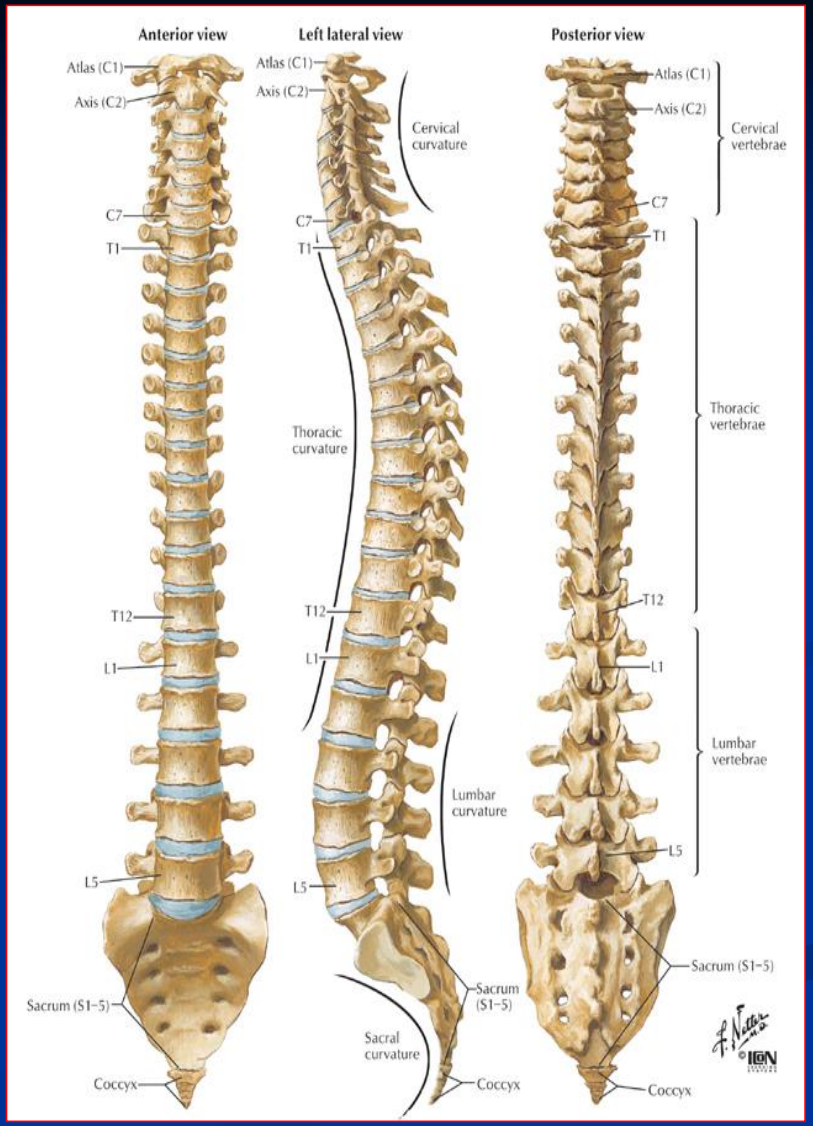
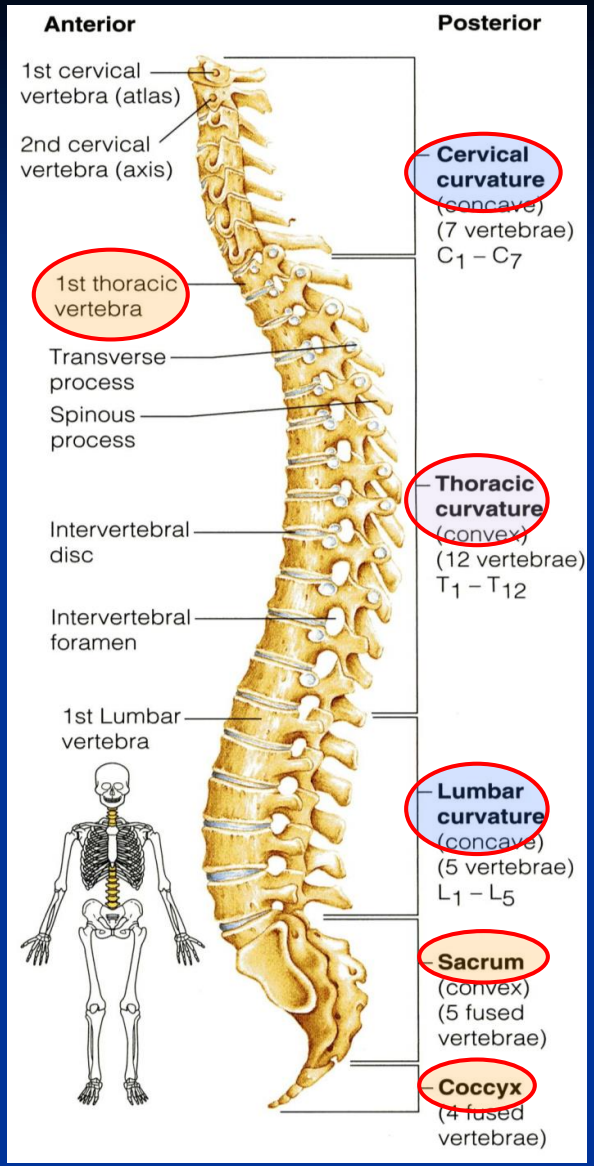
ANATOMY OF THE SPINE



Objectives

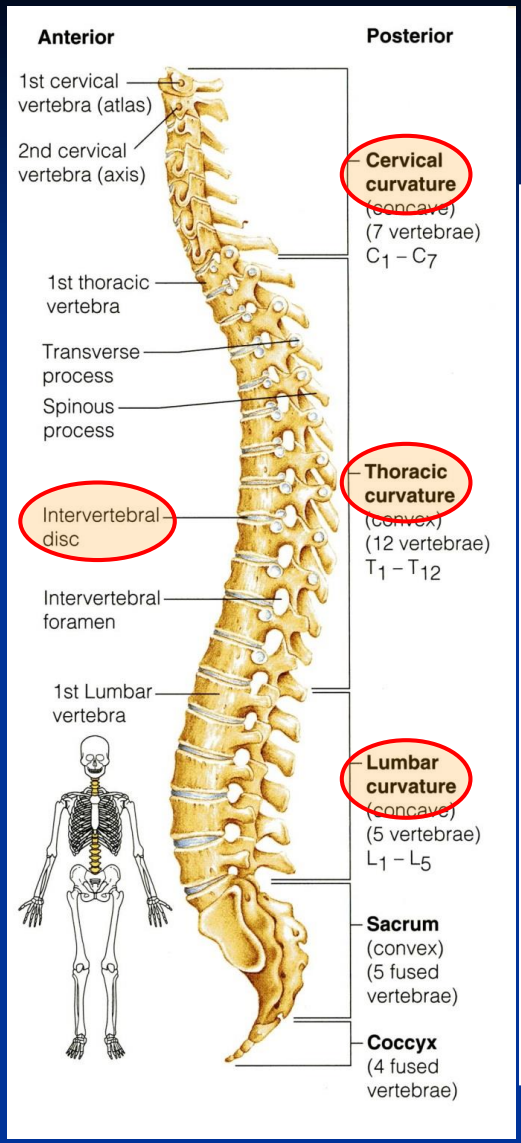
- **By the end of this lecture you should be able to:**
- Distinguish and describe the cervical, thoracic, lumbar, sacral and coccygeal vertebrae.
- Describe the vertebral curvatures.
- Describe the movement which occur in each region of the vertebral column.
- List the structures which connect 2 adjacent vertebrae together.
- List and identify the ligaments of the intervertebral joints.



