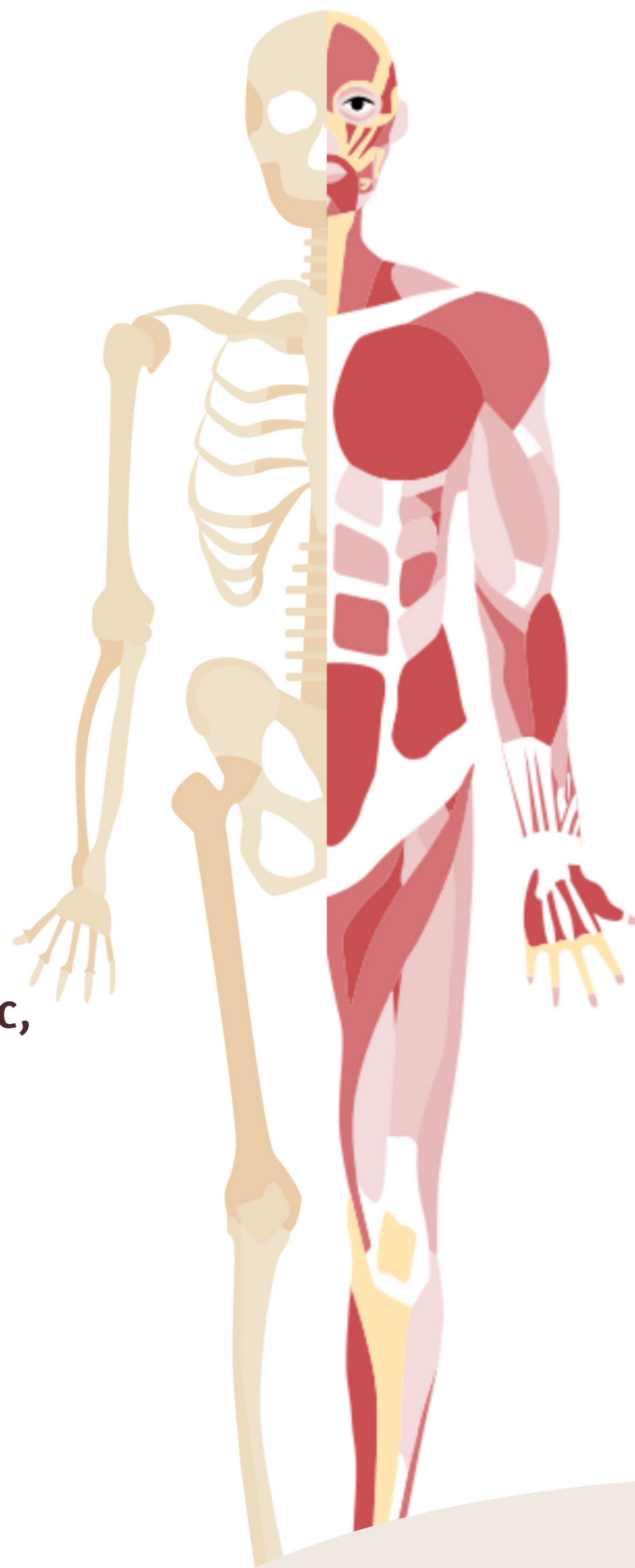


Lecture 3

ANATOMY OF SPINE

OBJECTIVES

- 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.
- **Identify the cervical, thoracic, lumbar, sacral and coccygeal vertebrae in a figure, plastic model and prosection.**
- List and identify the ligaments of the intervertebral joints.



Color Index:

- Main text
- Boys' Slides
- Girls' Slides
- Important
- Dr's Notes
- Extra



Editing File

Introduction

Boys'
Slides

The vertebral column (Spine) is one of the most important parts of the body.

The most important function of the spine is to protect the spinal cord.

Along with this major function, others include supporting the mass of the body, withstanding external forces, and allowing for mobility and flexibility while dissipating energy and protecting against impact.

The spine is connected to the muscles and ligaments of the trunk for postural control and spinal stability.

It can be separated into FIVE distinct sections:

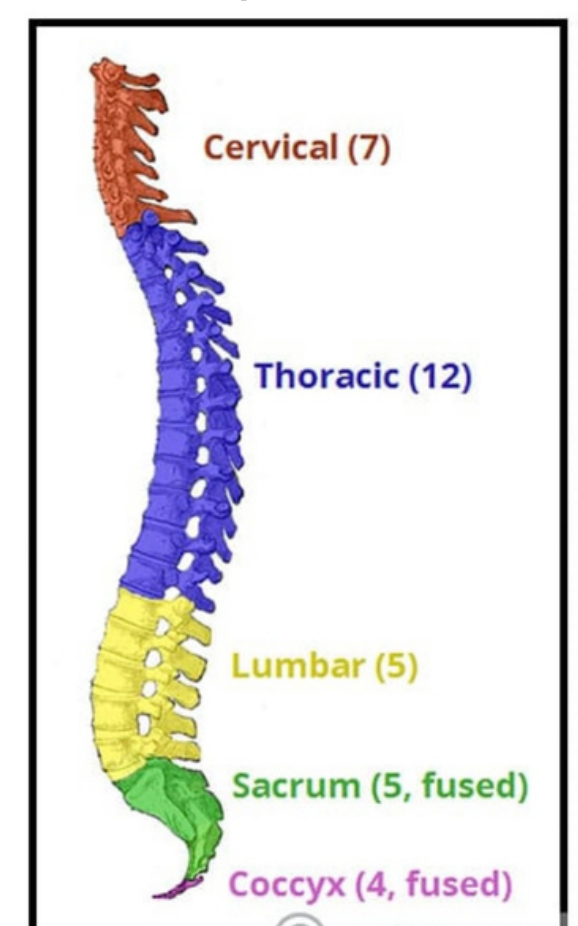
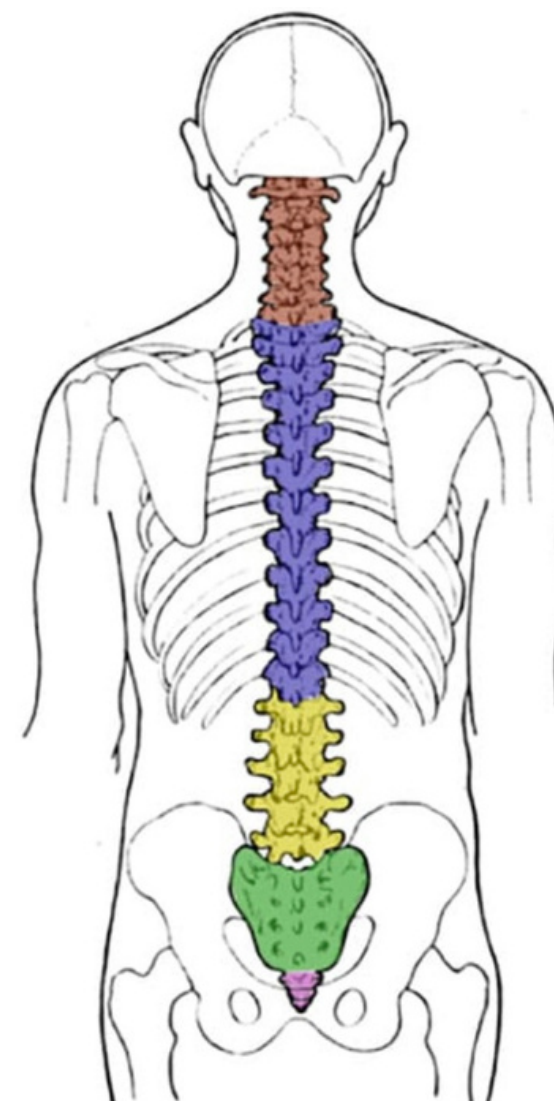
the cervical spine, the thoracic spine, the lumbar spine, the sacrum and the coccyx

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 (fused vertebrae)**:

1

The 24 single bone:(movable)

- **7 Cervical** vertebrae (concave)
- **12 Thoracic** vertebrae(convex)
- **5 Lumbar** vertebrae.(concave)

2

2 Fused bones: (immovable)

- **Sacrum (5 fused vertebrae)**.(Convex)
- **Coccyx (4 fused vertebrae)**.

• The **single vertebrae** are **separated** by pads of flexible **fibrocartilage** *secondary cartilaginous joint* called the **intervertebral disc (I/Vdisc)**.

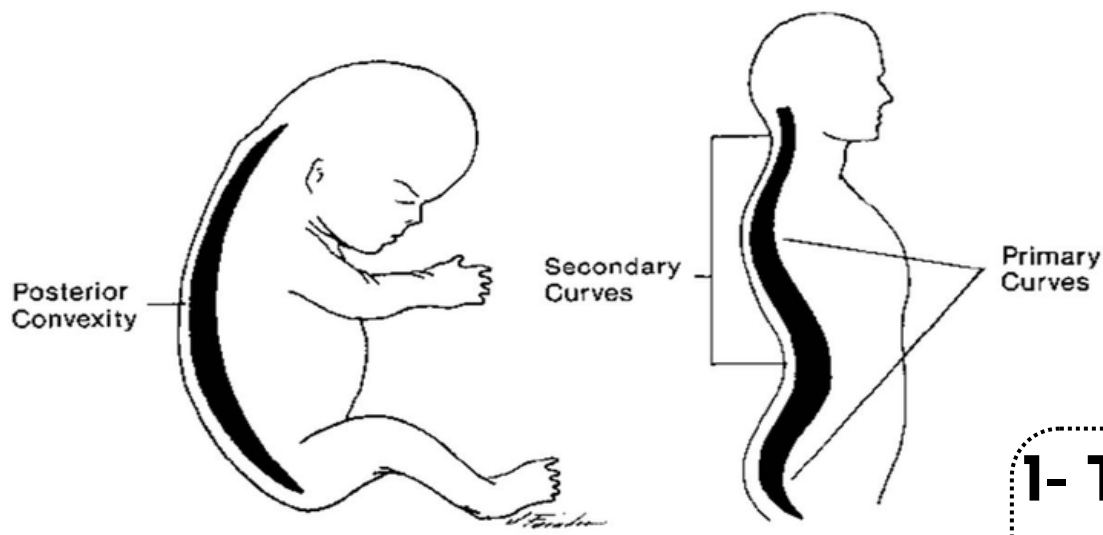
The intervertebral discs:

Cushion the vertebrae

Absorb shocks.

make the **body trunk flexible**.

Along with S-shaped curvatures of the VC **prevent shock to the head** during walk or run.



We have 2 spinal curvatures:

