

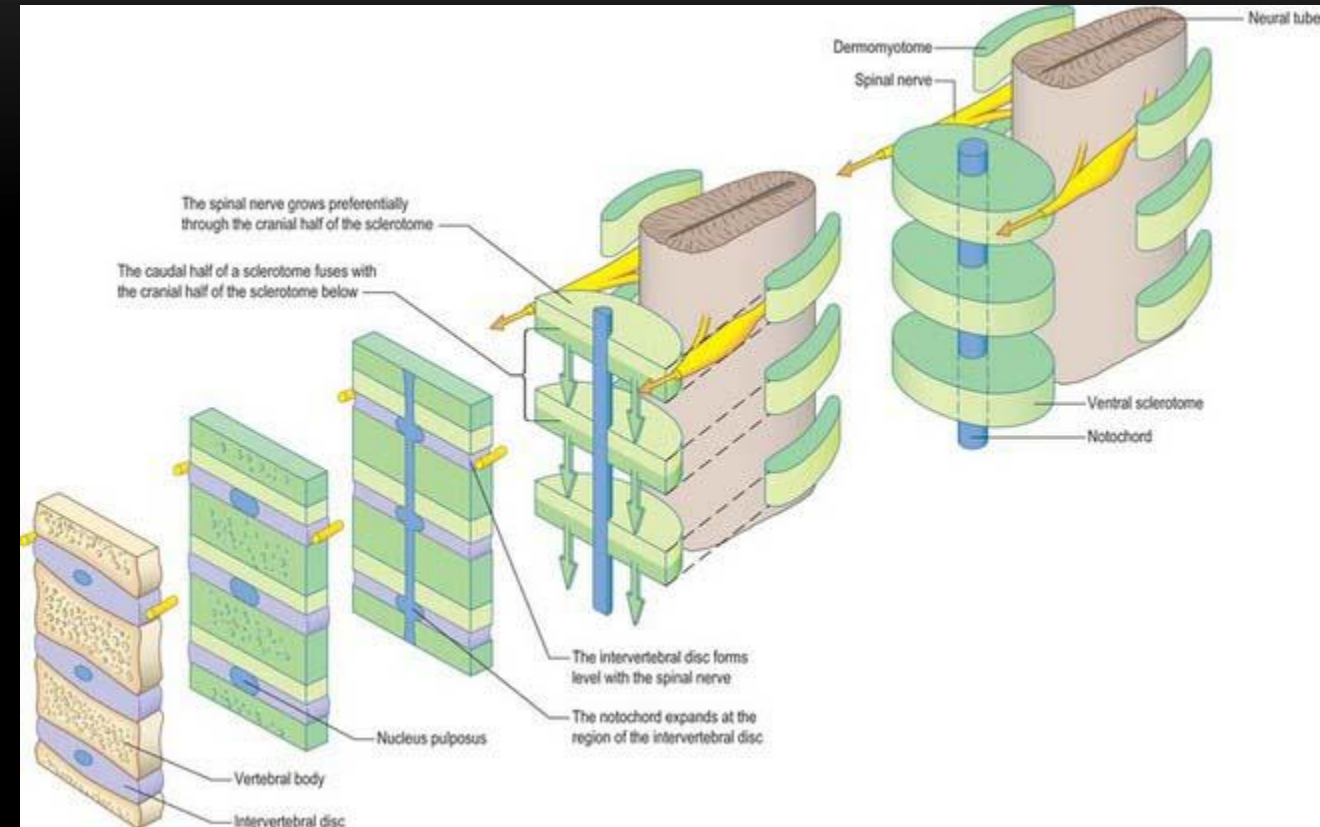


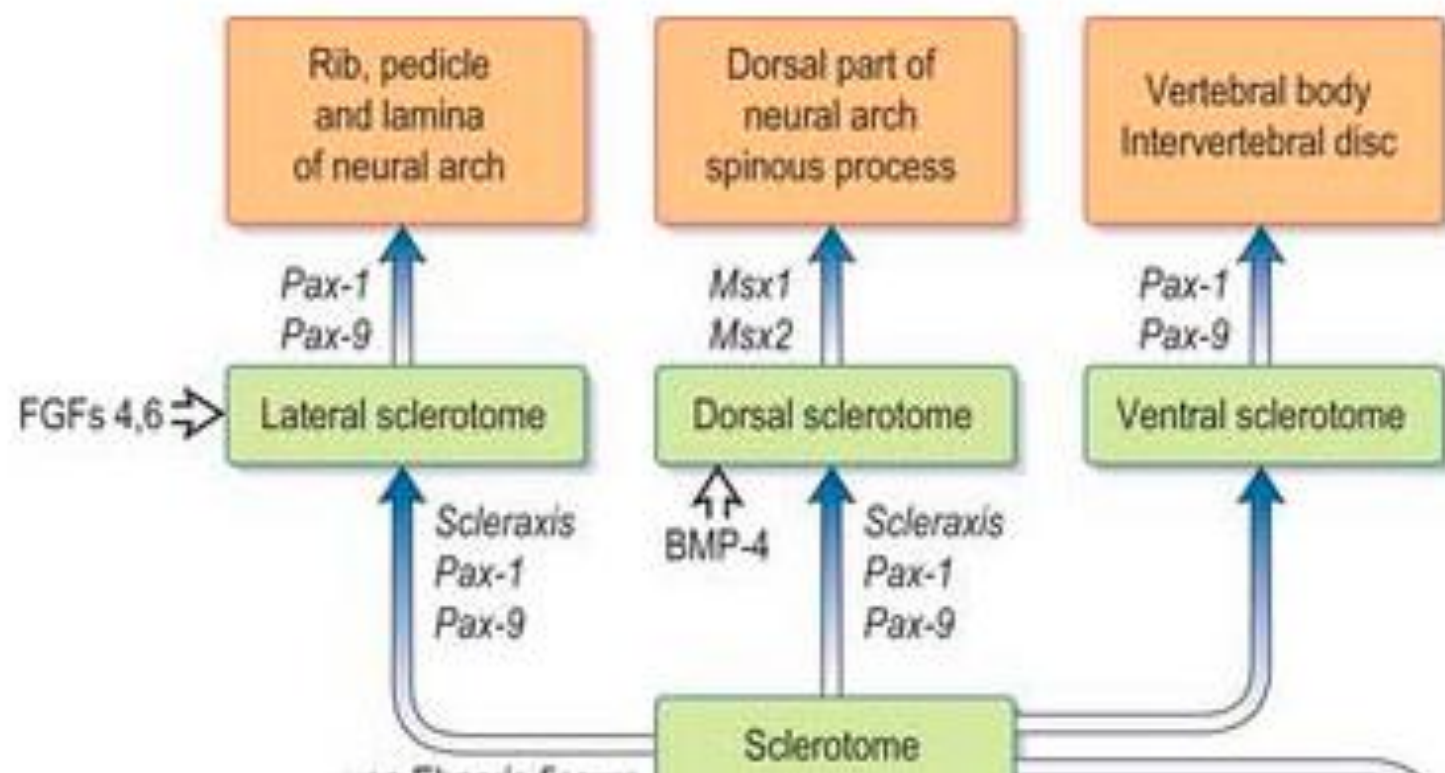
Vertebral
Column
(Spine)

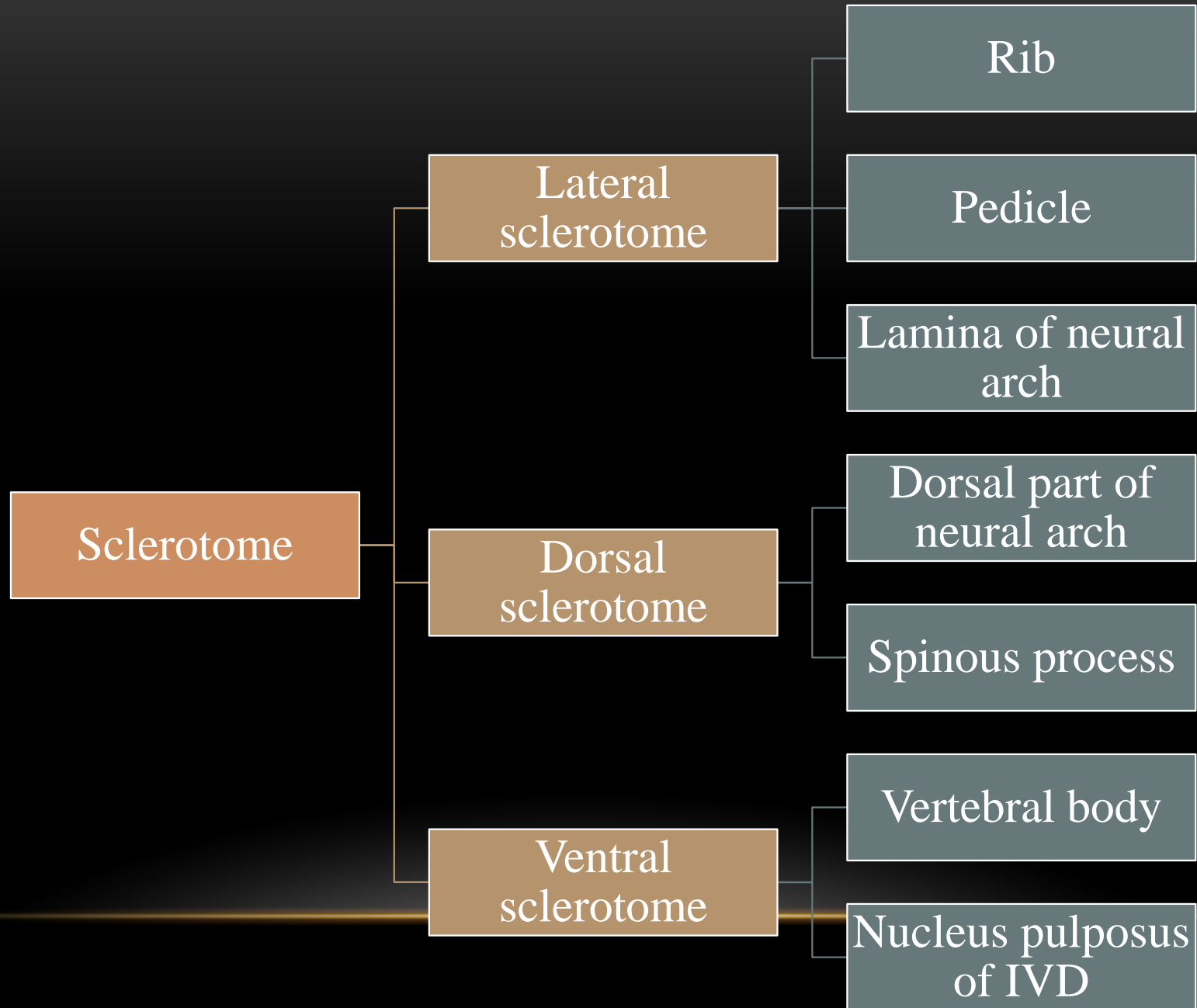
Embryology

The vertebra is derived from condensation of mesenchyme of bilateral sclerotome around the notochord.

The sclerotome: lateral ventral and dorsal; each gives part of the vertebra







Vertebral Column

Cervical: 7

Thoracic: 12

Lumbar: 5

Sacral: 5 (fused to form 1 sacrum)

Coccygeal: 4 (fused to form coccyx)

Total= 33 (counted as 26 in the total bones of the body because of fusion.)

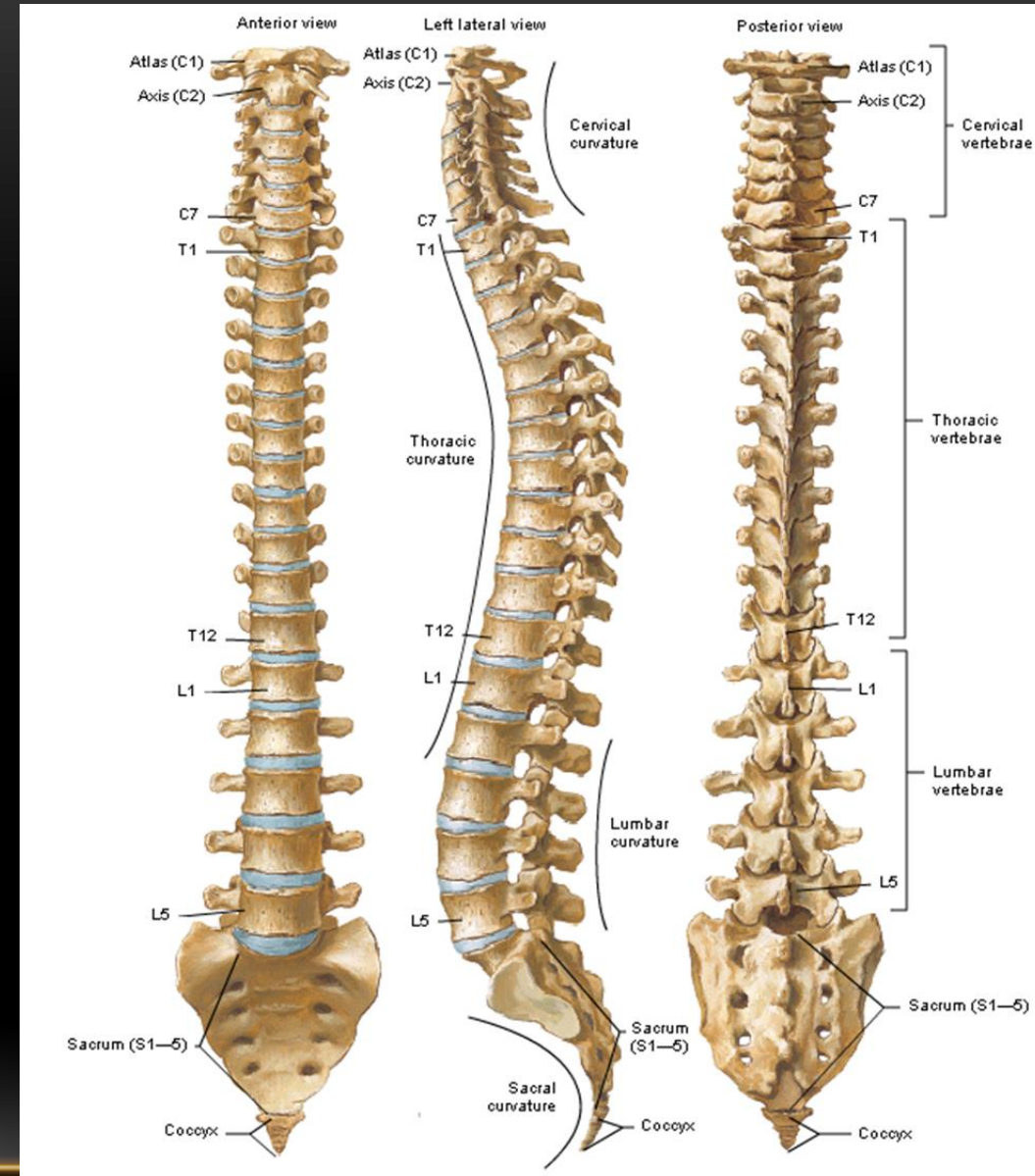


General Considerations ..1/3

Below the skull, the central axis of the body passes through the vertebral column.

The average length of the adult male vertebral column is 70 cm and in adult female 60 cm.

