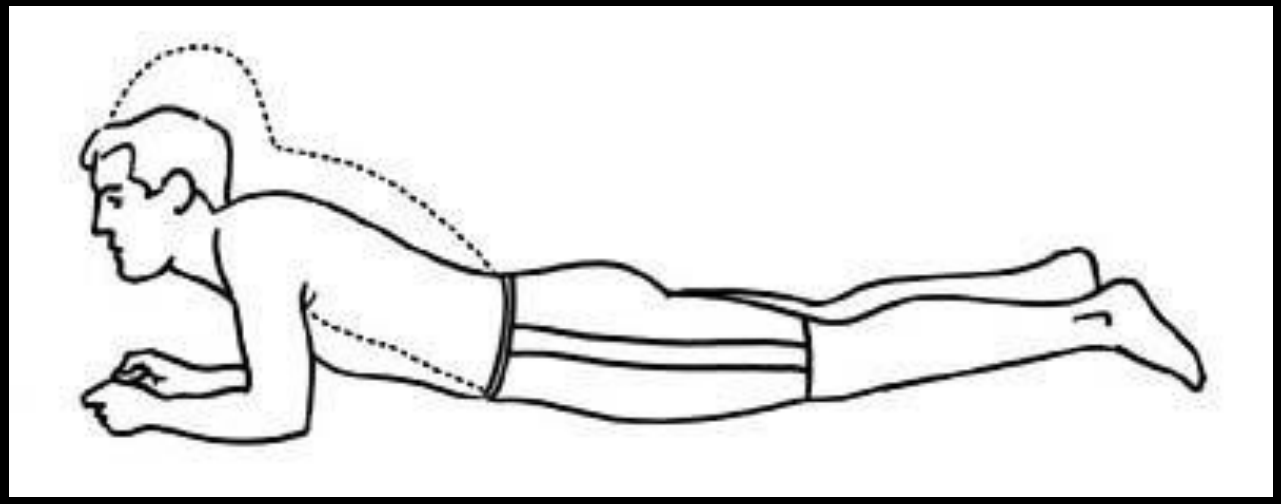


Fig 1: Rise up on elbows, keeping hips on floor.

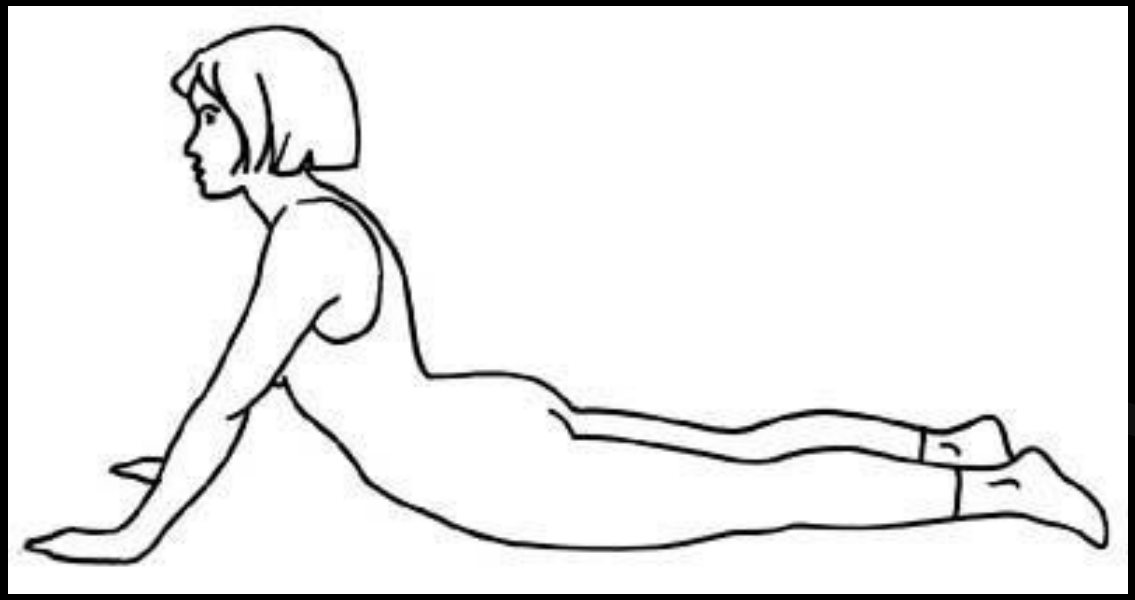
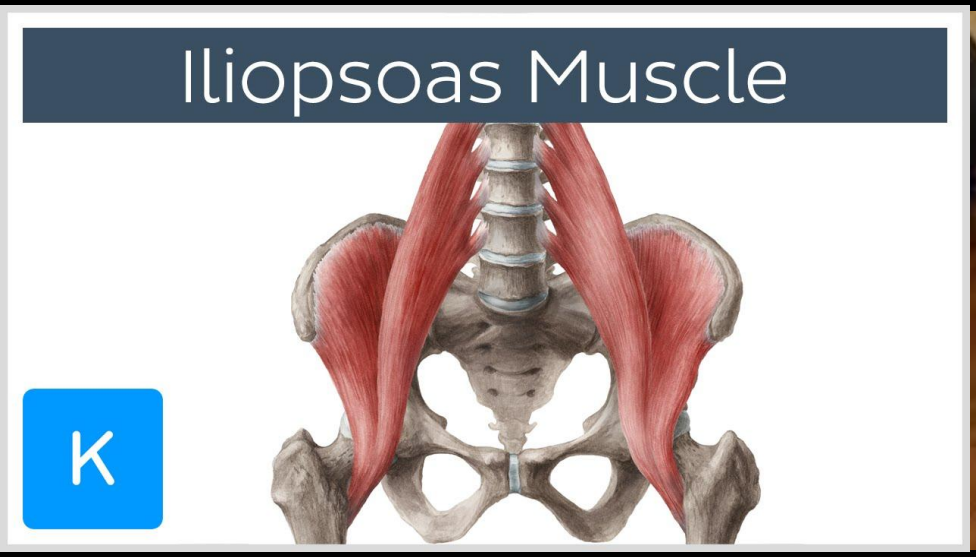


Fig 2: Press up on hands slowly, ***keeping hips in contact with floor***. Relax low back and buttocks.

Stretch the hip flexors




Questions?

Start Position
Lie supine (on back), Knees bent 90º, legs open
Arms extended at sides, soft elbows. Inhale to prepare

Step 2
Exhale. Tilt pelvis, rolling through spine to shoulder bridge
Keep weight on upper back and **not on neck**

Step 3
Inhale. Hold the bridge position

Step 4
Exhale. Roll down one vertebra at a time, lengthening spine to start position