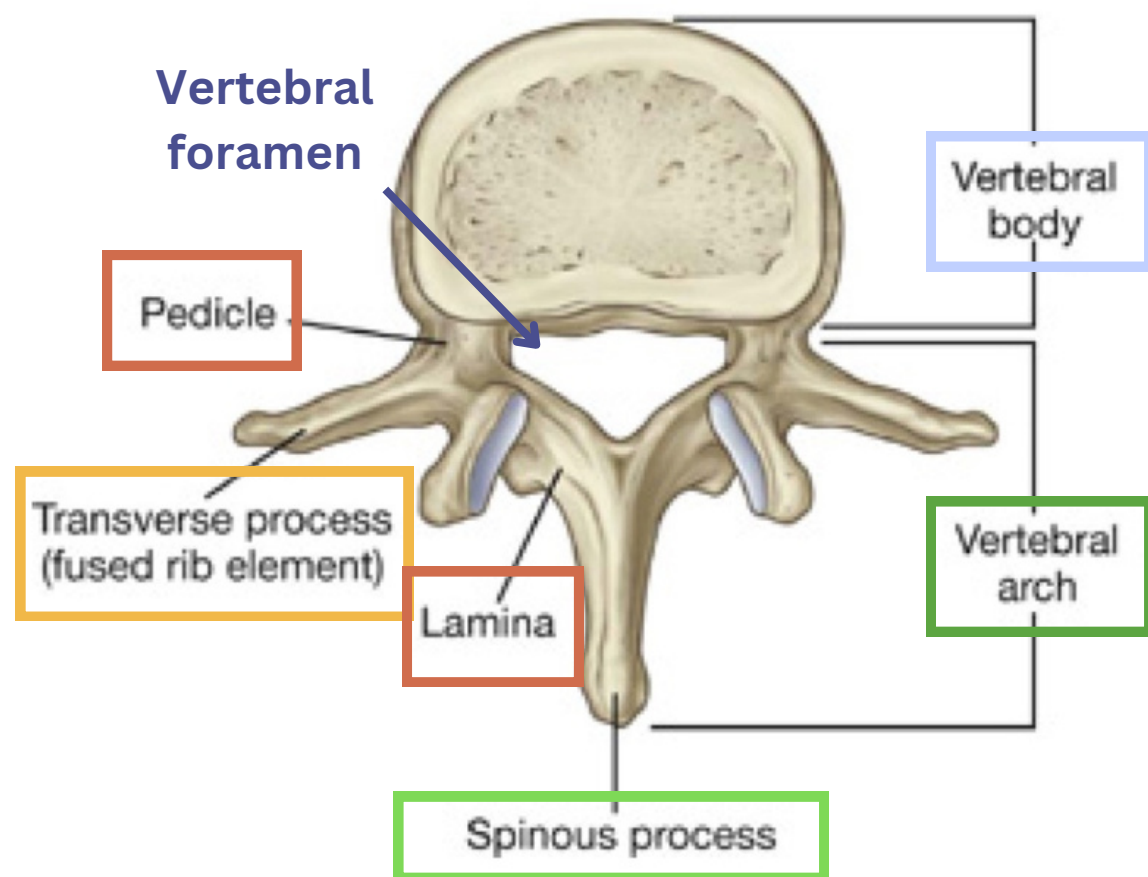
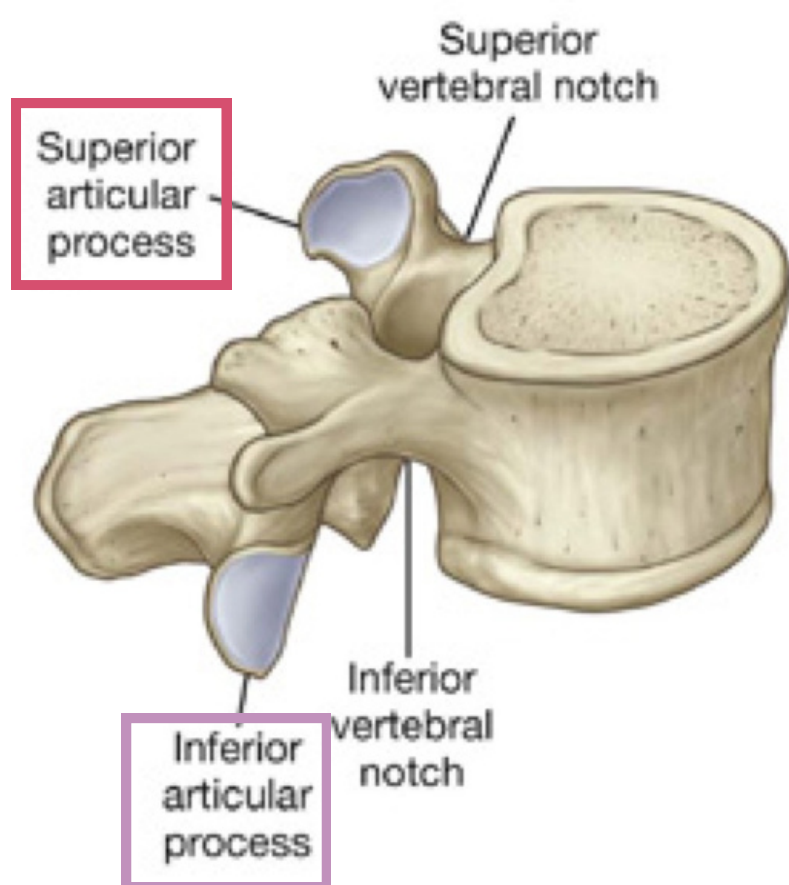
Spine curvatures

1- The primary curvatures

- Present **at** birth
- Present in the **Thoracic** and **sacral** regions
- **concave** forward

2- The secondary curvatures

- Present **after** birth
- The **cervical** a baby begins to hold his head (6th month)
- the **lumbar** curvature develops when the baby begins to walk (around the end of the 1st year).
- **Convex** forward



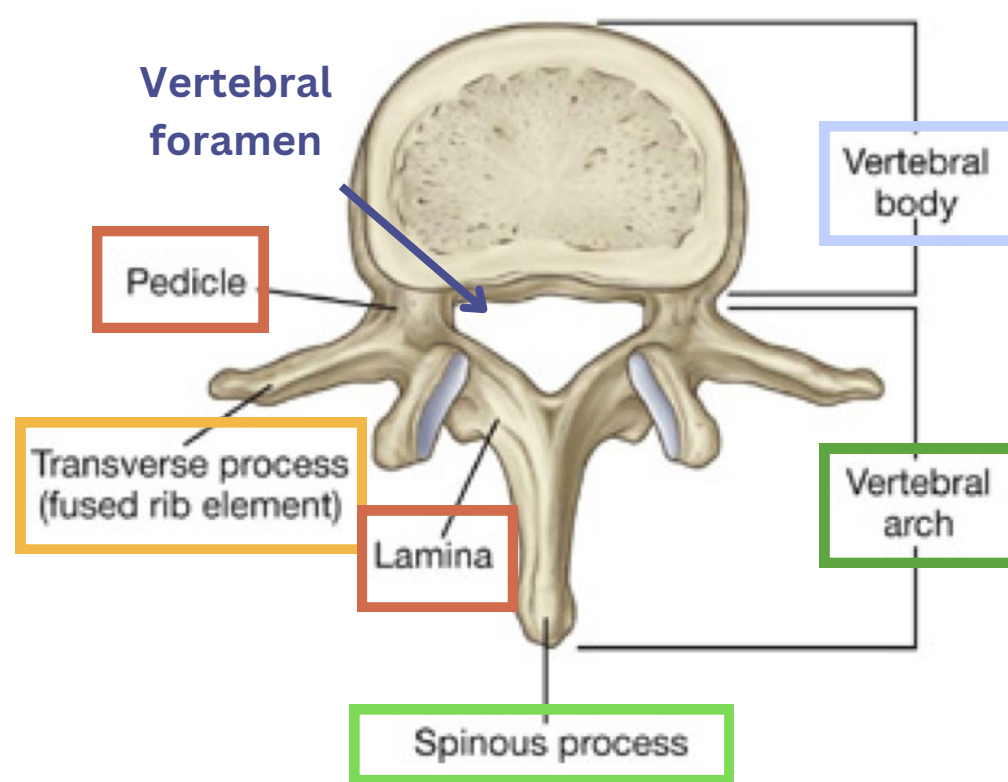
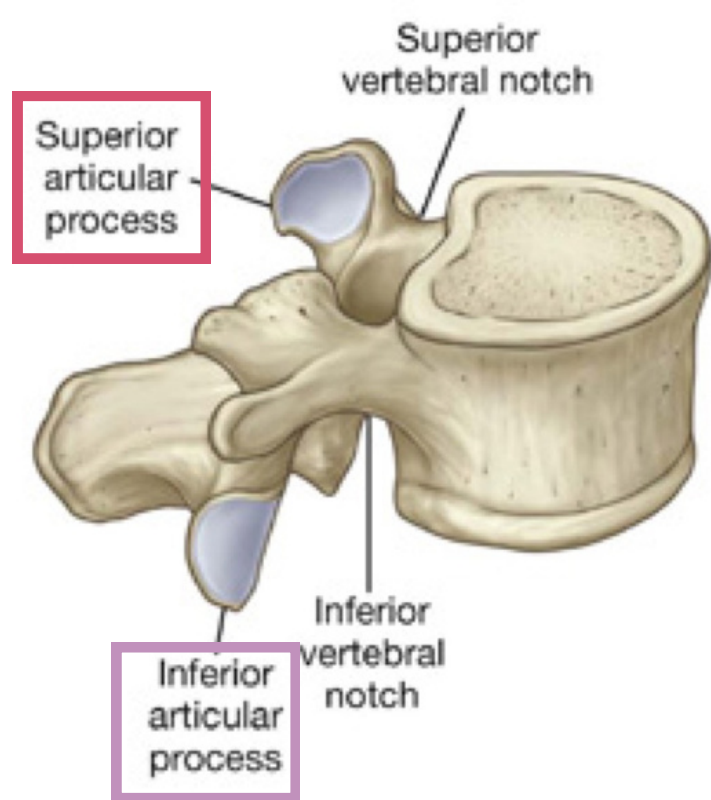
Body or Centrum:
disc-like, weight-bearing part that lies **anteriorly**.

Vertebral Arch (posterior): Formed from fusion of 2 **pedicles** and 2 **laminae**

Typical Vertebra
any vertebra is made up of:

Vertebral foramen:
lies between the body and the arch

spinal cord passes through the vertebral foramen

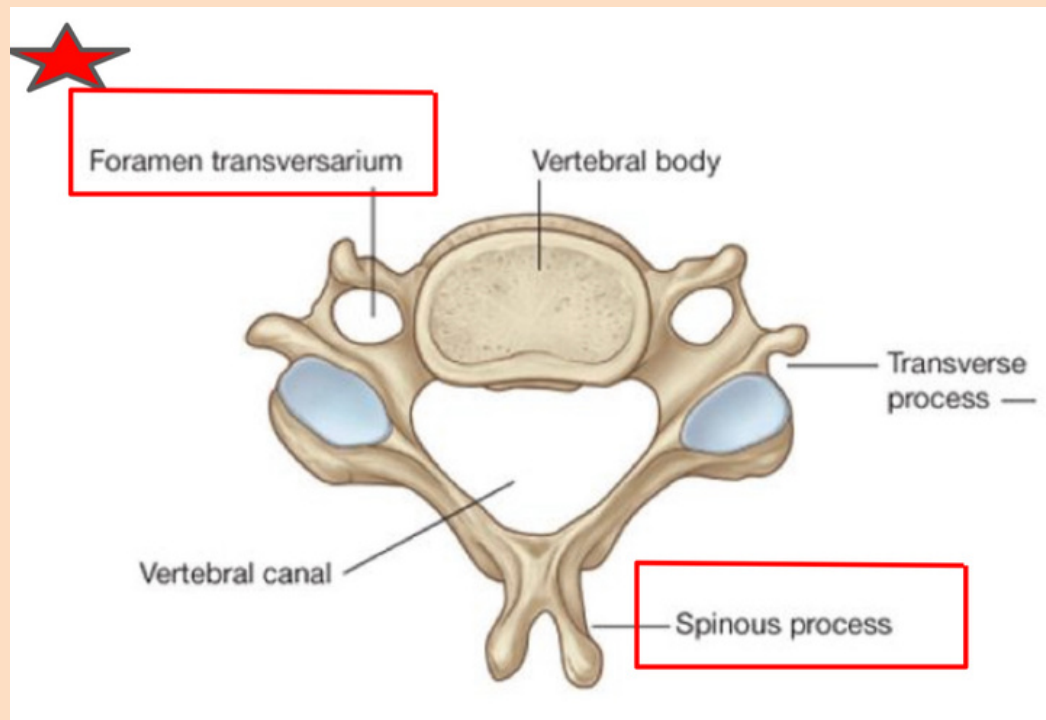


The vertebral arch carries 7 process:

- ◆ **2 transverse processes:** lateral projections from the arch
- ◆ **2 superior articular processes:** paired projections lateral to the vertebral foramen
forms joints between vertebrae
- ◆ **2 inferior articular processes:** paired projections lateral to the vertebral foramen
- ◆ **1 spinous process:** single projection arising from the posterior aspect of the vertebral arch.

Typical Cervical Vertebra:

The "typical" Cervical vertebrae (C3 to C6):



they're the smallest, lightest vertebrae, and their **spinous processes** are **short and bifid** (divided).

The transverse processes of the cervical vertebrae contain **foramina** *called foramen transversarium* through which the vertebral arteries pass on their way to the brain above.

The transverse processes foramina "foramen transversarium" transmits :
Vertebral vessels & sympathetic nerve fibers.

