Vertebral Column

Lectures Objectives

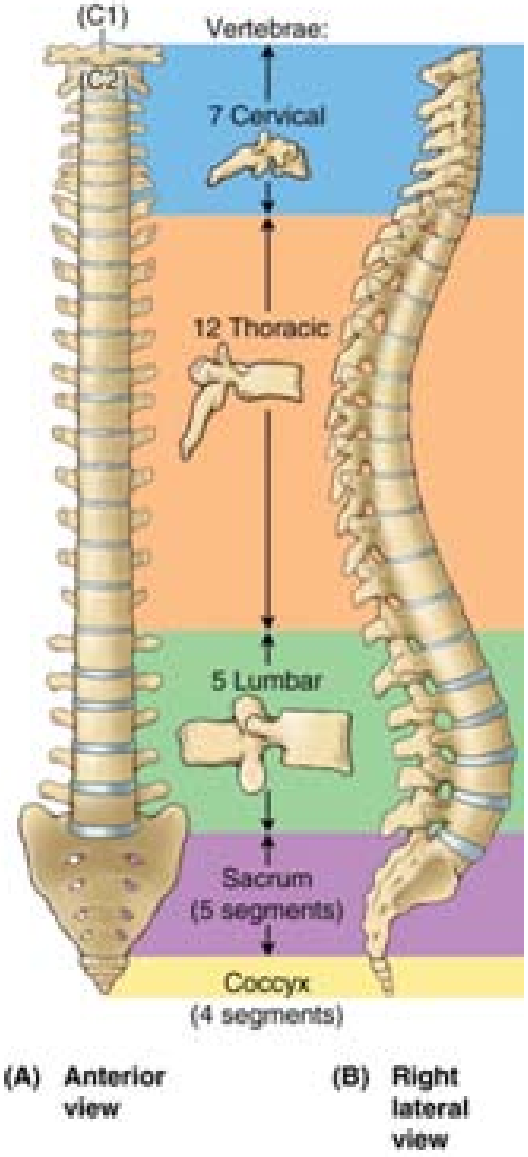
- Describe the **regions and curvatures** of the vertebral column and the number of vertebrae in each region.
- Describe the basic components of a **typical vertebrae** and their function.
- Identify and recognise the differences between cervical, thoracic and lumbar vertebrae.
- Describe and classify the **joints** associated with the vertebral column.
- Describe the location and general function of **ligaments**.
- Name the **true back muscles** and understand their relative positions and actions.
- Understand the relationships of **neural structures** and meninges to the vertebral column, including the points of exit of spinal nerves

Vertebral Column

- Also called the spine, backbone, or spinal column
- Functions to:
  - Protect the spinal cord and spinal nerves
  - Support the head
  - Serve as a point of attachment for the ribs, pelvic girdle, and muscles
  - Form the axis of the body
  - Important role in posture
- Vertebrae and intervertebral discs (IVD) compose the vertebral column
  - Vertebral column ~ 72-75 cm
  - ¼ of it is IVDs

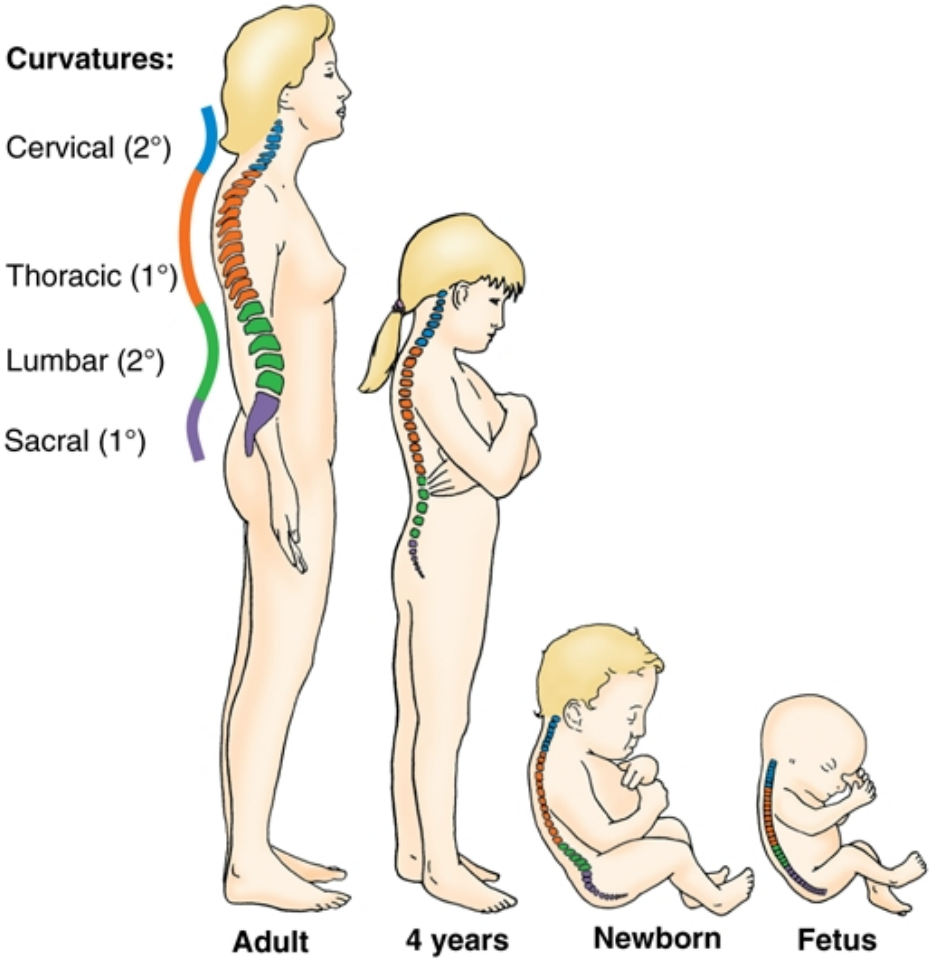
Vertebral Column (Regions)

- **Cervical Region**
  - Cervical vertebrae (C1–C7)
  - The atlas (C1) is the first cervical vertebra
  - The axis (C2) is the second cervical vertebra
- **Thoracic Region**
  - Thoracic vertebrae (T1–T12)
  - Articulate with the ribs
- **Lumbar Region**
  - Lumbar vertebrae (L1–L5)
  - Provide attachment for the large back muscles
- **Sacrum**
  - The sacrum is a triangular bone formed by the union of five sacral vertebrae (S1–S5)
  - Serves as a strong foundation for the pelvic girdle
- **Coccyx**
  - The coccyx, like the sacrum, is triangular in shape
  - It is formed by the fusion of usually four coccygeal vertebrae