SPINE OR VERTEBRAL COLUMN

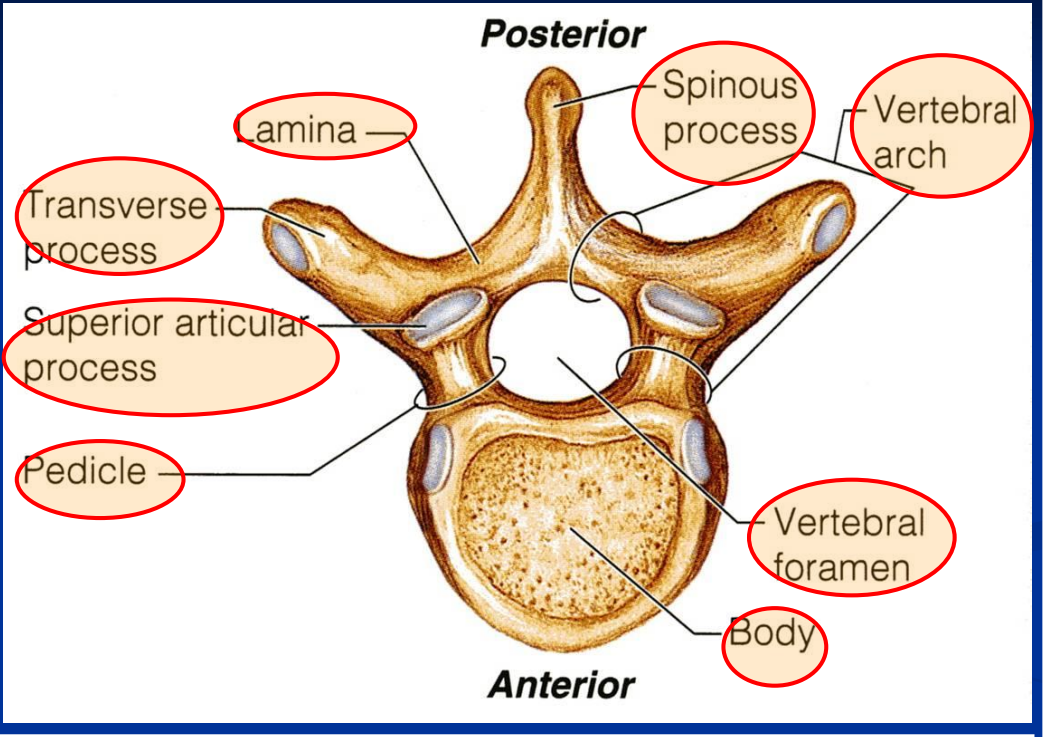
- The **vertebral column** extends from the skull to the pelvis.
- It surrounds and protects the spinal cord and supports the whole body.
- It is formed from **33** irregular **vertebrae.**
- It consists of **24** single vertebrae and **2** bones:
  - **Sacrum, (5 fused vertebrae).**
  - **Coccyx, (4 fused vertebrae).**
- Of the 24 single bones,
  - **7 Cervical vertebrae,**
  - **12 Thoracic vertebrae, and**
  - **5 Lumbar vertebrae.**

VERTEBRAL COLUMN



- The single vertebrae are separated by pads of flexible fibrocartilage called the **intervertebral disc.**
- The **intervertebral discs** cushion the vertebrae and absorb shocks.
- The discs and the **S-shaped curvatures** of the vertebral column work together to prevent shock to the head when we walk or run.
- They also make the body trunk flexible.
- The **spinal curvatures** in the **thoracic** and **sacral** regions are referred to as **primary curvatures,** because they are present when we are born.
- Later, the **secondary curvatures** develop.
- The **cervical curvature** appears when a baby begins to hold his head (6^{th} month), and the lumbar curvature develops when the baby begins to walk (around the end of the 1^{st} year).

TYPICAL VERTEBRA



• One spinous process: single projection arising from the posterior aspect of the vertebral arch.

• 2 Superior and 2 inferior articular processes:
Paired projections lateral to the vertebral foramen, allowing a vertebra to form joints with adjacent vertebrae.

• **Any vertebra is formed from body and arch.**

•Body or Centrum:

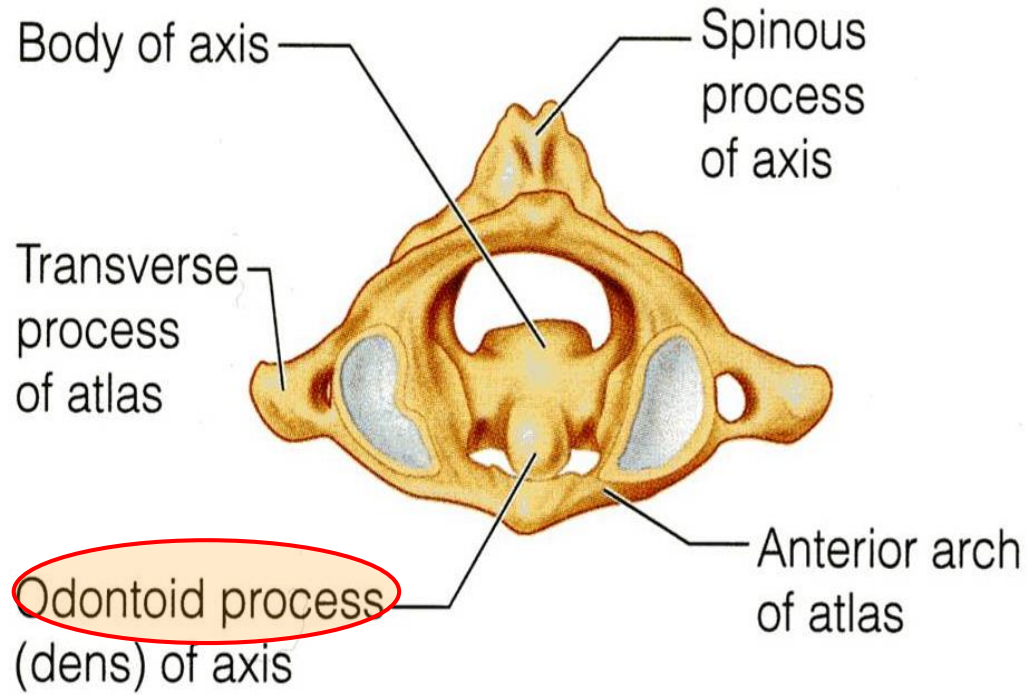
•Disc like, weight-bearing part of the vertebra that lies anteriorly.

▪Vertebral arch:

▪Formed from fusion of
- **•2 Pedicles,**
- **•2 Laminae**
- **▪Vertebral foramen:**
- **▪Lies between the body and the arch,** through which the spinal cord passes.
- **▪The vertebral arch carries 7 process:**

• **2 Transverse processes:** Lateral projections from the vertebral arch.

ATLAS & AXIS

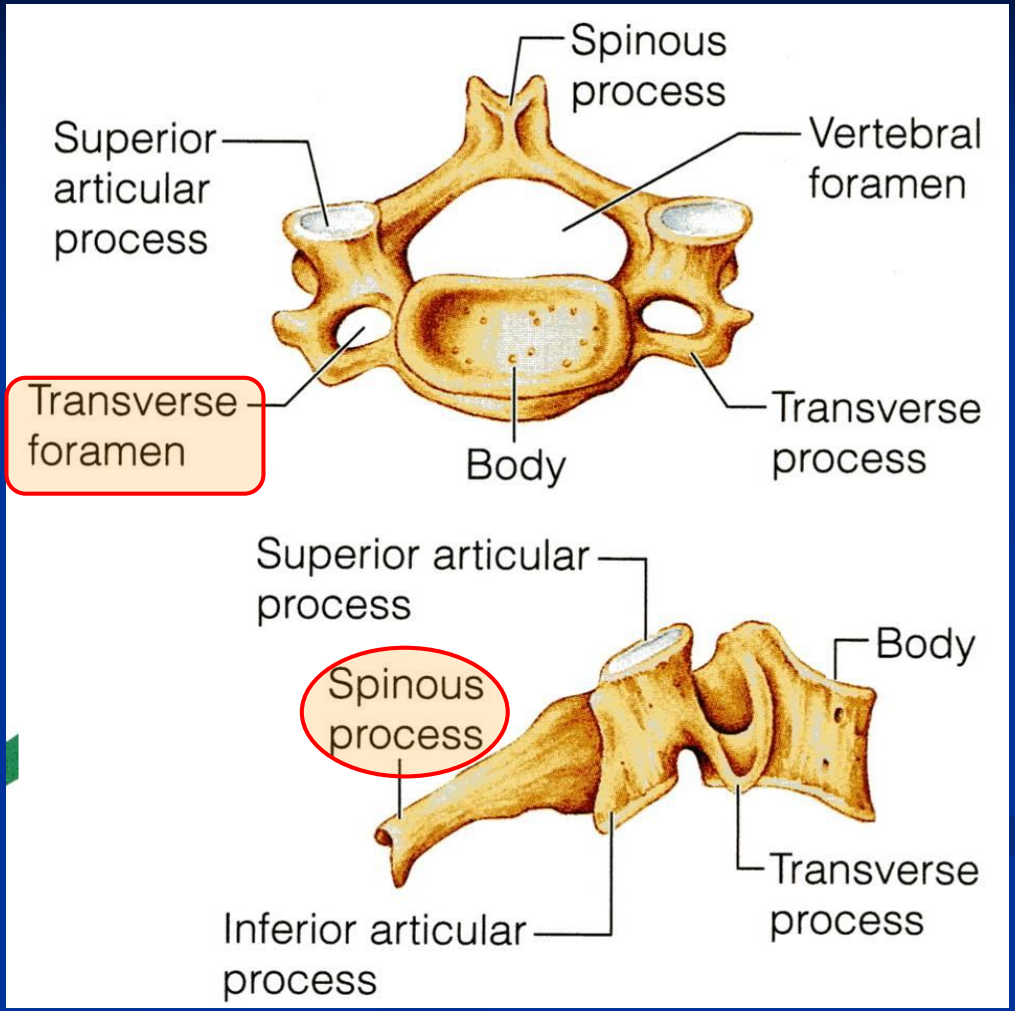


- The 7 **cervical vertebrae** (identified as C1 to C7) form the neck region of the spine.
- The first two vertebrae (**atlas** and **axis**) are different because they perform functions not shared by the other cervical vertebrae.