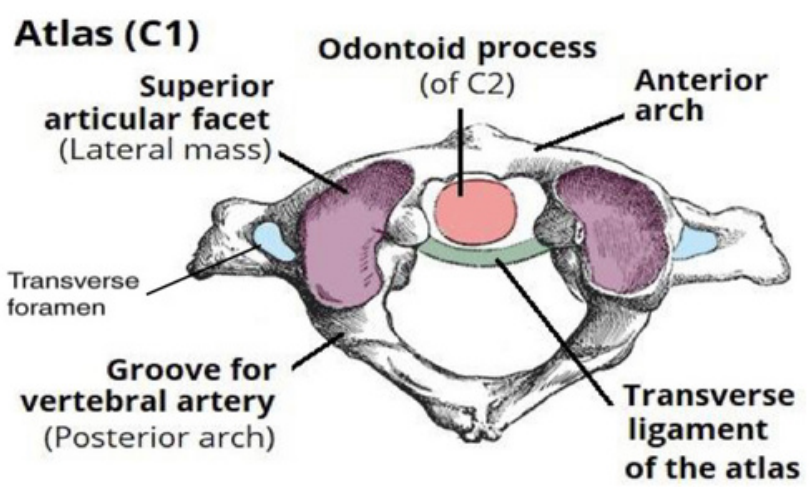
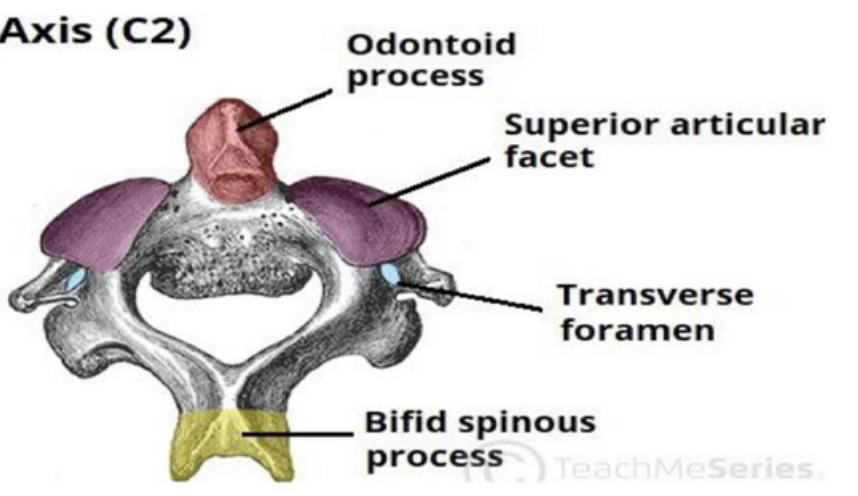
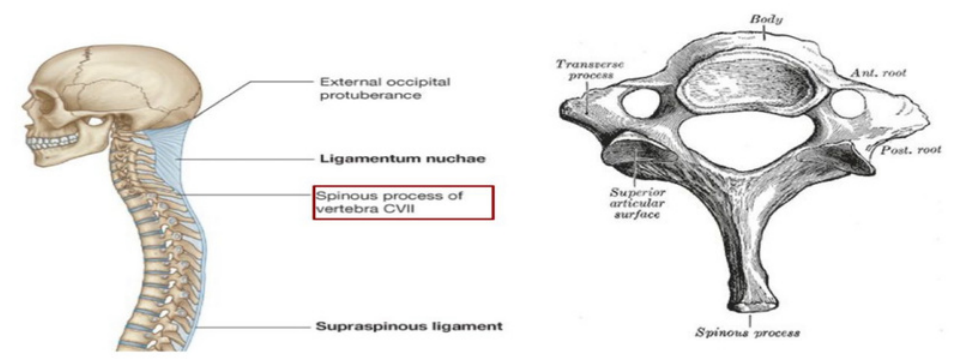
- Their transverse foramen is enlarged because of the the cervical enlargement in the spinal cord.
- Transverse foramina is a special feature for Cervical vertebrae

Atypical Cervical Vertebra:

IMPORTANT!

Atlas & Axis & C7 or Cervical prominens:

- 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 vertebra

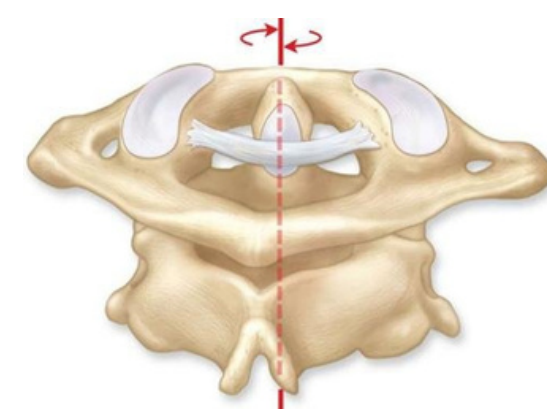
Atlas (C1):	Axis (C2):	C7 or Cervical prominens:
<ul style="list-style-type: none"> • has no body and is formed of 2 lateral masses. • contain kidney shaped facets superiorly. <p>No spinous process Ring like</p>	<p>It has a large upright process called odontoid process or dens that <u>acts as a pivot</u> for the rotation of the atlas and the skull</p>	<p>Longest spinous process which is NOT bifid It's the 1st spine to be felt subcutaneously in the root of back of the neck.</p>
<p>The facets forms a joint with the occipital condyles of the skull forming the atlanto-occipital joint</p>	<p>Forms a joint with the atlas called atlanto-axial joint The joint between C1 and C2 allows rotation of the head from side to side.</p>	<p>foramen transversarium does not transmit artery but vein if double.</p> <p style="text-align: right;">Only vein</p>
<p>Atlas (C1)</p> 	<p>Axis (C2)</p> 	

Movements

The **atlanto-occipital joint** allows flexion, extension, and lateral flexion movements (saying yes). **no rotation**



The **atlantoaxial joint** allows rotational movement (saying no)



APPLIED ANATOMY:



The cervical vertebrae (particularly C7), may be **FRACTURED** or, more commonly, **dislocated** by a fall on the head with acute flexion of the neck e.g. diving into shallow water.

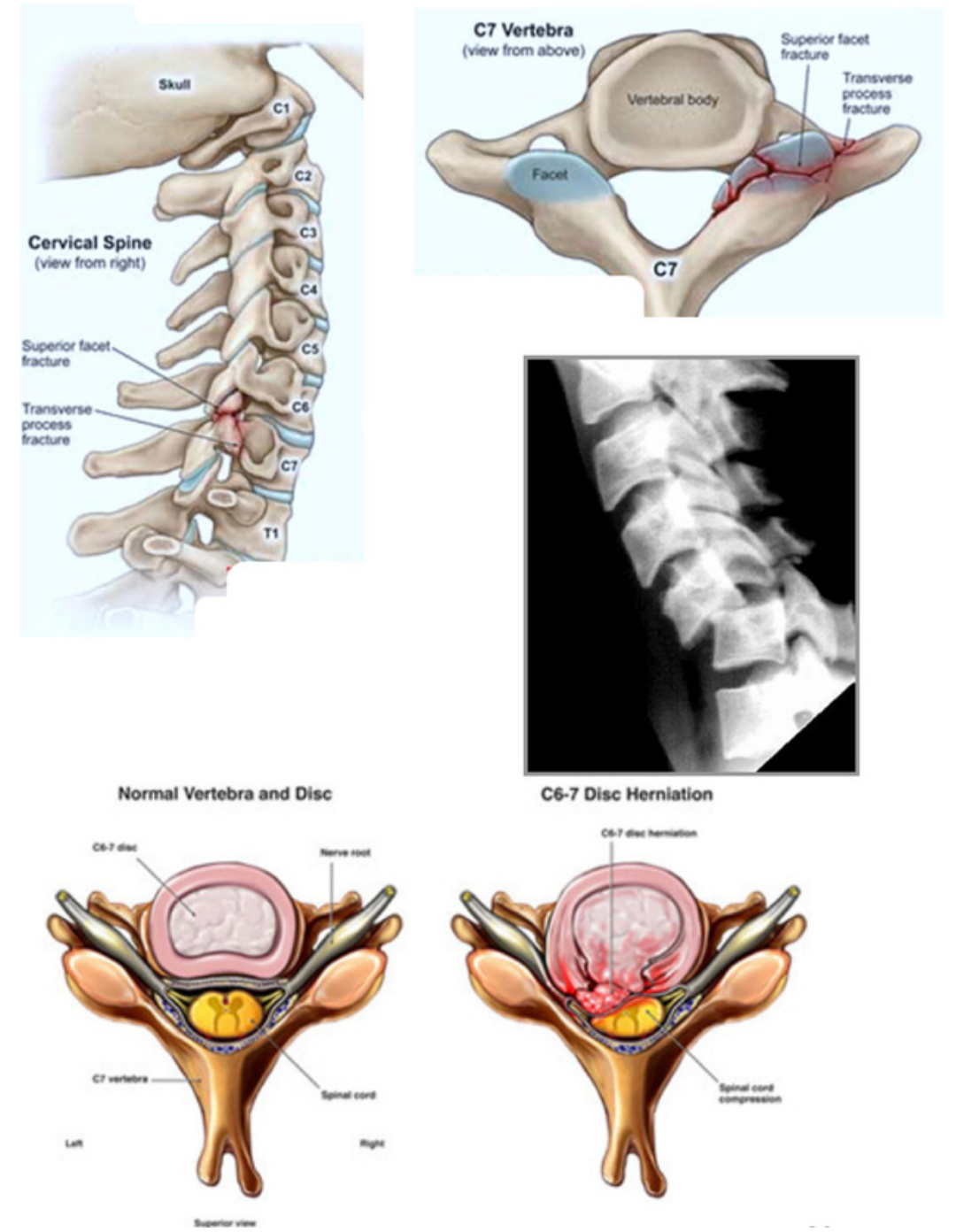
Dislocation may even result from the sudden forward jerk (during car or airplane crash).



WHY NOT FRACTURE-

the relatively horizontal intervertebral facets of the cervical vertebrae allow dislocation to take place without their being fractured.

Cervical disc prolapse- This may sometimes occur at the lower cervical intervertebral discs C5/6 and C6/7.

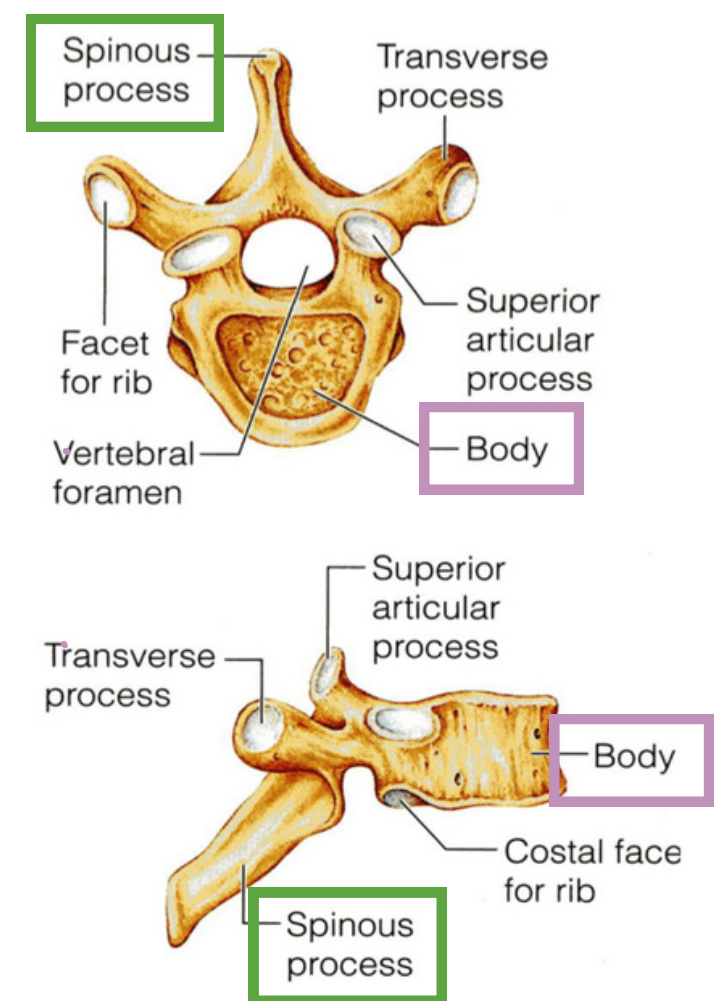


Thoracic and Lumbar Vertebrae:

THORACIC

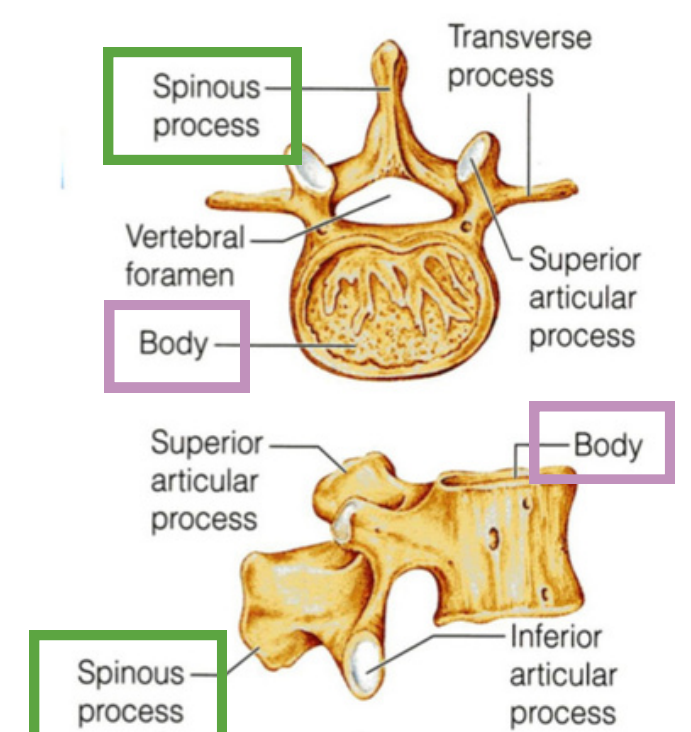
The 12 thoracic vertebrae (T1-T12) are almost typical, T2-T9 are typical while T1 and from T10 to T12 are atypical.