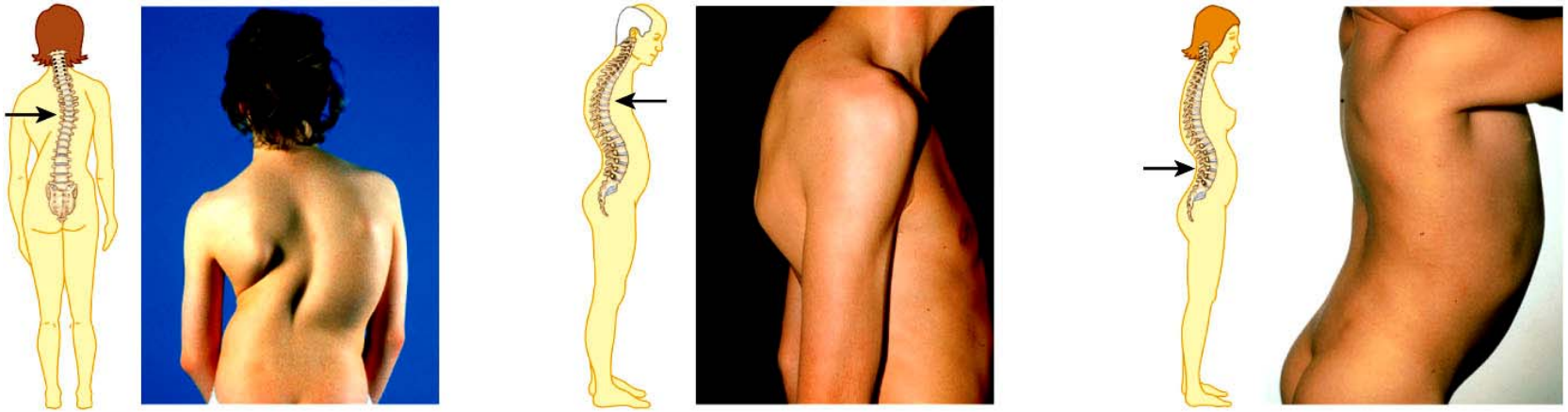
Curves of the Vertebral Column

- In newborn
  - Single curve, concave anteriorly
- ➢ Lumosacral angle appears during development
- In adult
  - Primary curves (concave anteriorly)
    - Thoracic and sacral are formed during fetal development
  - Secondary curves (convex anteriorly)
    - Cervical is formed when infant raises head at 4 months
    - Lumbar forms when infant sits up & begins to walk at 1 year



Curves of the Vertebral Column

- Functions of vertebral column curves
  - Curves increase the column strength
  - Help maintain balance in the upright position
  - Absorb shocks during walking, and help protect the vertebrae from fracture
- Various conditions may exaggerate the normal curves of the vertebral column
  - Kyphosis
  - Lordosis
  - Scoliosis



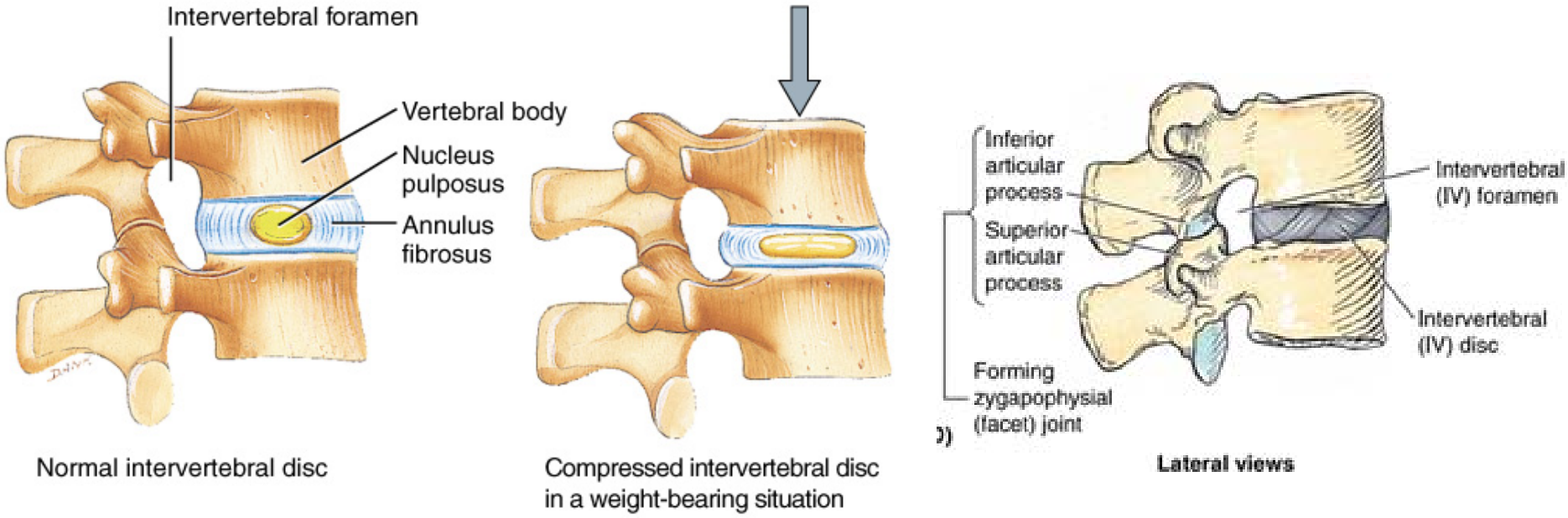
(a) Scoliosis (b) Kyphosis (c) Lordosis

Figure 07.25 Tortora - PAP 12/e

Intervertebral Discs

- Found between the bodies of adjacent vertebrae
- Thicker in cervical & lumbar regions (greatest movement)
- Functions to:
  - Form strong joints
  - Permit various movements of the vertebral column
  - Absorb vertical shock