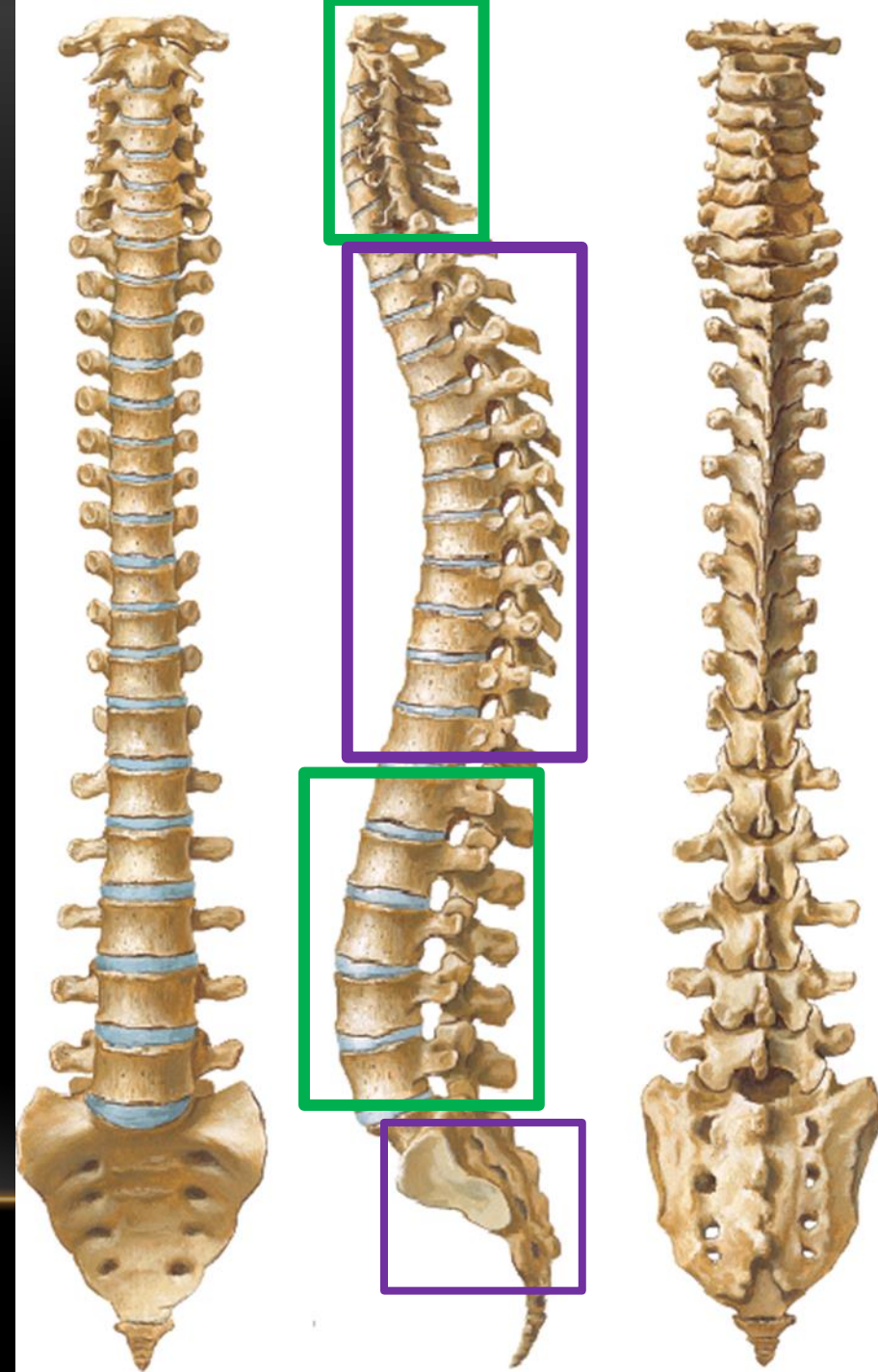
The vertebral bodies contribute 4/5 of the length of the vertebral column and the intervertebral discs 1/5.



General Considerations ..2/3

The cervical and lumbar regions show backward curvature (Lordosis) known as secondary curvature.

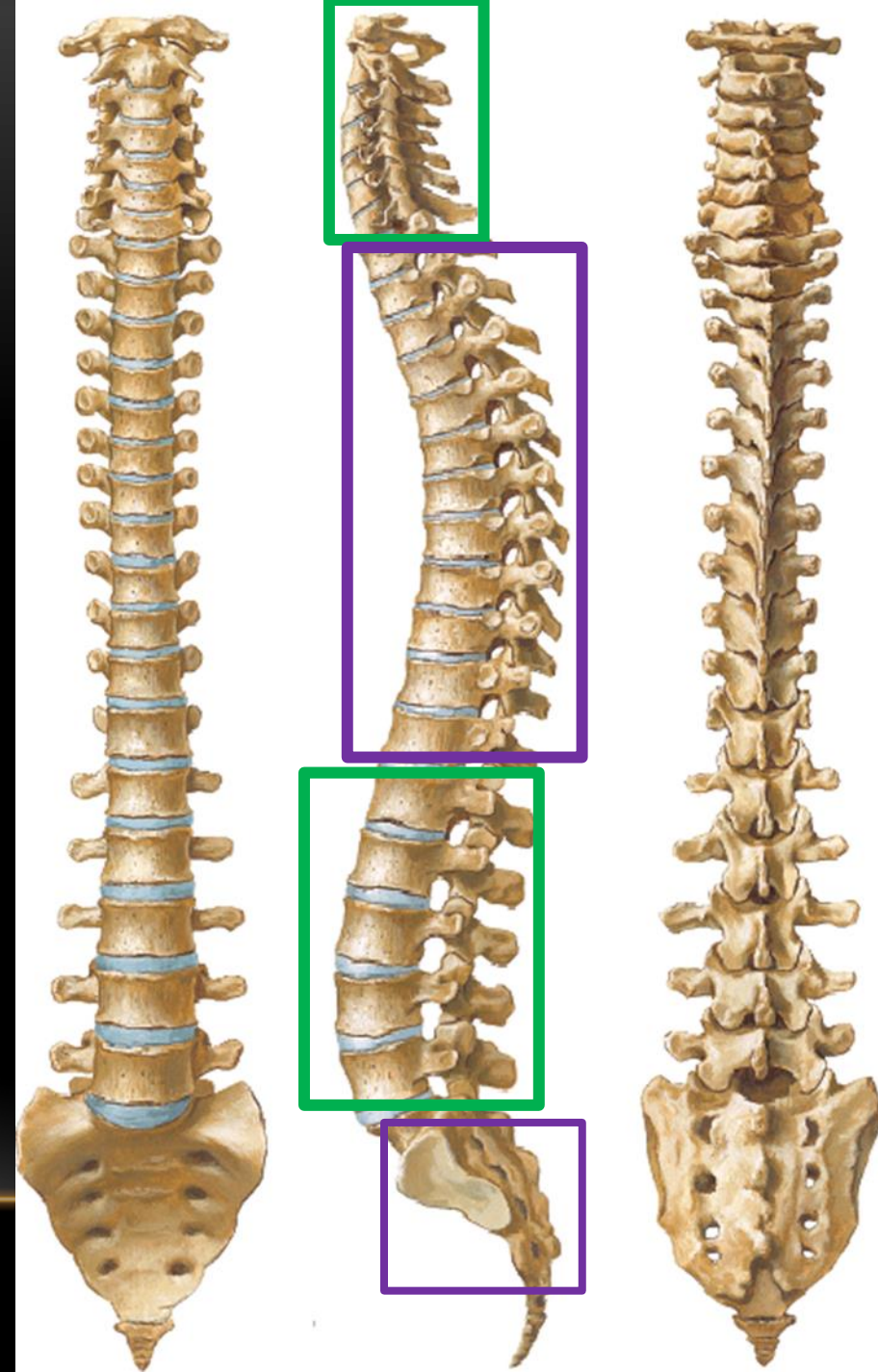
The thoracic and sacral regions show forward curvature (Kyphosis) corresponding to the primary curvature in the embryo.



General Considerations ..3/3

The primary curvature (Thoracic and sacral) is present at birth

The secondary curvature (cervical and lumbar) develops after birth



Movements at the Vertebral Column

Flexion: bending forward

Extension: bending backwards

Lateral flexion (Right/Left): bending side-wards

Rotation: Twisting the trunk

Circumduction: Doing movement

The axis of movement passes through the center of the vertebral bodies, so that the bodies do not move.

Movements are mostly permitted by the cervical & lumbar spines.
Thicker the intervertebral disc, greater the degree of movement



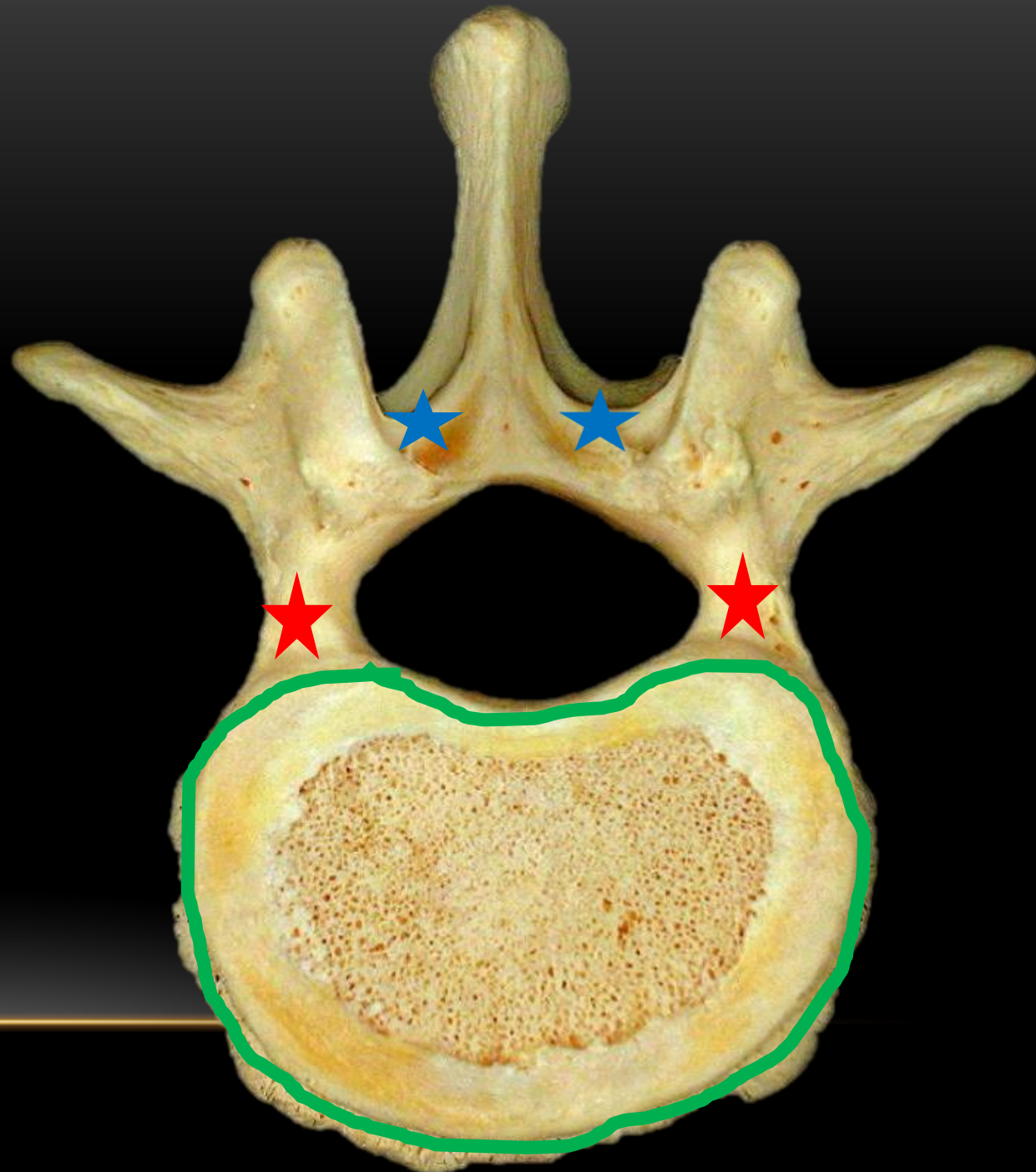
Typical Vertebra ..1/2

Body:

- Cylindrical, developed from calcified somite sclerotome
- Covered by the intervertebral disc (Fibrocartilage).

Vertebral (Neural) Arch:

- Consists of:
 - Pedicles (laterally) ★
 - Lamina (Posteriorly) ★
- Forms the vertebral foramen and protects the spinal cord



Typical Vertebra ..2/2
PROCESSES

(1) Spinous process ★

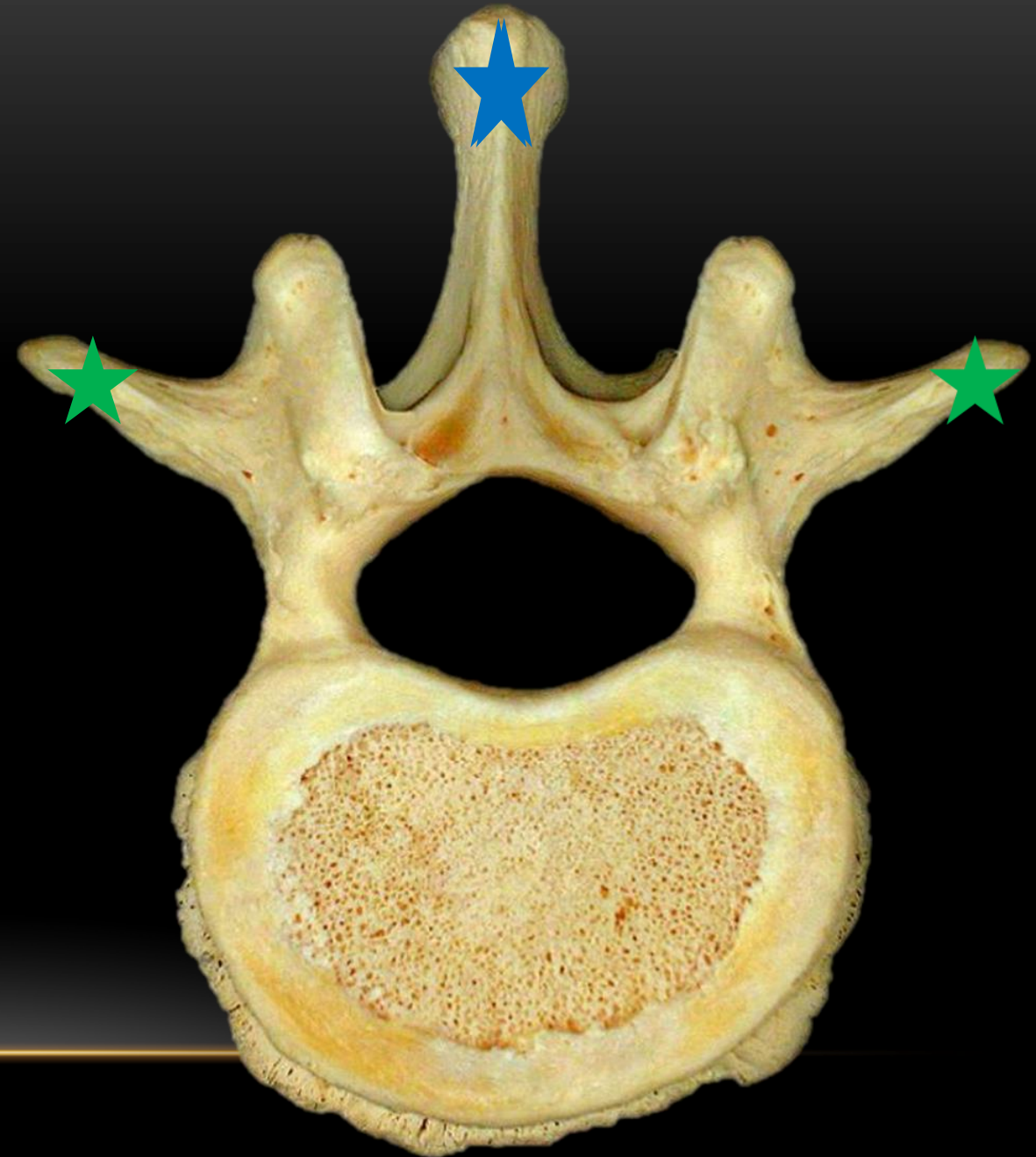
- Projects posteriorly
- Has special features in different parts