- They are larger than the cervical vertebrae.
- Their vertebral foramen or canal is small and circular.
- The **body** is somewhat heart-shaped and has two costal demifacets/semifacetes (**articulating surfaces**) on each side, which receive the **heads of the ribs**.
- Transverse process: **No foramen**.
- it has 2 costal facets (articulating surfaces) which receive the articulation of the tubercle of ribs of same number.
- **The spinous process** is long and hooks sharply downward (tapered downward).



LUMBAR

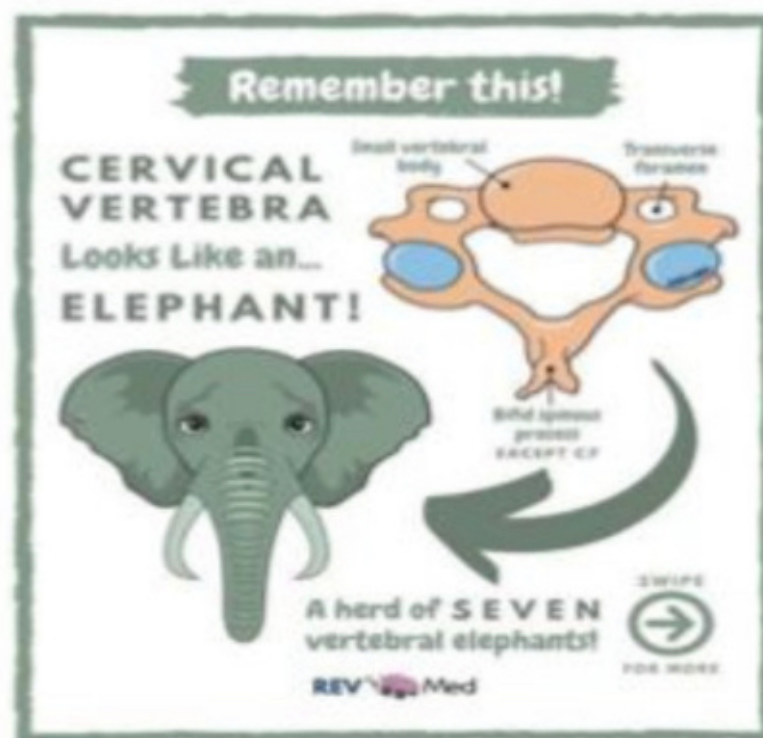
- The 5 lumbar vertebrae (L1-L5) have massive, block like bulky **bodies**.
- They have short, broad & flat or (hatchet-shaped) (flat and broad) **spinous processes**.
- They are the most solid of all vertebrae.





Remember 3 points to differentiate between cervical, thoracic and lumbar vertebra:

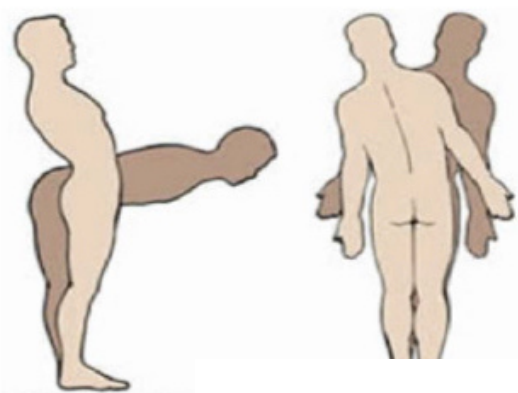
- 1- Foramen in transverse process = Cervical
- 2- Facet on the body = Thoracic
- 3- No foramen in transverse process and no facet on the body = Lumbar



MOVEMENTS OF THE THORACO-LUMBAR 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.



1

Flexion, extension and lateral flexion:

- **extensive** in the lumbar regions
- **restricted** in the thoracic region.



Helpful Video



2

Rotation:

- **extensive** in thoracic spine
- **least extensive** (Restricted) in the lumbar region.

Sacral and Coccyx Vertebrae:

- ◆ The sacrum is formed by fusion of 5 vertebrae.
- ◆ The sacrum is formed by fusion of 5 vertebrae.
- ◆ Superiorly it articulates with the L5.
- ◆ Inferiorly it connects with the coccyx.

1 Anteriorly

Sacral promontory is 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

2 Posteriorly

Its dorsal midline surface is roughened by the **median sacral crest**, the fused spinous processes of the sacral vertebrae.

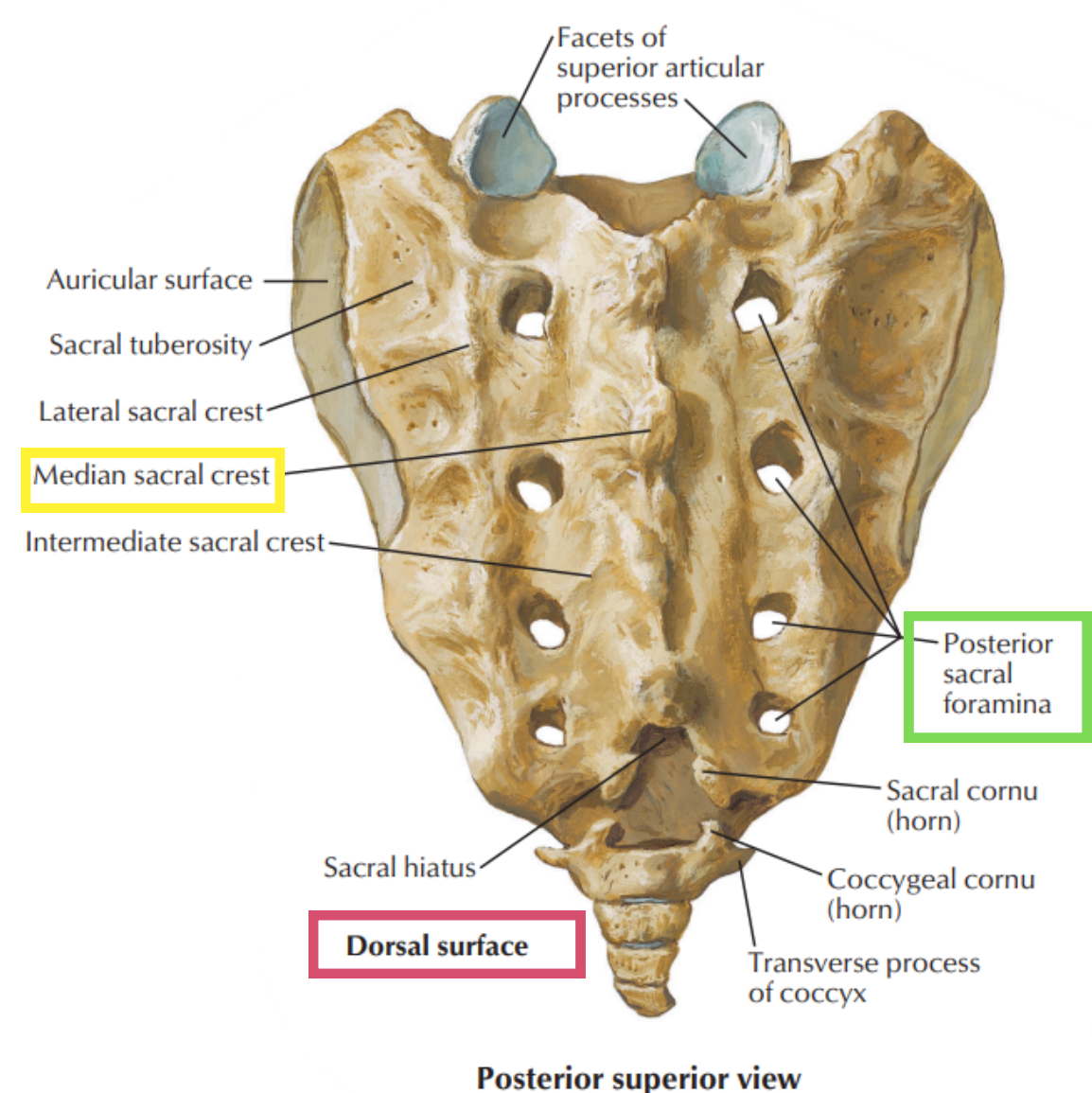
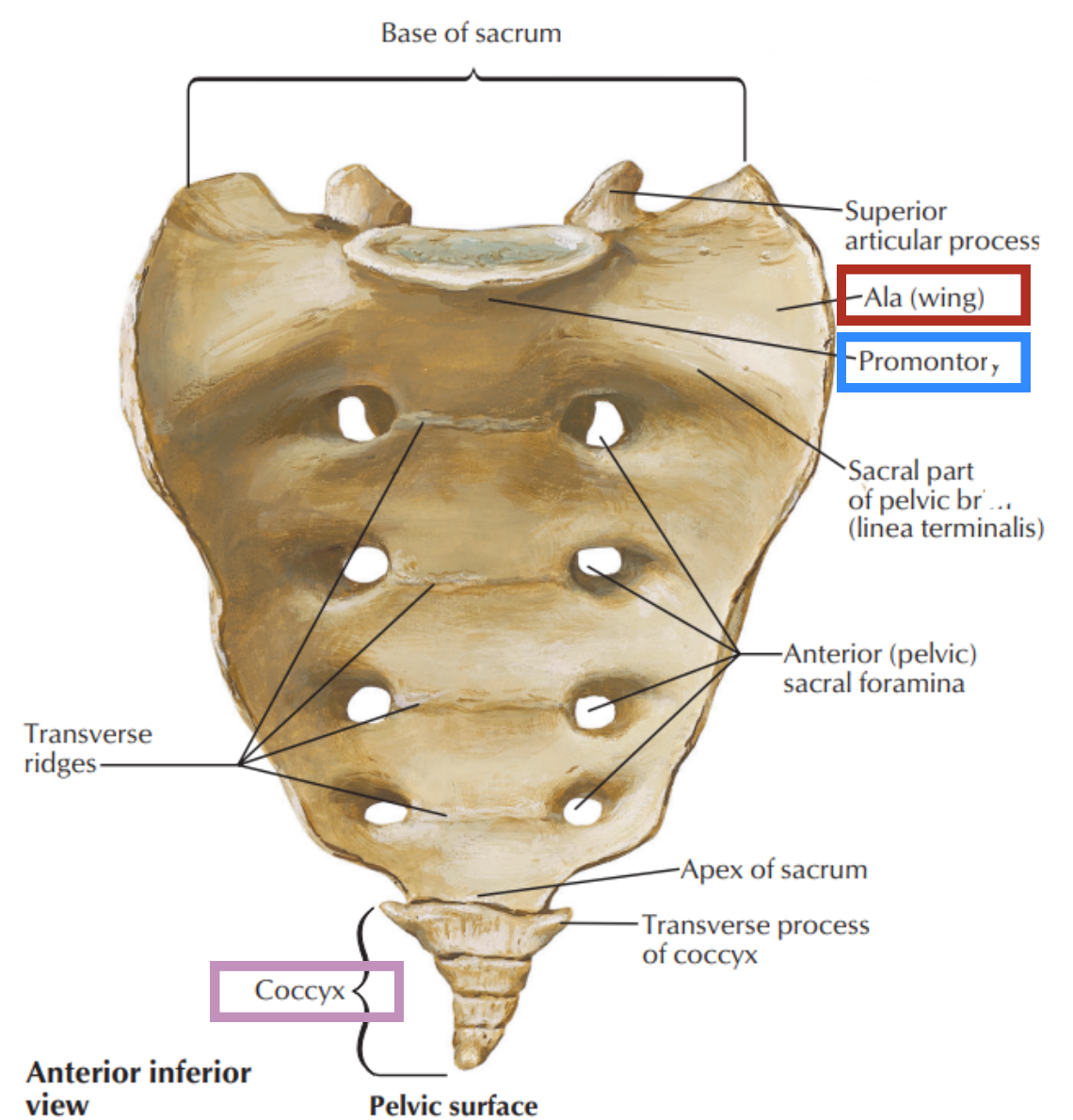
This is flanked laterally by the **dorsal sacral foramina**.