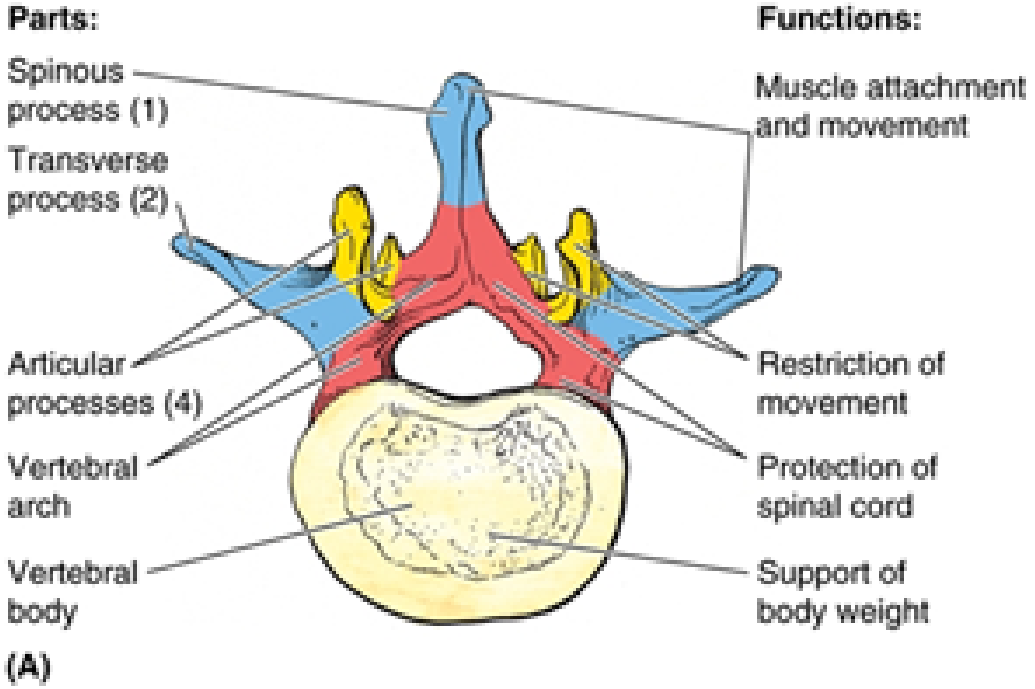
Intervertebral Discs



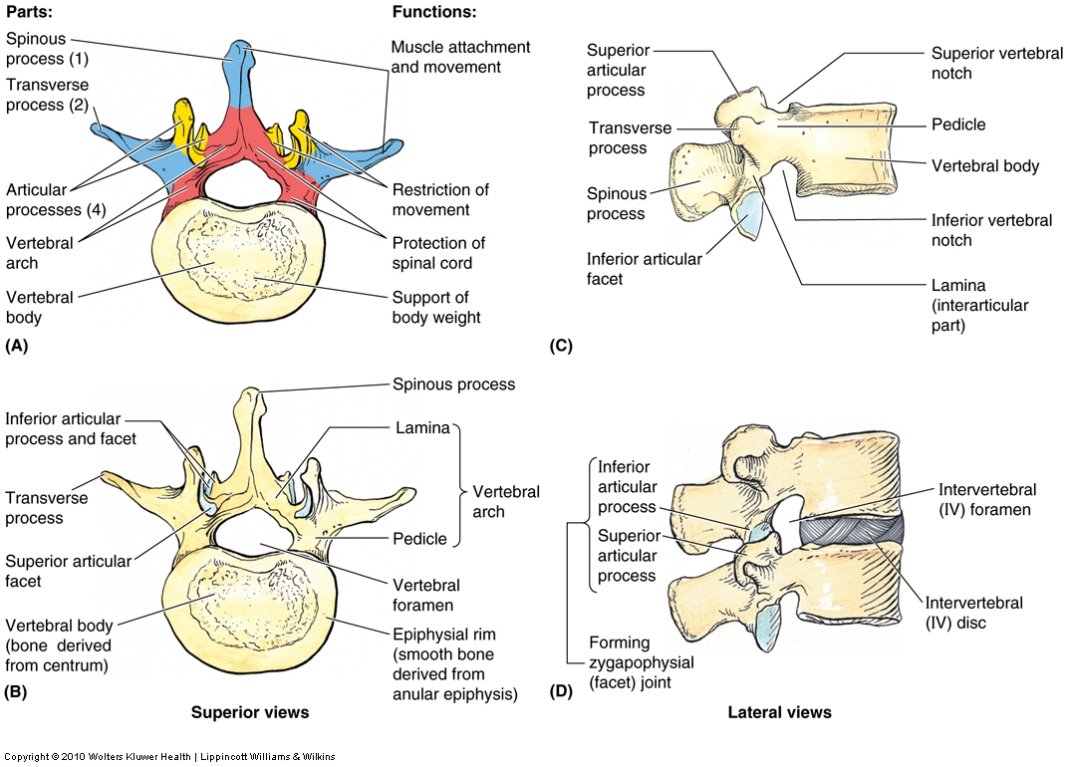
- Content :
  - Fibrocartilagenous ring (anulus fibrosus)
    - Concentric layers
    - Collagen bundles oriented in an alternative oblique directions
  - Pulpy center (nucleus pulposus)
    - Gelatinous material

Typical Vertebrae

- Vertebra typically consists of:
  - A body (weight bearing)
  - A vertebral arch (surrounds the spinal cord)
  - Several processes (points of attachment for muscles)

