Doctor 021

MSS
ANATOMY

#1

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Anatomy of Back

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outline

- Alignment of spine
- Anatomy of vertebrae column
- Anatomy of bone , muscles.
- Clinical applications

Learning outcome

- To Identify different parts of vertebra.
- To understand the importance of the anatomy of the spine.
- To understand the difference between different parts of the spine.
- To apply the basic knowledge to clinical practice

reference

Clinical anatomy for medical students

R.S. SNell

- Today we are going to talk about the anatomy of the back (the bony parts).
- The vertebral column is the central bony pillar of the body
- Remember that the axial skeleton is composed from:
- 1-the skull, 2- vertebral column, 3- the pelvis , so the central part is the vertebral column.
- It consists of multiple bony pieces that are called vertebrae, between them there is fibrocartilaginous tissue called intervertebral discs, these discs act as shock absorbents, because we are always under the effect of gravity.
- Without these discs, and under the continuous pressure of gravity, the bone will be destroyed and broken, so the intervertebral discs act as a pillow for shock absorption.

They are called according to their location:

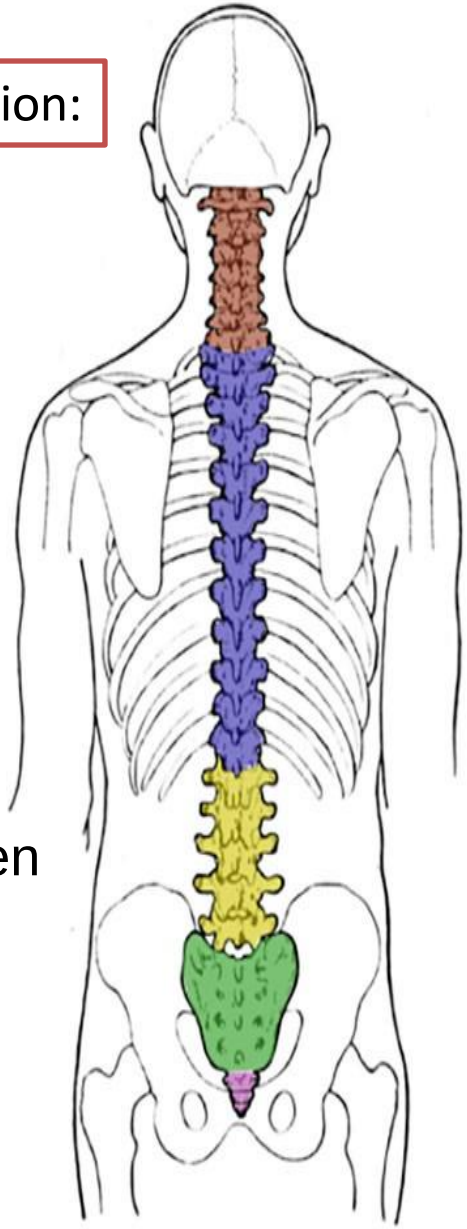
7 Cervical → in the neck

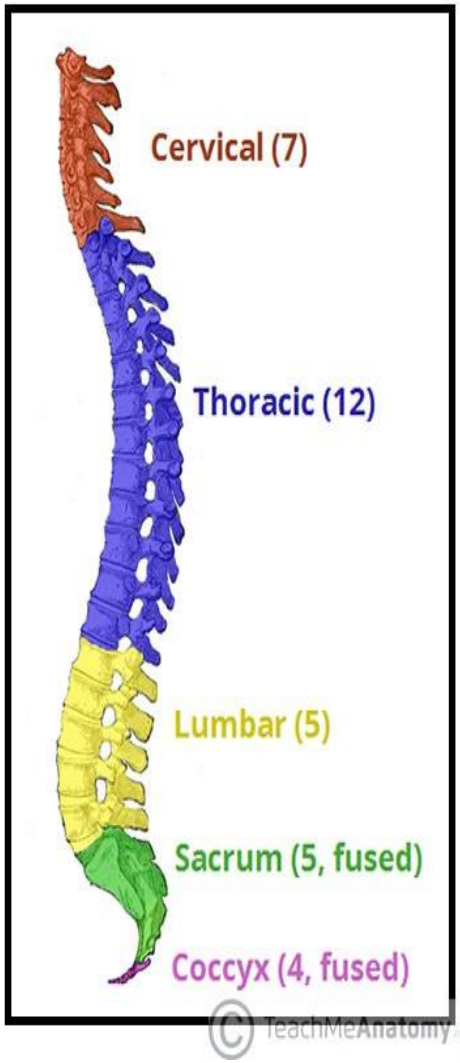
12 Thoracic → in the chest

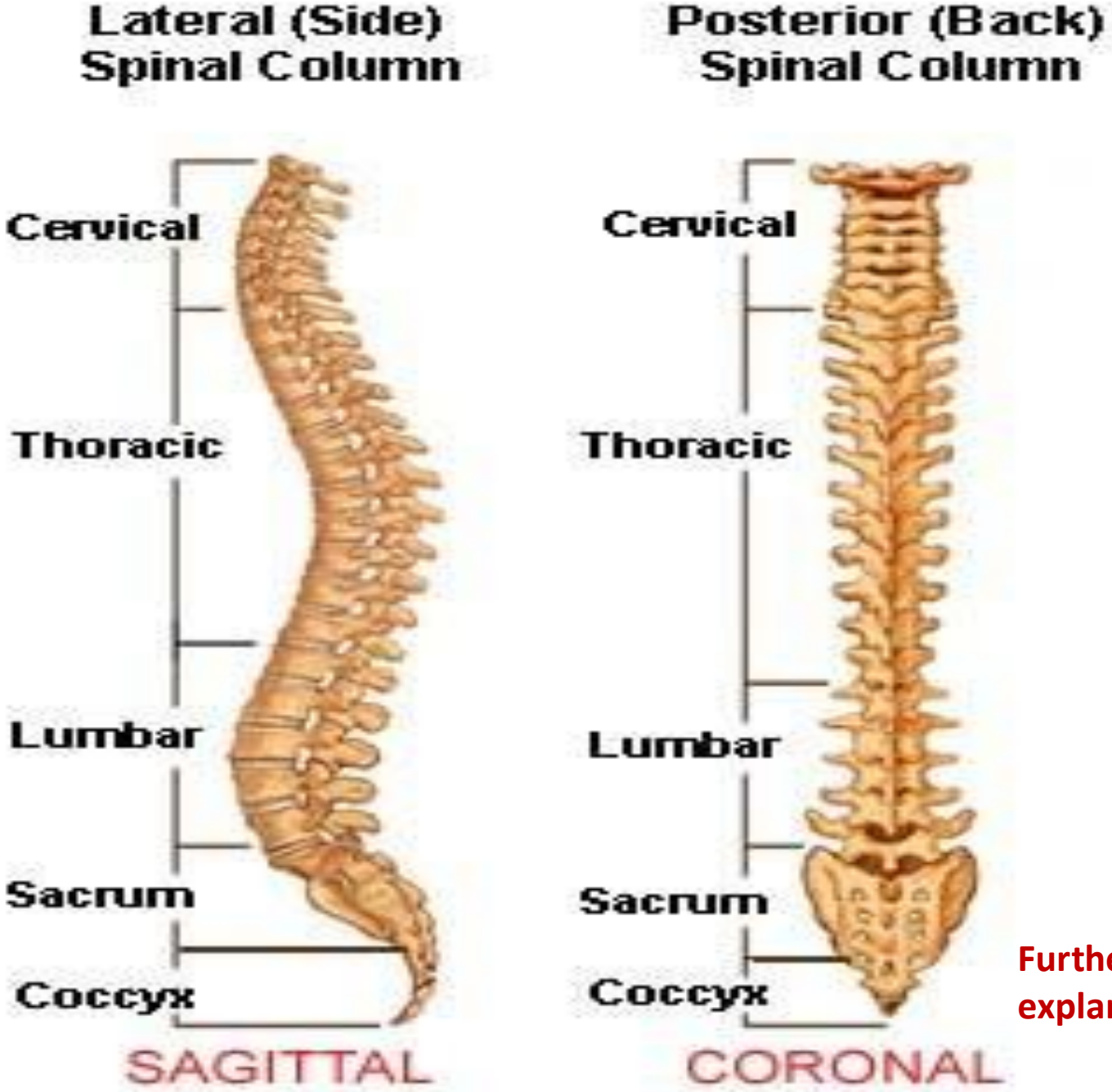
5 Lumbar → in the abdomen

5 Sacrum → in the pelvis

Coccyx → in the pelvis

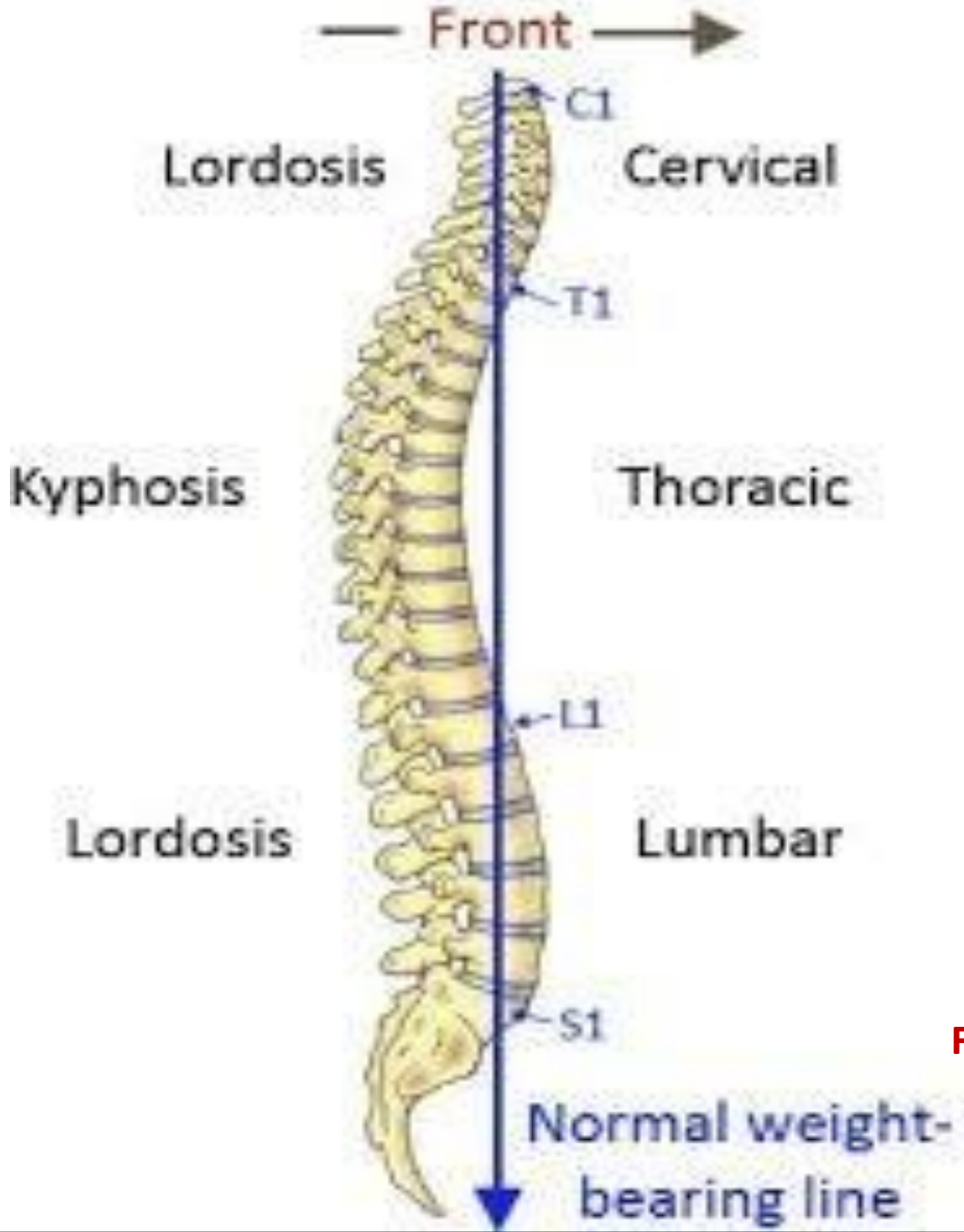






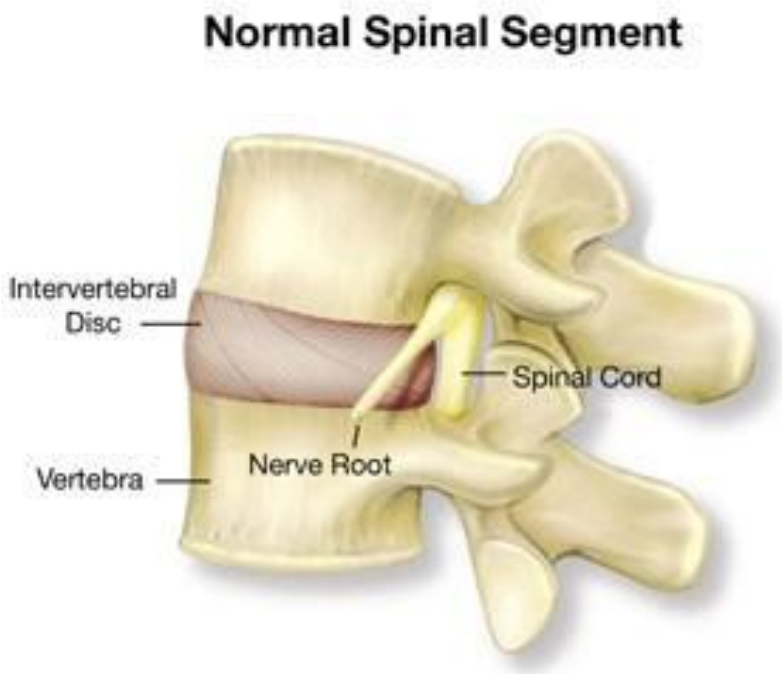
Further explanation→

- The alignment of the vertebral column is peculiar.
- In the AP (anterior posterior) view - examines the lungs, bony thoracic cavity, mediastinum, and great vessels (google)- it is straight, because the main and most important function of the vertebral column is to maintain the head central over the pelvis in order to allow our brain to work in equilibrium - our right side should always be equal to our left side.
- It has other functions like the protection of the spinal cord and the spinal nerves.
- In the lateral View, the vertebral column is curvy in shape, and there are different types of curves:
  - Lordosis: convex anteriorly, like the cervical and the lumbar curves
  - Kyphosis: convex posteriorly, like the thoracic and the sacral curves.