The **atlas** (C_1) **has no body,** formed of 2 lateral masses.
The superior surfaces of each lateral mass contain kidney shaped facet that receive the occipital condyles of the skull. This joint allows you to **nod "yes."**
The **axis** (C_2) acts as a pivot for the rotation of the atlas (and the skull) above.
It has a large upright process, the **odontoid process,** or **dens,** which acts as a pivot .
The joint between C_1 & C_2 allows to rotate the head from side to side to say **"no."**

TYPICAL CERVICAL VERTEBRAE

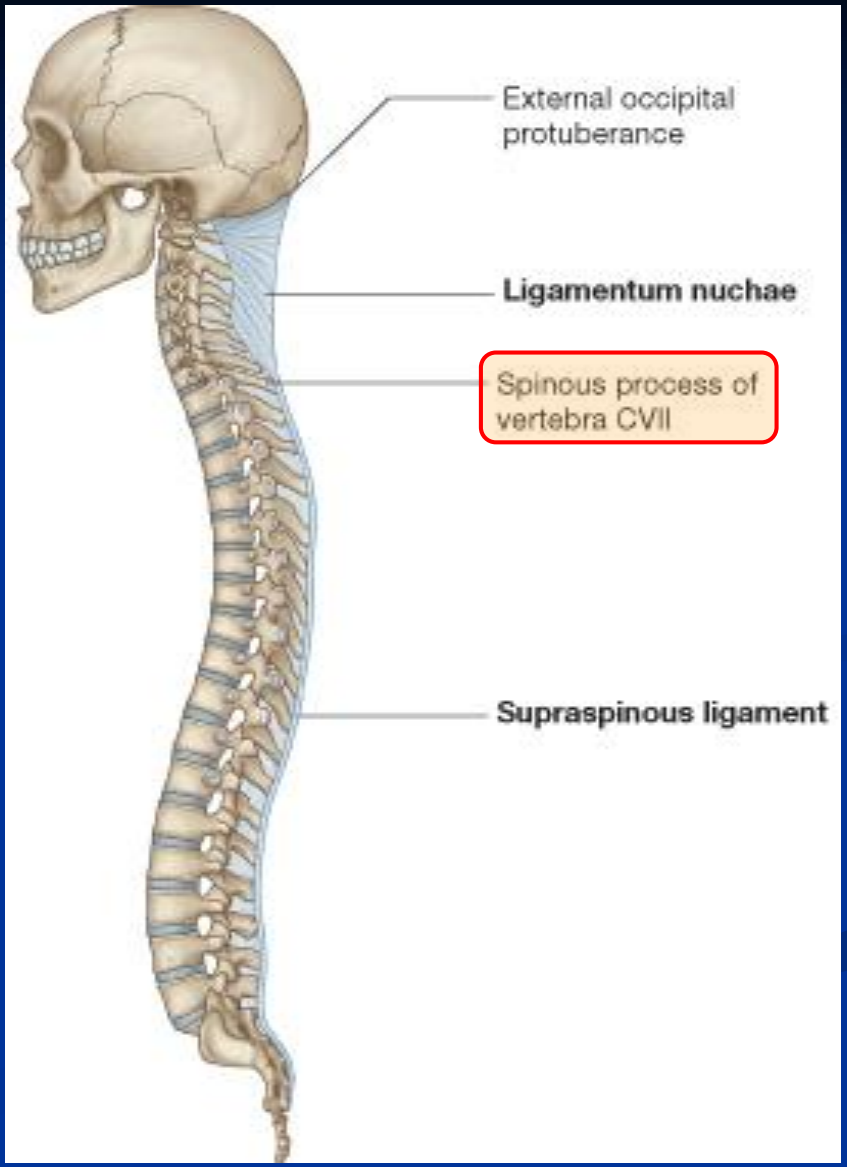
- The "typical" cervical vertebrae (C_3 to C_6) are the smallest, lightest vertebrae, and their **spinous processes** are short and bifid.
- The transverse processes of the cervical vertebrae contain **foramina** through which the vertebral arteries pass on their way to the brain above.



7th CERVICAL VERTEBRA OR Cervica Prominens

It has the **longest** spinous process which is **not bifid**.

It is the first spine to be felt **subcutaneously** in the root of the back of the neck.



MOVEMENTS IN THE ATLANTO-OCCIPITAL JOINT

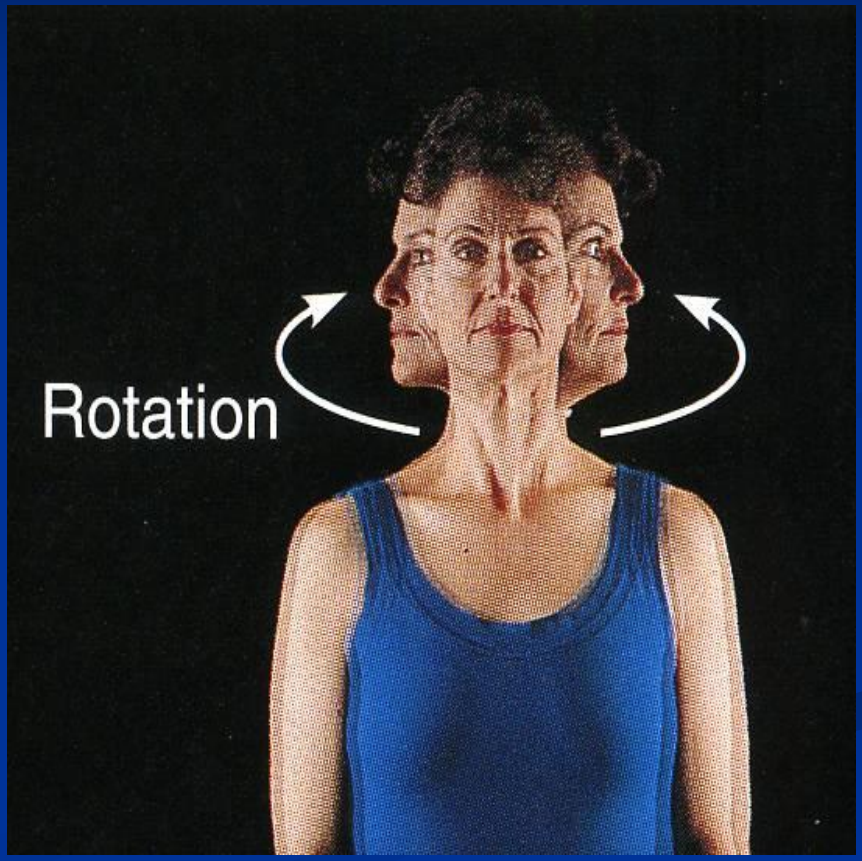
The joints are capable of:

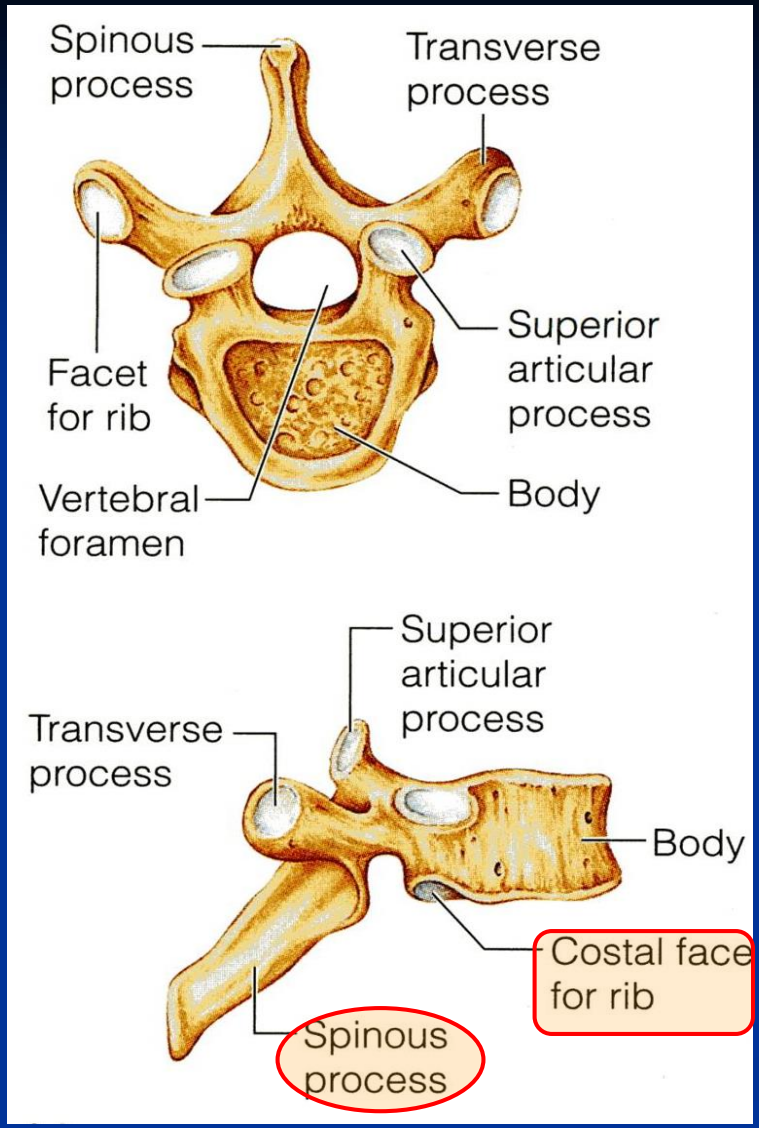
- Flexion,
- Extension, and
- Lateral flexion;
- **They do not rotate.**

MOVEMENTS IN THE ATLANTO-AXIAL JOINT

Extensive rotation of the atlas and the skull (and thus of the head on the axis).

That is to say **"NO"**

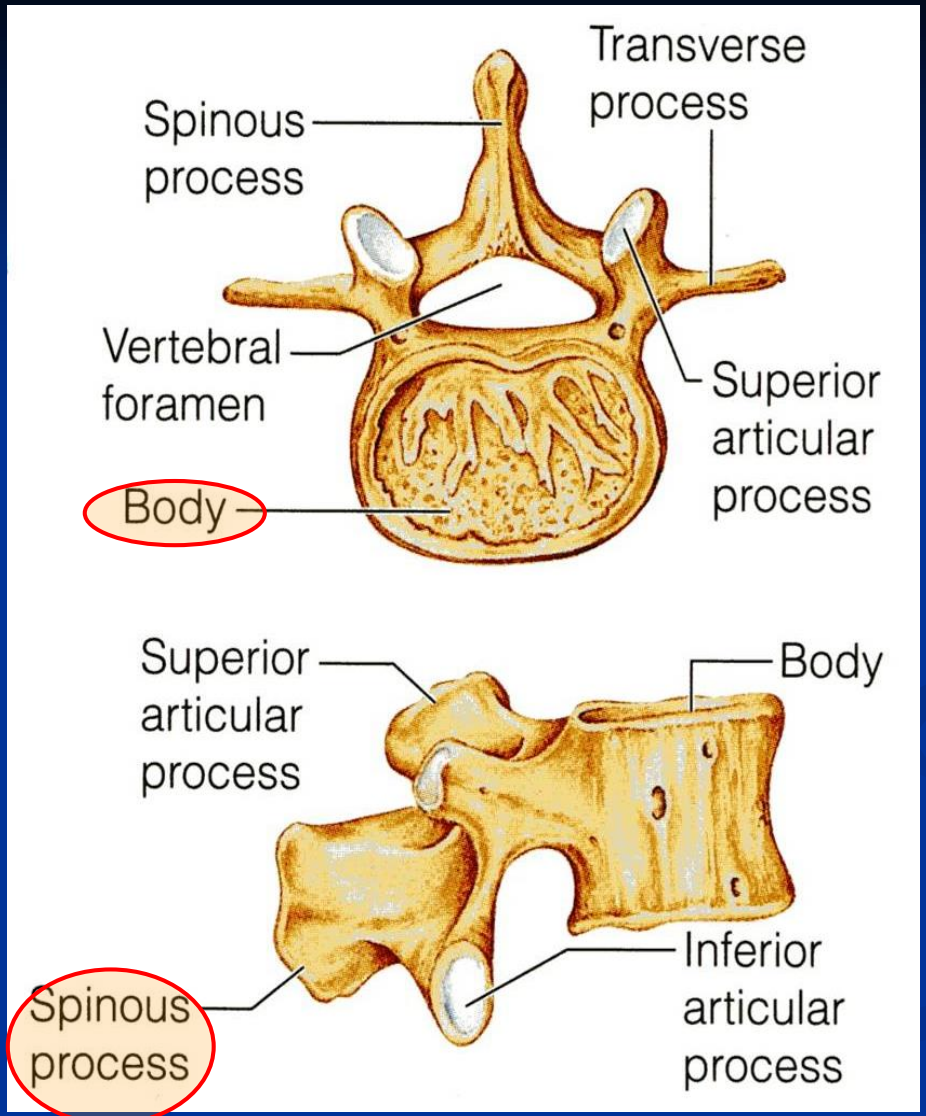




THORACIC VERTEBRAE

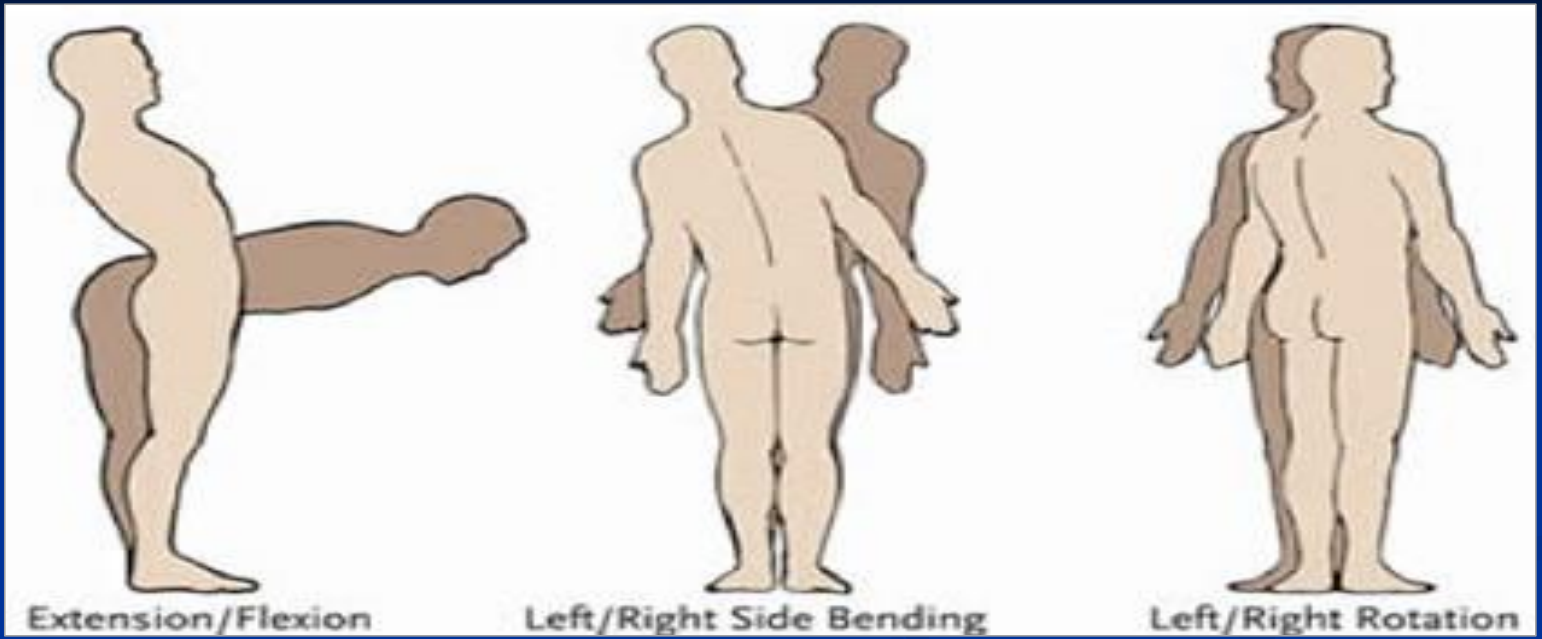
- The 12 **thoracic vertebrae** (T_1-T_{12}) are almost typical.
- They are larger than the cervical vertebrae.
- The body is somewhat heart-shaped and has two **costal demifacets** (articulating surfaces) on each side, which receive the heads of the ribs.
- The **spinous process** is long and hooks sharply downward.