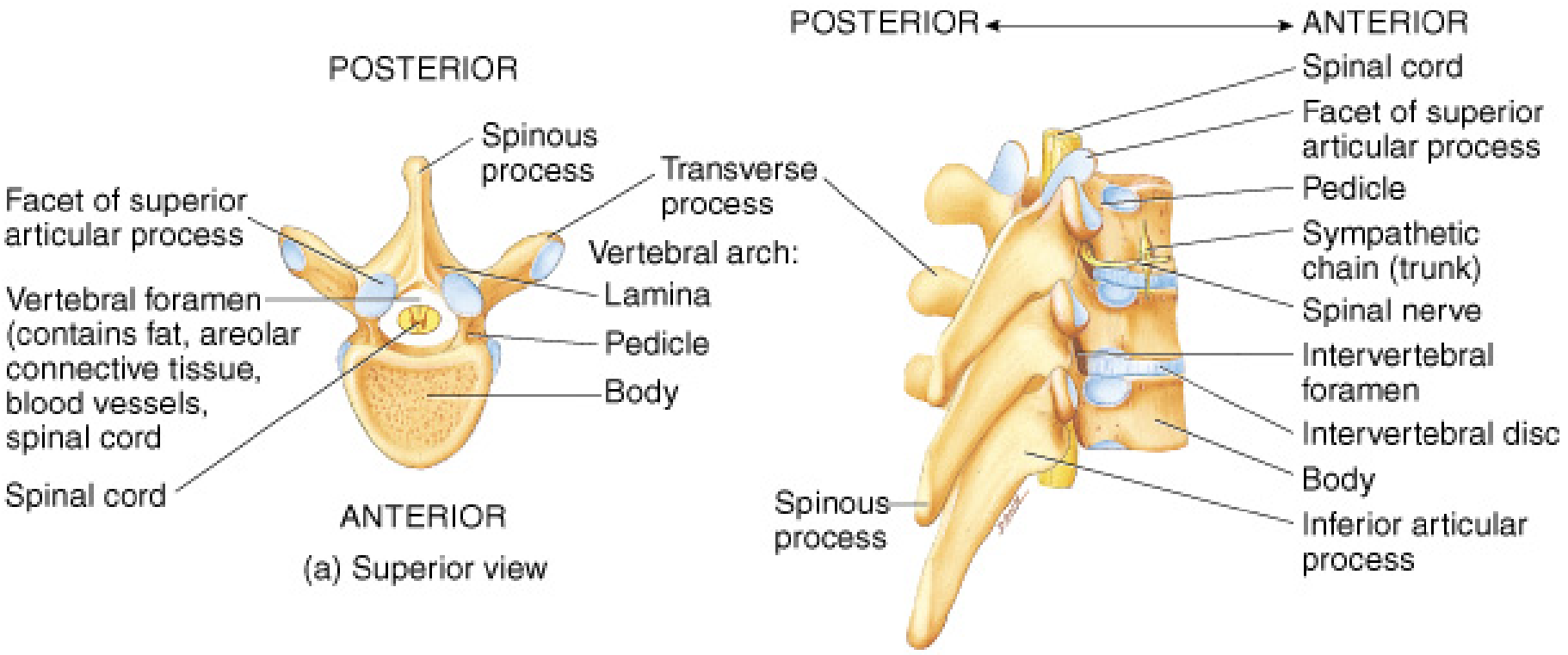


Typical Vertebrae



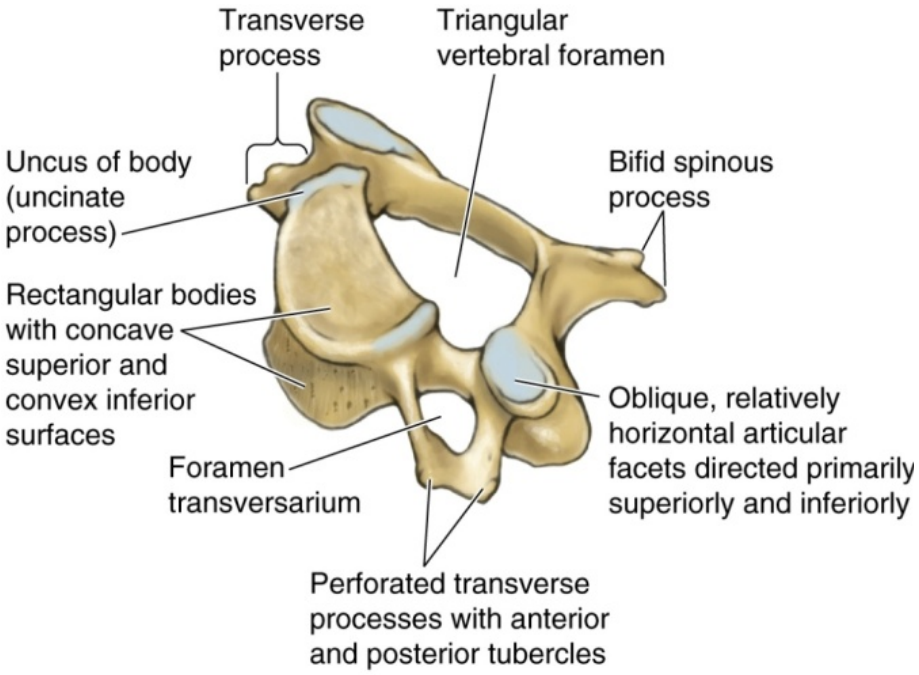
- Body (anterior)
  - weight bearing
- Vertebral arch
  - Pedicles (cylindrical)
  - Laminae (flattened)
- Vertebral foramen
  - Spinal cord and its coverings
- Seven processes
  - 2 transverse
    - Muscle attachment
  - 1 spinous (posterior)
    - Muscle attachment
  - 4 articular
- Vertebral notches on pedicles
  - Superior & inferior

Intervertebral Foramen & Spinal Canal



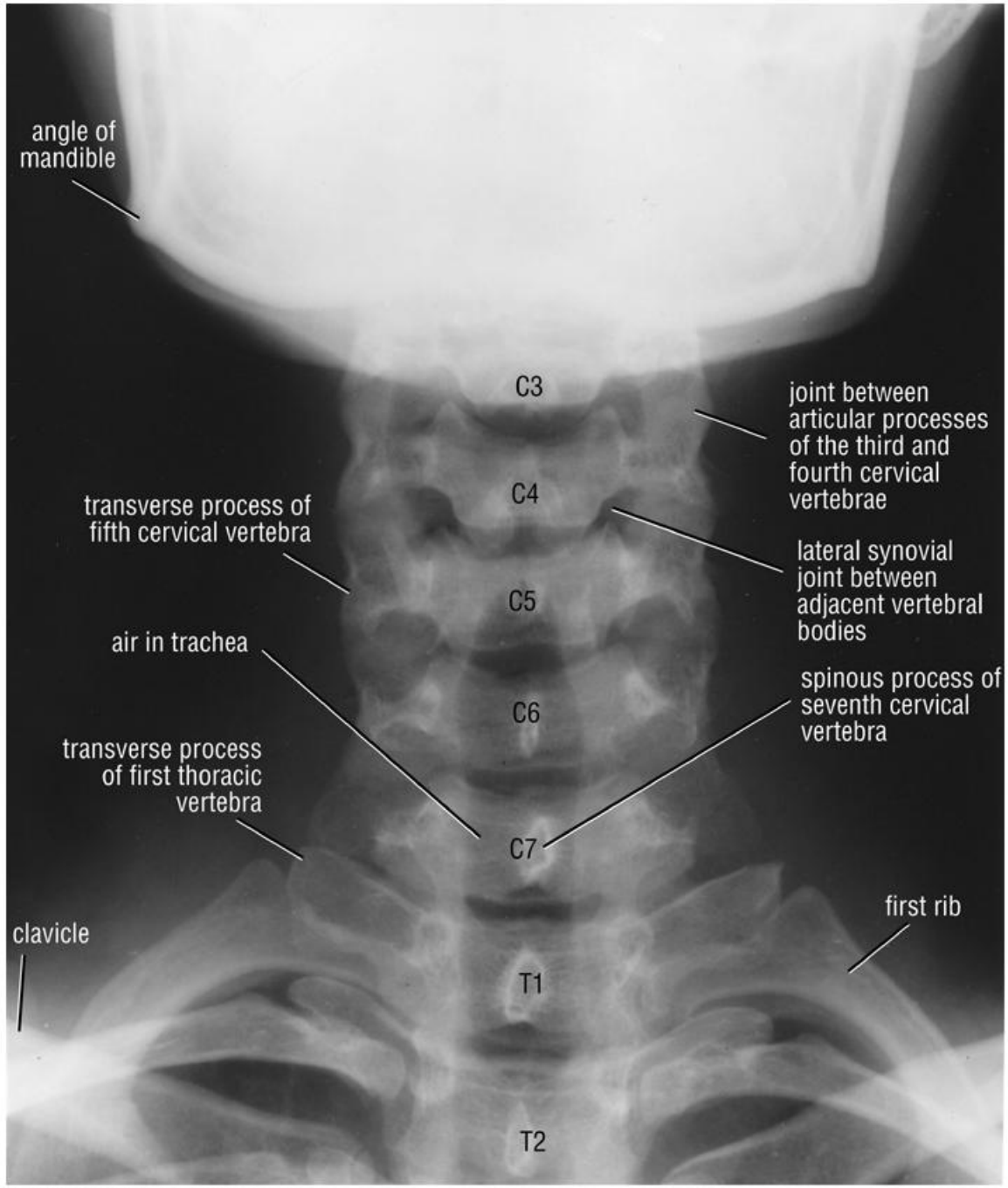
- Spinal canal is all vertebral foramena together
- Intervertebral foramen are 2 vertebral notches together
  - Transmit spinal nerves and blood vessels

Typical Cervical Vertebrae (C3-C7)