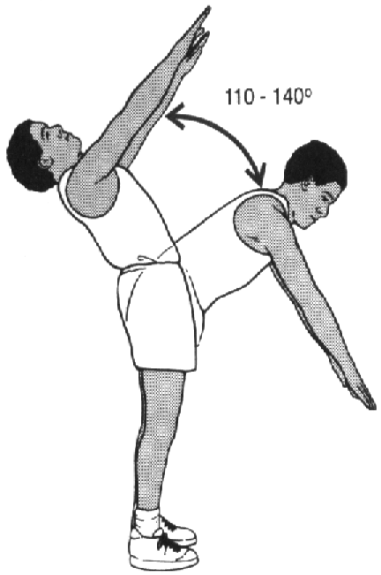
Further explanation→

- The gravity line -the line of gravity is an imaginary vertical line from the center of gravity to the ground or surface the object or person is on (google)- passes through parts of the vertebral column.
- If the gravity line passed through the whole vertebral column, the vertebrae would be destroyed.
- The curves allow the gravity line to pass 50% anterior to the vertebral column and 50% posterior to the vertebral column.
- In this way, most of the vertebral column is away from the gravity line, except at certain points : C1, T1, L1, S1, which are the points where the gravity line touches the vertebral column.
- From C1 to T1 the gravity line is posterior to the vertebral column.
- From T1 to L1 the gravity line is anterior to the vertebral column.
- From L1 to S1 the gravity line is posterior to the vertebral column.
- From S1 to the end of the vertebral column the gravity line is anterior to the column.
- Any change in this alignment would causes problems - fractures, pain, etc...-.



- The vertebral column is divided into many segments.
- A segment is two vertebrae and the disc between them.
- So the segment is the functional unit of the vertebral column, and we can consider it as a joint.
- So we have multiple segments and multiple joints.
- These joints are very important because they give the vertebral column its flexibility.

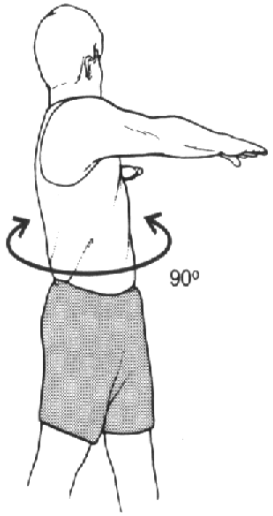
- **collectively – LARGE ROM**
- **flex/ ext**
- **L-R rotation**
- **L-R lateral flexion**



Flexion and Extension

Lateral Flexion

- The vertebral column is highly flexible.
- we can do flexion, extension, bending and rotation.
- Also we can do complex motions (a combination of the previously mentioned movements, like flexion and bending, at the same time), no other joint can do this.



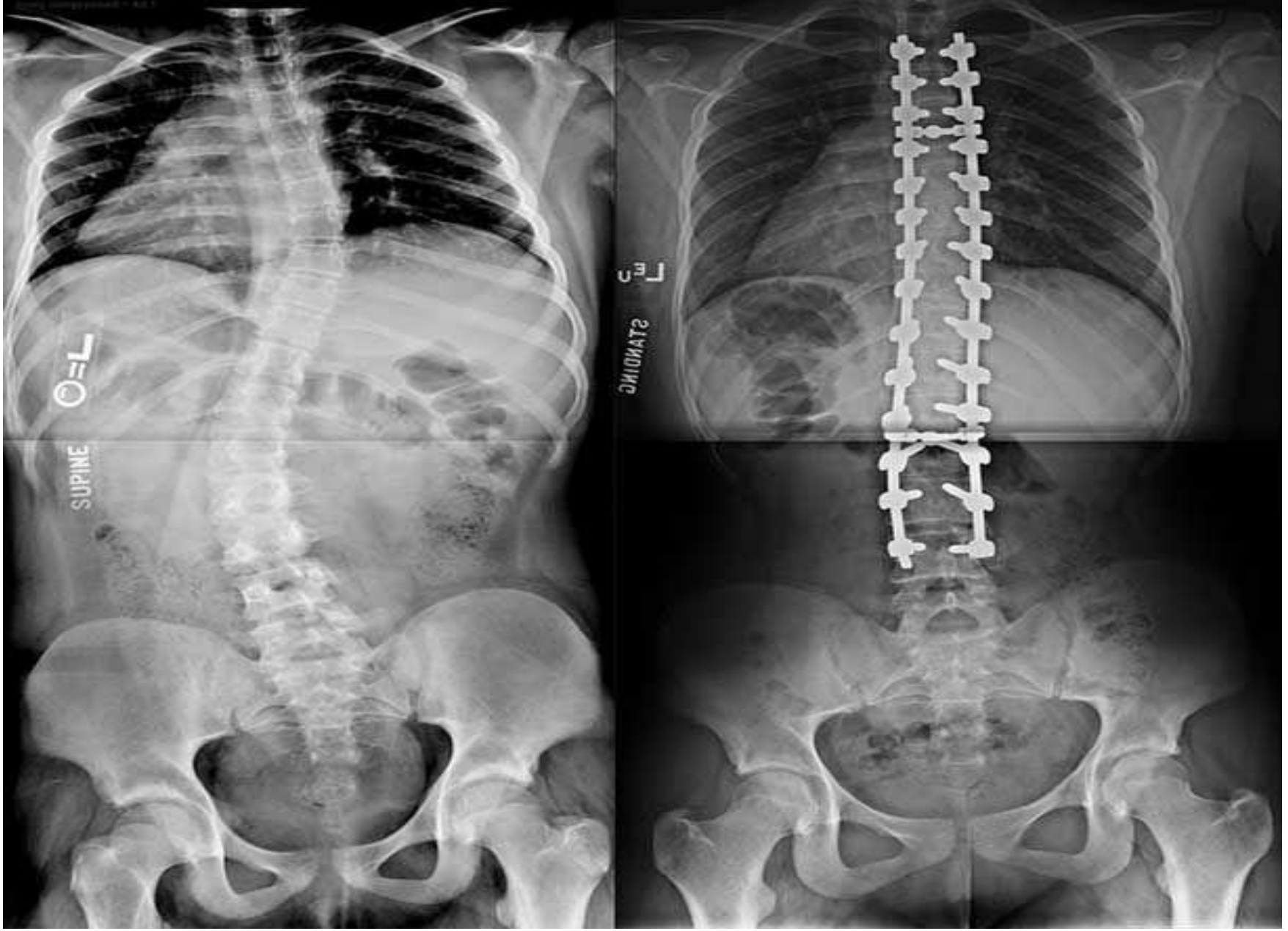
Rotation

Clinical case:

Further explanation→

Clinical case :

- This patient has lateral deviation of the spine (remember that the vertebral column must be straight in the AP view)
- This is called Scoliosis.
- The patient might suffer from:
  - pain
  - atrophy of the muscles of the **left** side because they are compressed due to the higher gravity effect on them in comparison to the opposite area.
  - ugly appearance because the scapula is more prominent than the other side.



The X-ray of the patient

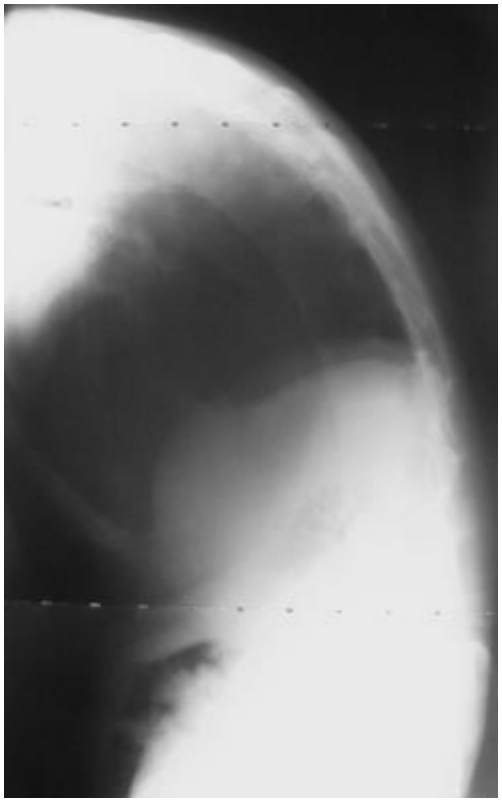
The post operative X-ray after the correction of her Scoliosis.

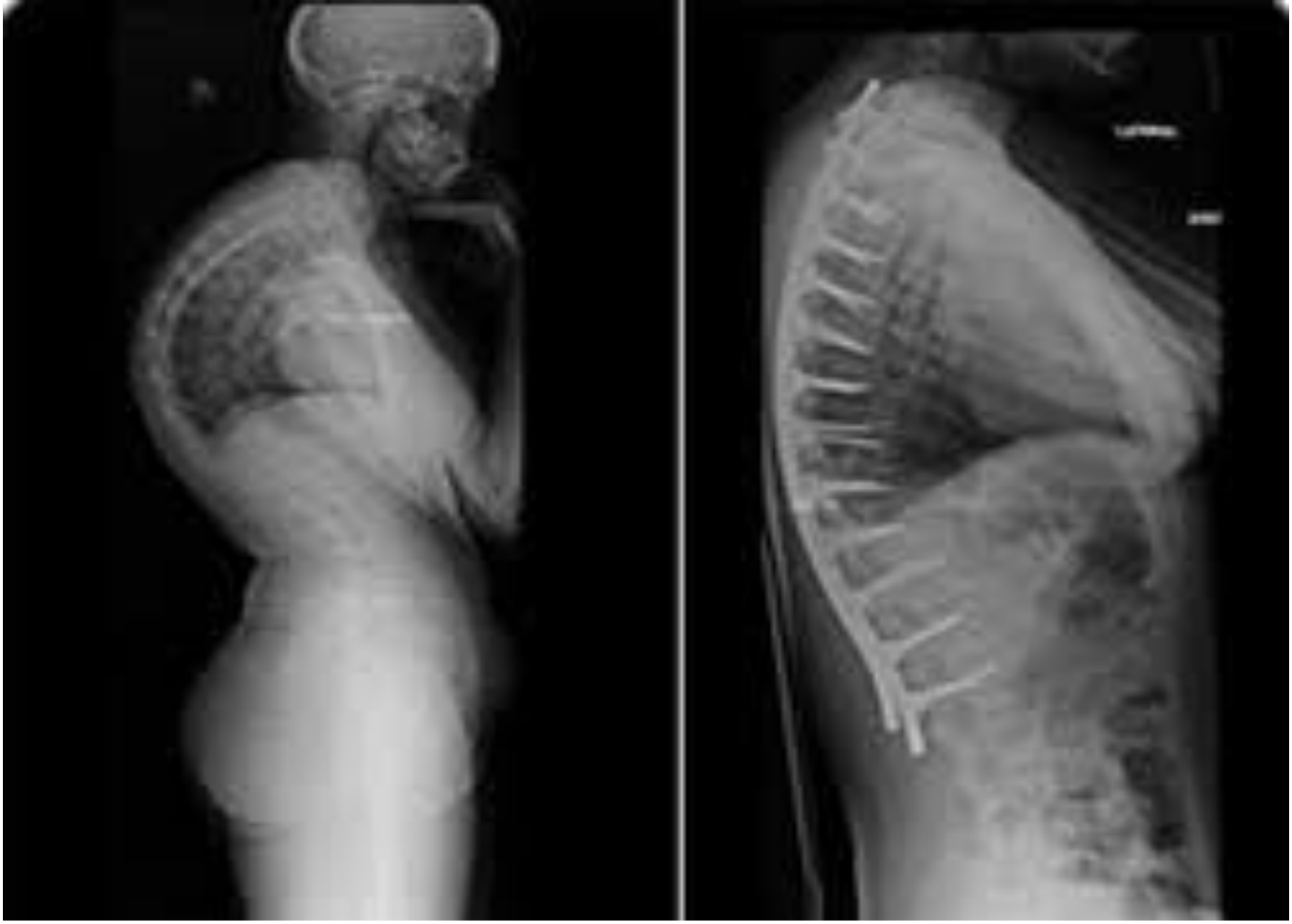
Ankylosing spondylitis

Clinical features

– Kyphotic posture

- This patient has ankylosing spondylitis.
- Ankylosing spondylitis patients have hyperkyphosis, which means that most of the gravity line is located anterior to the vertebral column.
- So that the patient does not have good muscles to extend his vertebral column, and the muscles of the back will be under continuous stretch causing the patient to suffer from severe back pain.
- The patient must regain the normal kyphosis and lordosis to reduce the pain and improve the his appearance.