(2) Transverse processes ★

- Project laterally

(3) Articular Processes (facets)

- 2 superior (facing posteriorly) and 2 inferior (facing anteriorly)



Foramina associated with the vertebral arch

(1) vertebral foramina

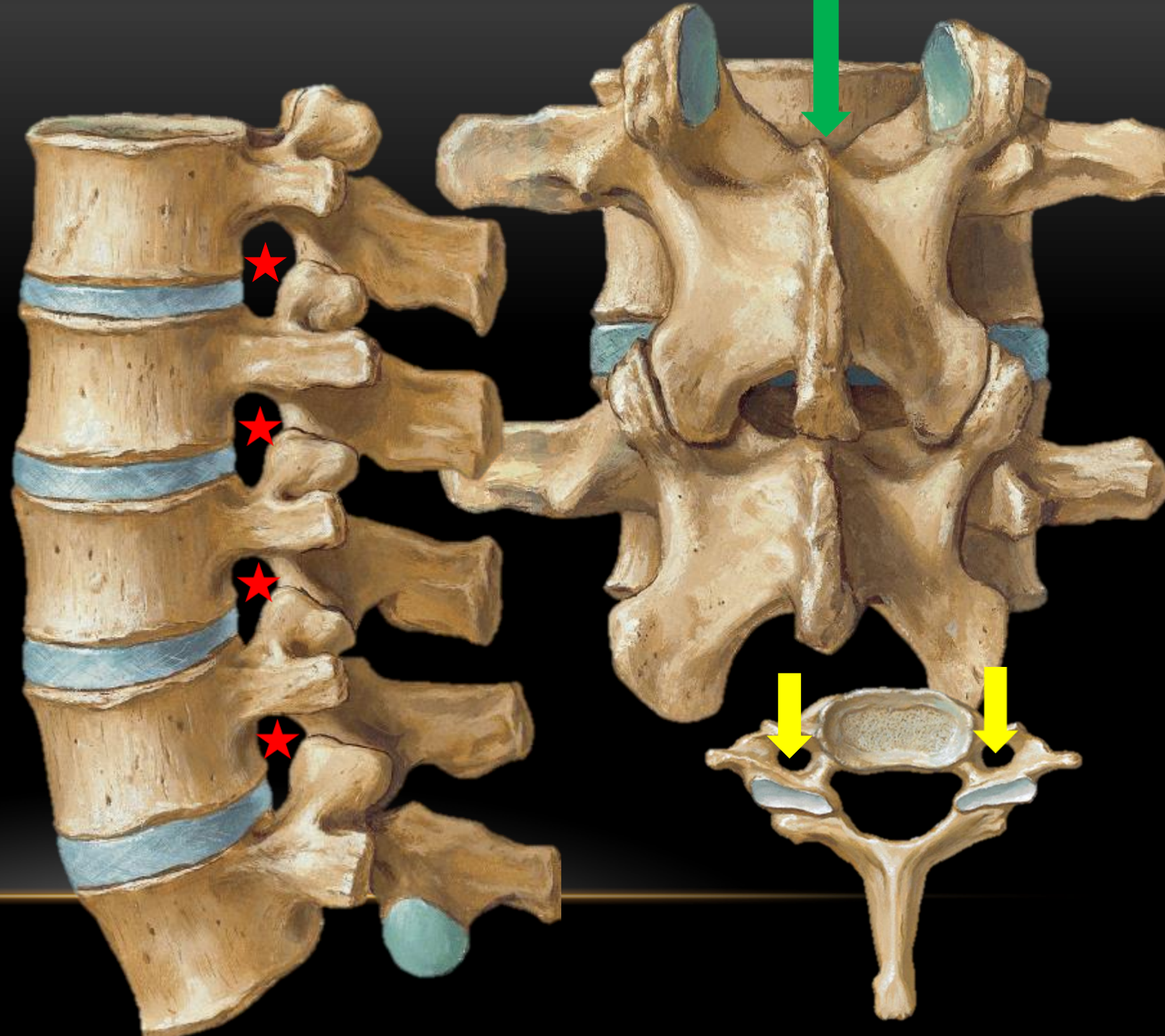
- Formed by the vertebral bodies and vertebral arches
- Collectively form the vertebral canal

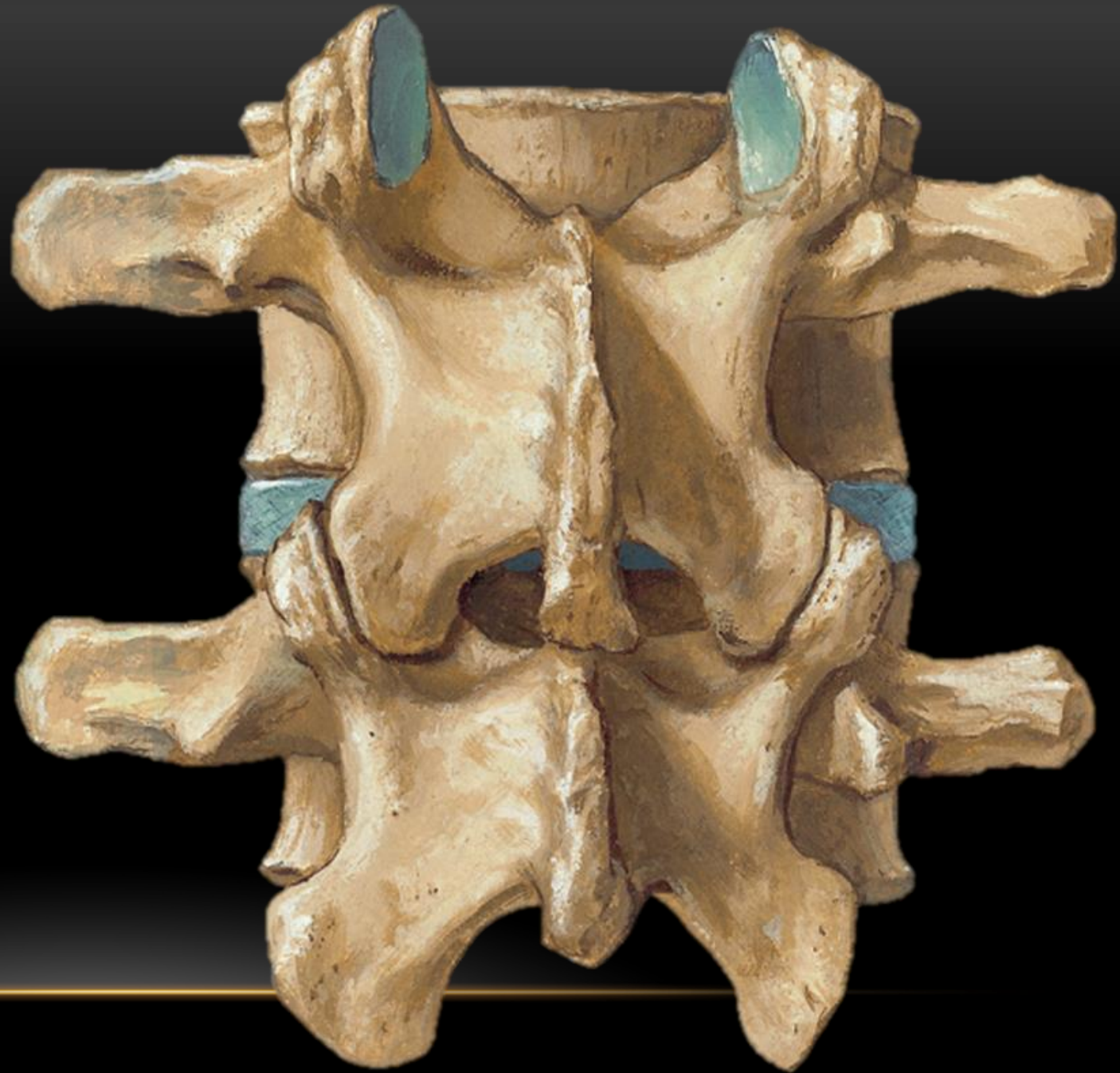
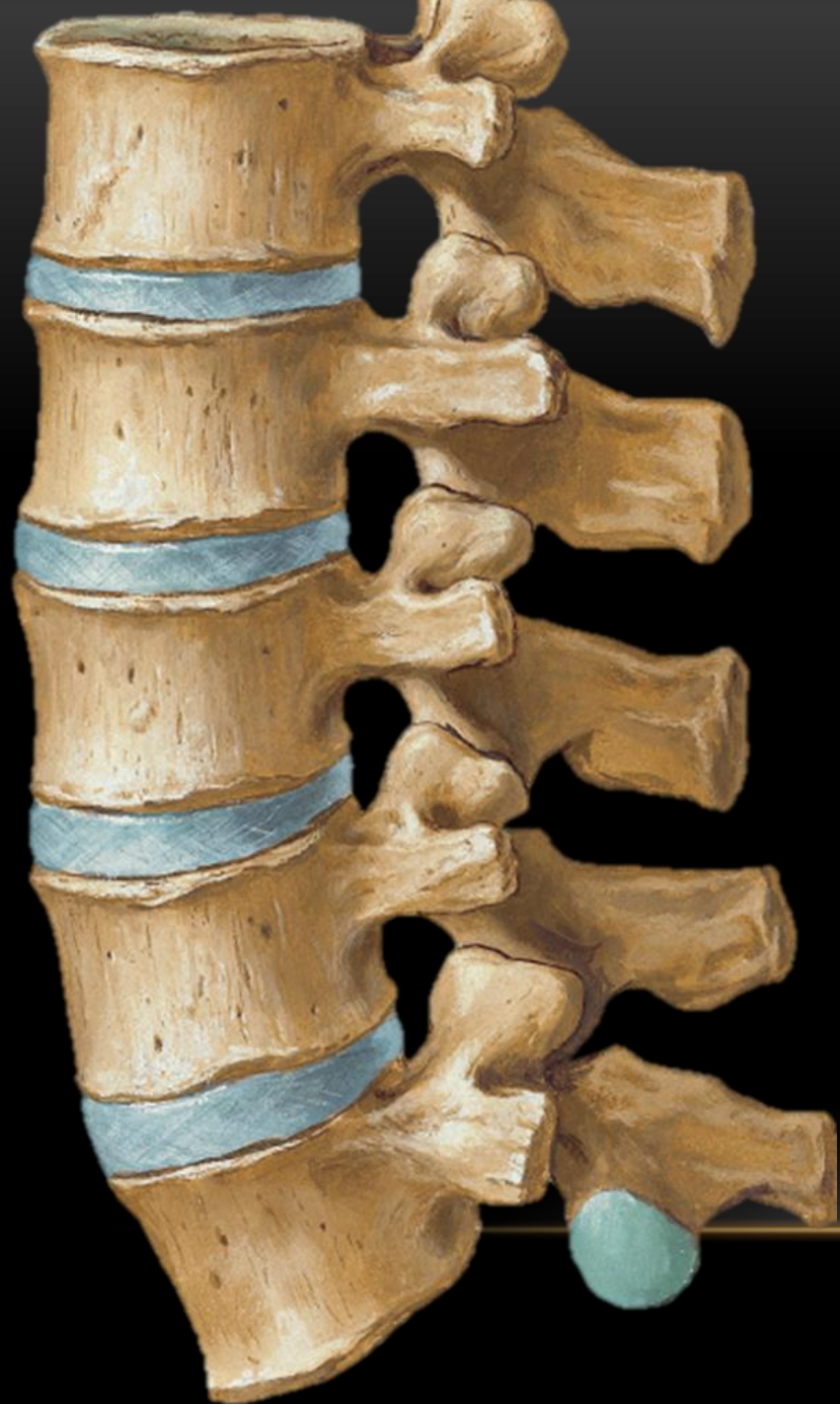
(2) Intervertebral foramina: ★

- Located between inferior and superior surfaces of pedicles of adjacent vertebra
- Transmit spinal nerves

((3) Transverse foramina: ↓

- Present in the transverse foramina of the cervical vertebra
- Transmit vertebral artery (Except C7), veins and autonomic fibres associated with the artery.





Functions of the Vertebral Column

Protects the spinal cord & spinal nerves.

Supports the weight of the body superior to the level of the pelvis.

Provides a partly rigid & flexible axis for the body & an extended base on which the head is placed and rotates.