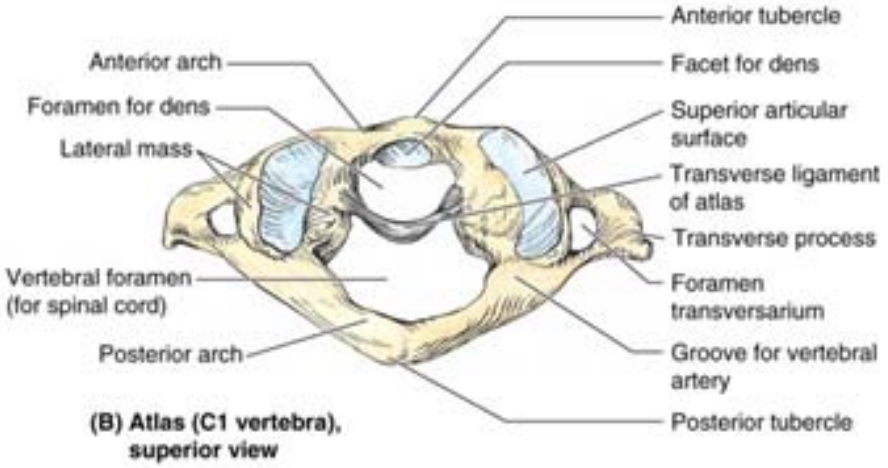
(A) Cervical vertebra

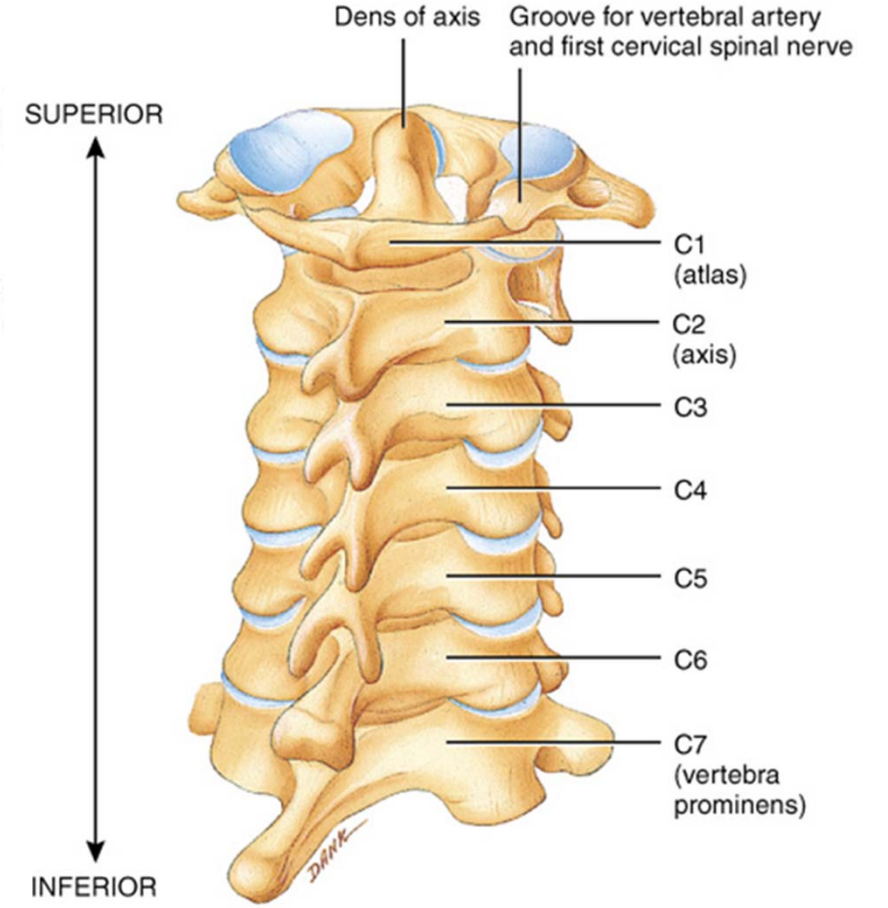
- Smaller bodies
  - Uncus of the body (elevated superolateral margin)
- Larger vertebral foramen
  - triangular in shape
- Transverse processes
  - shorter
  - transverse foramen
    - For vertebral artery and veins except C7
    - Anterior and posterior tubercles
      - For levator scapulae & scalenes
      - Carotid tubercle (anterior tubercle of C6)
- Spinous processes of C2 to C6 often bifid
  - C7 (prominens) has long prominent spinous process
- Superior articular processes face posteriosuperior



Atypical Cervical Vertebrae

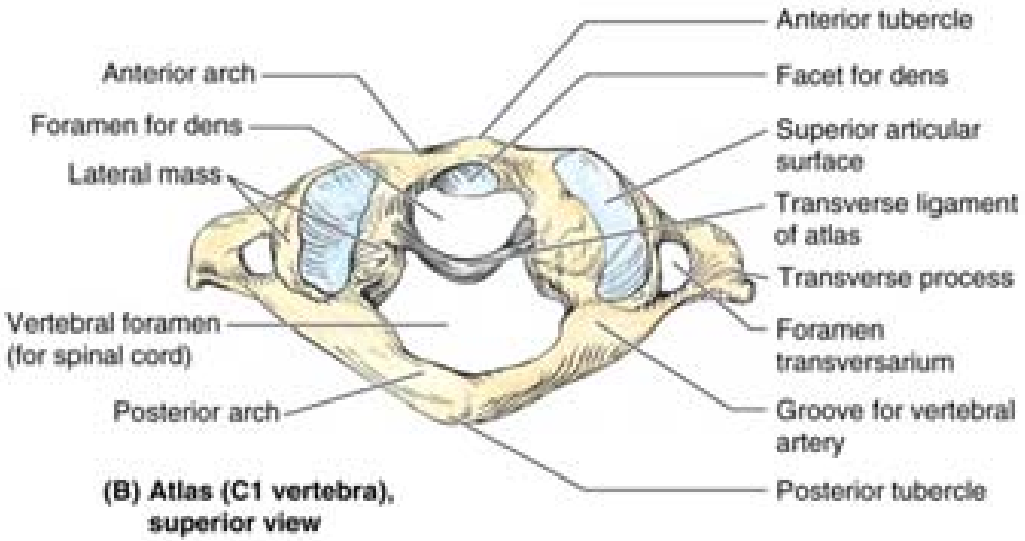
- C1 (Atlas)
  - NO body or spinous process
  - Ring shape bone
    - Anterior arch
      - Anterior tubercle
    - Posterior arch
      - Posterior tubercle
      - Groove for the vertebral a.
  - Lateral masses
    - Superior facets for occipital condyles
    - Transverse process
      - More laterally placed than others (atlas is the widest)
  - Nodding movement at atlanto-occipital joint signifies “yes”