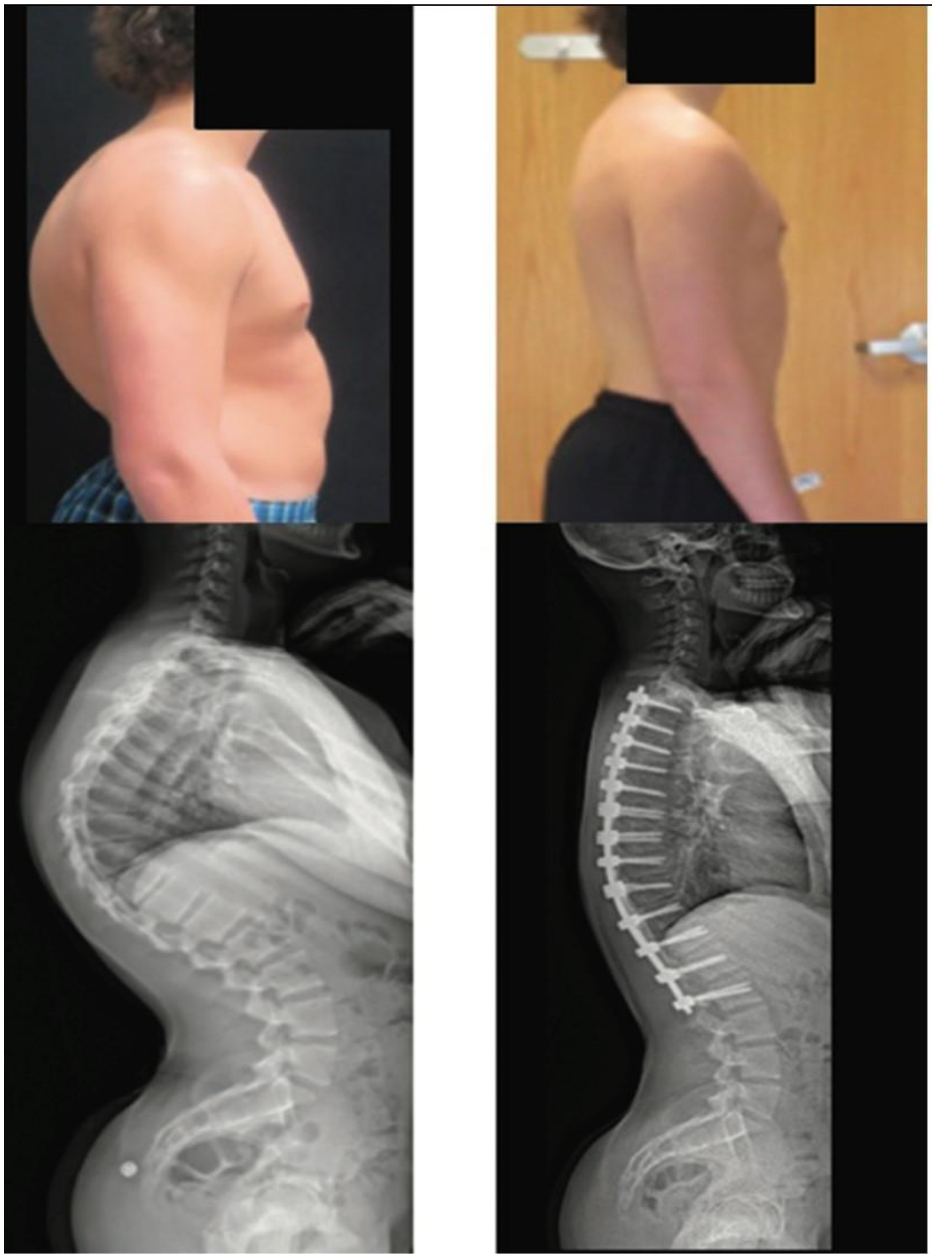




This patient has hyperkyphosis

This is after correction of the vertebral column.

This patient has hyperkyphosis



This is after correction of the vertebral column.

Types of vertebrae

There are multiple classification of the vertebrae, but this is the most important one:

1- typical, they have:

a-body

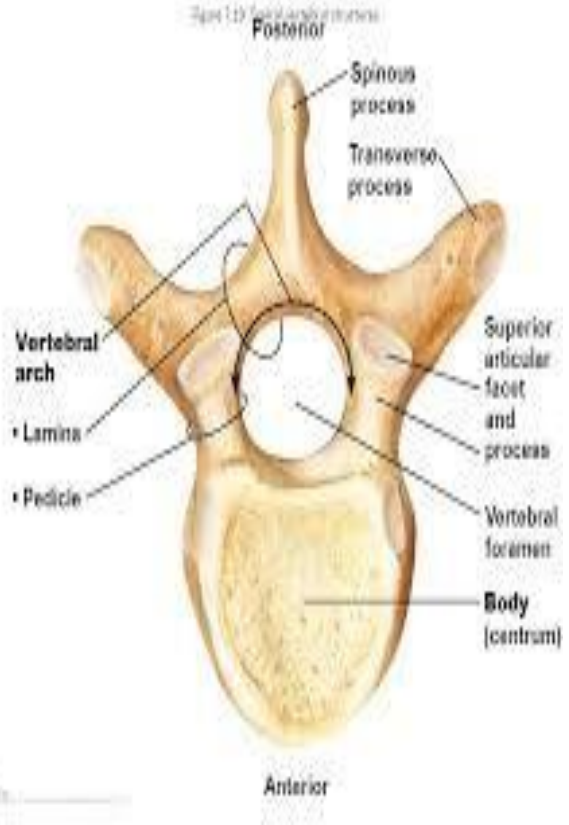
b-arch

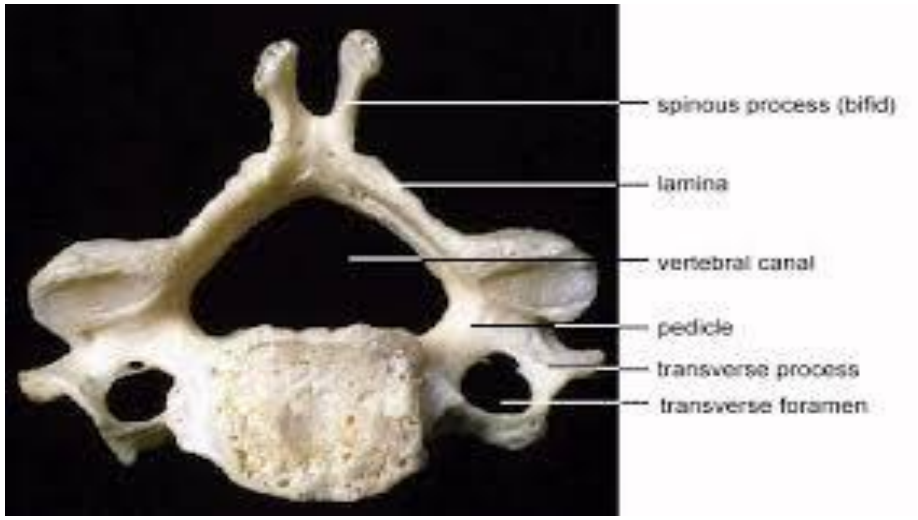
2-atypical, may have a body and an arch and:

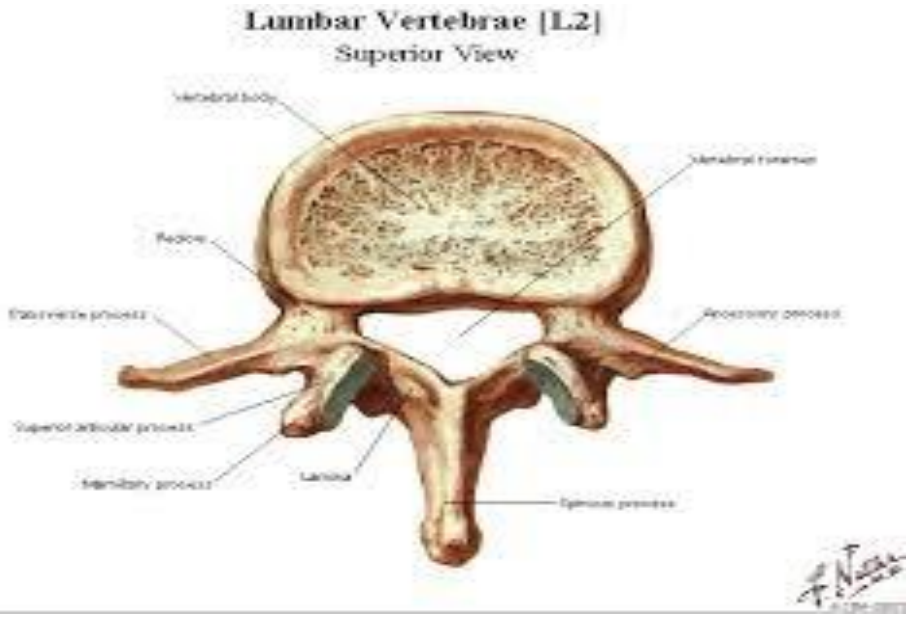
a-additional structures

or

b-fused

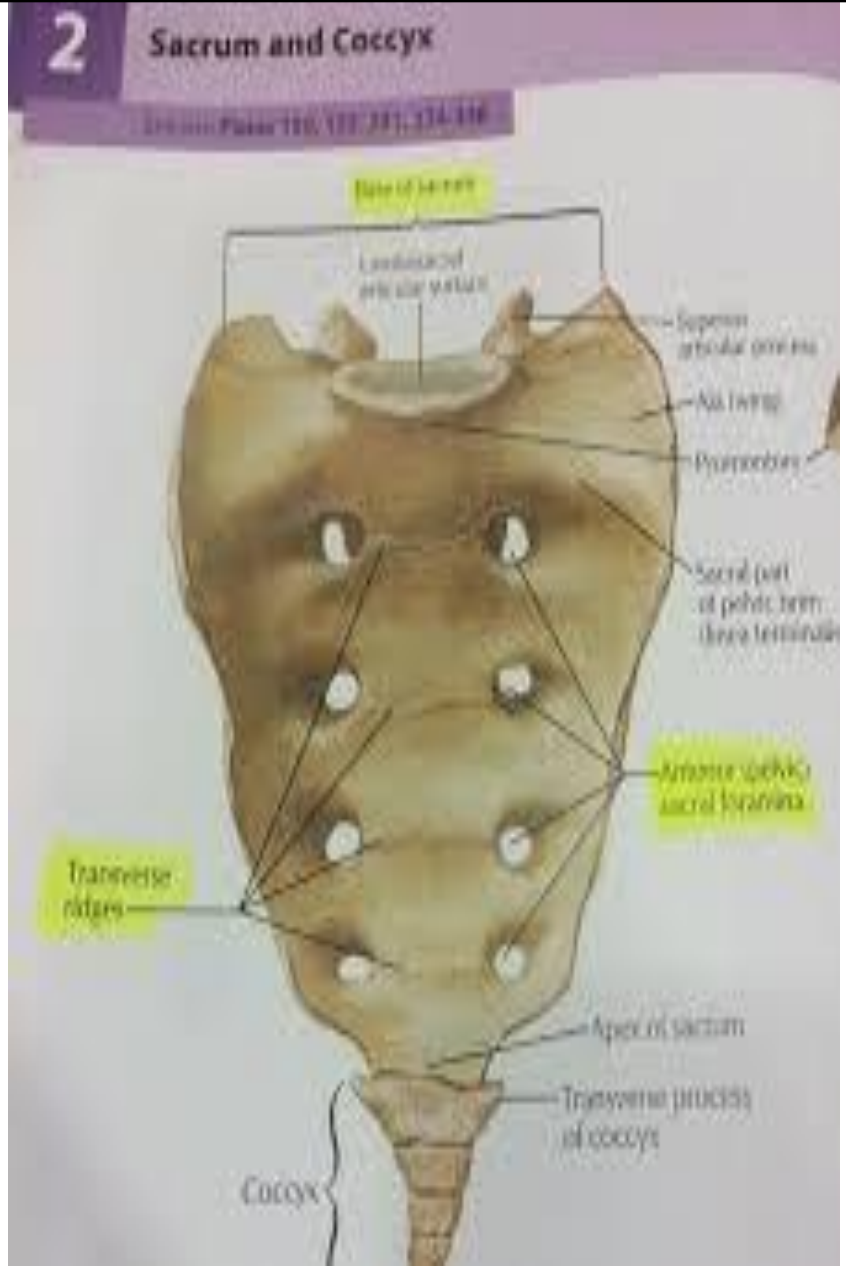




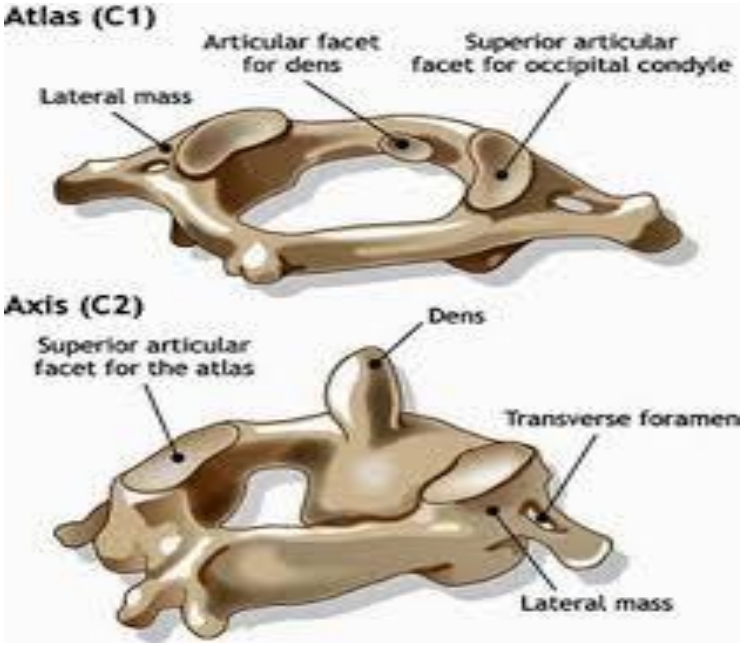


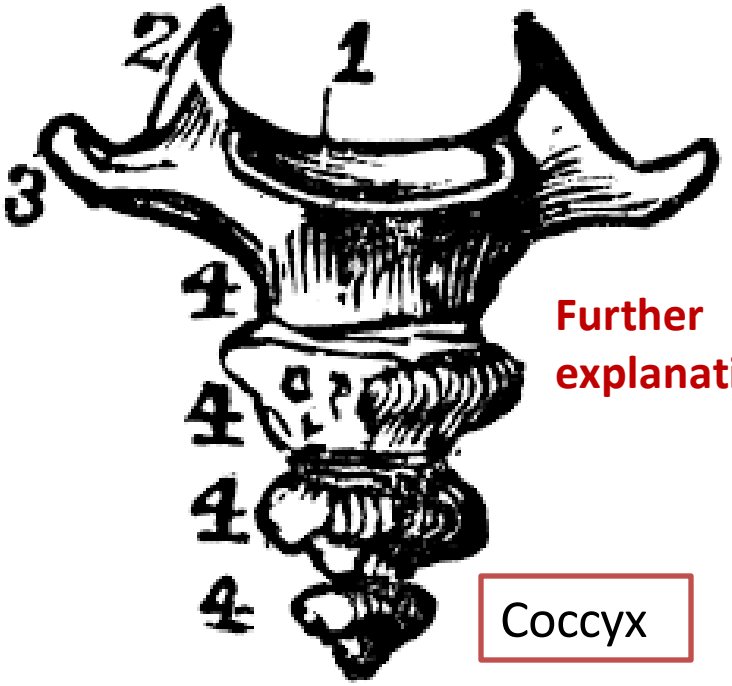
- All of these vertebrae are typical because they all have a body and an arch, regardless of their location.
- Most of the vertebrae are typical.