Plays an important role in posture & locomotion



Important Surface Landmarks Related to the Vertebral Column

T2: Jugular notch

T3: Base of the spine of the scapula

T4: beginning and end of the aortic arch, bifurcation of the trachea

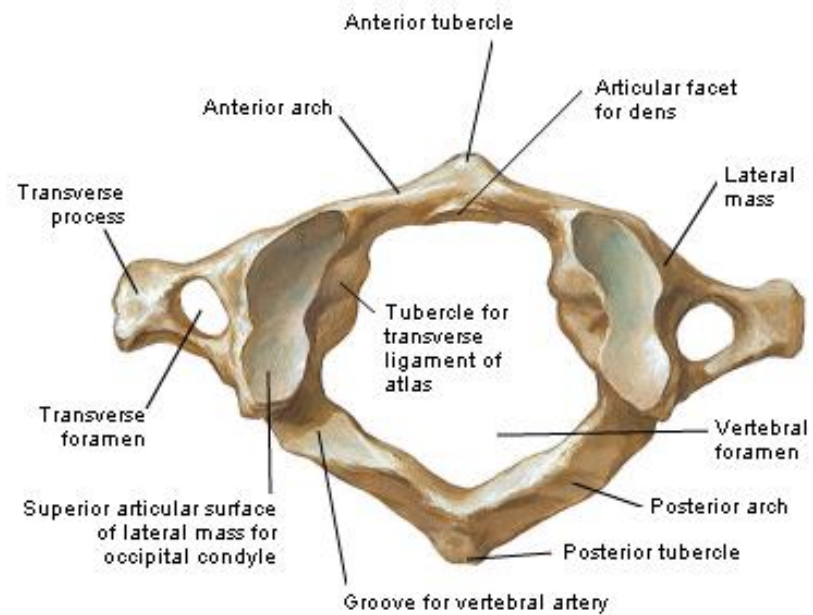
T7: Inferior angle of the scapula

L4: iliac crest

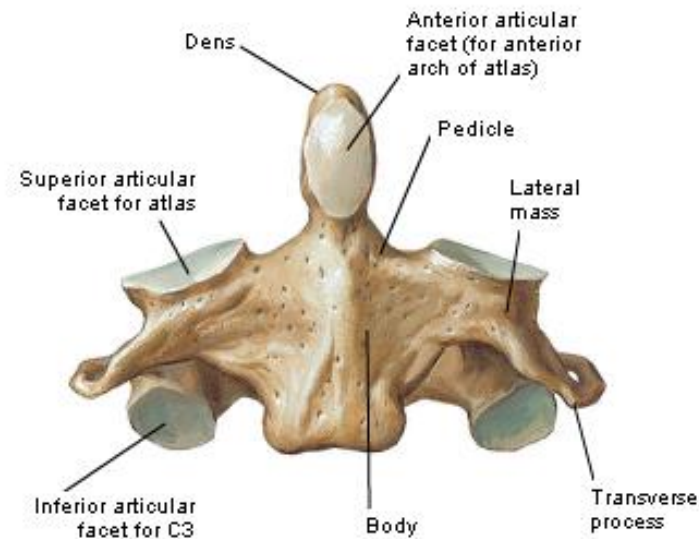
S2: Posterior superior iliac spine



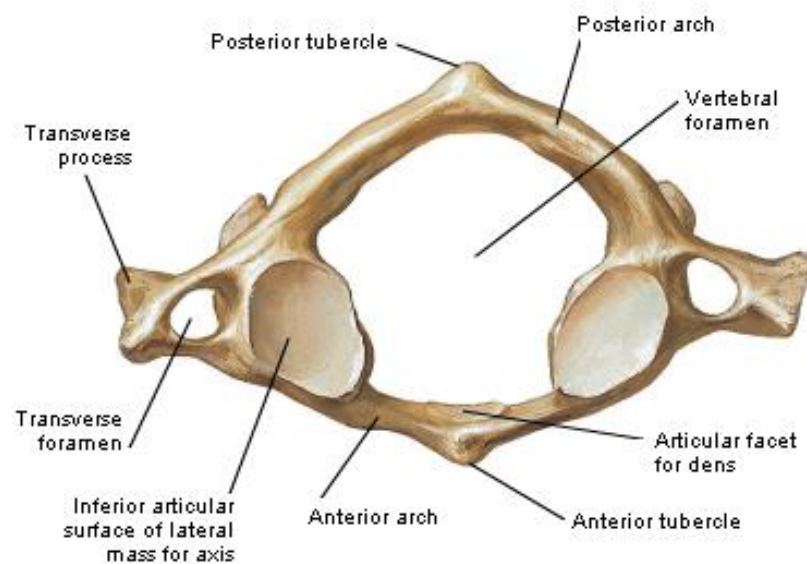
Cervical Vertebrae



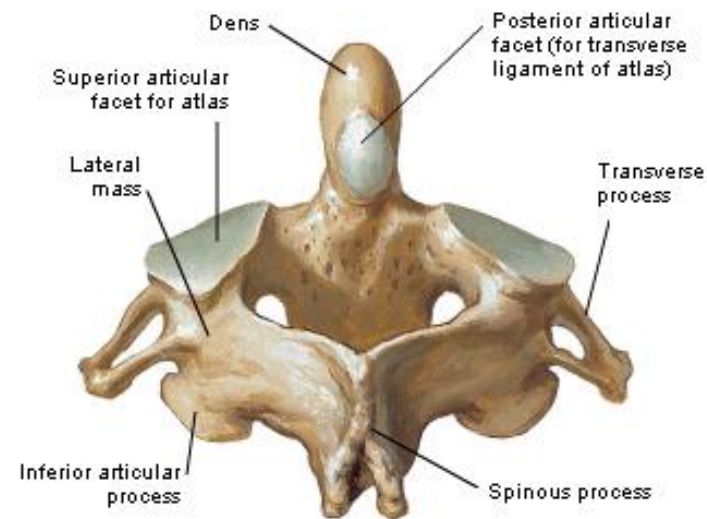
Atlas (C1): superior view



Axis (C2): anterior view



Atlas (C1): inferior view



Axis (C2): posterosuperior view

Atlas (C1)

The widest cervical vertebra

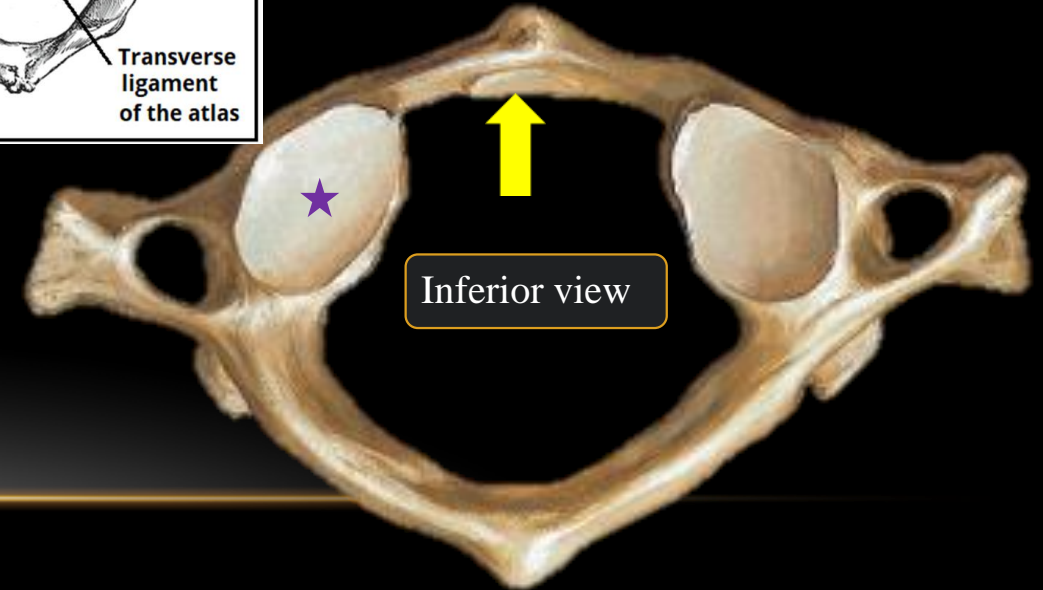
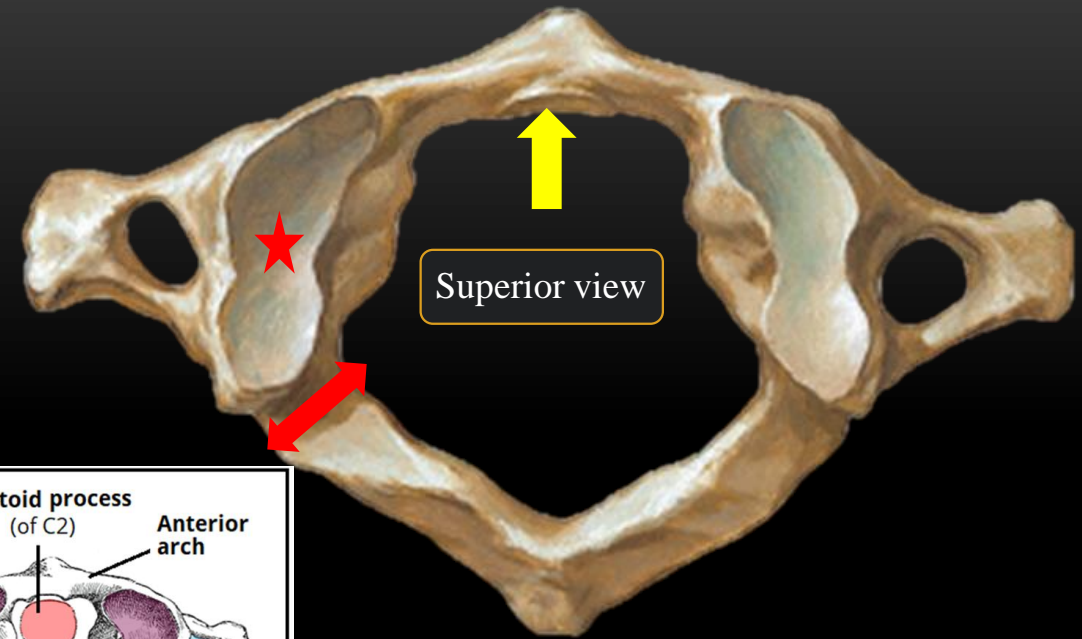
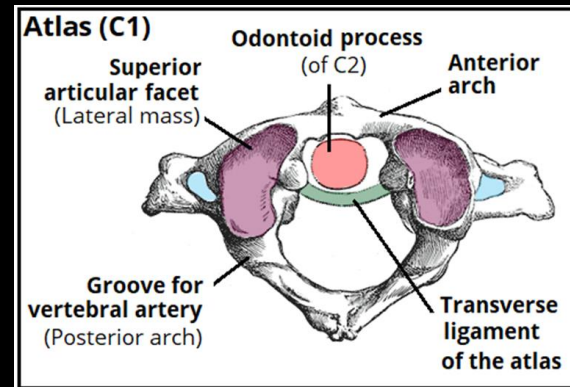
No vertebral body, No spinous process

Has lateral masses each contains:

- a superior articular facet (for articulation with occipital condyles) ★
- an inferior articular facet (for articulation with C2). ☆

The anterior arch contains a facet for articulation with the dens of the axis. ↑

The posterior arch has a groove for the vertebral artery and C1 spinal nerve. ↘



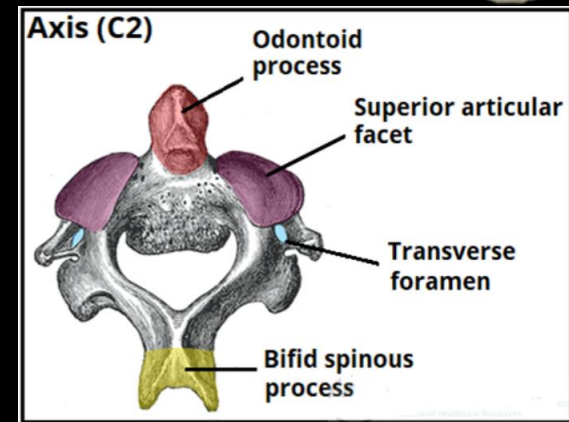
Axis (C2)

Has the smallest transverse process

Has dens (odontoid process) which extends superiorly from the anterior portion of the vertebra

The dens articulates with the anterior arch of the atlas, creating the **medial atlanto-axial joint**. This allows for rotation of the head independently of the torso.

Has **superior articular facets**, which articulate with the inferior articular facets of the atlas to form the two lateral atlanto-axial joints.



Typical Cervical Vertebra (C3-C6)

Triangular vertebral foramen.

Bifid spinous process

Transverse foramina – holes in the transverse processes. They give passage to the vertebral artery (Except C7), vein and sympathetic nerves.



Cervical Vertebra (C7)

Non bifid, thick spinous process, almost horizontal.

The vertebral artery does not pass through the transverse foramen





Thoracic
(Dorsal)
Vertebrae

General Features of Typical Thoracic Vertebrae (T2-T9)

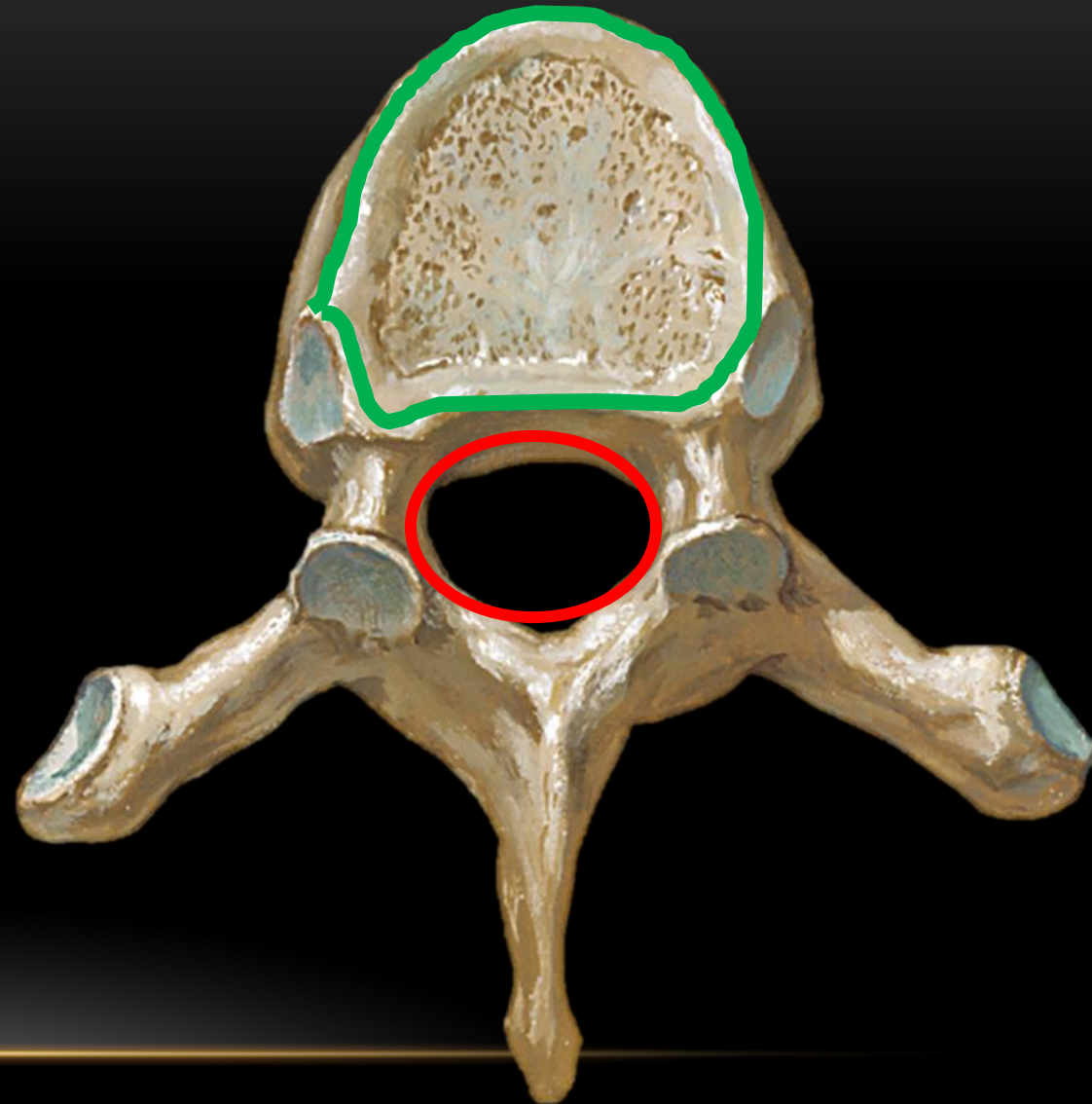
Body: Heart shaped; one or two costal facets for articulation with head of rib

Vertebral foramen: Circular and smaller than those of cervical and lumbar vertebrae

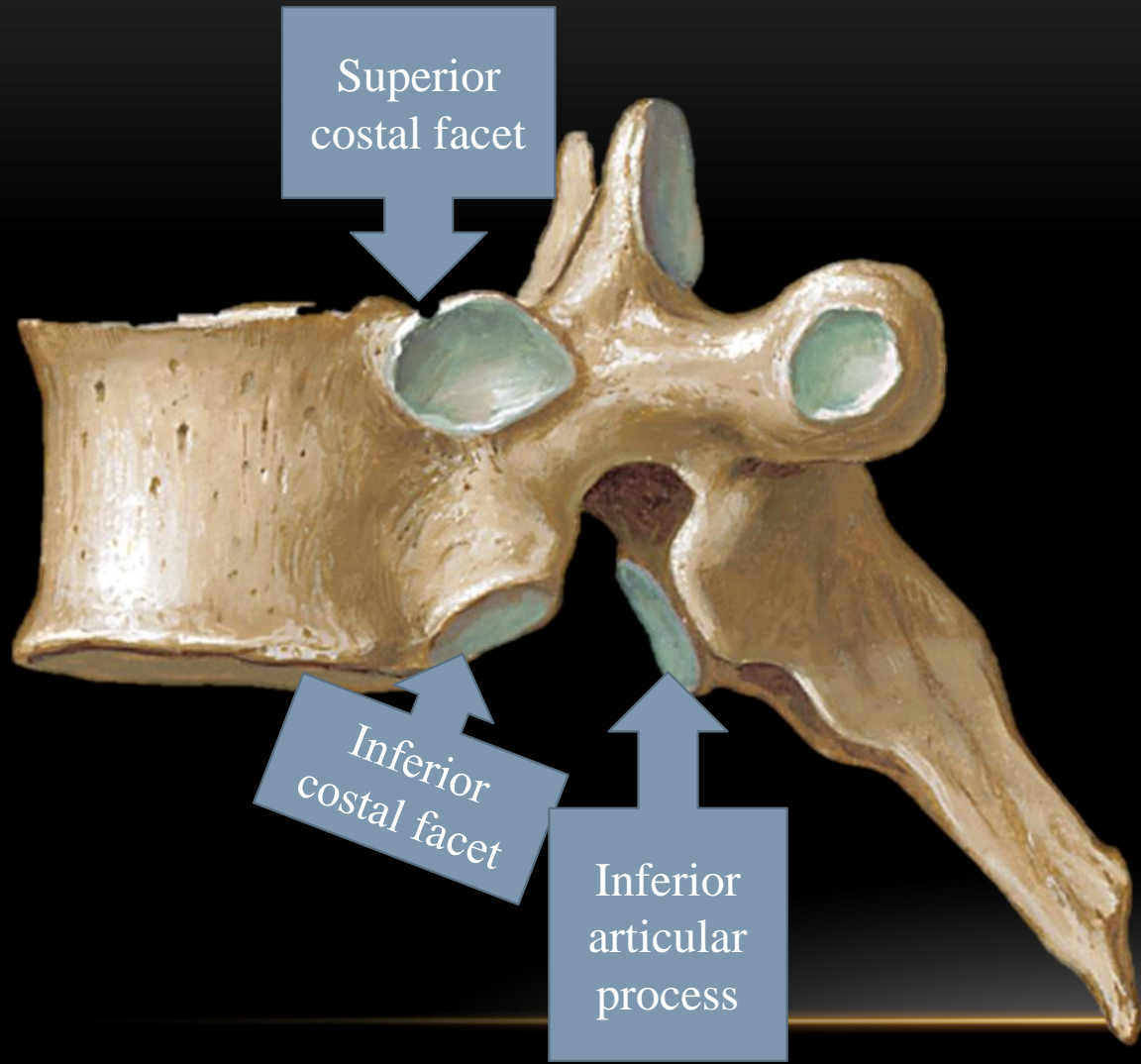
Transverse processes: Long and strong and extend posterolaterally; length diminishes from T1 to T12