LUMBAR VERTEBRAE



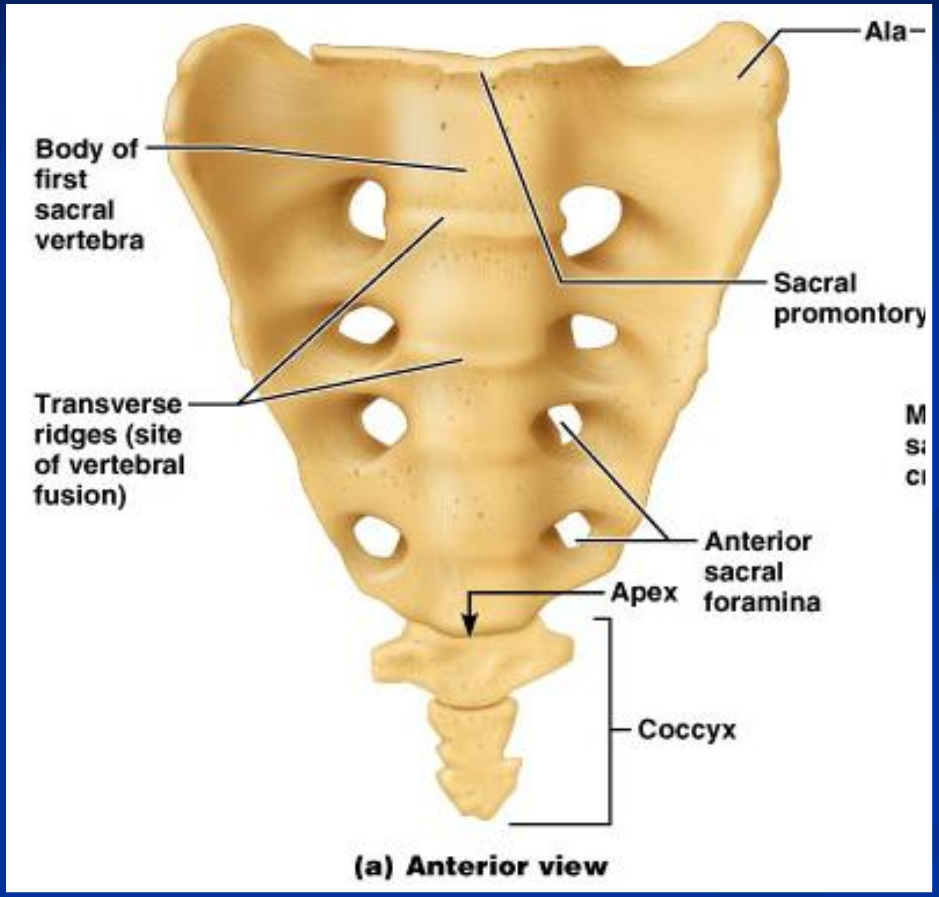
- The 5 **lumbar vertebrae** (L_1-L_5) have massive, block like bodies.
- They have short, hatchet-shaped **spinous processes**.
- They are the most solid of all vertebrae.

MOVEMENTS OF THE THORACOLUMBAR SPINE



The following movements are possible on the spine:
Flexion, extension, lateral flexion and rotation.
In the thoracic region, the **ribs**, the **costal cartilages**, and the **sternum** severely **restrict the range of movement.**
Flexion, extension and lateral flexion: are **extensive in the lumbar regions but restricted in the thoracic region.**
Rotation:
It is **extensive in thoracic spine and least extensive** in the **lumbar region.**

SACRUM



- The **sacrum** is formed by fusion of 5 vertebrae.
- Superiorly it articulates with L5, and inferiorly it connects with the coccyx.

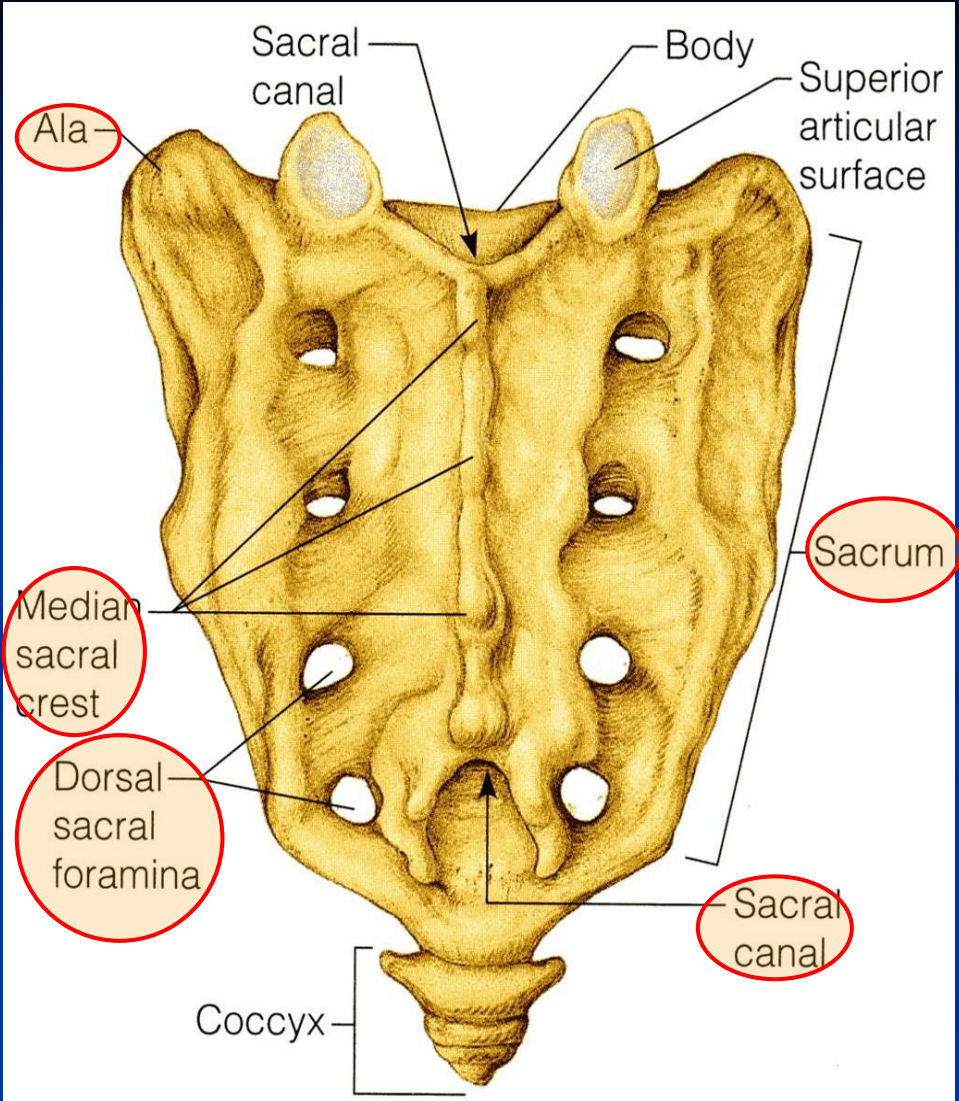
➢ **Sacral Promontory:**

➢ The anterior and upper margin of the first sacral vertebra.

- The wing like **ala** articulate laterally with the hip bones, forming the sacroiliac joints.