For clearer images, please go to slides 27-29. We just had to keep the original ones here.



Sacrum



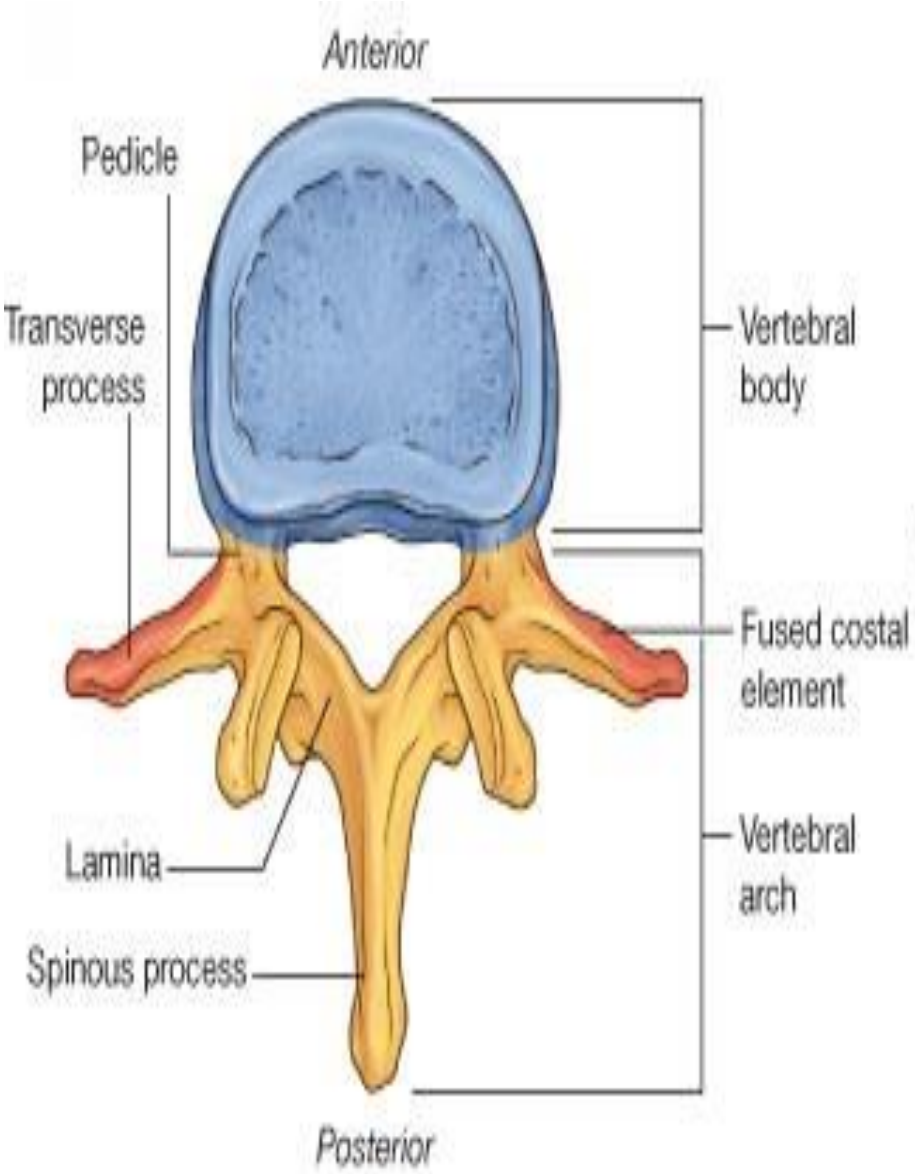


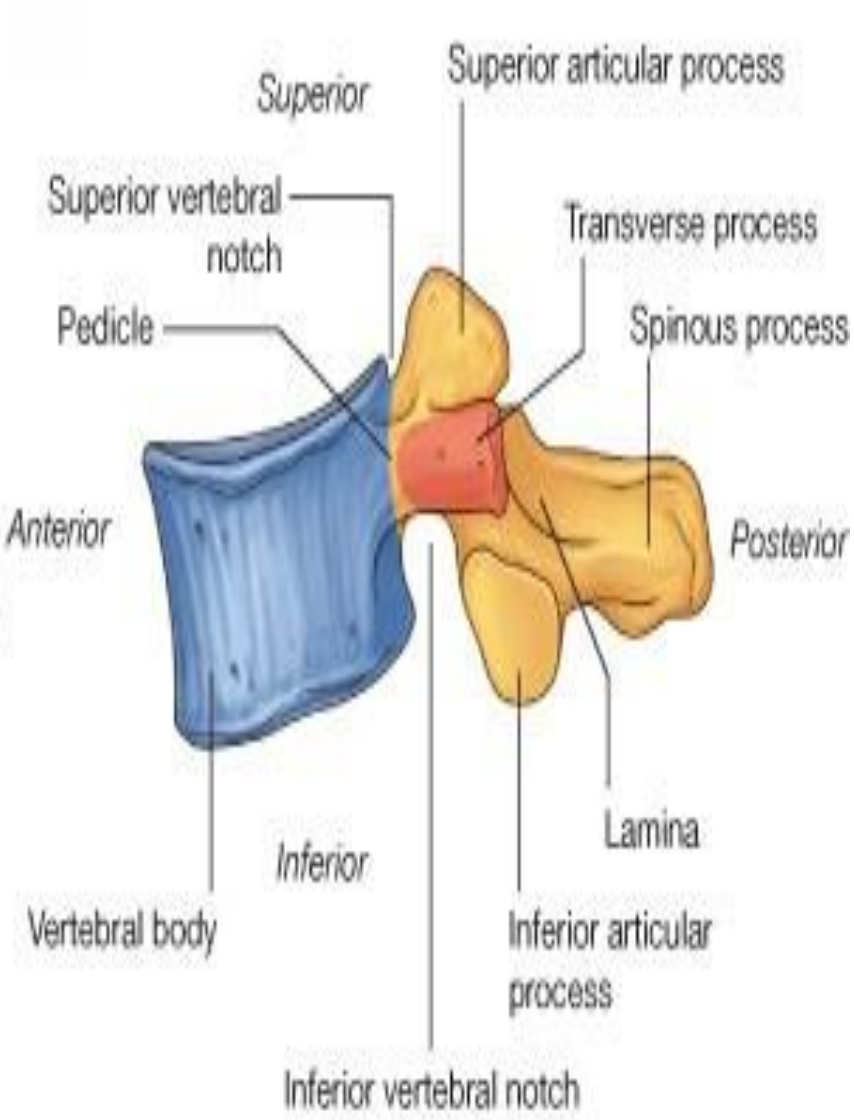
Coccyx

Further explanation→

Atypical vertebrae

- sacrum vertebrae has a body and an arch but they are fused so they are atypical vertebrae.
- The coccyx has body only, there is no arch, so it is an atypical vertebra.
- C1 has two arches with no body, so it is an atypical vertebra.
- C2 (the axis) has a body and an arch but also has axissory process called odontoid process, so it is an atypical vertebra.





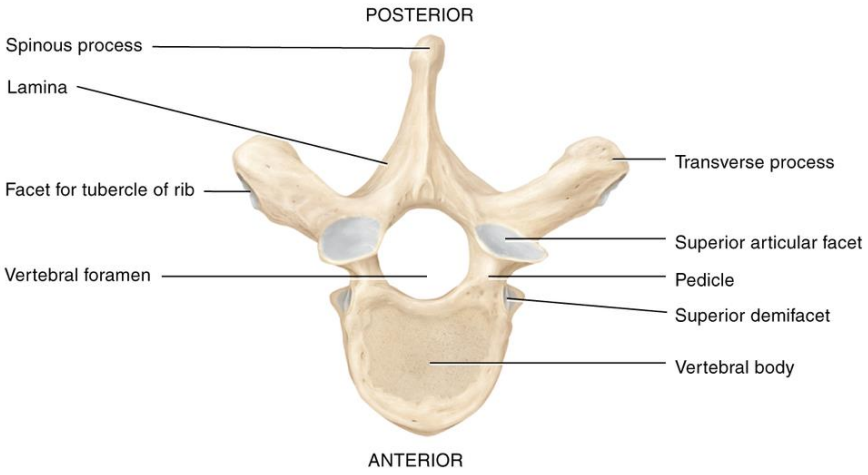
Further explanation→

- Typical vertebrae have a body and an arch, and the body is larger than the arch because 80% of the weight is carried by the body.
- At the same time, the size of the body increases as we go down, for example the bodies of the cervical vertebrae are smaller than the bodies of the thoracic, this makes sense because the cervical vertebrae are holding the head, while the thoracic vertebrae are holding the head and the upper limbs , the lumbar vertebrae are holding the head, the upper limbs and the trunk and so on.

The arch posteriorly is composed of:

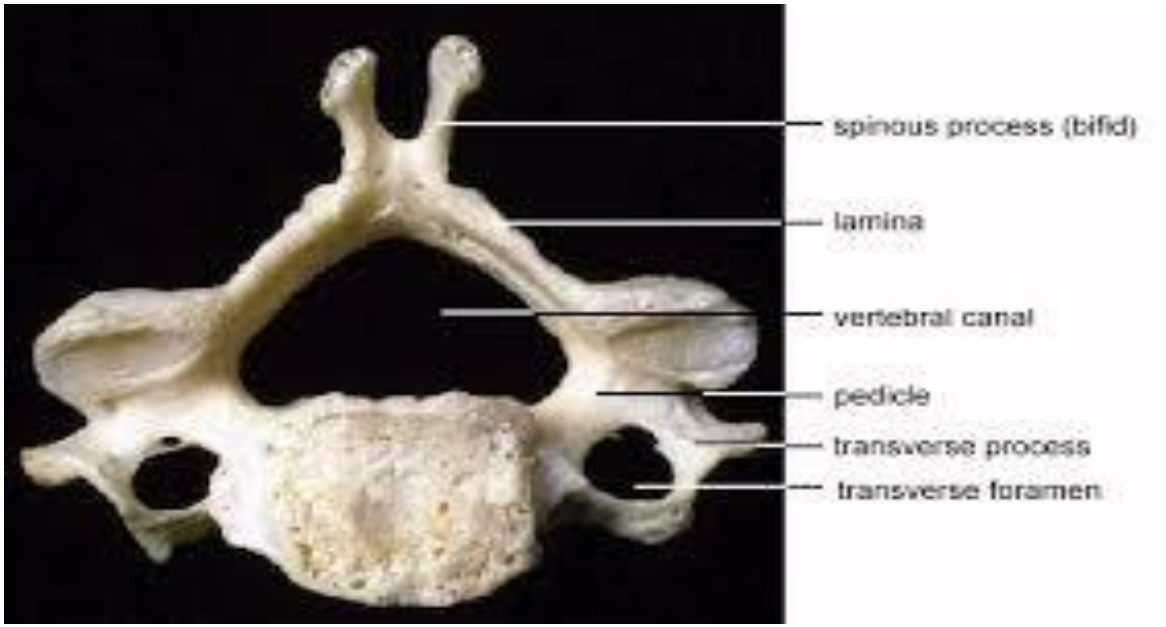
- two pedicles which connect the body to the arch.
- 2 laminas
- spinous process
- transverse process
- facet joint (inferior and superior)

- The strongest part of the vertebra is the pedicle, because it is holding the body to the arch.



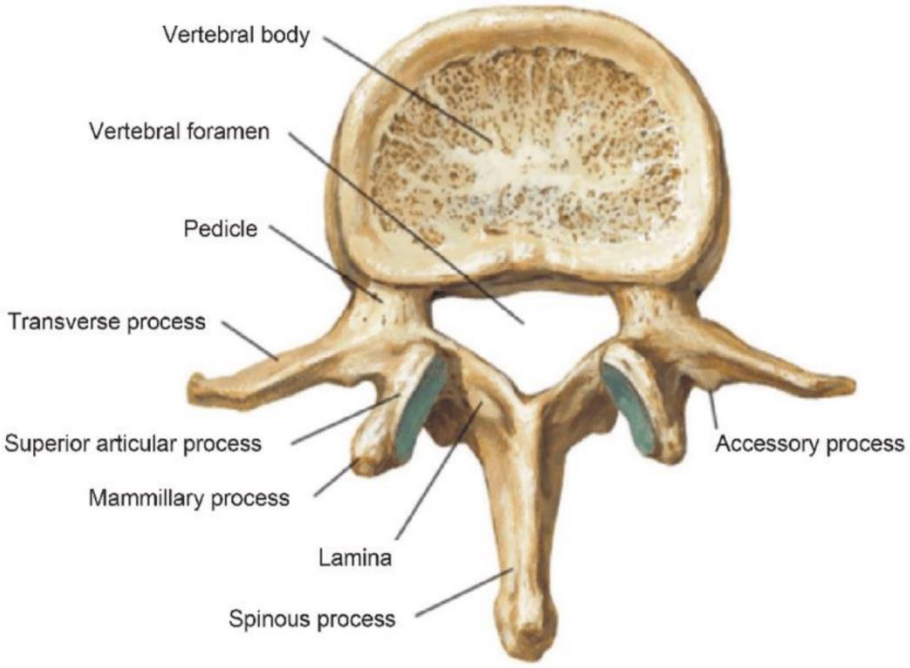
Thoracic vertebra

- Body: heart shaped
- Spinous process: thin and long.
- Facet: for the articulation of the ribs (costovertebral junction which is important for respiration, movement of the chest wall).



Most cervical vertebrae are typical but there are variations between them.

- Body: circular in shape.
- Spinous process is short and bifid (it has 2 parts).
- Transverse process: has foreman transversarium for the passage of the vertebral artery.