Articular processes: Superior facets directed posteriorly and slightly laterally; inferior facets directed anteriorly and slightly medially; plane of facets lies on arc centered around vertebral body

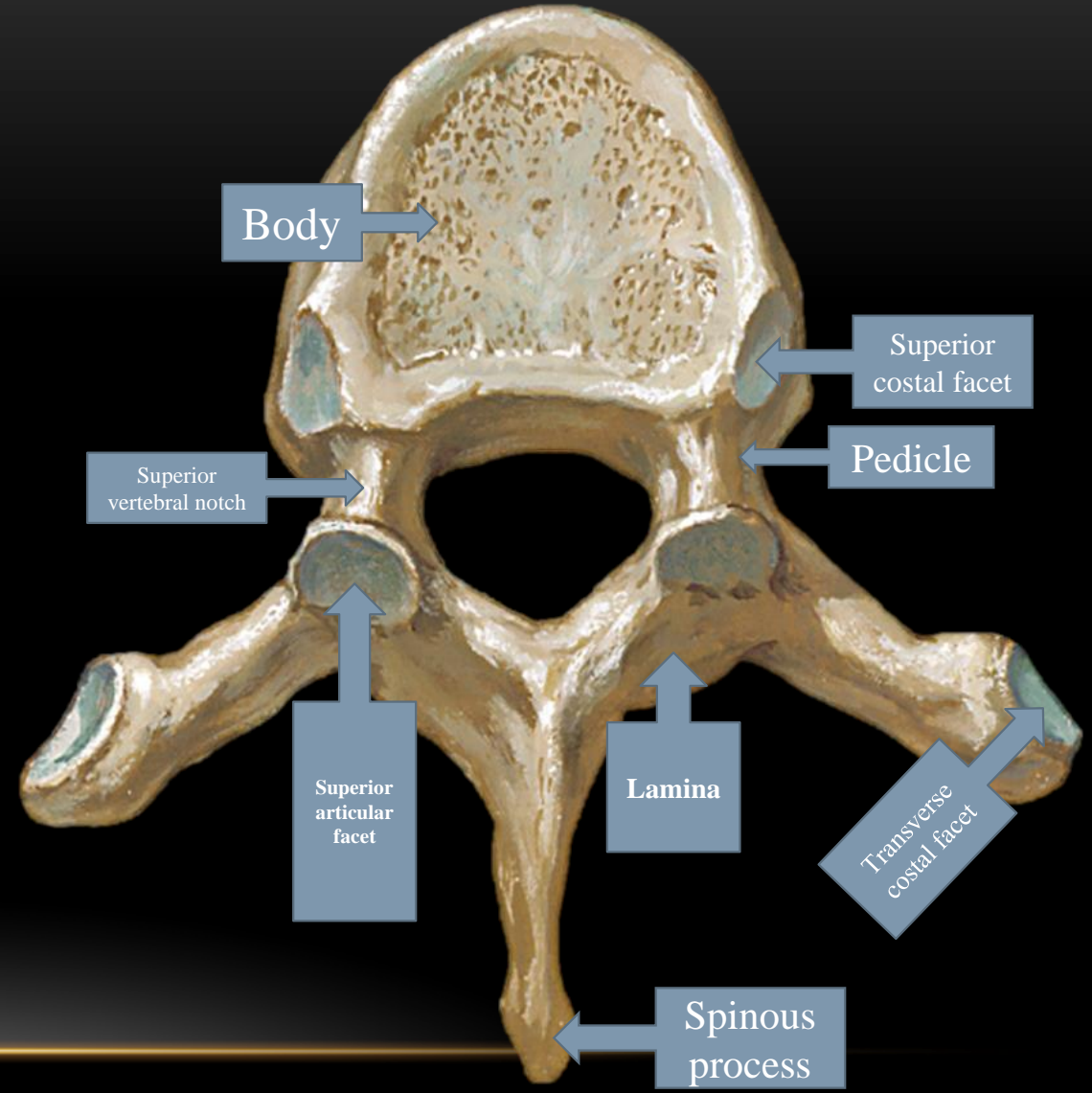
Spinous process: Long slope posteroinferiorly; tips extend to level of vertebral body below



T6 Lateral view



T6 Superior view



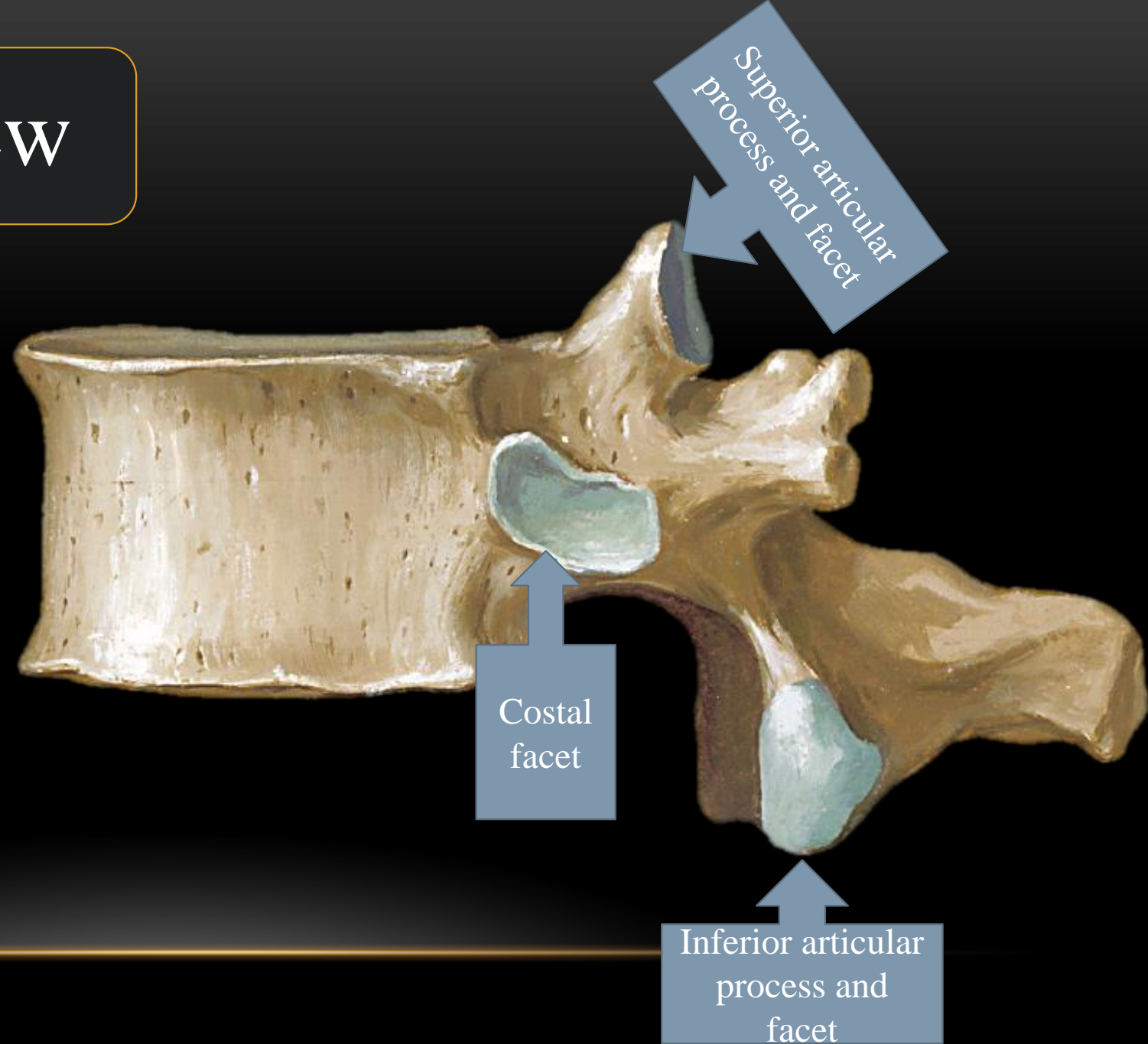
Atypical Vertebrae


T1: the superior facet is not a demifacet, as it is the only vertebra to articulate with the first rib.

T10: A single pair of whole facets is present which articulate with the 10th rib. These facets are located across both the vertebral body and the pedicle.

T11 & T12: Each have a single pair of entire costal facets, which are located on the pedicles.

T12 Lateral View





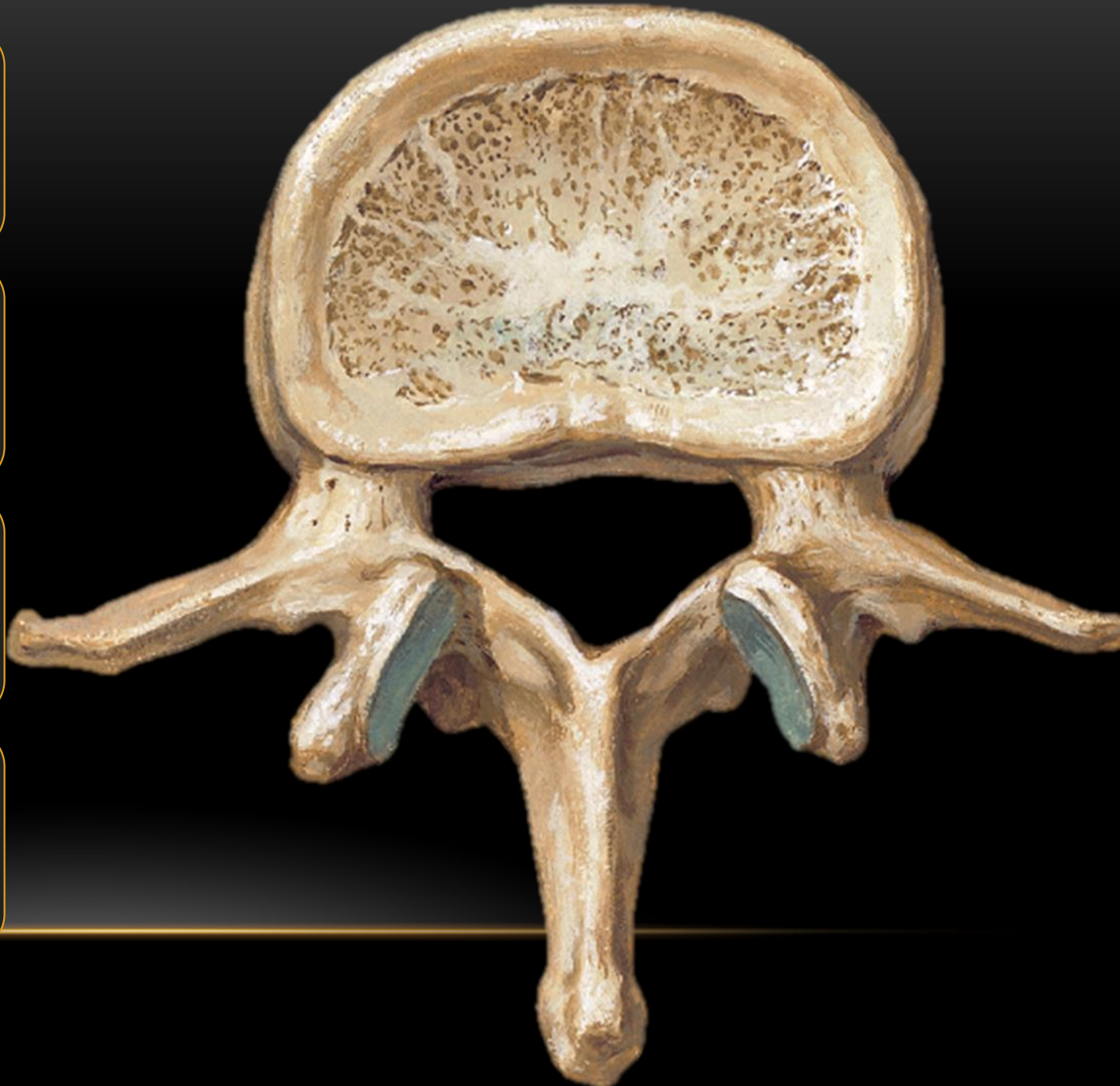
Lumbar
Vertebrae

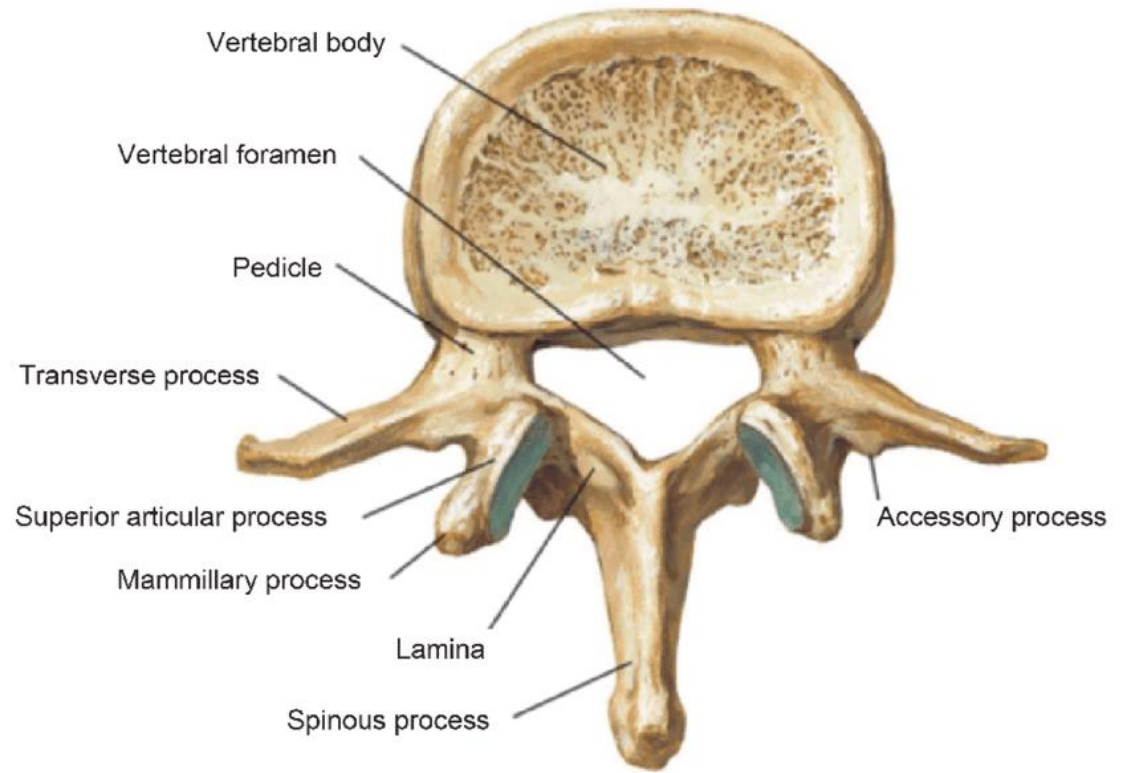
The size of the body increases from L1 to L5.