The vertebral canal continues inside the sacrum as the sacral canal.

The canal opens inferiorly in what is called **sacral hiatus** (hiatus=opening).

Coccyx

formed from the fusion of 4 tiny, irregularly shaped vertebrae.



Vertebral joints:

Adjacent vertebrae are held together by:

Strong ligament

Small joints

Joints between:

Neural arches

Bodies

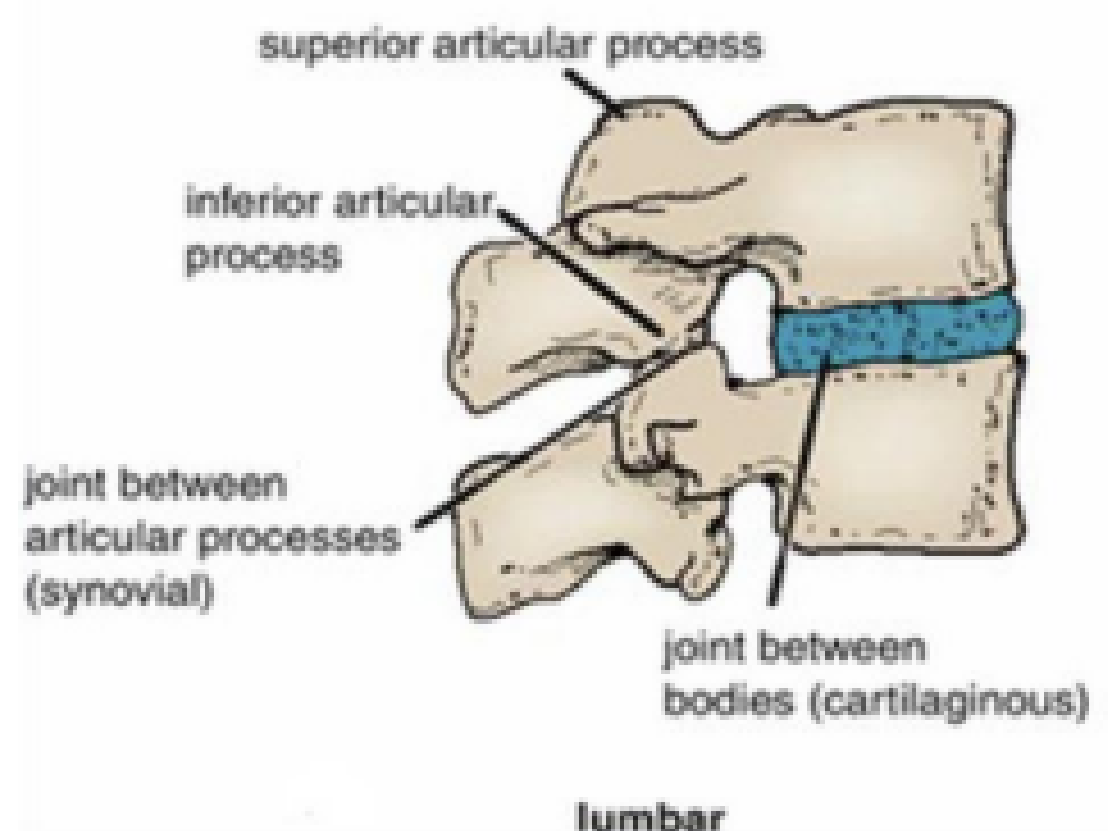
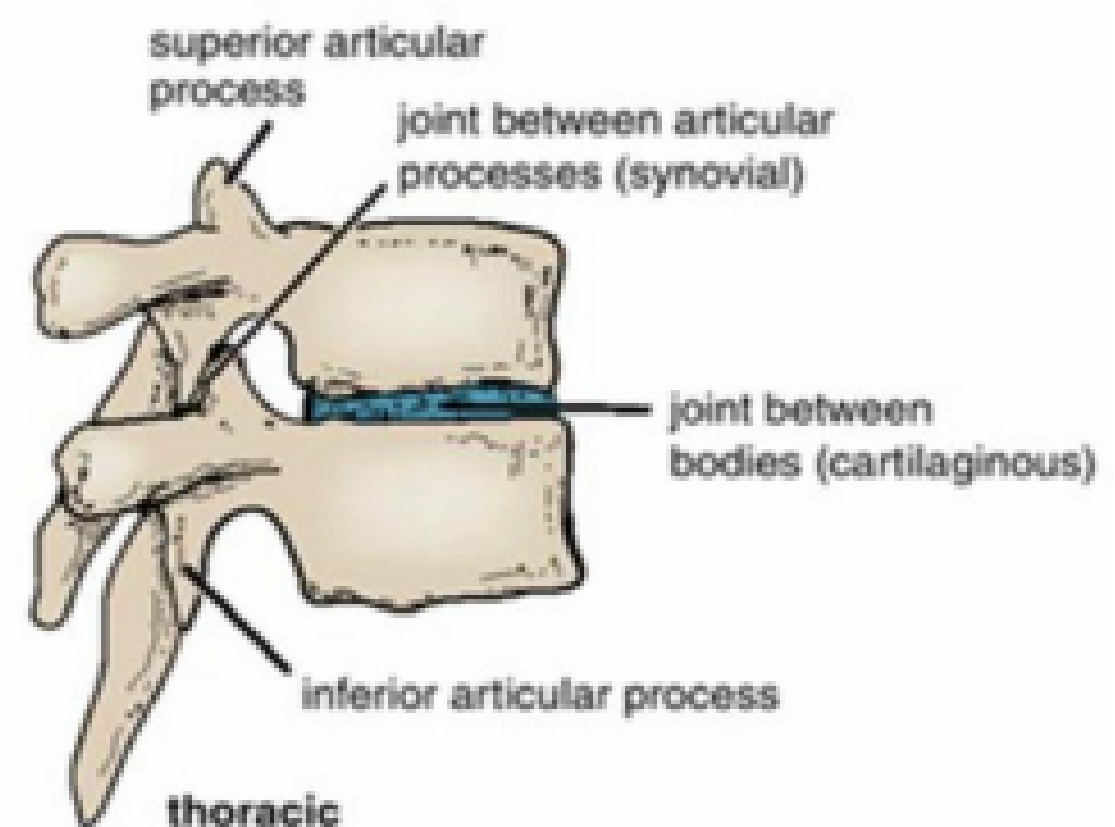
Note: joints between neural arches (vertebral arches) allows greater range of movements than joints between bodies

Joints between two vertebral bodies

It is a secondary cartilaginous joint (Symphysis)
Remember cartilaginous joint were of two type primary and secondary)

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 form 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.

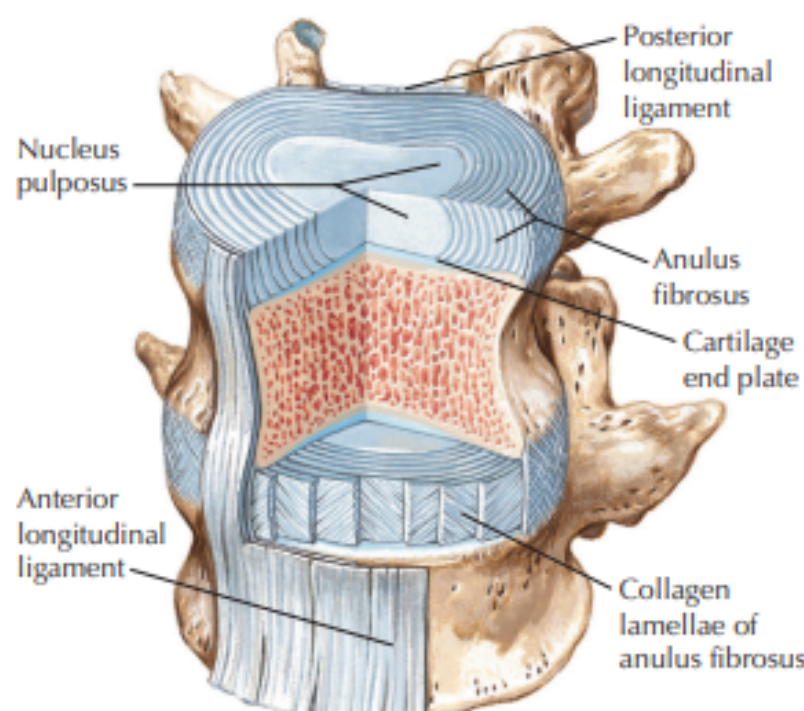
The discs most commonly affected are at the cervicothoracic and lumbosacral junction.

Each disc is formed of:

1 Peripheral part, called the annulus fibrosus, composed of fibrocartilage.

2 Central part, the nucleus pulposus (15% of whole disk), a mass of gelatinous material which is made up of mostly water (large amount of water) (90% at birth and 70% at old age), small number of collagen fibers & few cartilage cells.

No discs are found between C1 & C2 or in the sacrum or coccyx. (or C1 & occipital condyle)



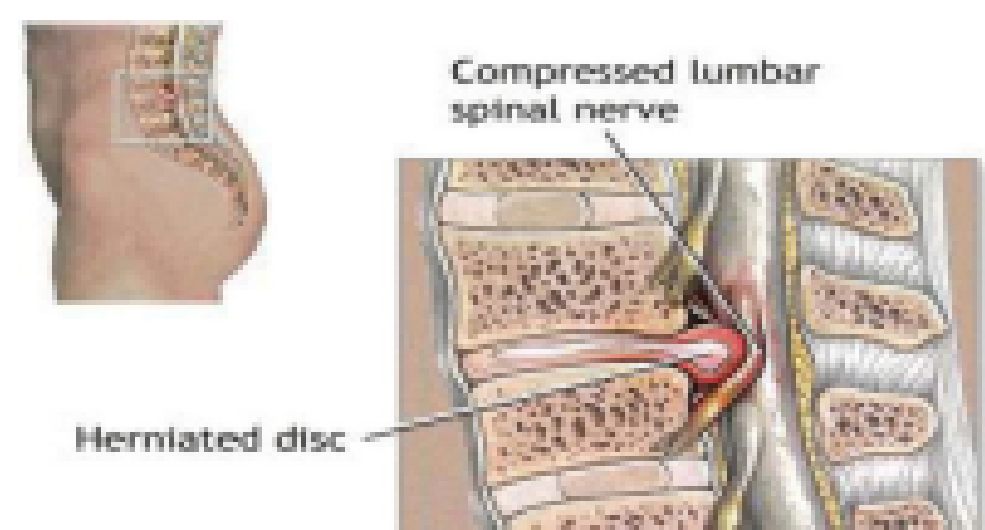
Functions:

1 Allow one vertebra to rock (move) forward and backward on another (flexion and extension of vertebral column)

2 Serve as shock (trauma) absorbers when the load on the vertebral column suddenly increases (when one jumps from a height)

Applied Anatomy:

Disk prolapse / Herniated/Slipped disk: 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 the spinal cord itself.