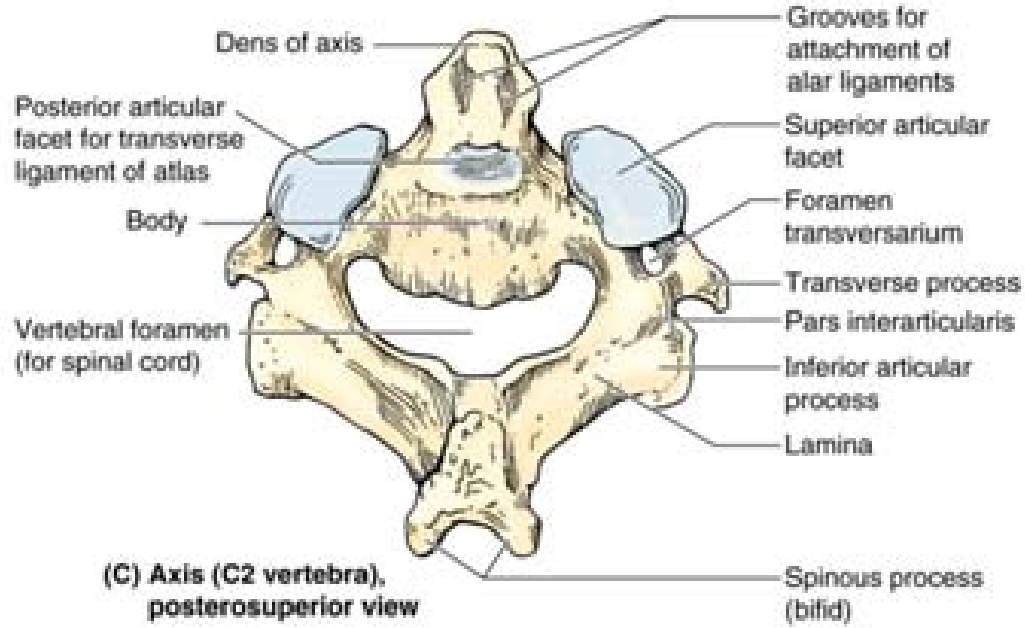


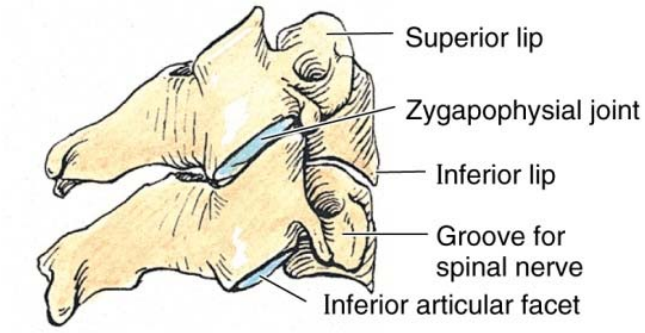


Atypical Cervical Vertebrae

- C2 (Axis)
  - Dens or odontoid process
    - from body of axis
  - Superior articular facets
  - Pivotal movement at atlanto-axial joint signifies “no”

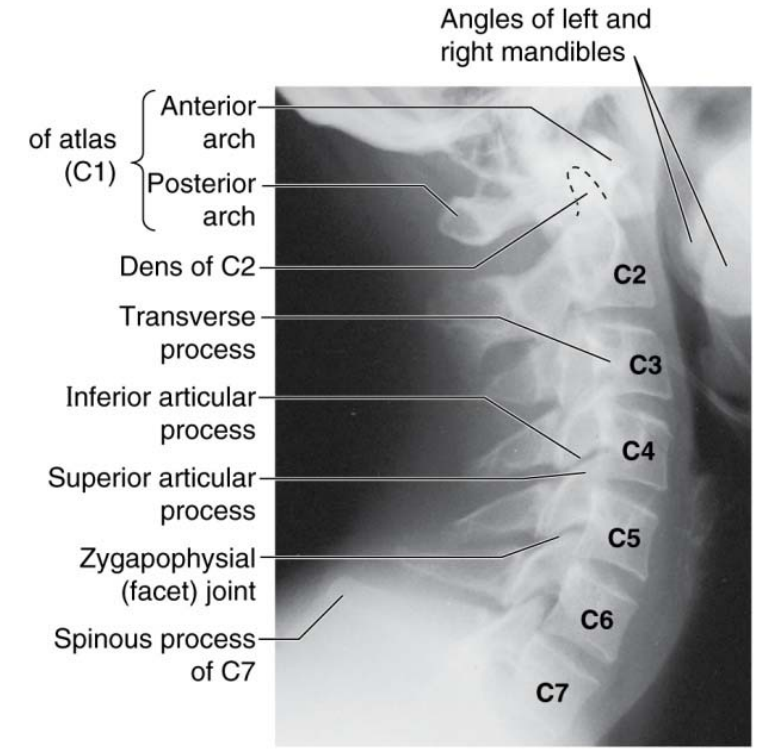






(B) Lateral view, articulated typical cervical vertebrae C4 and C5

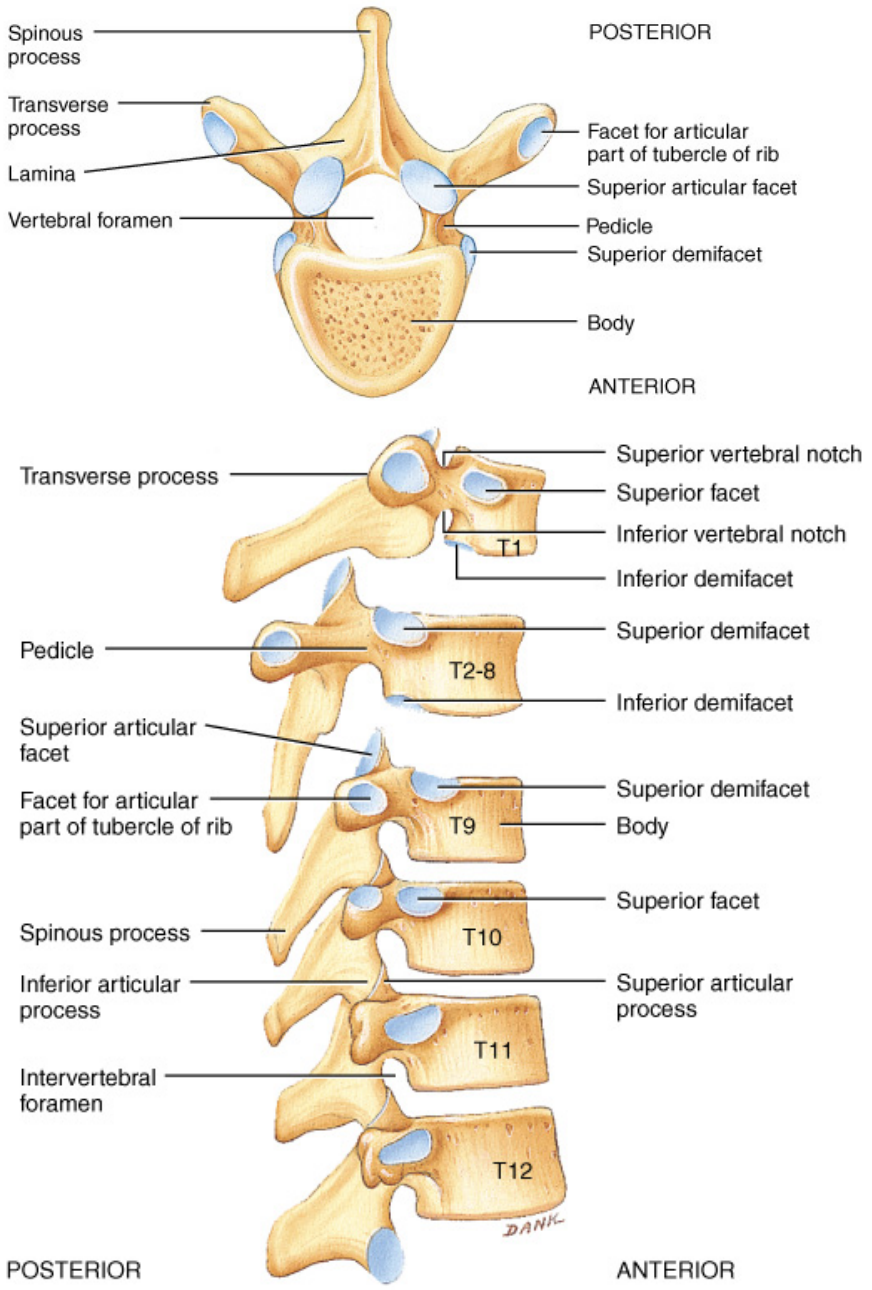
Typical cervical vertebrae



(C) Lateral radiograph, vertebrae C1-C7

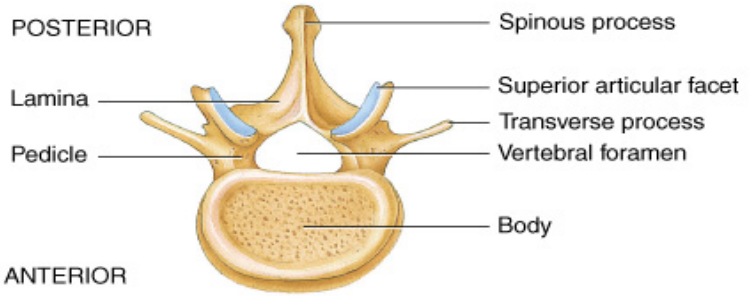
Thoracic Vertebrae (T1-T12)