Lumbar:

- Body: kidney shaped
- Spinous process: short and thick

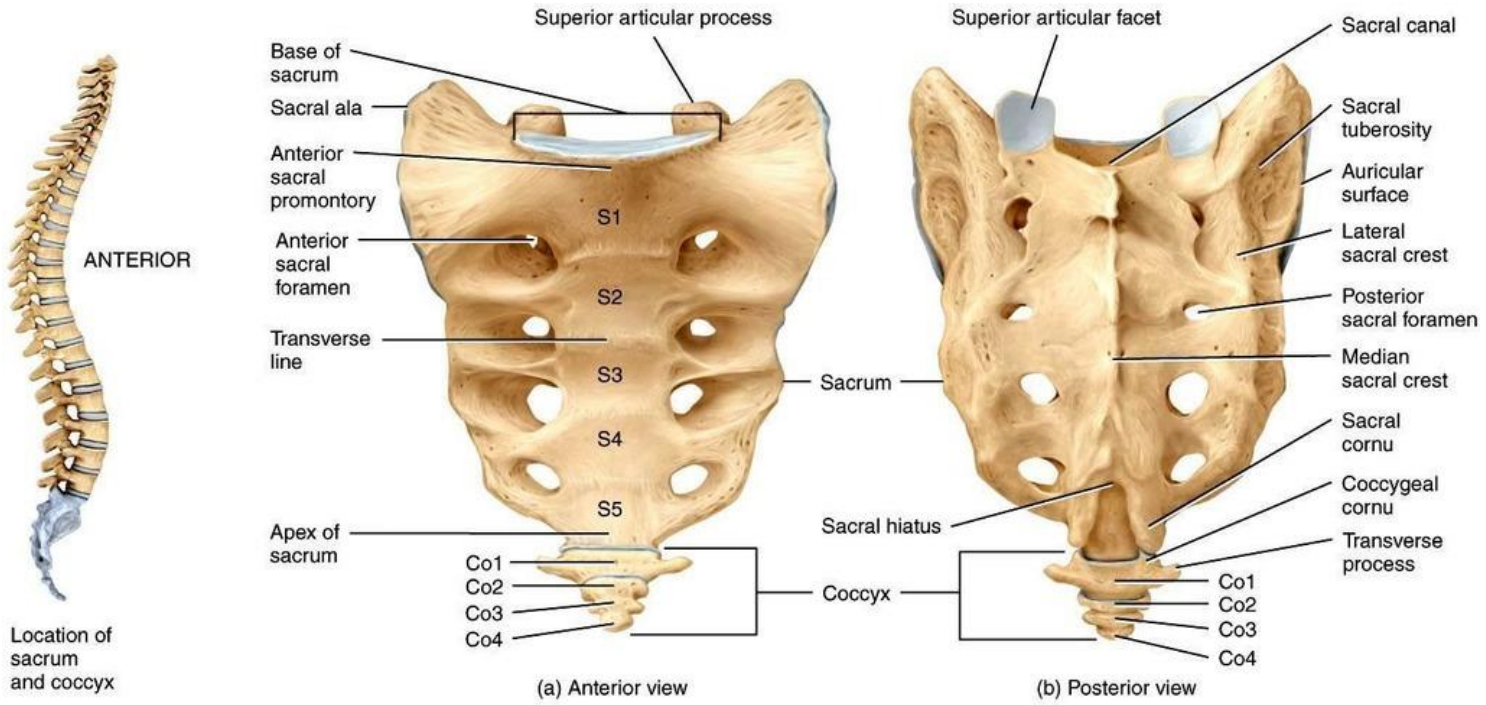
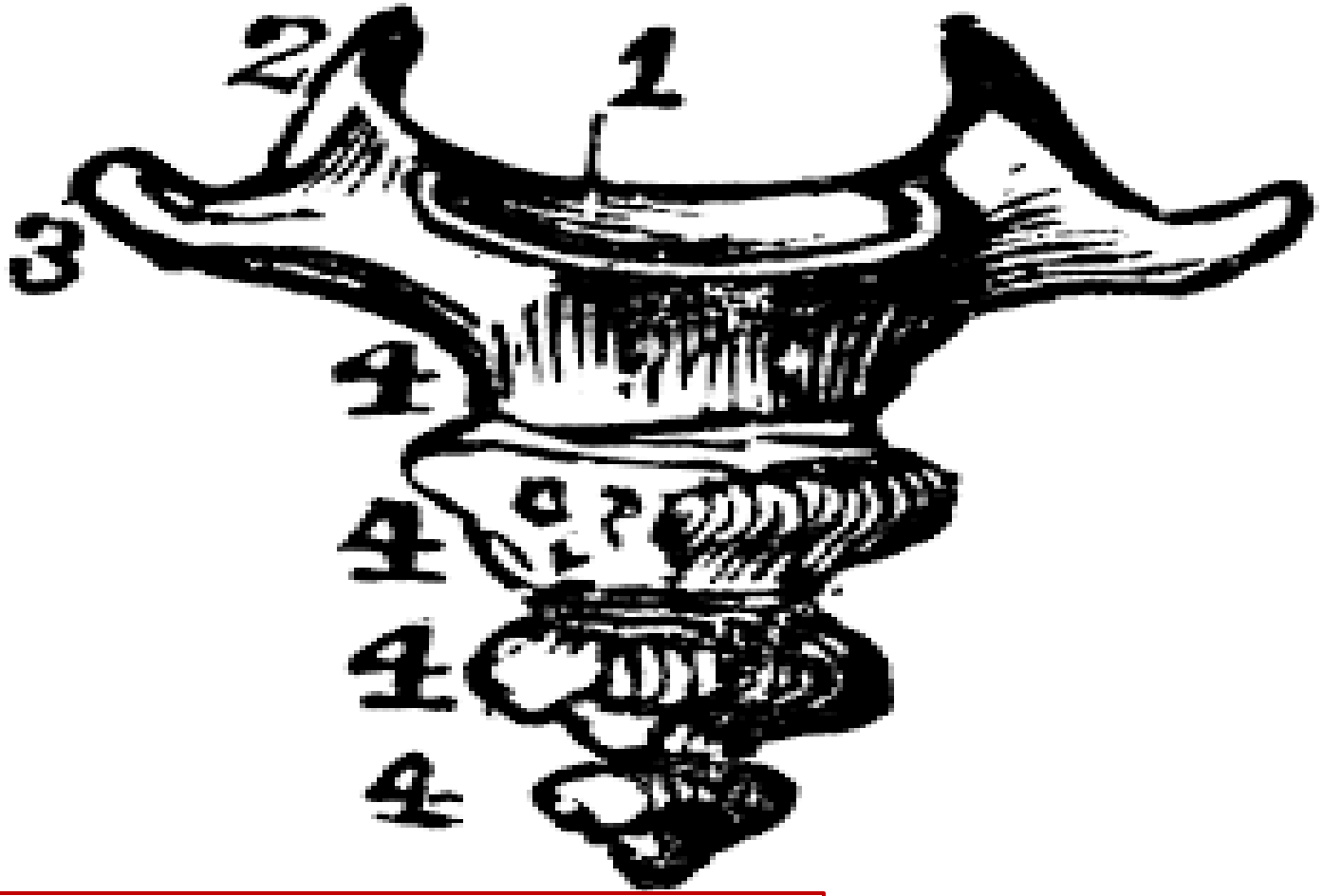


Figure 07.20ab Tortora - PHA 11/e

Sacrum:

- Atypical
- Body and arch are fused
- No pedicle and lamina



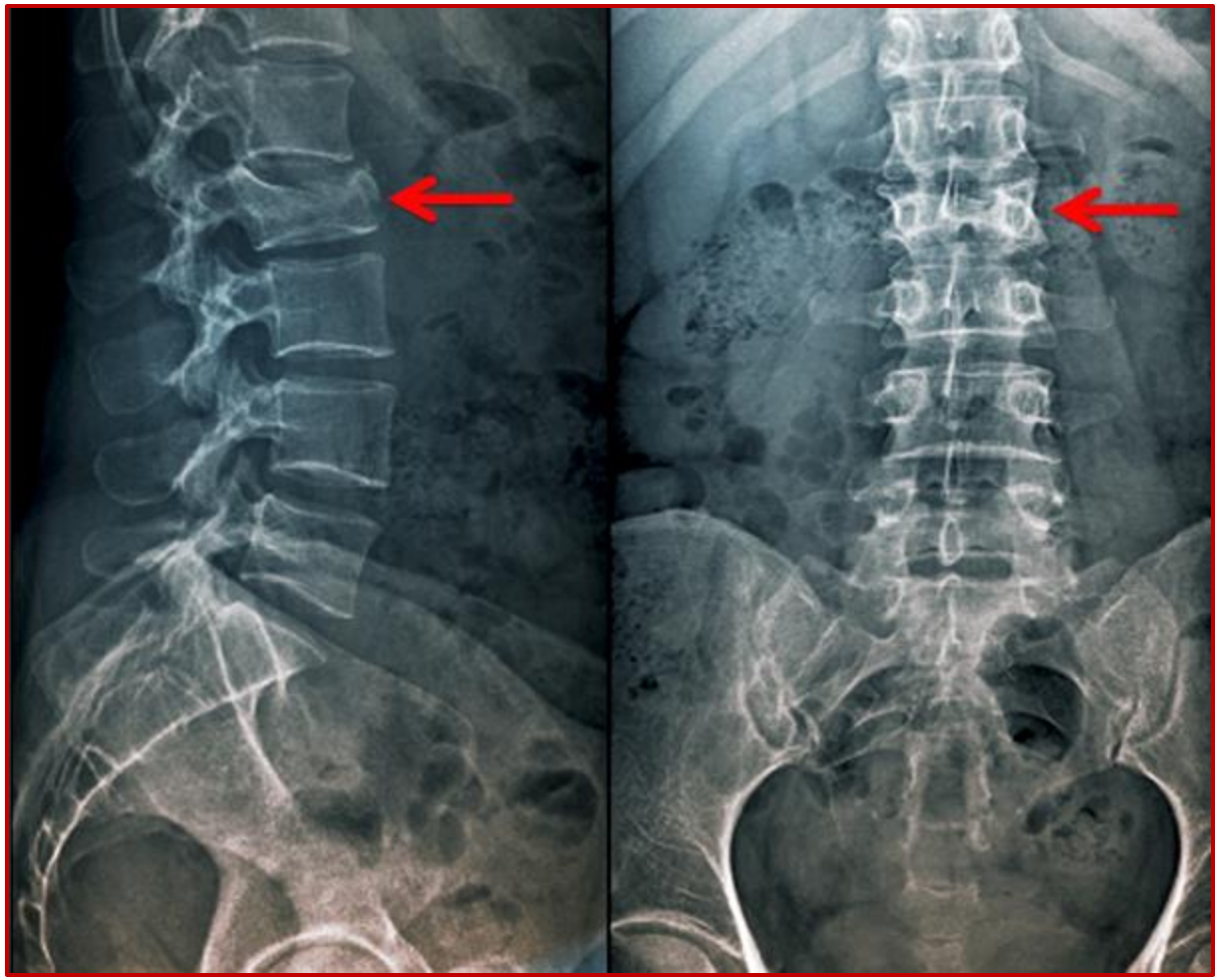
Coccygeal:

- atypical
- they have no arches
- they are bodies attached close to each other

In this X ray, you can see:

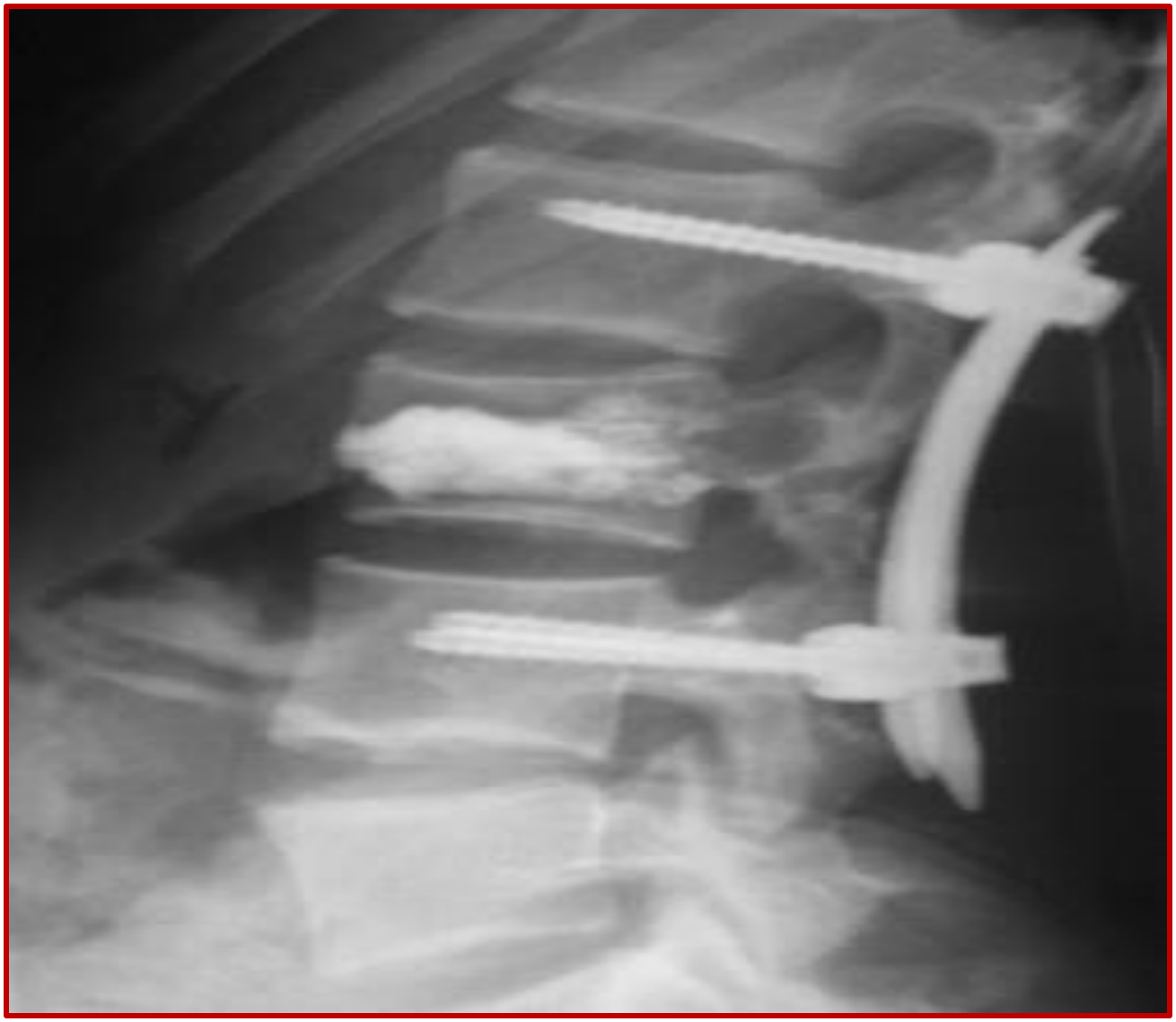
- Vertebrae quadrangular in shape
- Pedicles which connect body to arch
- Spinous process in the middle
- Size of vertebrae increase as we go downward