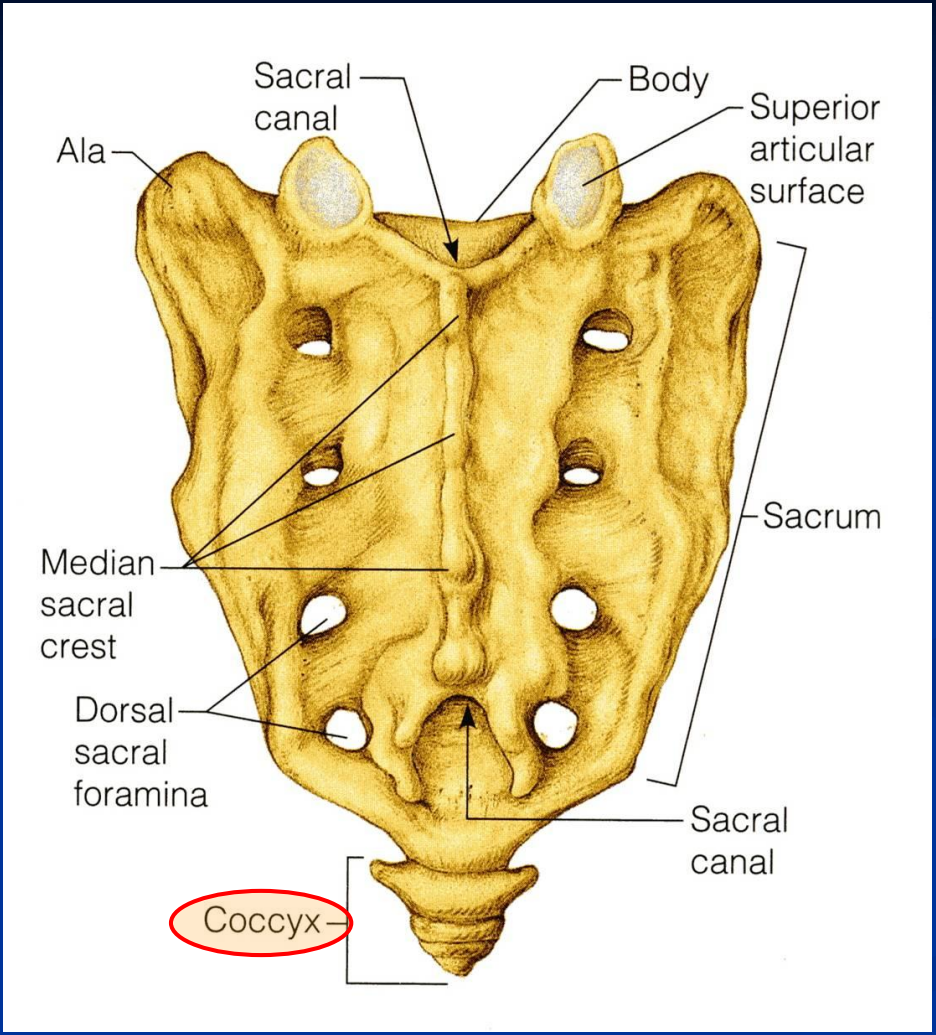
- The sacrum forms the posterior wall of the pelvic cavity.

SACRUM



- Its dorsal midline surface is roughened by the **median sacral crest, (**the fused spinous processes of the sacral vertebrae).
- This is flanked laterally by the **dorsal sacral foramina**.
- The vertebral canal continues inside the sacrum as the **sacral canal.**
- The sacral canal opens inferiorly in what is called sacral hiatus.

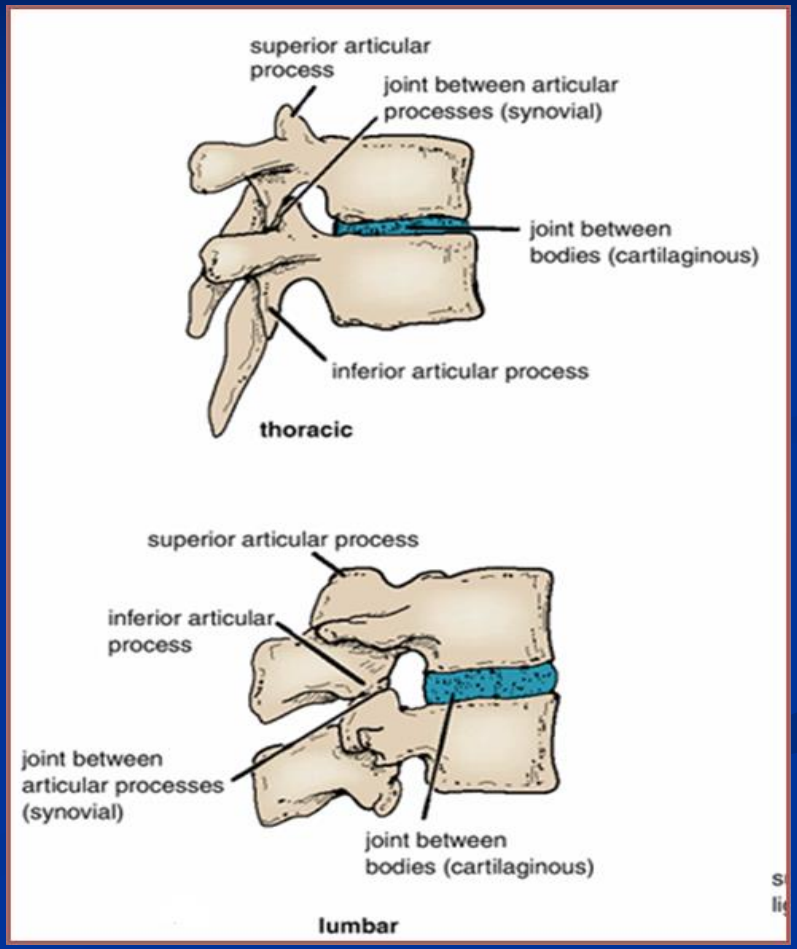
COCCYX



The **coccyx** is formed of fusion of **4** tiny, irregularly shaped vertebrae.

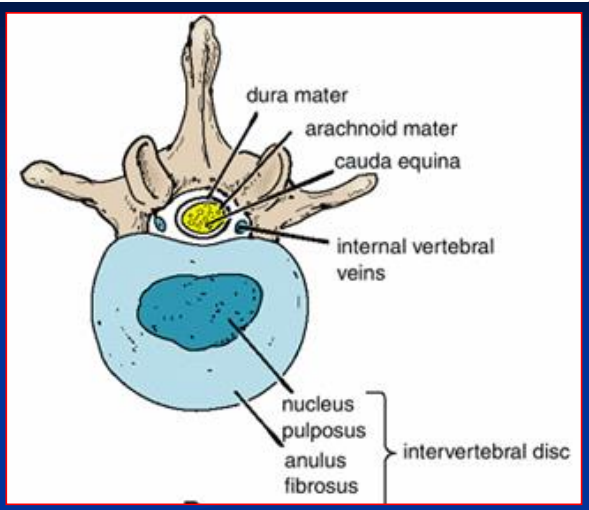
JOINTS BETWEEN TWO VERTEBRAL BODIES

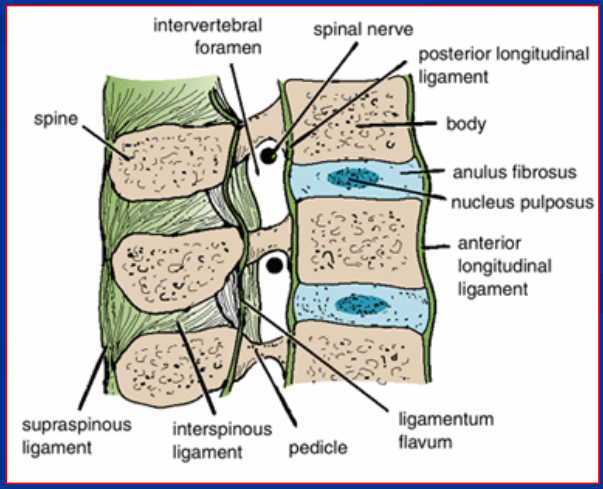
- It is a secondary **cartilaginous** joint.
- The **upper** and **lower** surfaces of the **bodies** of 2 adjacent vertebrae are covered by **thin plates** of **hyaline cartilage.**
- Sandwiched between the plates of hyaline cartilage is an intervertebral disc of **fibrocartilage.**



INTERVERTEBRAL DISCS

- The intervertebral discs forms about **one fourth of the whole length of the vertebral column.**
- They are **thickest** in the **cervical** and **lumbar** regions, where the movements of the vertebral column are greatest.
- **Each disc consists of a:**
  - **Peripheral part, called** the **annulus fibrosus**, composed of fibrocartilage.
  - **Central part, called** the **nucleus pulposus**, a mass of gelatinous material.
  - The nucleus pulposus formed of:
    1. Large amount of water,
    2. Small number of collagen fibers,
    3. Few cartilage cells.
- **No discs** are found between the first & second cervical vertebrae or in the sacrum or coccyx.