- Larger and stronger bodies (heart shape)
- Longer transverse processes
- Longer spinous process (pointed downward)
- Facets or demifacets on body for head of rib
- Facets on transverse processes (T1-T10) for tubercle of rib
- Superior articular processes face posteriolateral

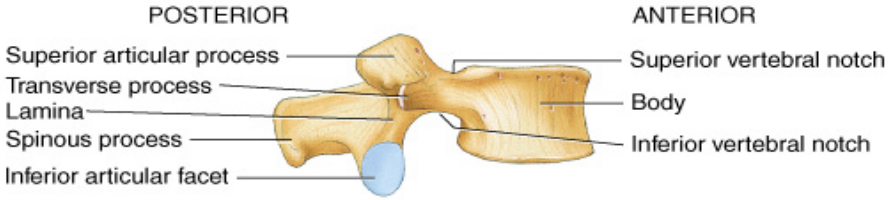


Lumbar Vertebrae (L1-L5)

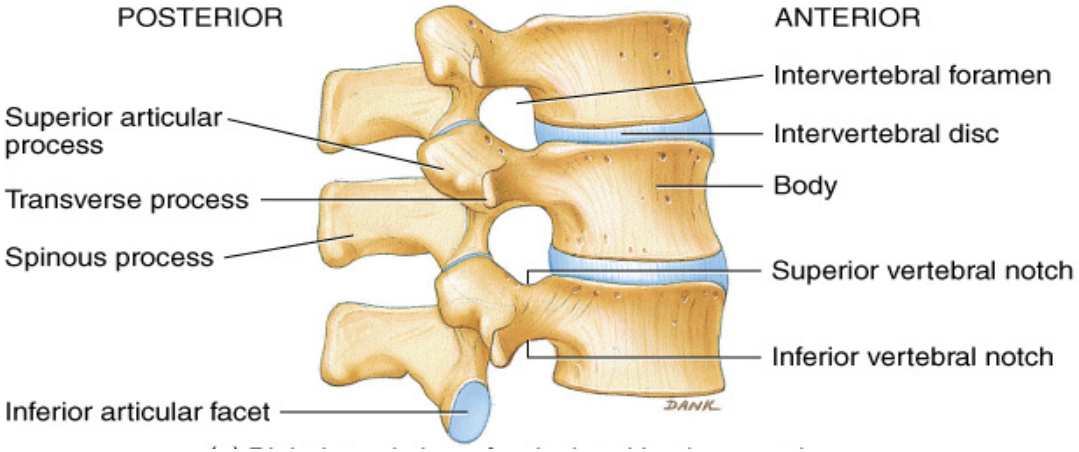
- Strongest & largest
- Body is large (kidney shape)
  - L5 is the largest
- Vertebral foramen is triangular in shape
  - cervical > lumbar > thoracic
- Transverse processes long and slender
  - Accessory process
    - Attachment of lumbar intertransversarii mm.
- Short thick spinous process (backward)
  - back musculature



(b) Superior view



(c) Right lateral view



Vertebral Column

TABLE 7.4

Comparison of Major Structural Features of Cervical, Thoracic, and Lumbar Vetebrae

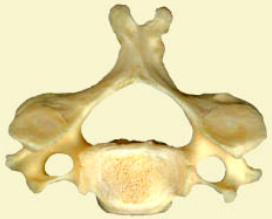
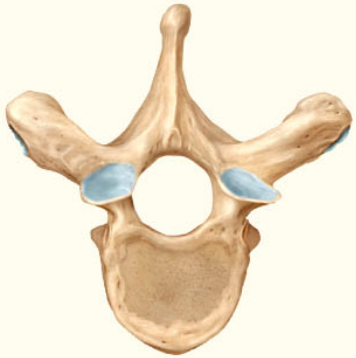
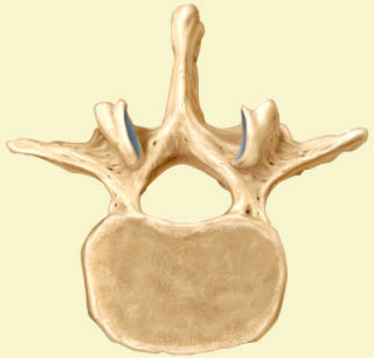
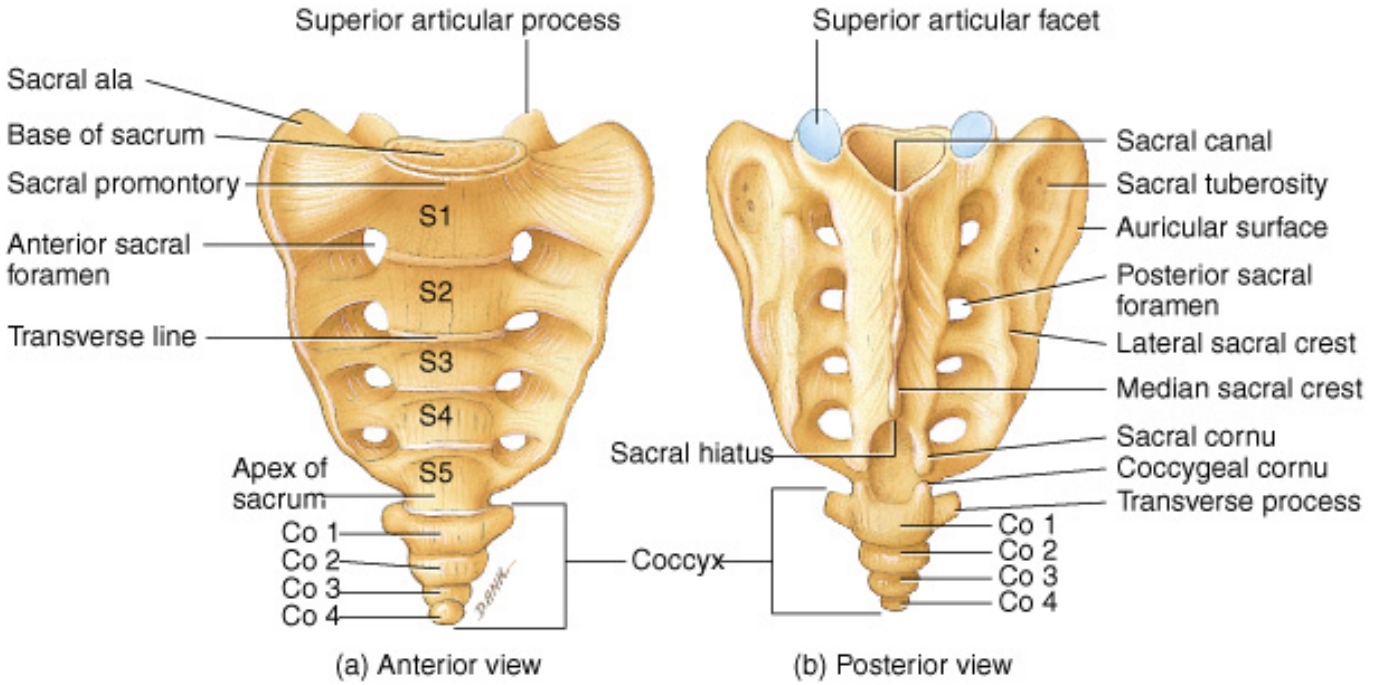
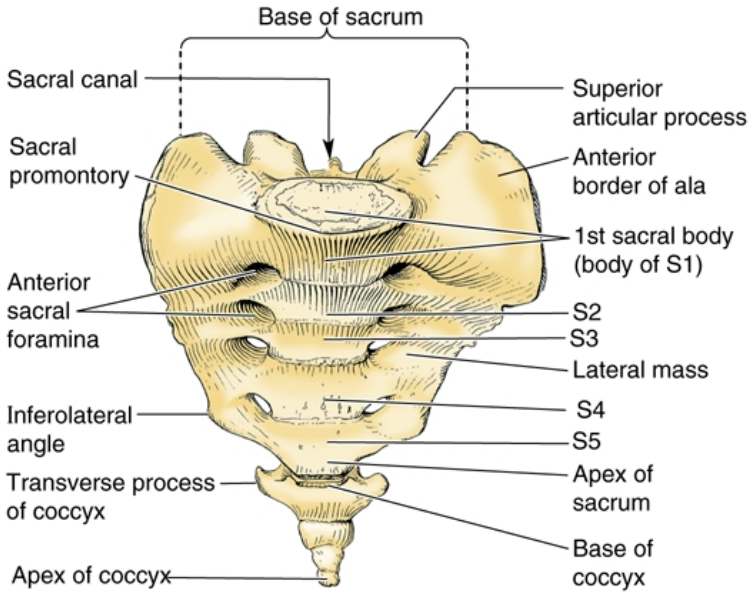
CHARACTERISTIC	CERVICAL	THORACIC	LUMBAR
Overall structure			
Body	Small.	Larger.	Largest.
Foramina	One vertebral and two transverse.	One vertebral.	One vertebral.
Spinous processes	Slender and often bifid (C2–C6).	Long and fairly thick (most project inferiorly).	Short and blunt (project posteriorly rather than inferiorly).
Transverse processes	Small.	Fairly large.	Large and blunt.
Articular facets for ribs	Absent.	Present.	Absent.
Direction of articular facets			
Superior	Posterosuperior.	Posterolateral.	Medial.
Inferior	Anteroinferior.	Anteromedial.	Lateral.
Size of intervertebral discs	Thick relative to size of vertebral bodies.	Thin relative to size of vertebral bodies.	Massive.