Lateral view



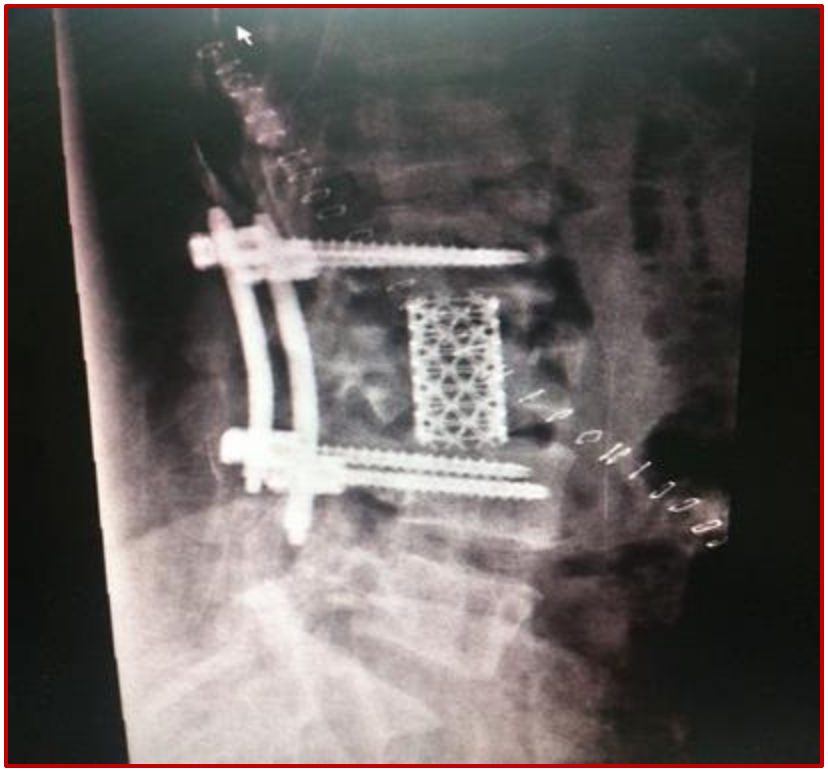
This patient came after falling. Look at where the arrow is pointing, the size of the vertebra isn't right. This patient has a fracture. He could end up with hyperkyphosis **(instead of lordosis in the lumbar region)**, positive sagittal **balance**, gravity line passing anterior, and severe pain. Therefore, we need to return the vertebra to its normal height.

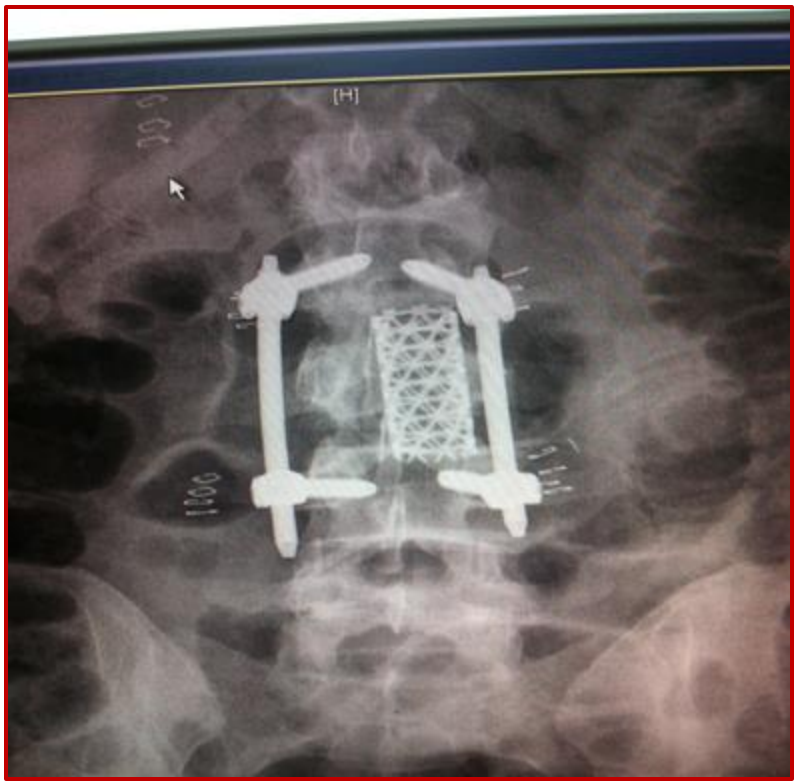
Google: A forward stooping posture due to the events of failure of compensation is referred to as positive sagittal balance.



This patient is suffering from pain and fatigue, so we need to restore the vertebral height by using bone grafts and fixing the spine to prevent its rotation and allow the healing of the vertebra.

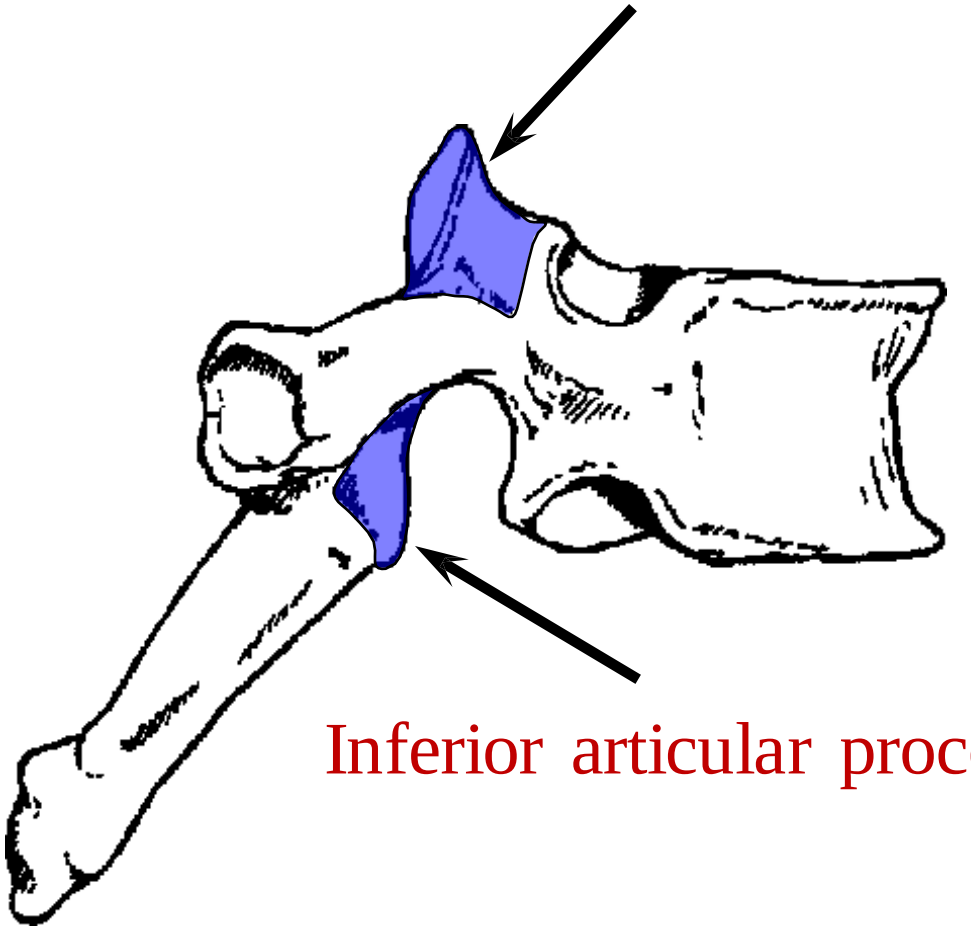
The upper part of vertebra is destroyed and a piece entering the canal will cause injury to spinal cord. He could be paralyzed or not; we need to replace the vertebra with a metallic one before paralysis occurs.




[H]

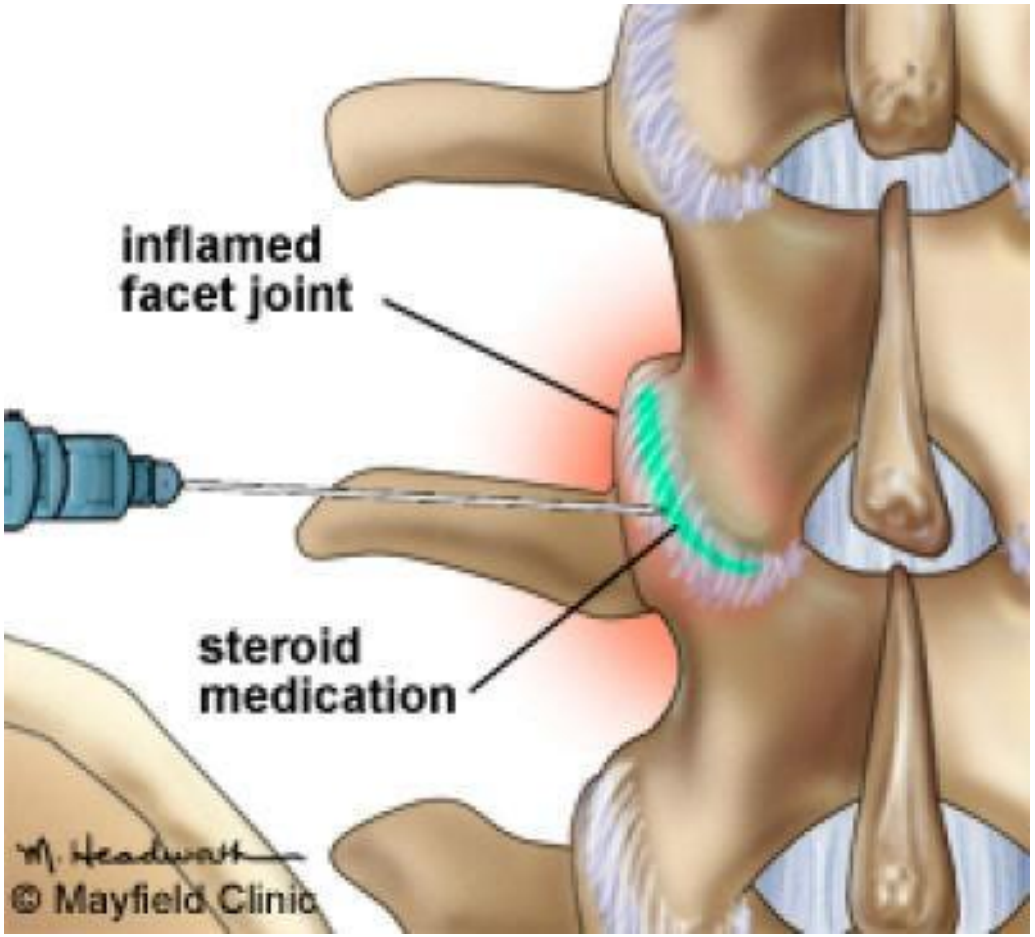
Vertebral Articulation

- each articulation is a fully encapsulated synovial joint
- these are often called apophyseal joints

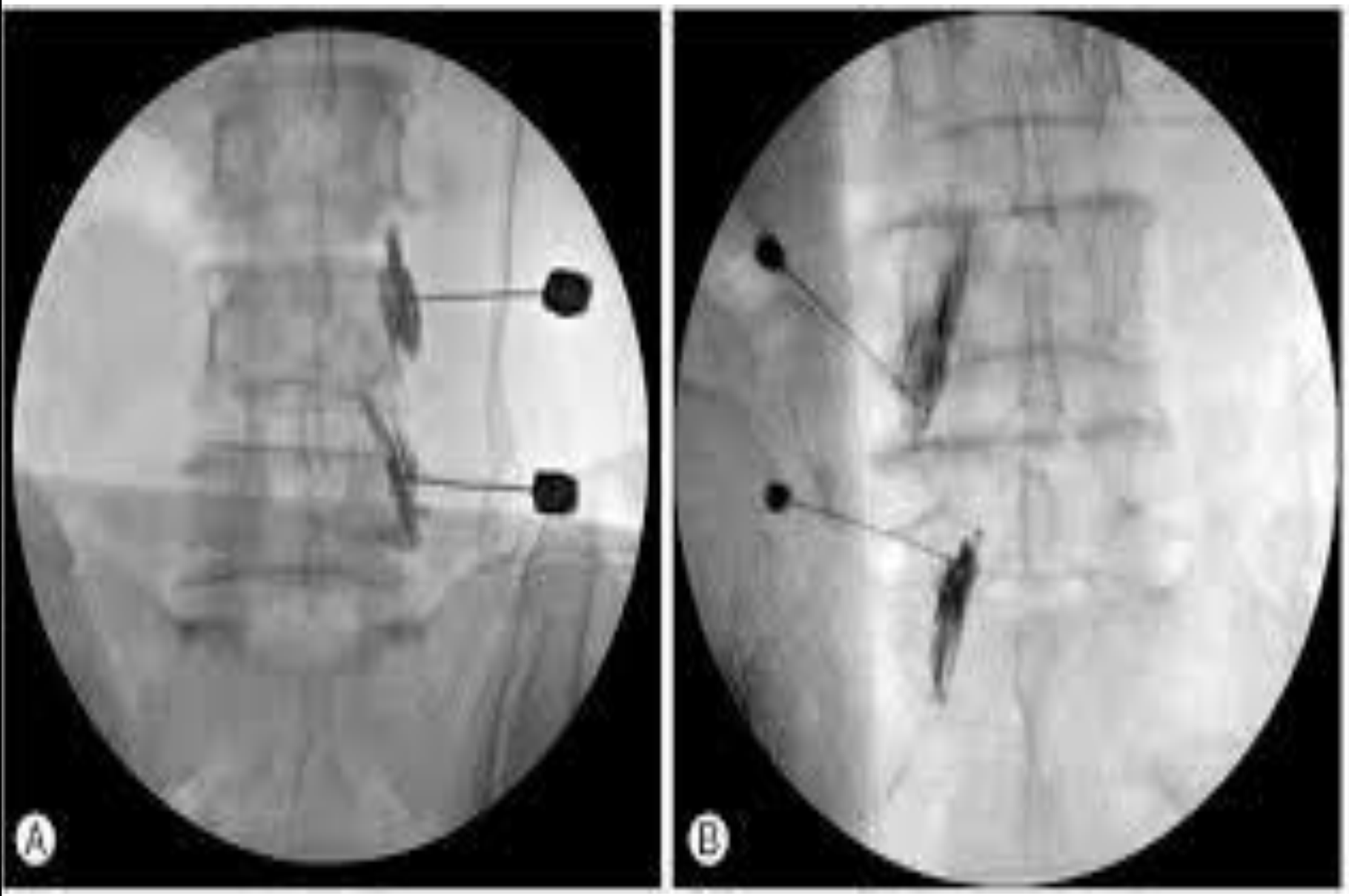


Note: the processes are bony outcroppings.