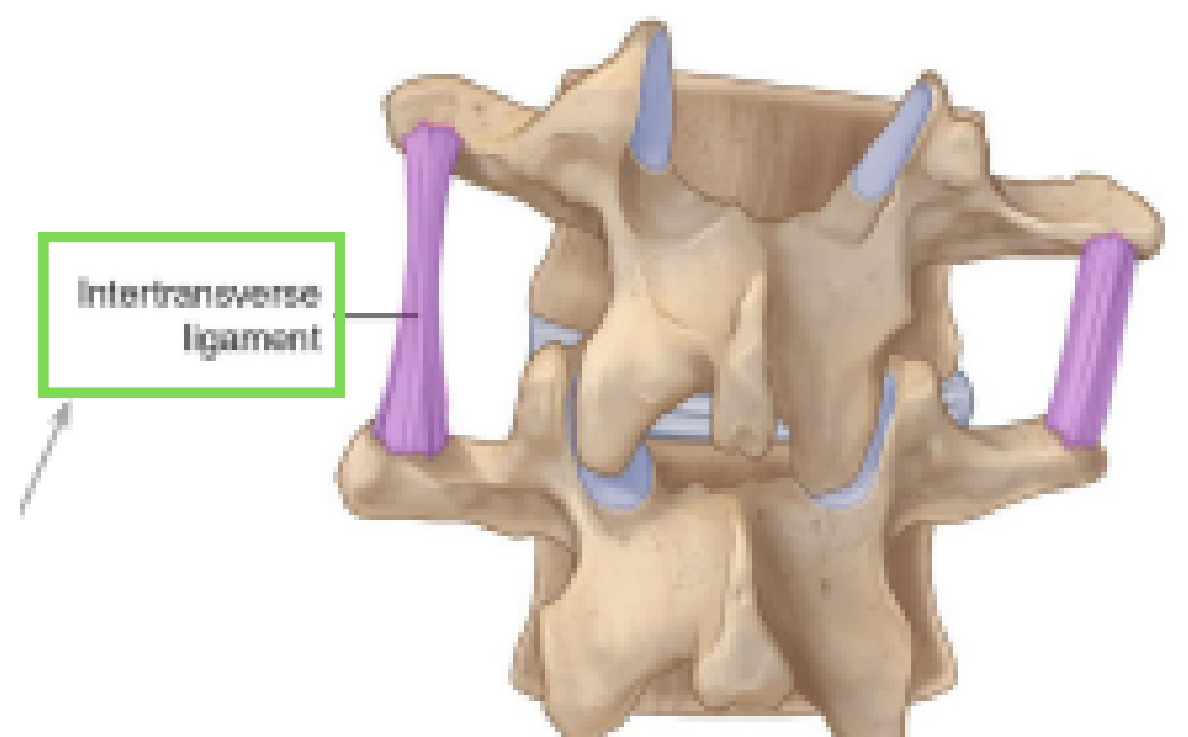
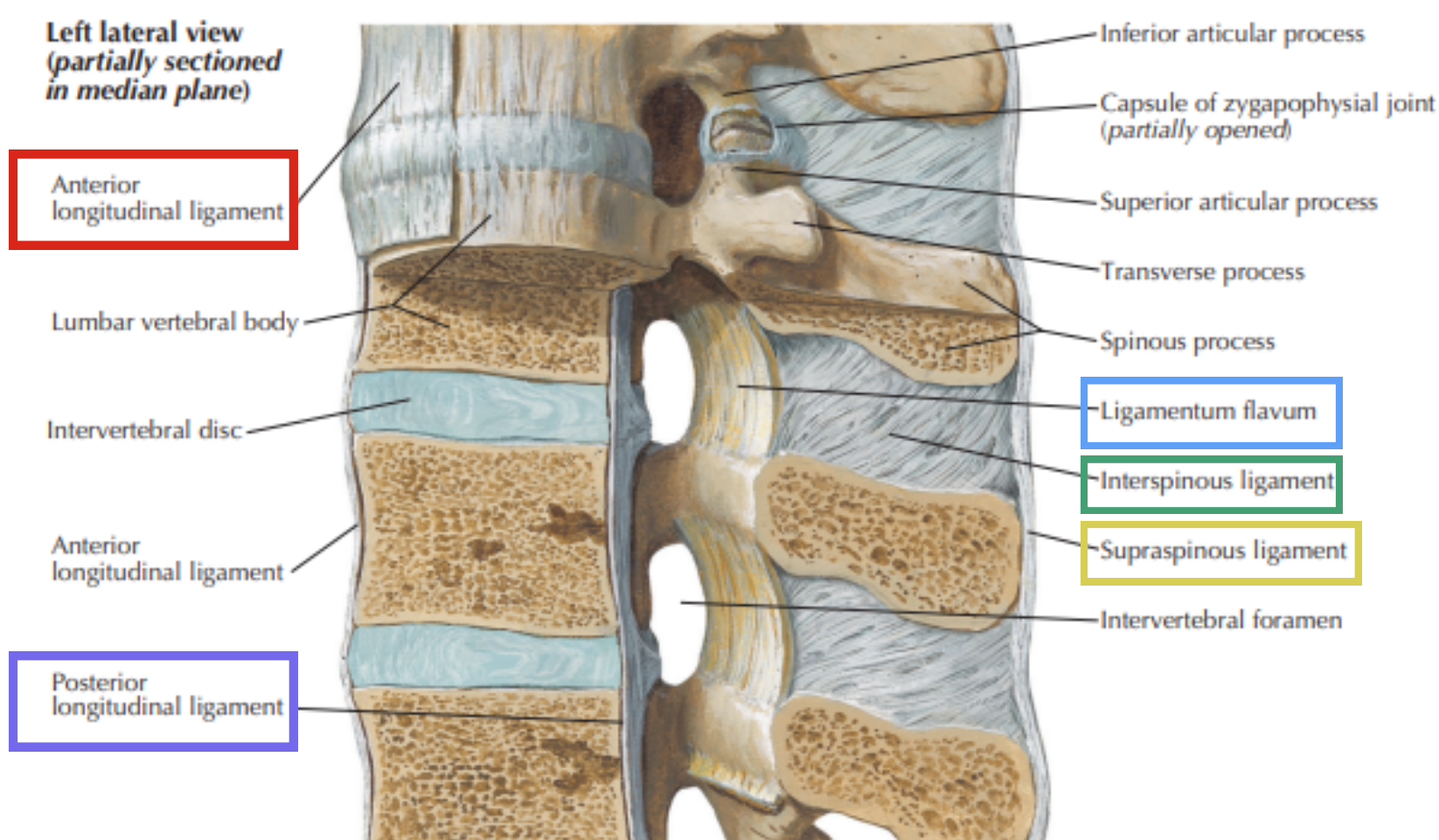
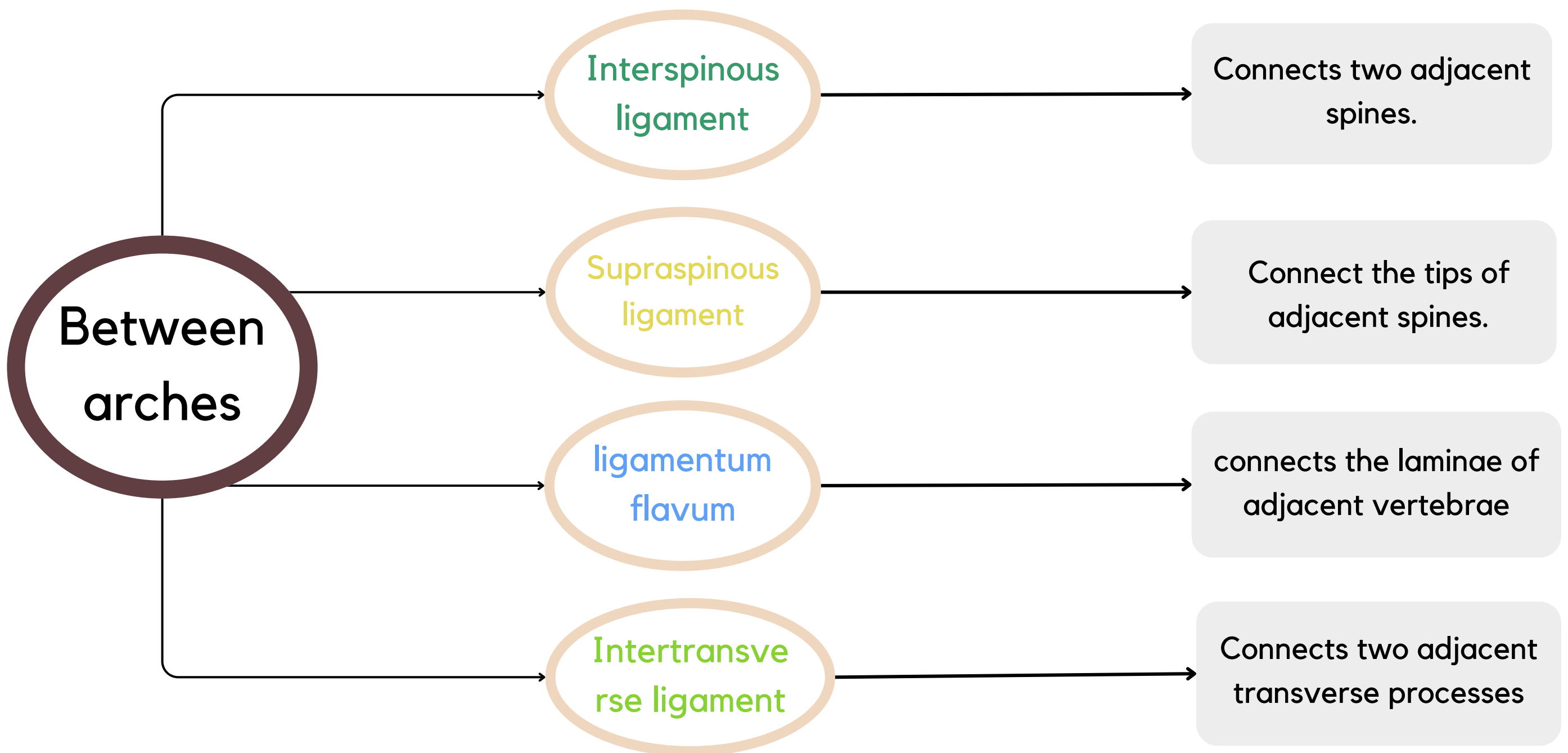
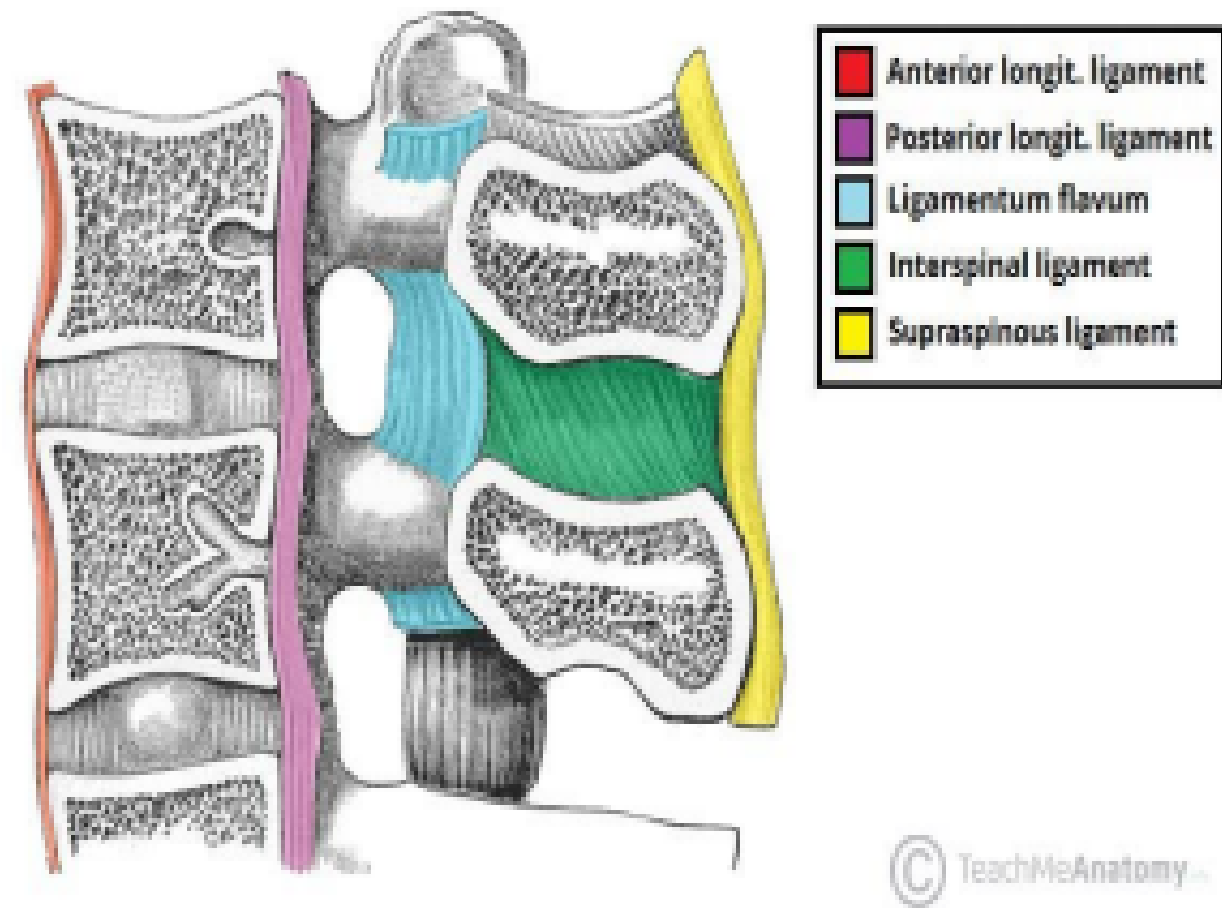
Ligaments