The vertebral foramen is flattened triangular.

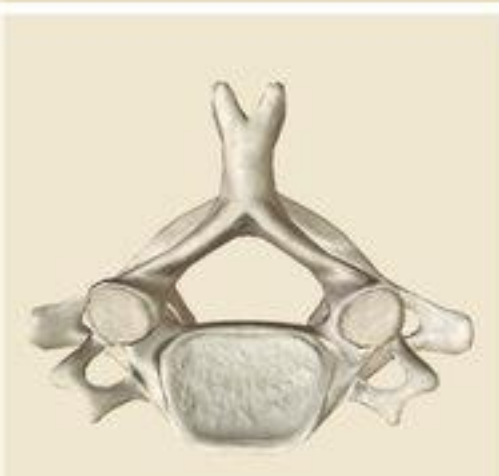
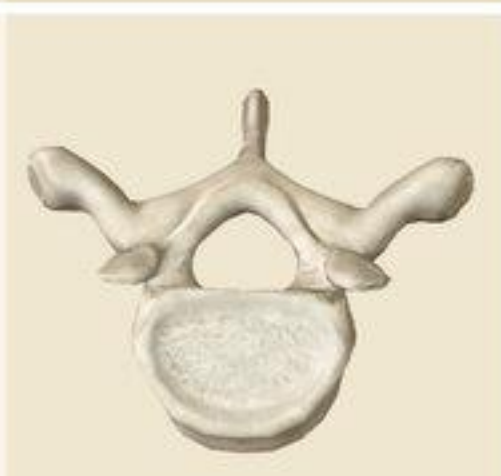
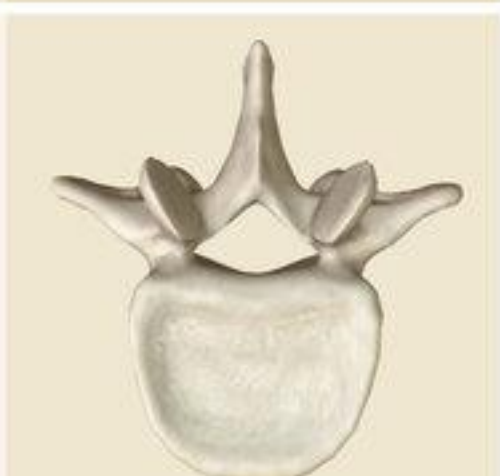
The transverse processes are short with no facets.

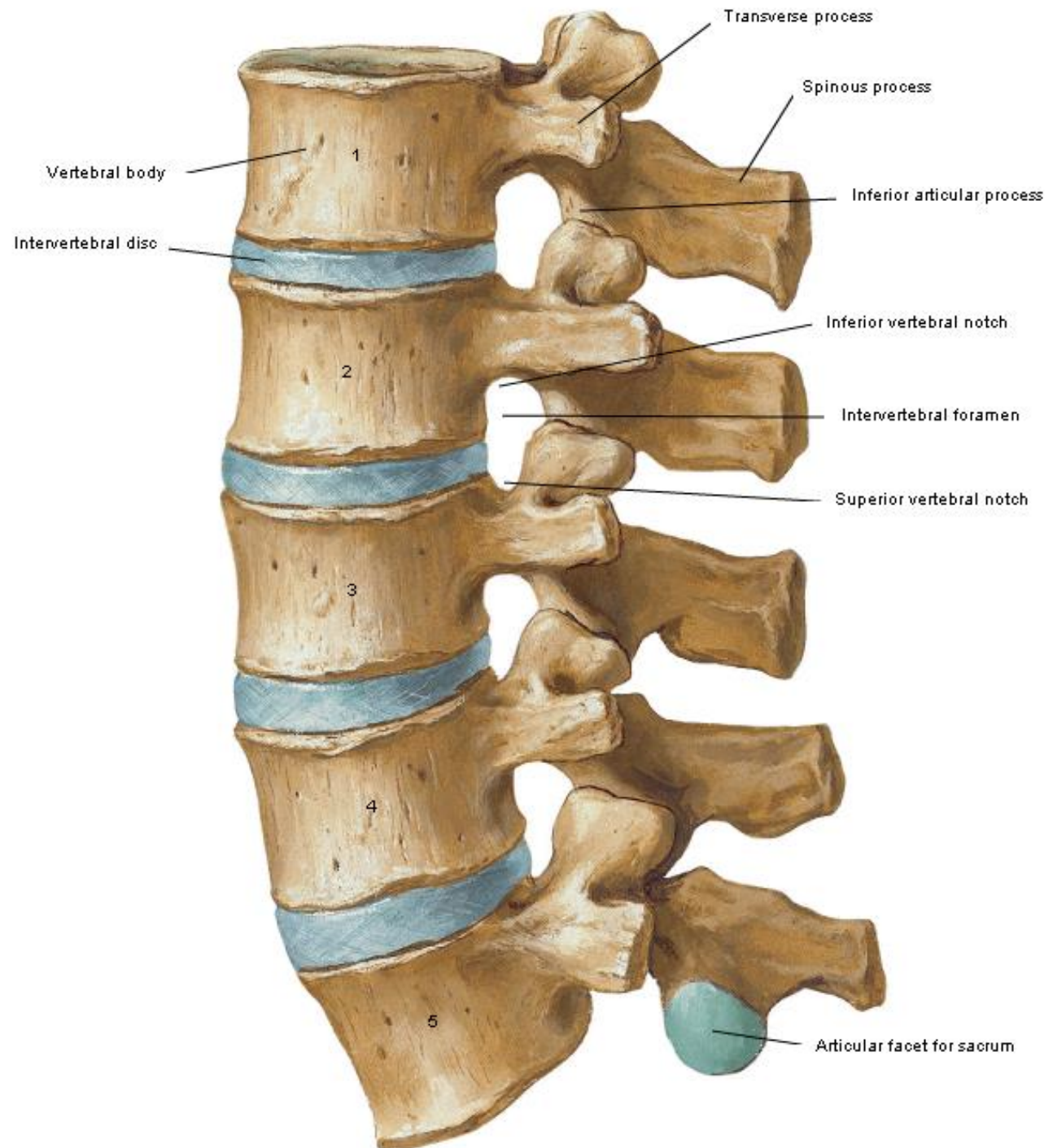
L5 vertebra has the heaviest body, smallest spinous process, and thickest transverse process.

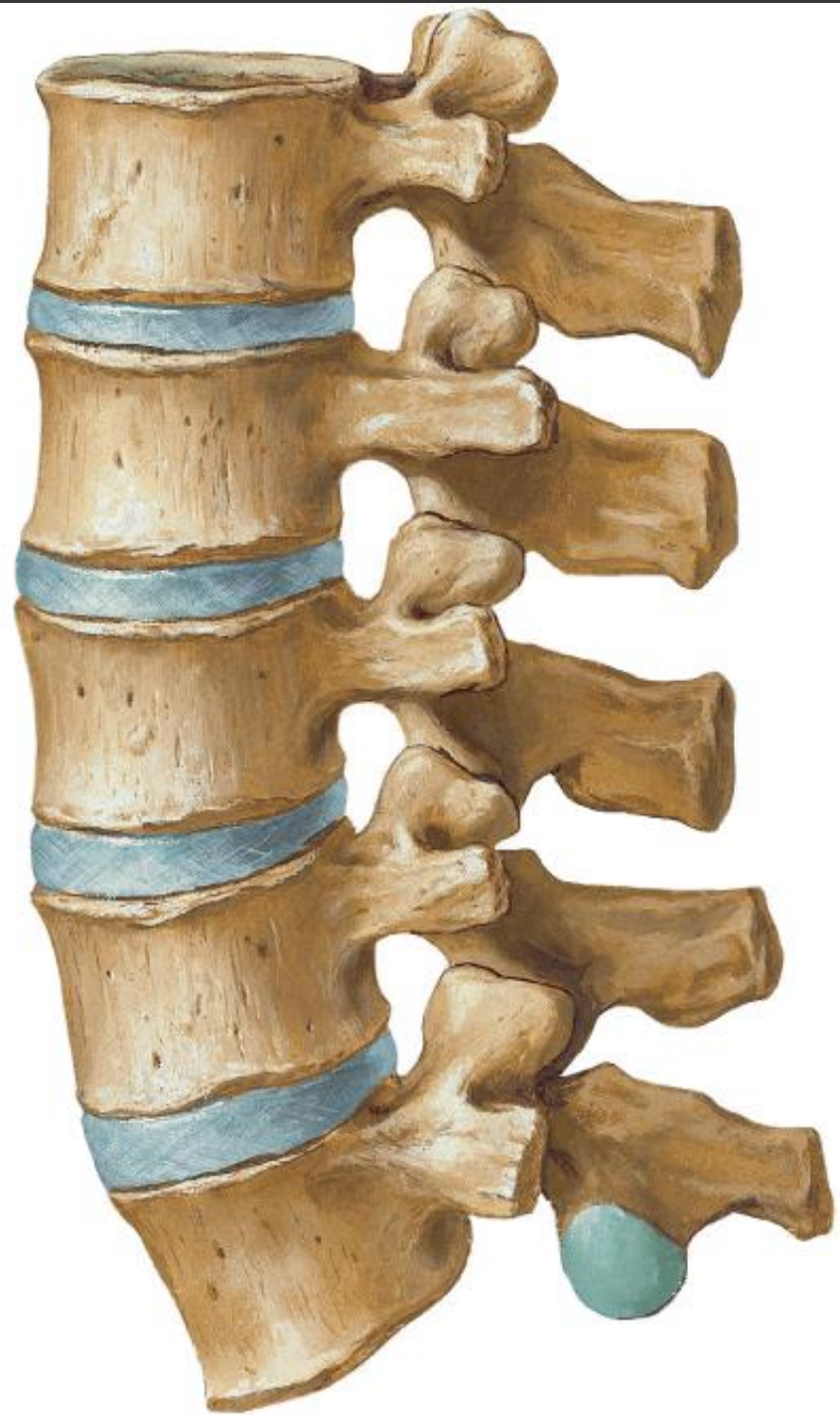




Comparison of Cervical, Thoracic, and Lumbar Vertebrae

Characteristic	Cervical vertebrae	Thoracic vertebrae	Lumbar vertebrae
Body shape and size	Small and oval; C ₁ lacks a body; C ₂ has the dens on the superior surface of its body	Larger and heart-shaped; contain costal facets	Largest and kidney-shaped
Vertebral foramen shape	Triangular	Circular	Flattened triangular
Transverse processes	Contain transverse foramina	Long; contain articular facets for ribs	Short with no facets or foramina
Spinous processes	Most are fork-shaped; C ₁ lacks a spinous process	Long; point inferiorly	Thick; point posteriorly
Appearance (superior view)			







Sacrum

Large, triangular wedge-shaped composed of 5 fused segments (vertebrae).

Has 4 pairs of anterior and 4 pairs of posterior foramina.

Forms the posterior part of the pelvis and strengthen it.



Parts of the Sacrum

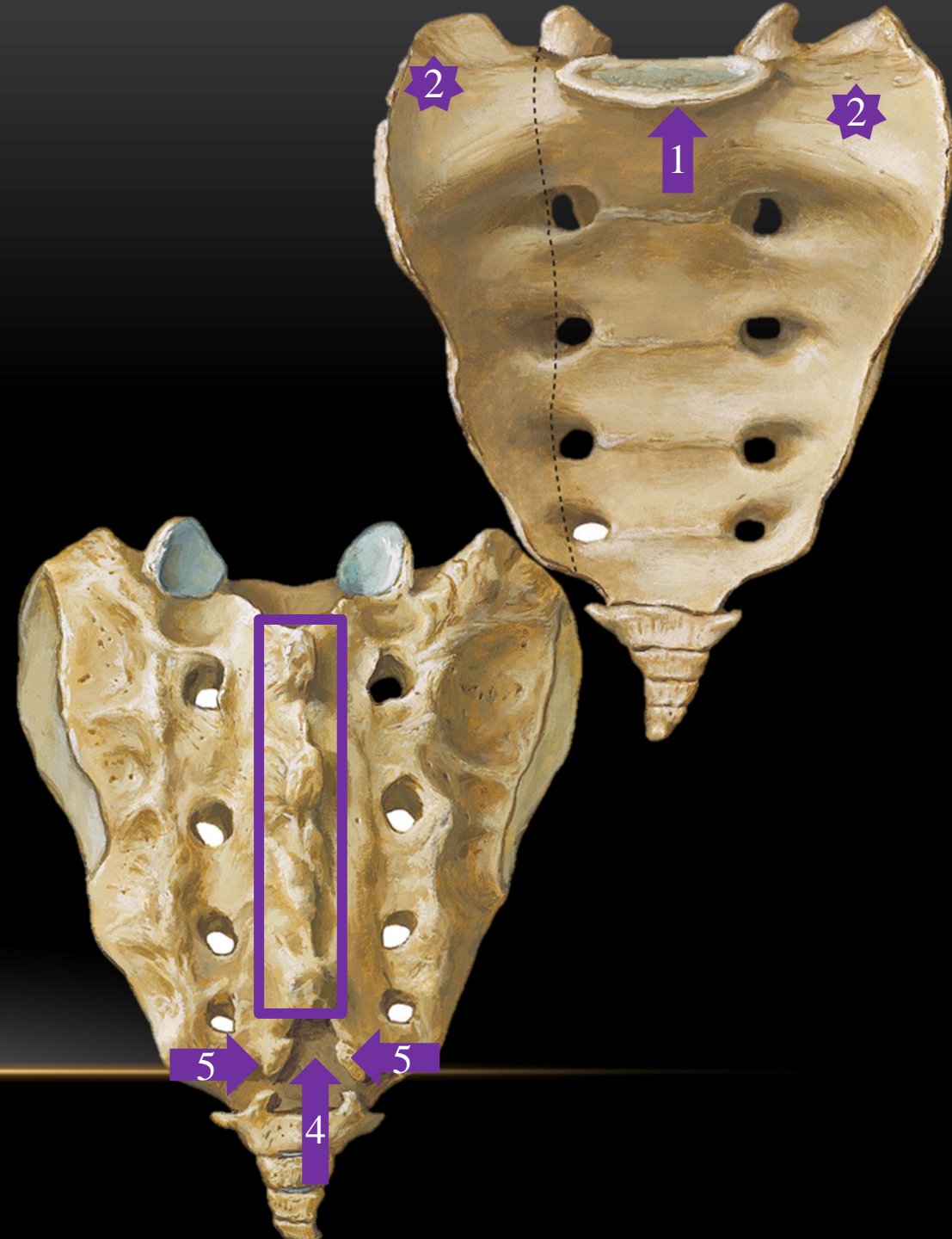
(1) Promontory: the prominent anterior edge of S1.