- Superior articular facet articulates with the inferior articular facet of the vertebra above.
- Inferior articular facet articulates with the superior articular facet of the vertebra below.
- They together form the facet joint which is a synovial joint like knee and hip joints.
- Therefore, its prone to synovitis, osteoarthritis and rheumatoid arthritis.



Sometimes, we need to deliver medication inside the joint to relieve pain, we insert a needle and use dye to make sure we're in the facet joint.
We could also give local steroids as they're anti-inflammatory.


A
B

Vertebral column is hyperflexible due to the presence of multiple vertebrae and multiple discs.
Flexibility and stability are inversely proportional to each other.
More flexibility→ more chance for fractures and dislocations.

Stability of any joint in the body depends on 3 factors

- Shape of the bone like hip joint which is ball and socket. The shape of the bone gives stability.
- For other joints like the knee joint it's more about the ligaments (condyle of femur and condyle of tibia). Ligaments give stability, eg: anterior cruciate, posterior cruciate, medial collateral and lateral collateral.
- Muscles: neither shape of bone nor ligaments are important for stability but rather muscles (eg: back). The most important stabilizers are muscles of the back There are 3 layers: superficial, intermediate and deep. Each layer is composed of many muscles.

Muscles of back

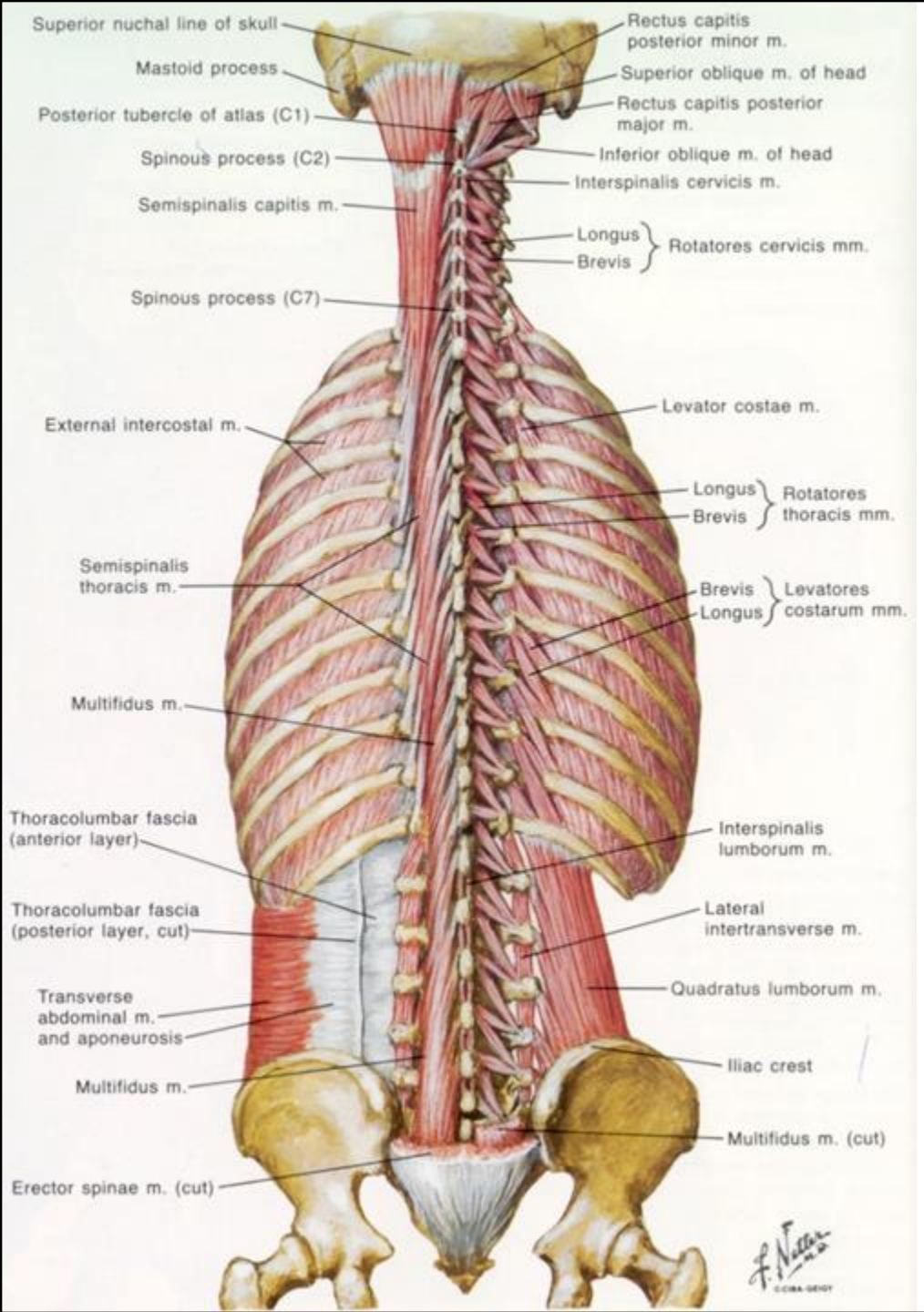
1-superficial muscles

- **ass with shoulder girdle**
- trapezius, latissimus dorsi, levator scapulae

2- intermediate muscles

- **ass with respiration**
- serratus post sup , serratus post inf

The main function of superficial muscles is to assist in shoulder girdle, but they work secondarily on the spine.
Intermediate muscles are similar to the superficial ones. Their main function is respiration, but they also work on the stability of the spine.
Nevertheless, the main stabilizers are the deep muscles of the back.



3- Deep muscles-

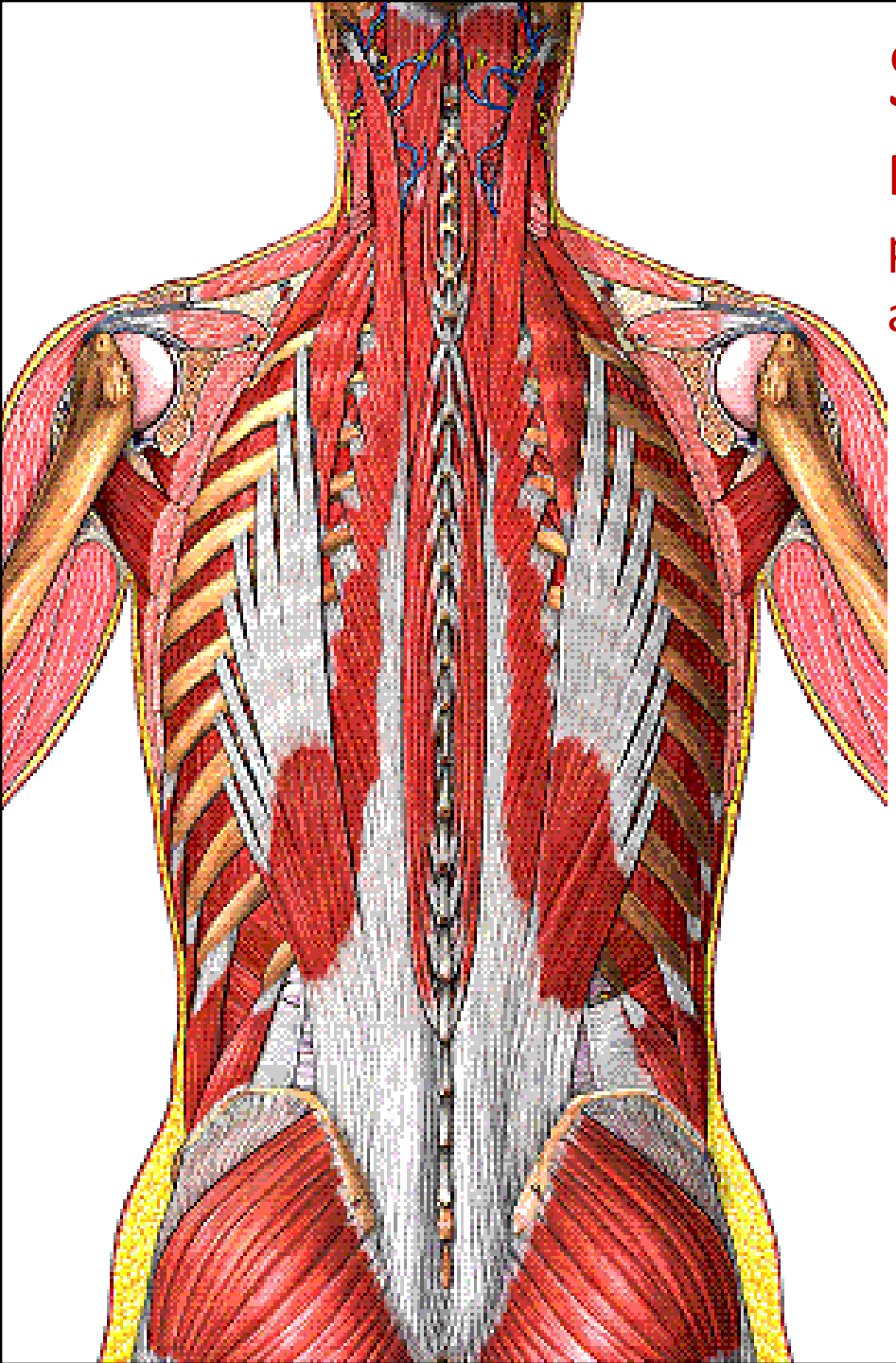
Posterior Muscular Support

primarily produce

extension and

medial/lateral flexion

- Superficial to deep
  - **erector spinae**
  - **semispinalis**
  - **deep posterior**



Spine -

Posterior Muscular Support

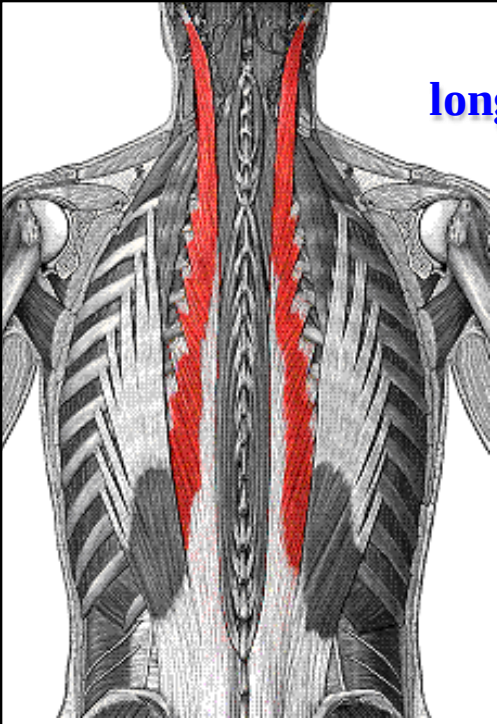
primarily produce extension and medial/lateral flexion

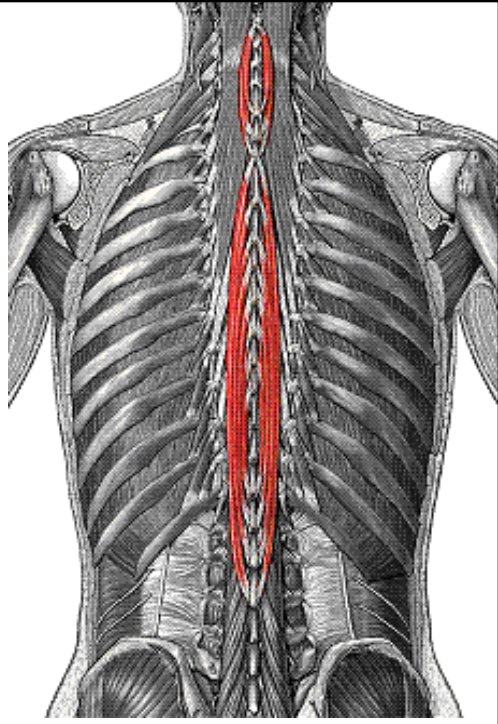
- Posteriorly
  - **erector spinae**
    - **iliocostalis**
    - **longissumus thoracis**
    - **spinalis**

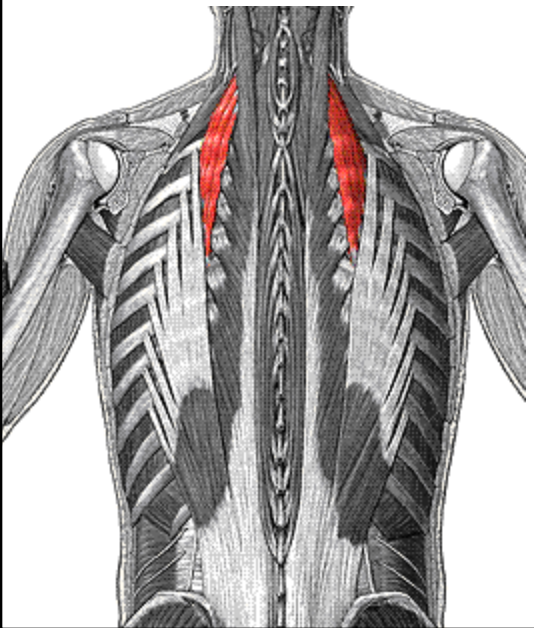
- The muscles are distributed, some work on cervical spine alone, lumbar spine alone, on thoracic and cervical together, and others work between vertebrae.
- There is a huge number of muscles, and you don't need to memorize the muscles' names, just know that there are multiple layers, and that they could work between vertebrae, on segments or on the whole vertebral column.
- Their main job is extension to maintain posture.
- Secondary job: medial and lateral flexion.
- They are fatigue resistant; that's why you could sit or stand for very long times. If one experiences back pain, it could be either due to muscle weakness or a pathologic problem.