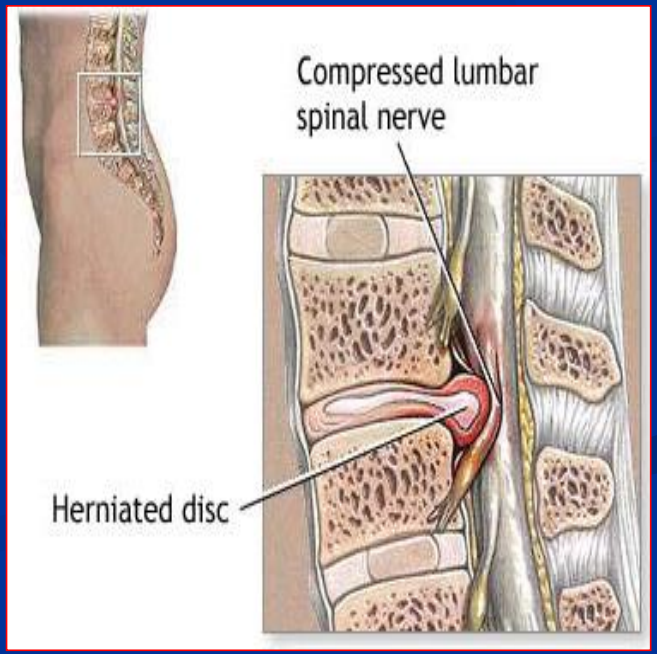


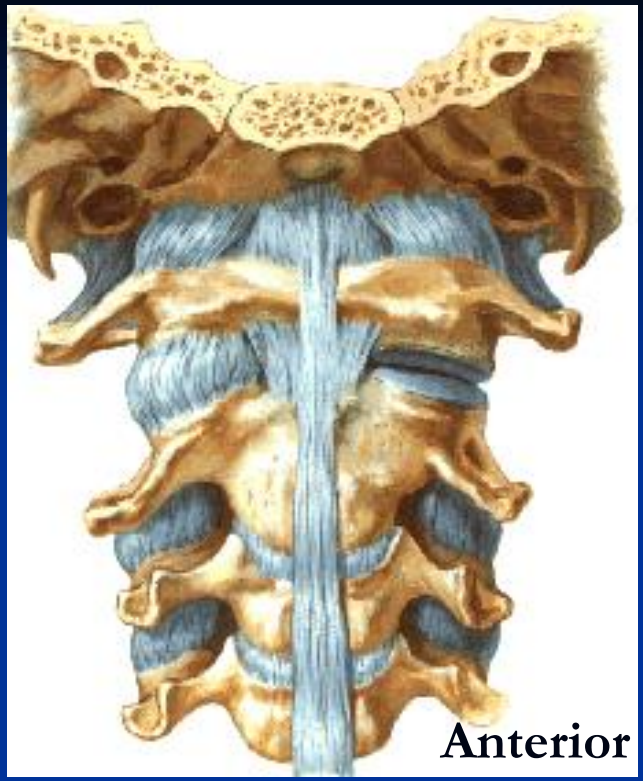


FUNCTION OF INTERVERTEBRAL DISCS

- **Allow** one vertebra to rock forward or backward on another, as in **flexion and extension of vertebral column.**
- **Serve as shock absorbers** when the load on the vertebral column is suddenly increased, as **when one is jumping.**

- Sometimes, the **annulus fibrosus** ruptures, **allowing the nucleus pulposus to** herniate and protrude into the vertebral canal, where it may press on the spinal nerve roots, or the spinal nerve, or even spinal cord itself.



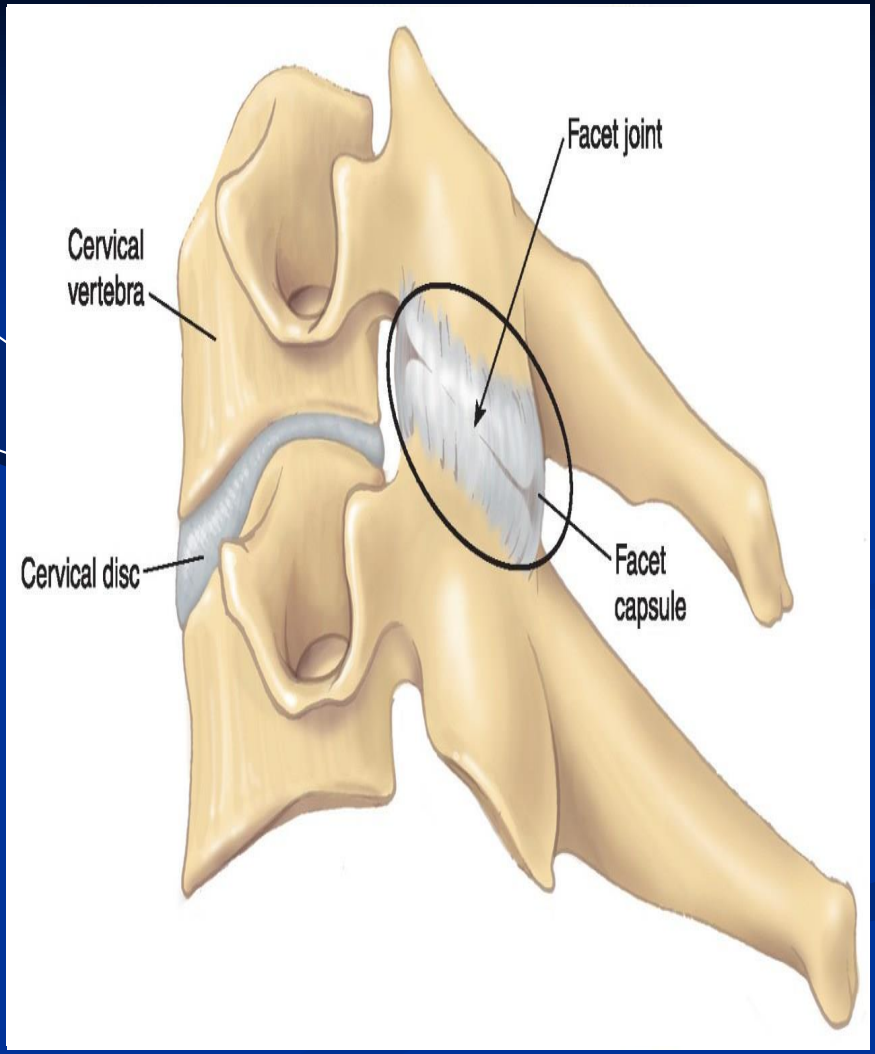


LIGAMENTS

- The anterior and posterior longitudinal ligaments run as continuous bands along the anterior & posterior surfaces of the vertebral bodies.
- These ligaments hold the vertebrae firmly together but at the same time permit a small amount of **movement** to take place.

The joints between two vertebral arches consist of synovial joints between the superior and inferior articular processes of 2 adjacent vertebrae.

The articular facets are covered with hyaline cartilage, and the joints are surrounded by a fibrous capsule.



OTHER LIGAMENTS

Supraspinous ligament:

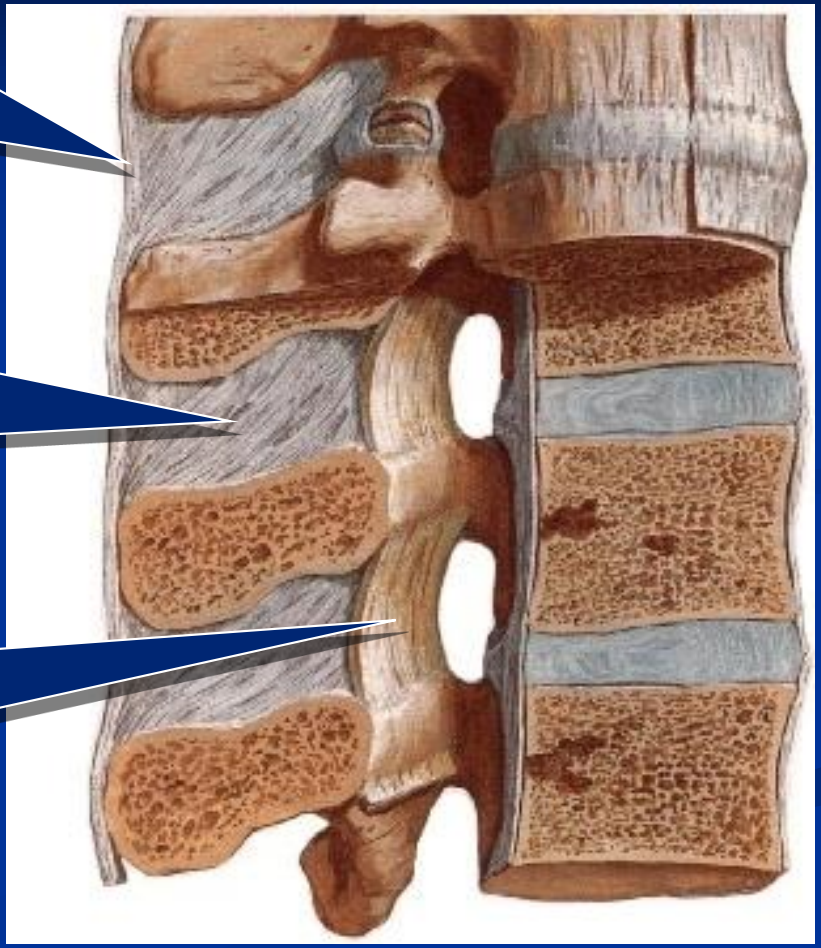
It runs between the tips of adjacent spines.