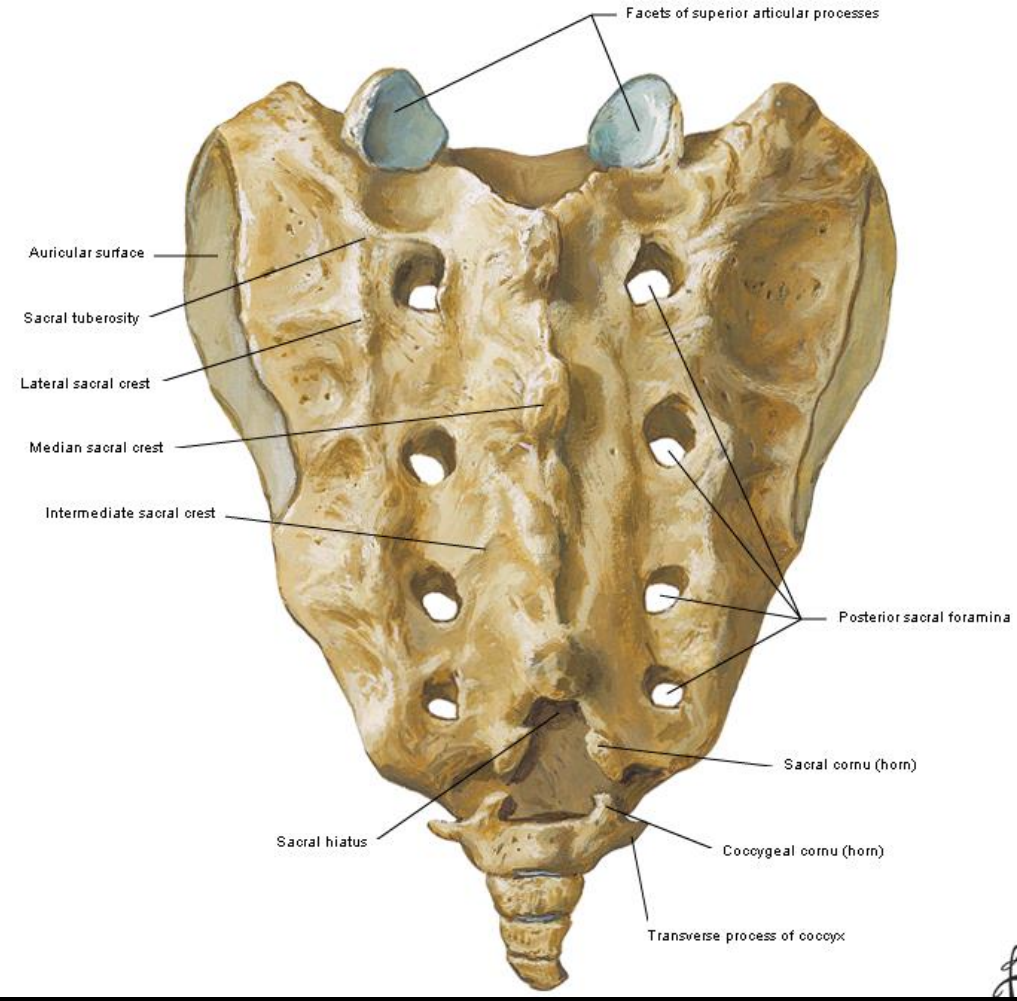
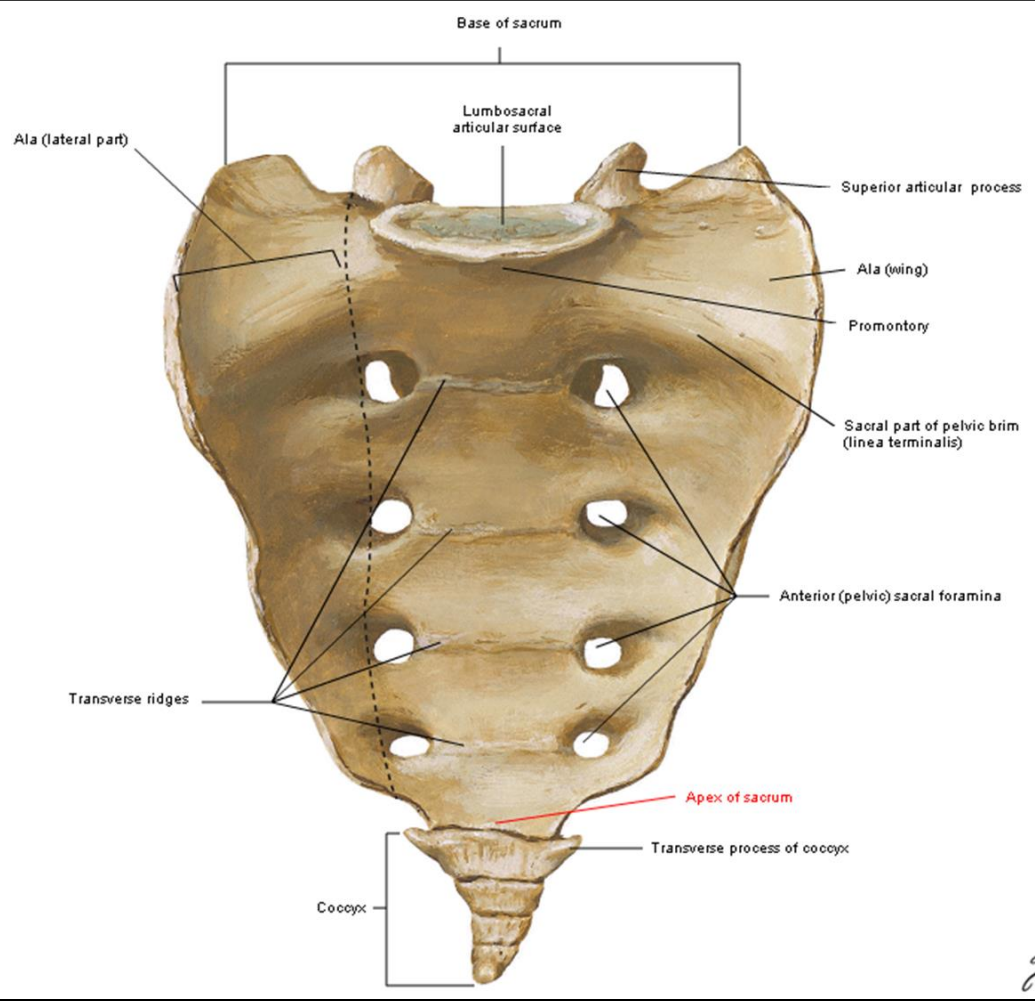
(2) Ala: fused transverse and costal processes of S1 (the superolateral part of the sacrum).

(3) Median sacral crest: fused spinous processes.

(4) Sacral hiatus: formed by fusion of the lamina of S5.

(5) Sacral cornu: Pedicles of S5.

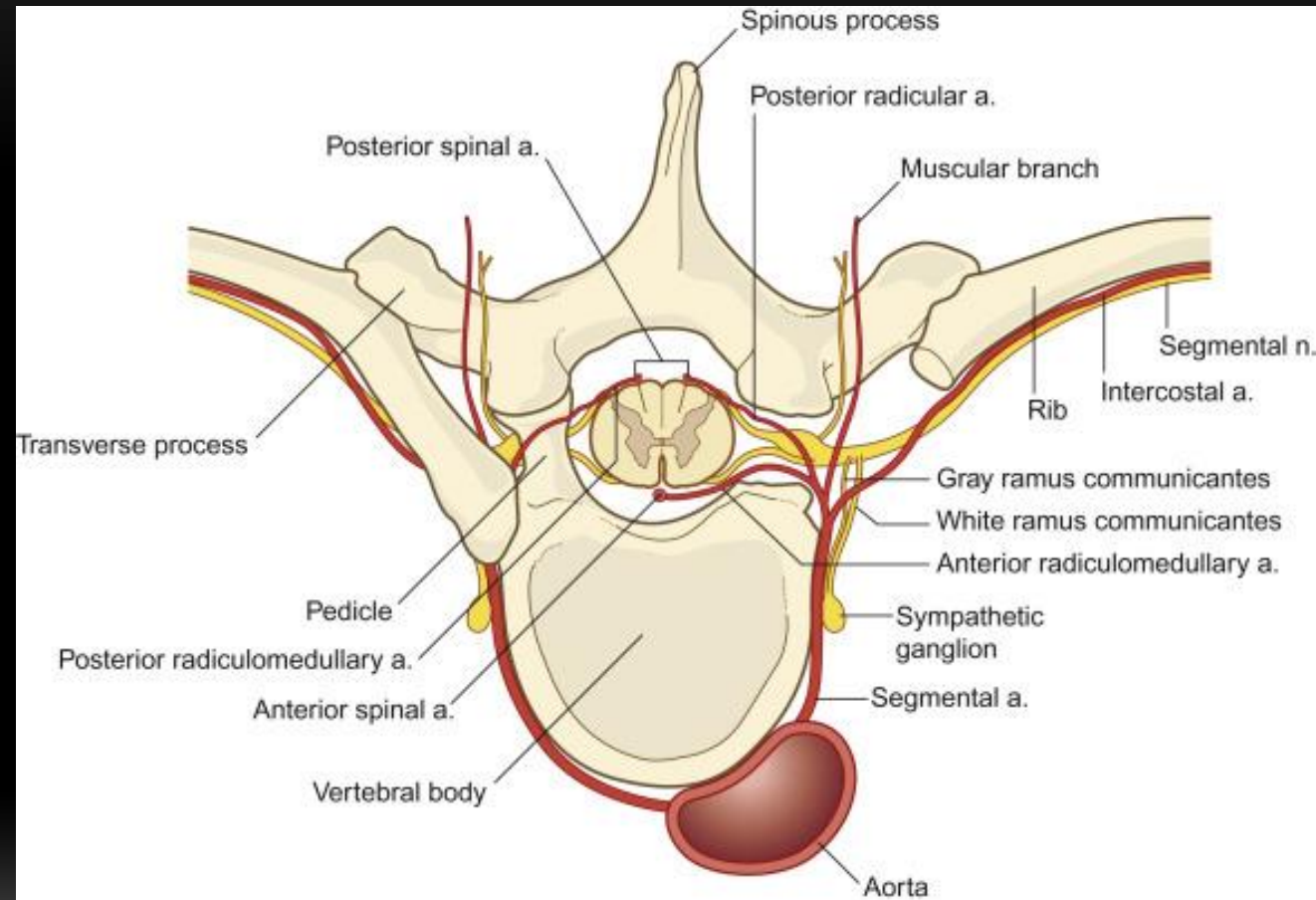






Arteries of the vertebral column

The vertebrae are supplied segmentally by the vertebral, ascending and deep cervical, posterior intercostal, lumbar and lateral sacral arteries, which give multiple small branches to the vertebral bodies.



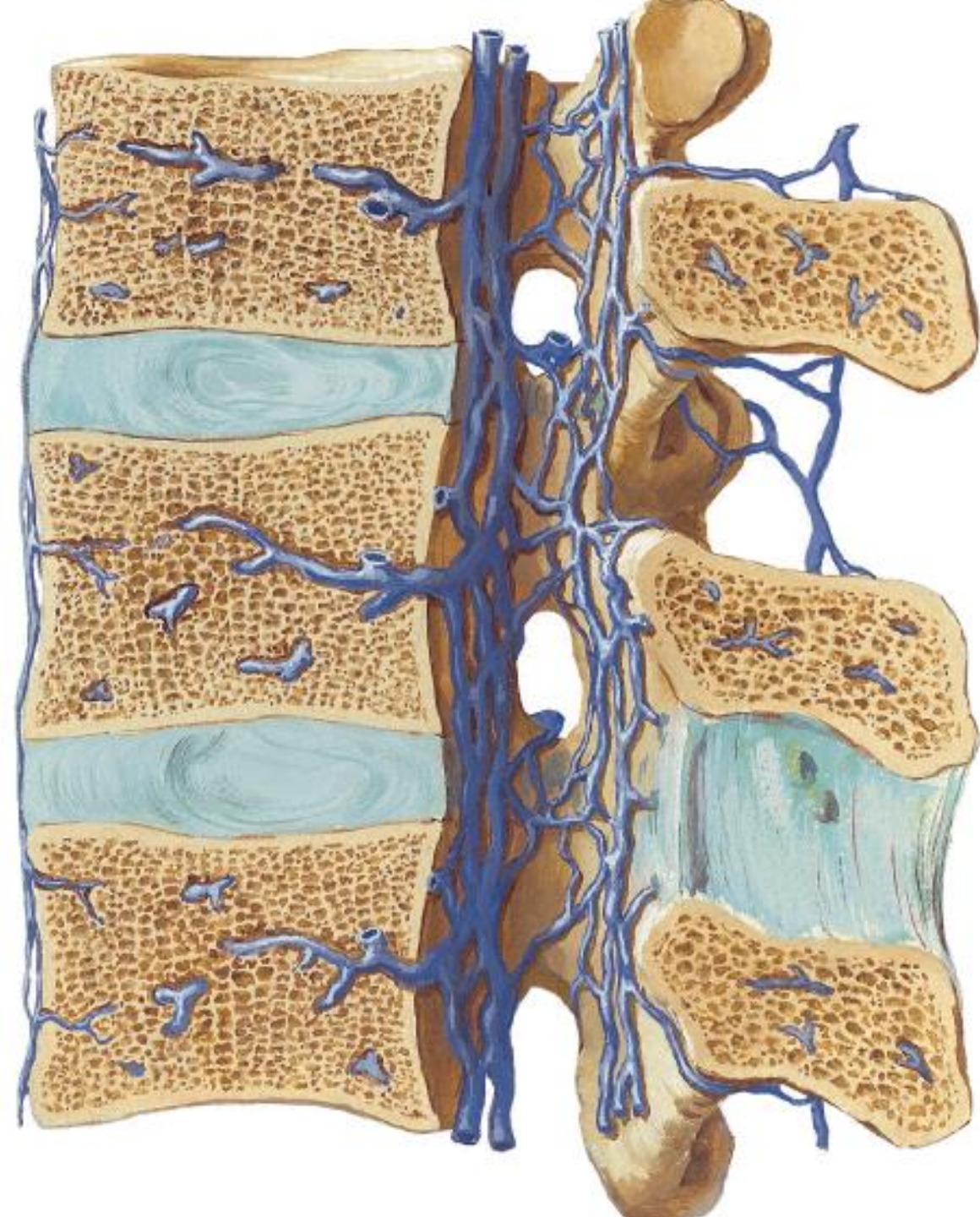
Veins of the vertebral column

The richly supplied red marrow of the vertebral body drains through its posterior surface by a pair of large basivertebral veins into the internal vertebral venous plexus, which lies inside the vertebral canal, outside the dura. It drains into the external vertebral venous plexus.

This intramuscular plexus, which also receives blood from the neural arch, drains into the regional segmental veins (vertebral, posterior intercostal, lumbar and lateral sacral veins), which in turn drain into brachiocephalic veins, superior vena cava, inferior vena cava and internal iliac veins.

Venous communication is thus established in the pelvis with veins draining the pelvic viscera, in the abdomen with the renal veins, in the thorax with the azygos venous system, and in the neck with the inferior thyroid veins.

In this way, by reflux blood flow through these largely valveless veins, malignant disease may spread from prostate, kidney, breast, bronchus and thyroid gland to the bodies of the vertebrae.