Helpful Video

Between Bodies

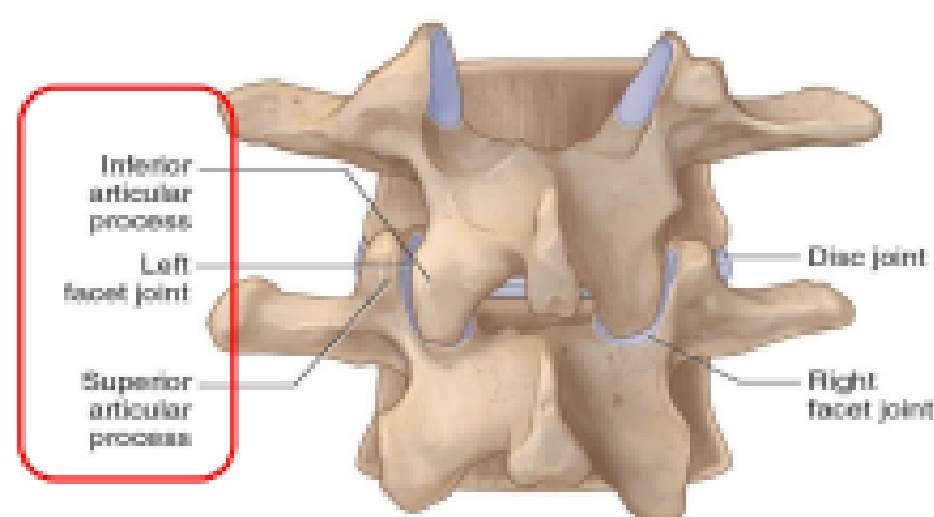
- The **anterior** and **posterior longitudinal ligaments** run as continuous bands along the anterior & posterior surfaces of the vertebral bodies.
- These ligaments hold the vertebrae firmly together but at the same time **permit a small amount of movement** to take place.



Joints between two vertebral arches:

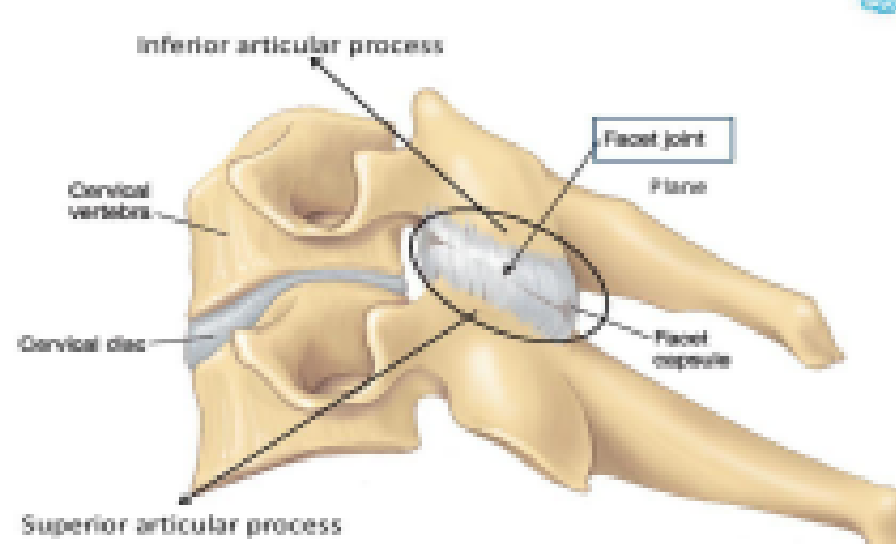
1

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



2

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

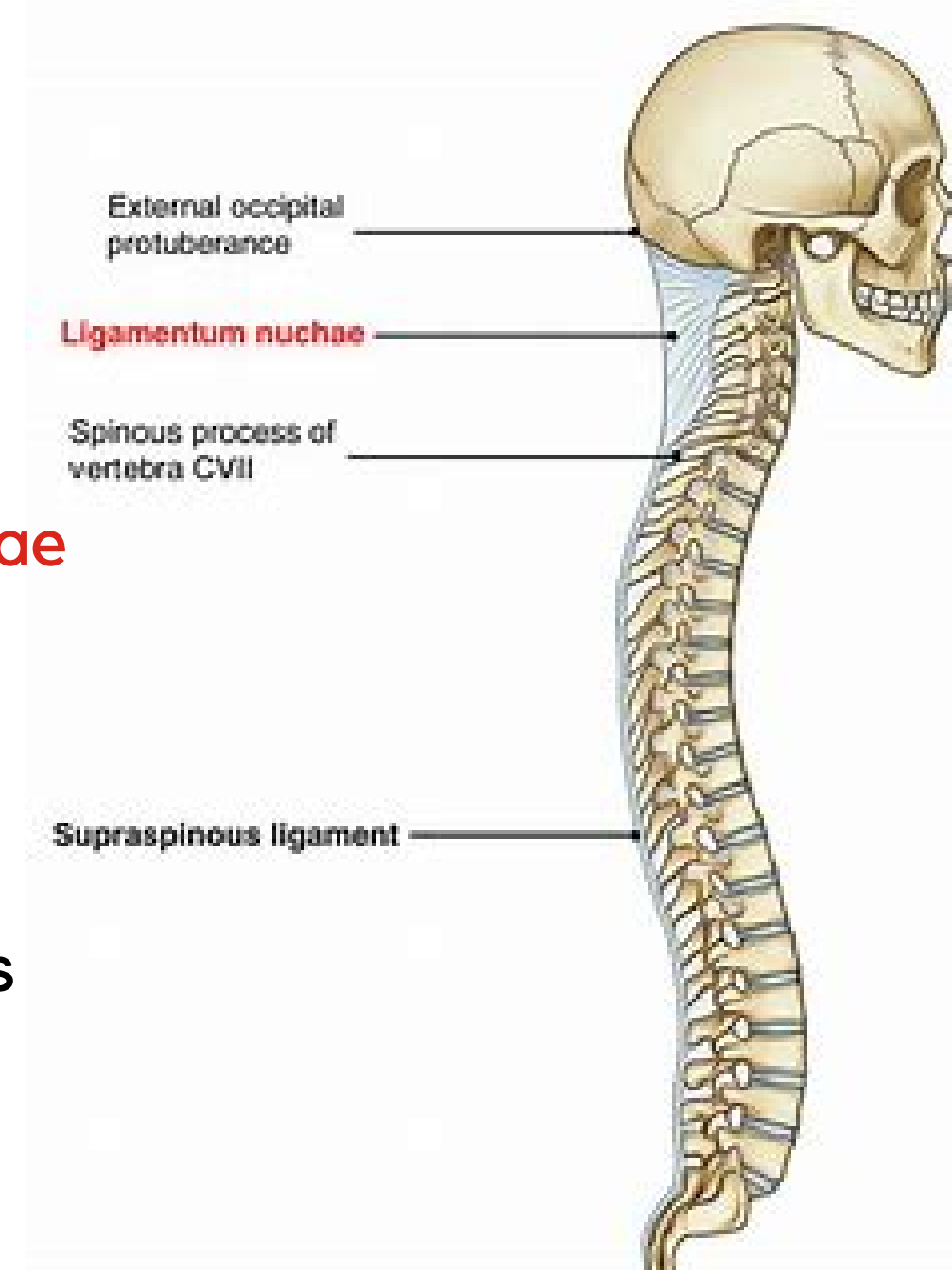


- ◆ Between pedicles - intervertebral foramen
- ◆ Adjacent articular process Synovial joint (Facet joints or Zygapophyseal joints)
- ◆ **Other arch by ligaments:**
 - **Ligamentum Flava:** yellow, high elastic fibers, join the adjacent lamina, stretch by the flexion of spine (in leaning forward -Anti - Gravity support).
 - **Supraspinous ligament:** strong, white, join the tips of spinous process, lax in extended spine, taut by full flexion & support spine (touching the toes).
 - Interspinous & Intertransverse ligaments: weak ligaments

Ligamentum nuchae:

IMPORTANT!

- 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 7th cervical vertebra**.
- Its **anterior border** is strongly attached to the cervical spines in between.



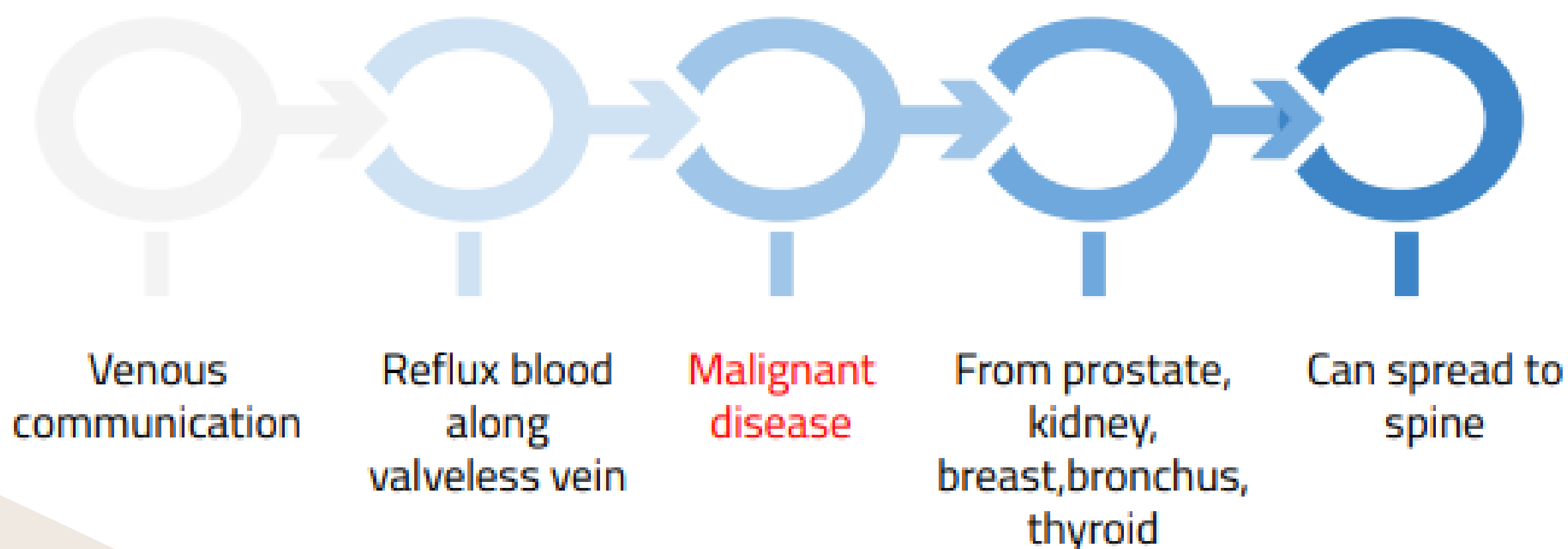
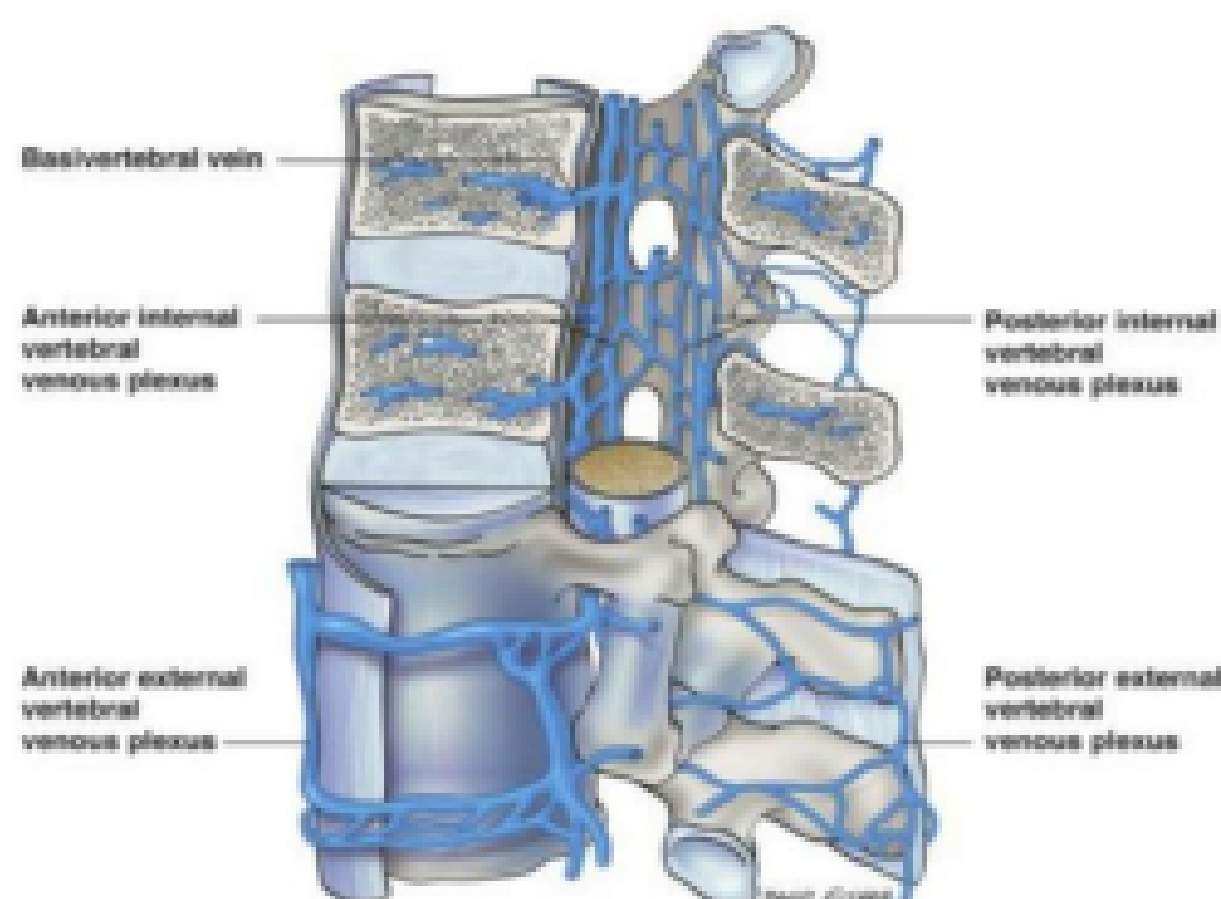
Blood supply of the vertebrae