Interspinous ligament:

It connects adjacent spines.

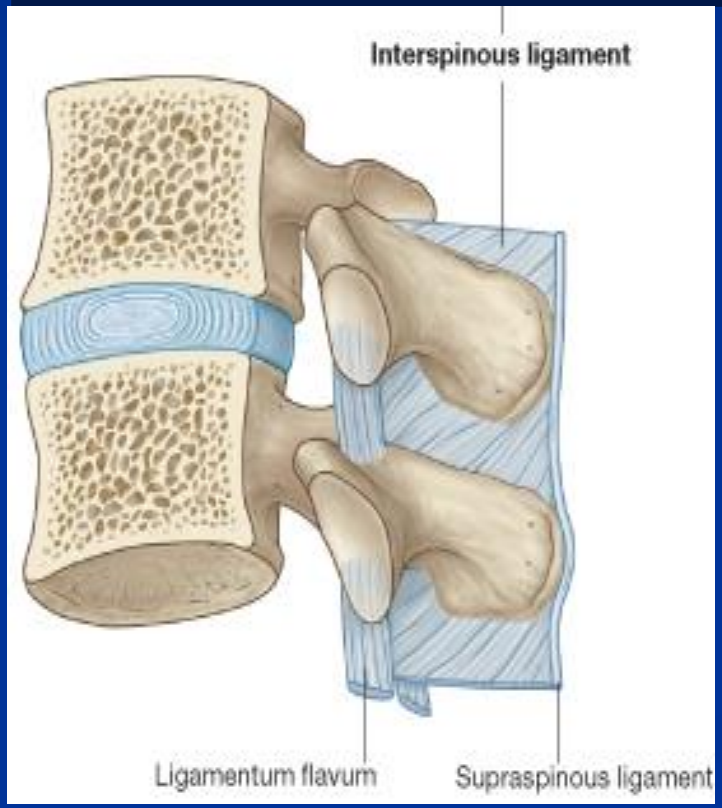
Ligamentum flavum:

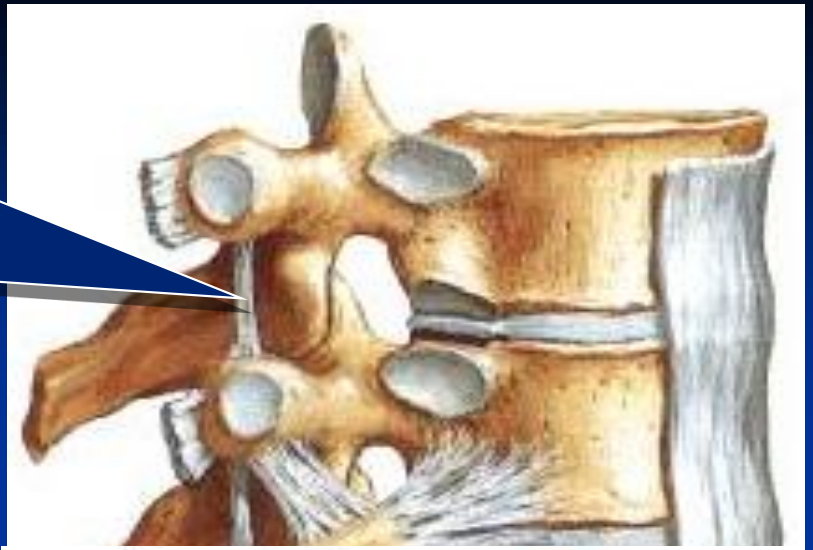
It connects the laminae of adjacent vertebrae.

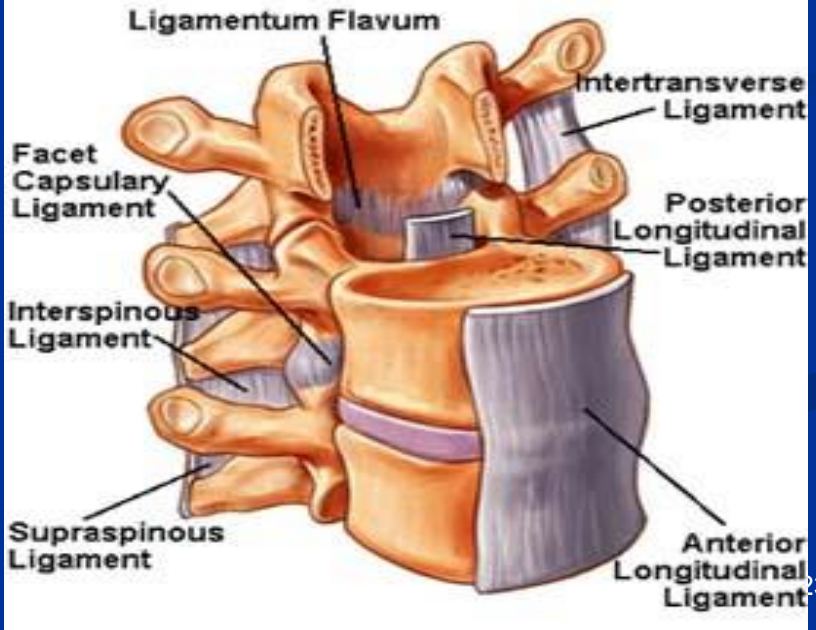


Intertransverse ligaments

It connects 2 adjacent transverse processes.

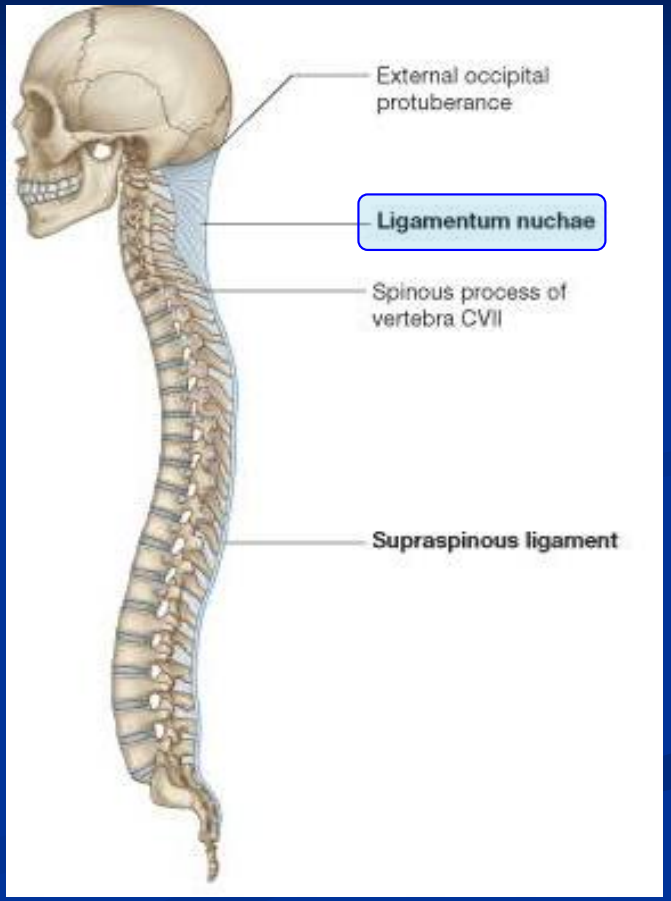






LIGAMENTUM NUCHAE

- In the cervical region, the **Supraspinous** and **Interspinous** ligaments are thickened to form the strong **ligamentum nuchae.**
- It extends from the external occipital protuberance of the skull to the spine of the **seventh** cervical vertebra.
- Its anterior border is strongly attached to the cervical spines in between.



THANK YOU AND GOOD LUCK