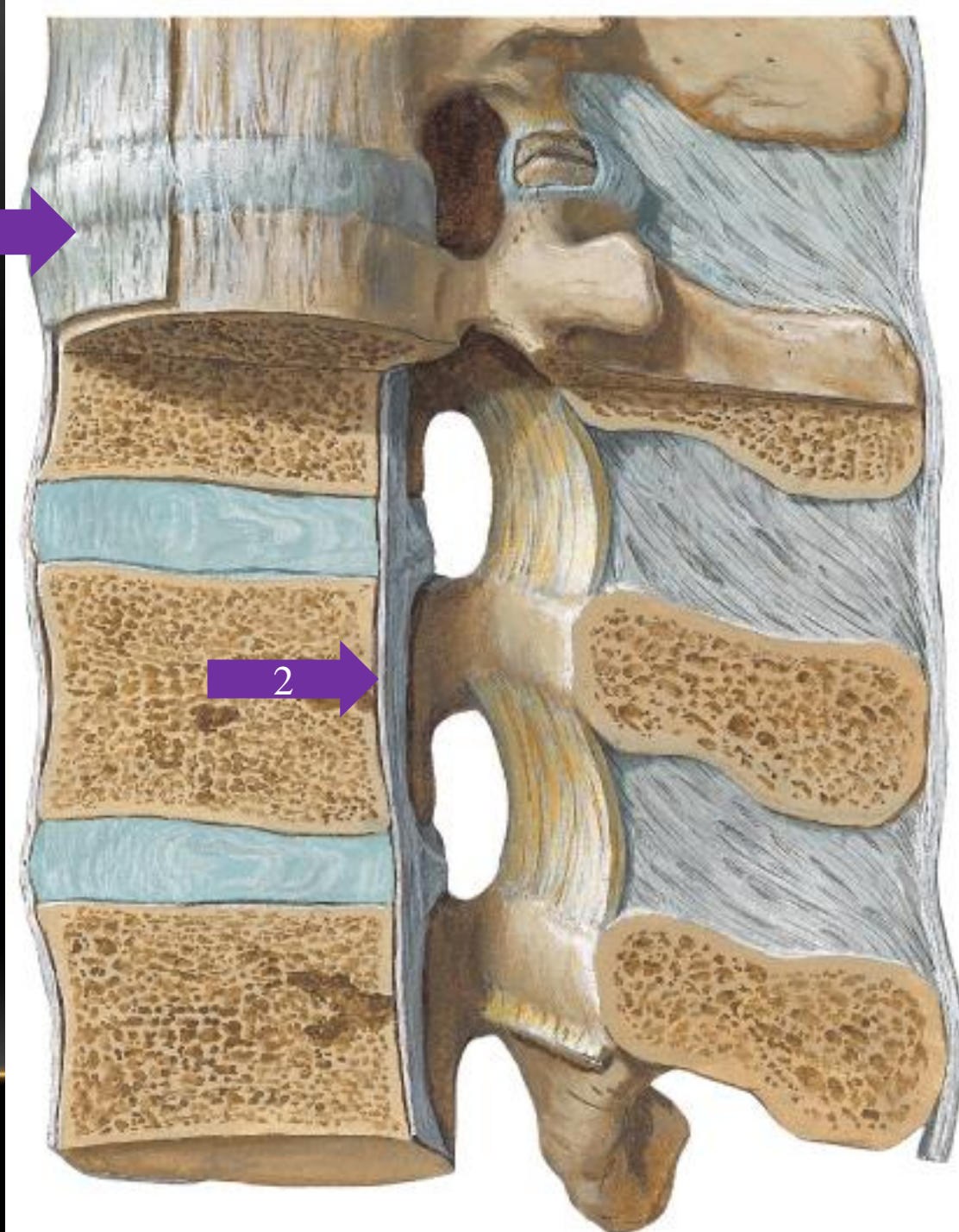
Ligaments of the vertebral column ..1/3

Anterior longitudinal ligament (1):

- Strong and broad
- Attached to the anterior surfaces of vertebral bodies and intervertebral discs.
- Extends from the sacrum to the anterior tubercle of atlas.
- Continues as *atlanto-occipital membrane*.

Posterior longitudinal ligament (2):

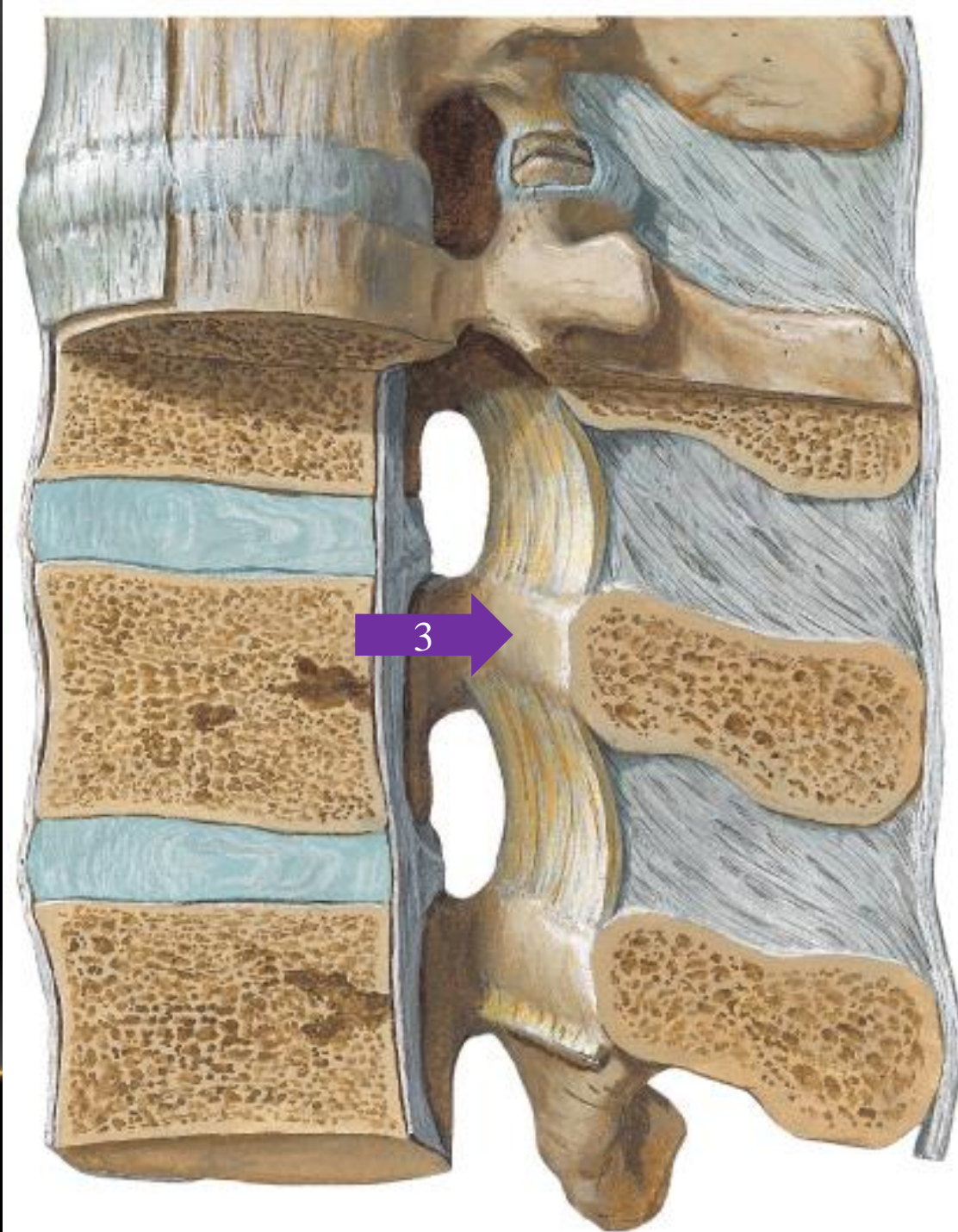
- Located inside the vertebral canal
- Attached to the posterior surfaces of IVD and adjacent vertebral bodies.
- Continues in the foramen magnum as *membrana tectoria*



Ligaments of the vertebral column ..2/3

Ligamentum flavum (3):

- Yellow in color due to high content of elastic fibres.
- Connects adjacent lamina
- Restores the vertebral column to erect posture after flexion
- Attached to the posterior arch of the atlas.
- Continues as the posterior atlanto-occipital membrane.



Ligaments of the vertebral column ..3/3

Interspinous ligaments (4):

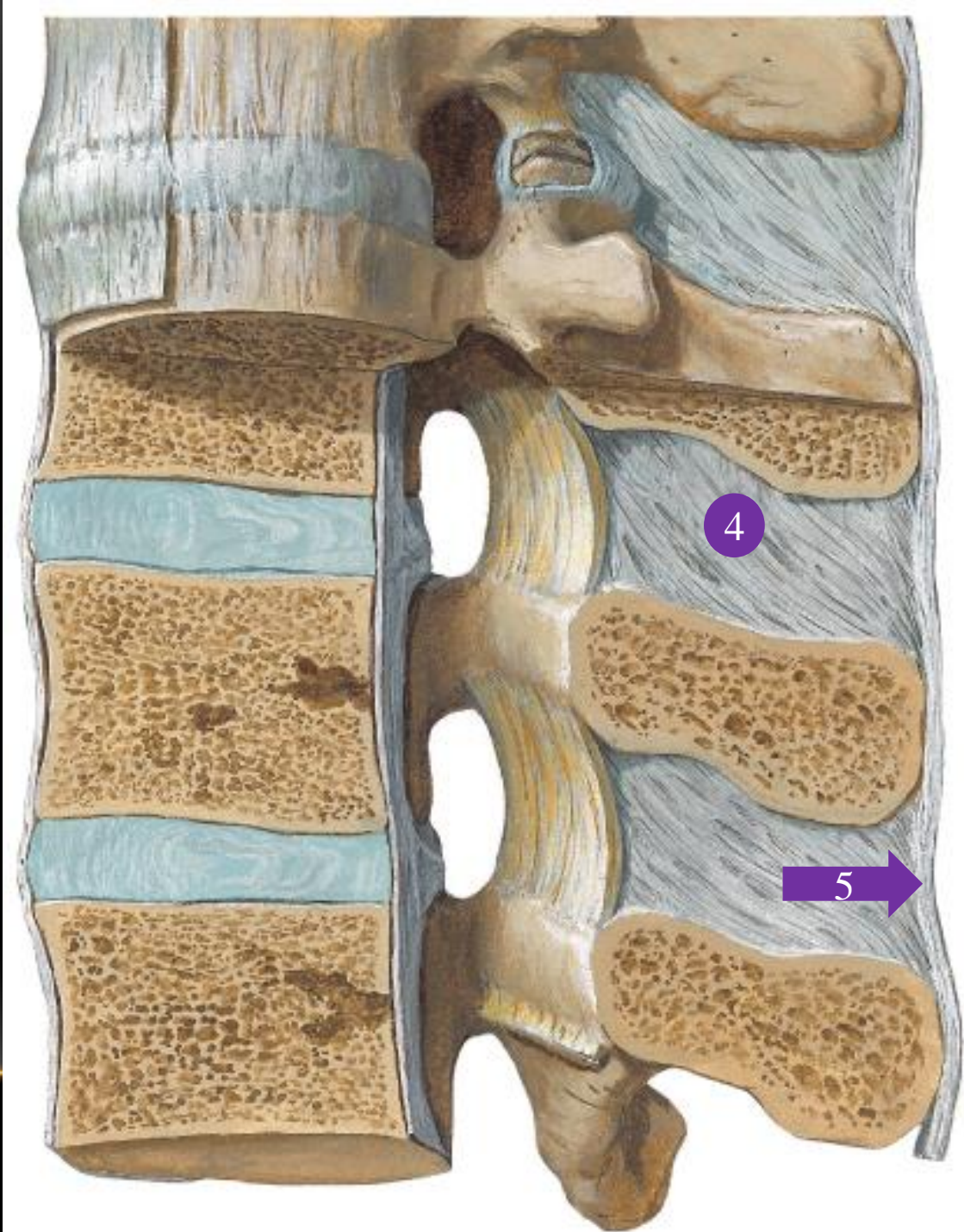
- Connect adjacent spines

Supraspinous ligaments (5):

- Connects the tips of adjacent spines

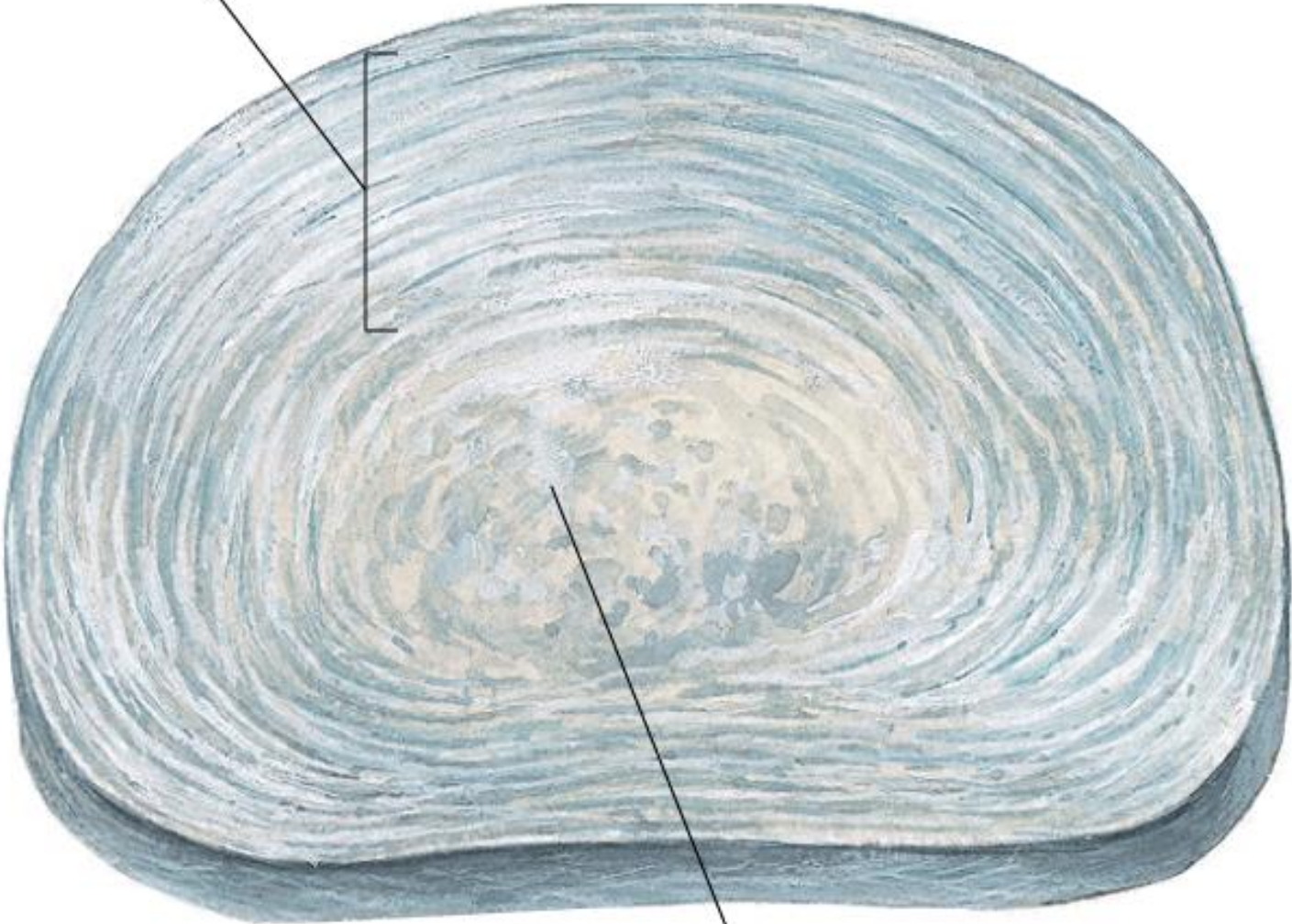
Ligamentum Nuchae:

- Thickened inter and supraspinous ligaments in the cervical region.



Intervertebral Disc (IVD)

Anulus fibrosus



Nucleus pulposus