Segmentally (according to region) by:

- The vertebral Artery
- Ascending and deep cervical arteries.
- Intercostal artery.
- Lumbar and lateral sacral arteries

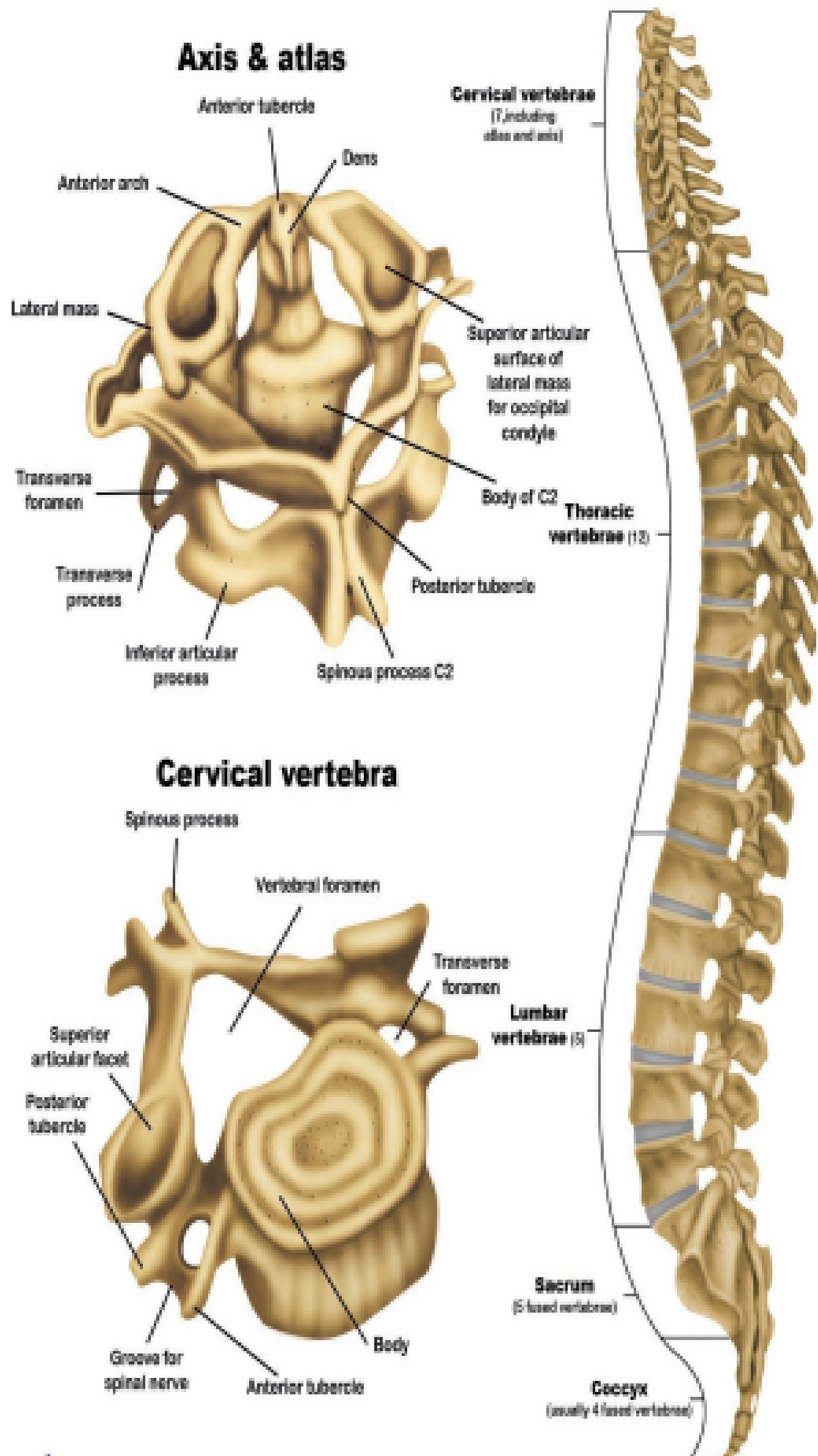
Drains by:

Basivertebral veins → Internal vertebral venous plexus → External vertebral venous plexus → Into Regional segmental veins [vertebral, post intercostal, lumbar and lateral sacral veins]

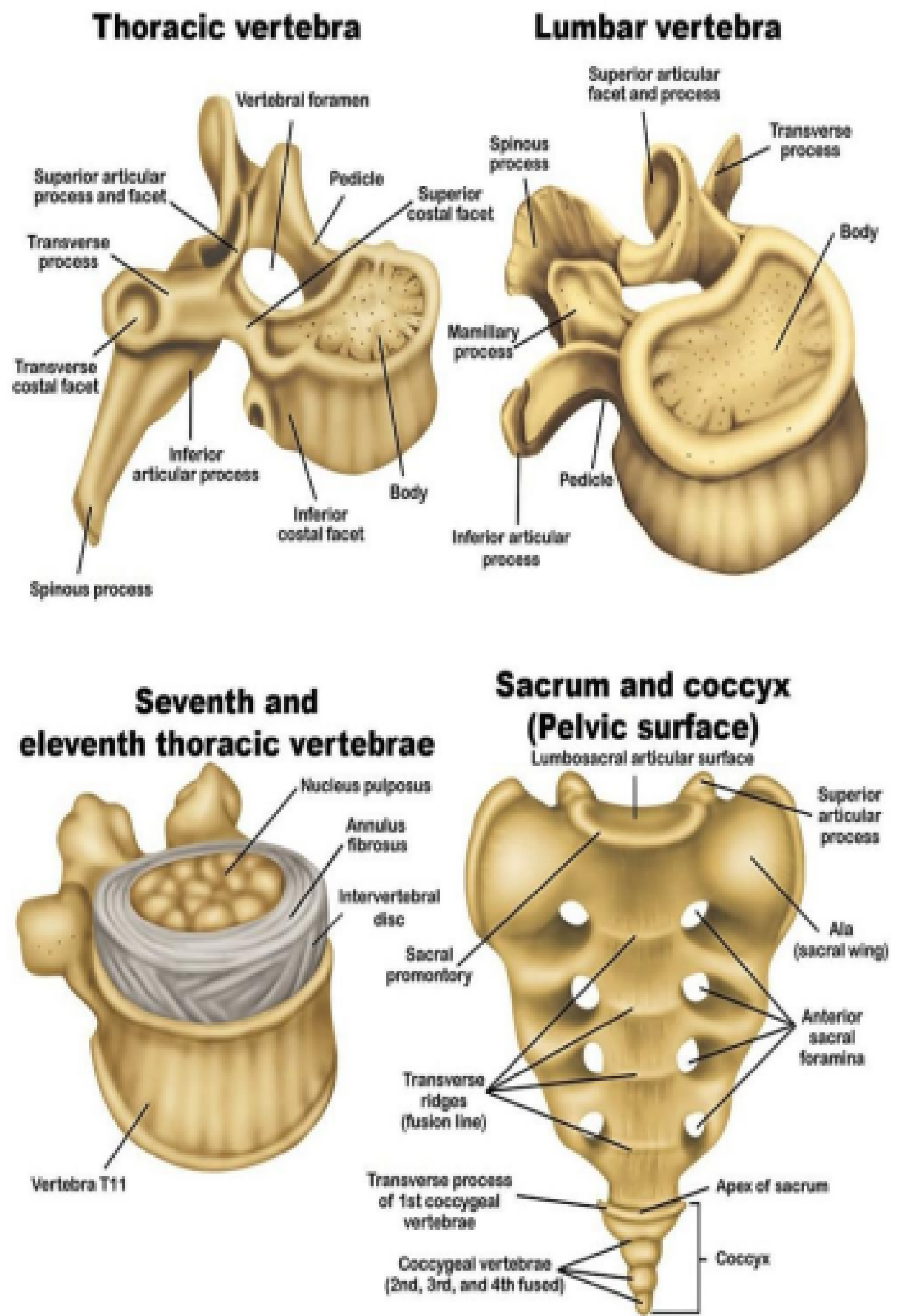


Summary

The Vertebral Column Support Card



The Vertebral Column Support Card



MCQs

1

The cervical vertebrae have _____, which the thoracic and lumbar vertebrae do not have?

A) Spinous processes

B) Transverse foramen

C) Transverse processes

D) Articular processes

2

The transverse arch is attached to the body of a typical vertebrae via?

A) Ligaments

B) Processes

C) Laminae

D) Pedicles

3

When does the secondary (cervical) curvature occur?

A) When baby begins to hold head up

B) When baby begins to crawl

C) When baby can sit without support

D) When baby starts to walk

4

To which spine the ligamentum nuchae is attached?

A) C2

B) T7

C) L5

D) C7

5

the intervertebral disc are thickest in the?

A) cervical

B) Lumbar

C) Both A&B

D) Thoracic



1-B 2-D 3-A 4-D 5-C

SAQs

1

How can you differentiate between cervical and lumbar vertebrae?

 The presence of transverse foramen in the cervical vertebrae

2

What are the structures that connect the bodies of vertebrae?

 Intervertebral disc, anterior longitudinal ligament, posterior longitudinal ligament

3

What are the two ligaments that attach in the spinous processes?

 Supraspinous ligament and interspinous ligament

4

What are the structures that connect the vertebral arches?

 Synovial joints between superior and inferior articular process, ligamentum flavum, interspinous ligament, intertransverse ligament and supraspinous ligament



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