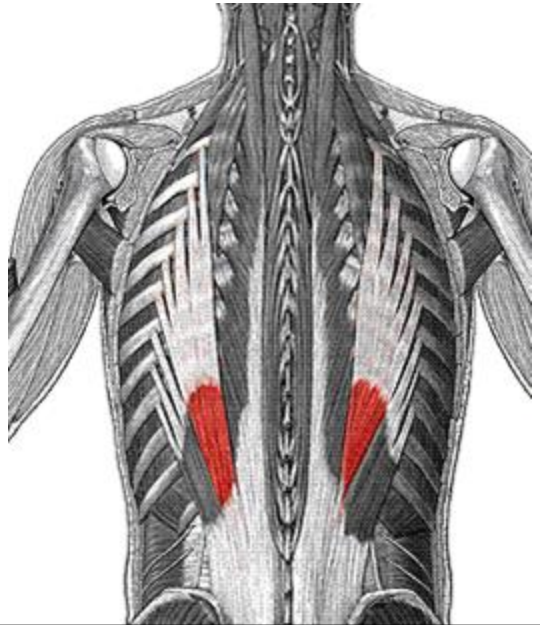
Erector spinae

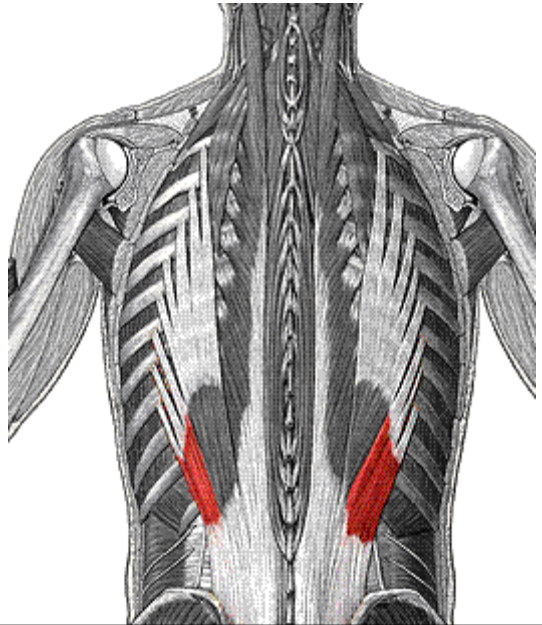
Versatile muscles that can generate rapid force yet are **fatigue resistant**



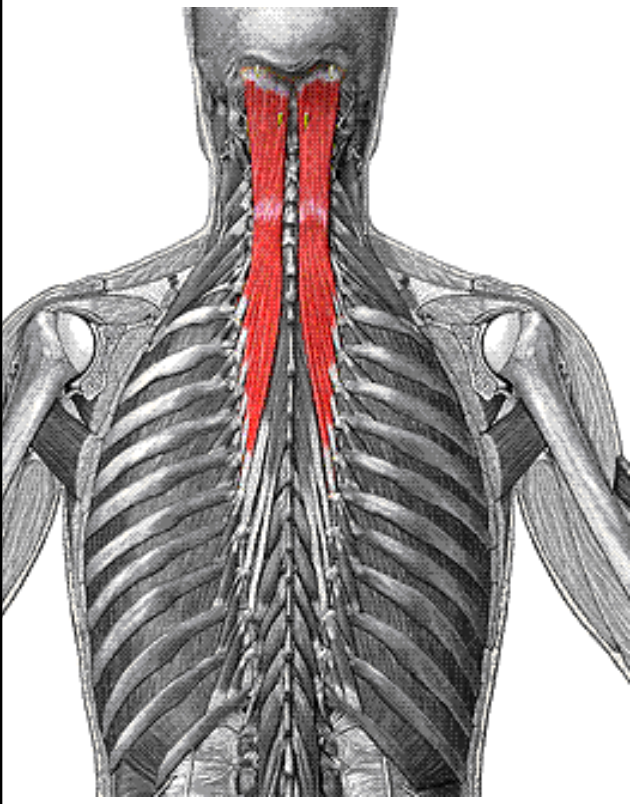




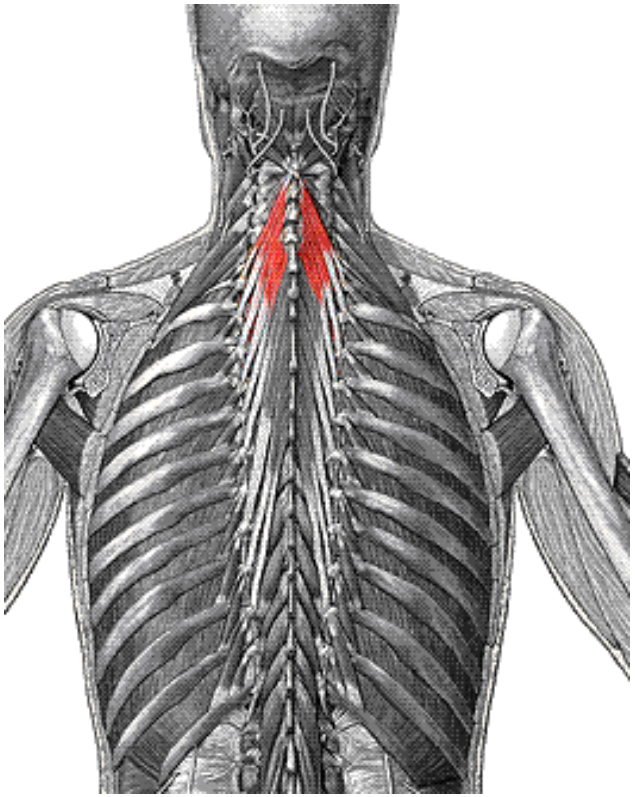




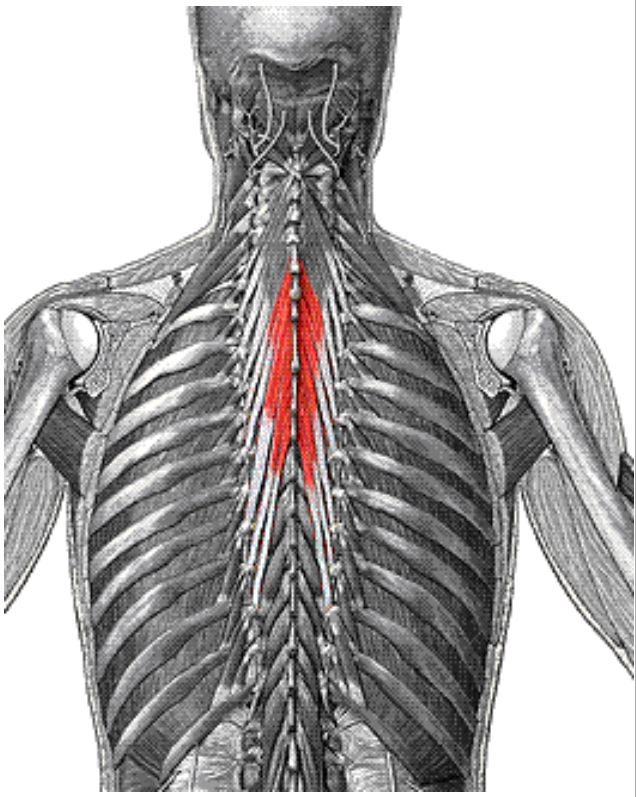
Semispinalis



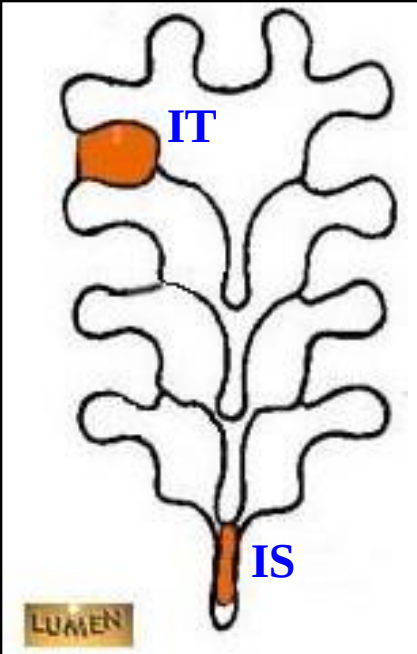
capitis

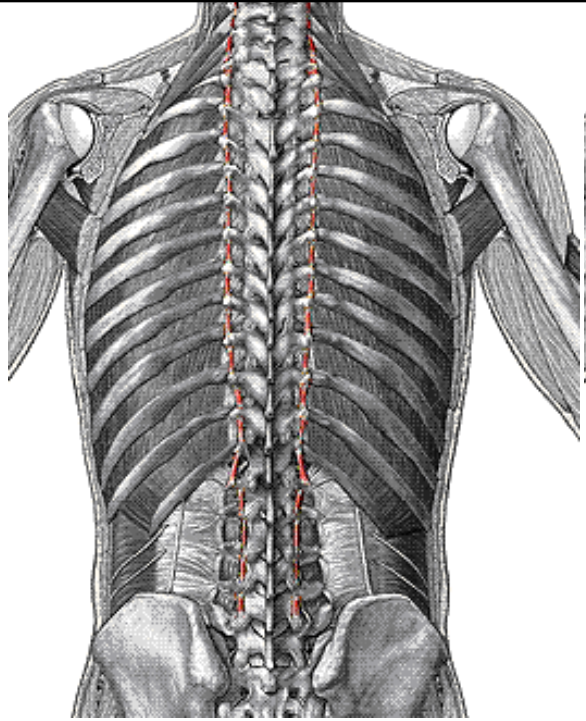


cervicis

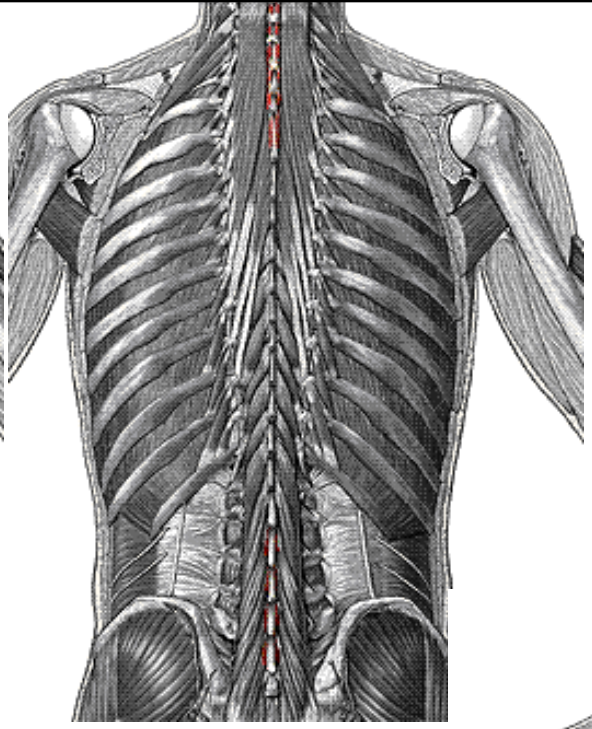


thoracis

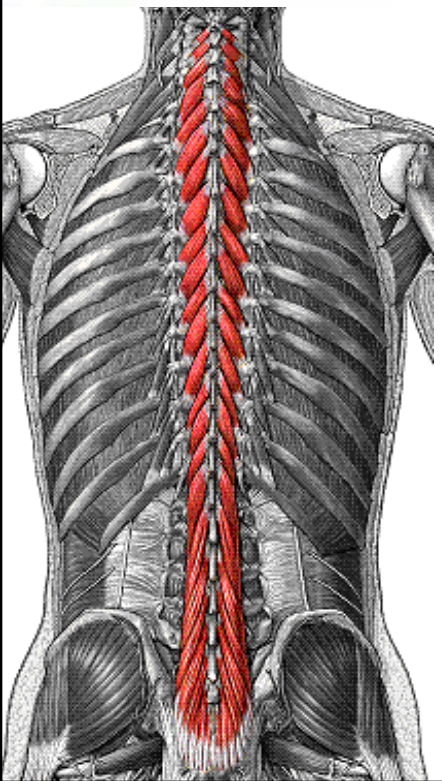




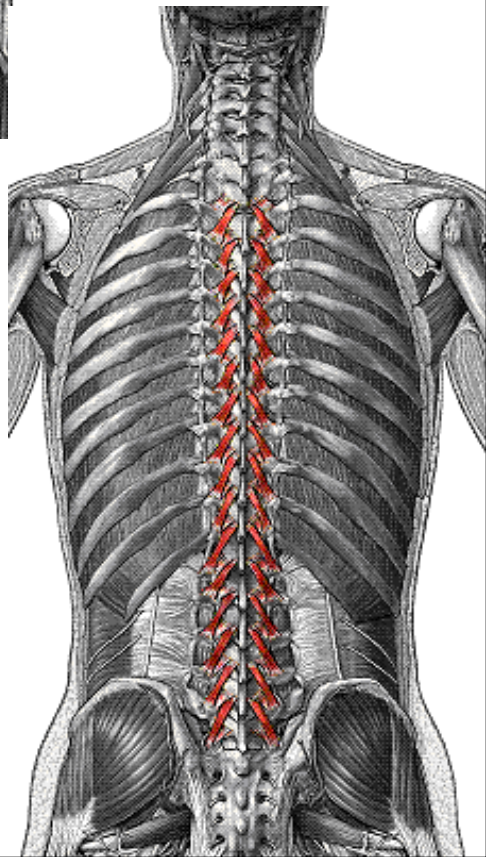
intertransversarius



interspinales



multifidus



rotatores

Deep posterior

V2
Slide 7: we added a box.
Slide 15 : left side not lateral.
Slide 25 : we added a box.
slide 33: positive sagittal balance not analysis+ we added (instead of lordosis in the lumbar region).
slide 34: we added a text box.

Thank you