Table 07.04 Tortora - PAP 12/e

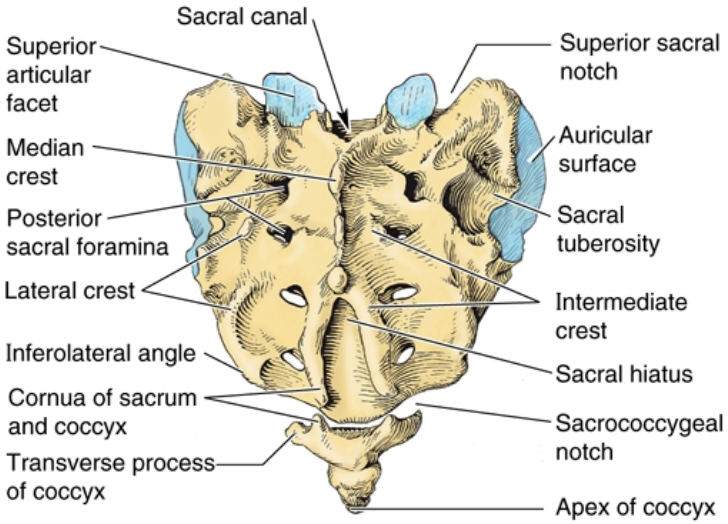
Sacrum



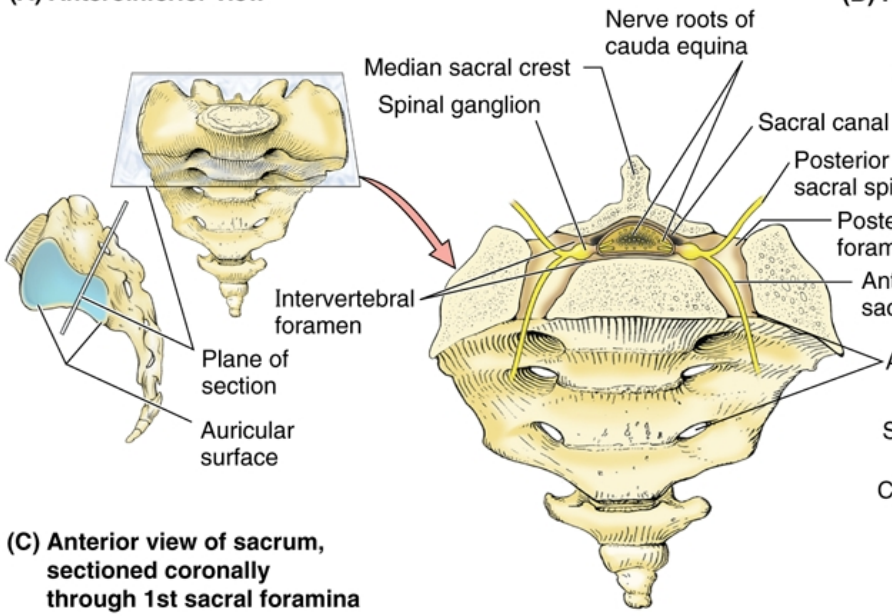
- Union of 5 vertebrae (S1 - S5) by age 30
  - median sacral crest was spinous processes
  - sacral ala is fused transverse processes
- Sacral promontory (anterosuperior margin)
- Sacral canal ends at sacral hiatus (laminae don't meet)
- Auricular surface & sacral tuberosity of sacroiliac joint
- Anterior and posterior sacral foramina
  - Ventral and dorsal rami of spinal nerves respectively



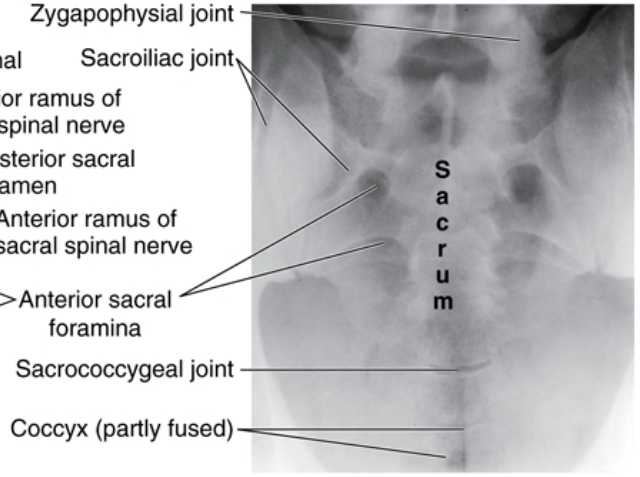
(A) Anteroinferior view



(B) Posterosuperior view

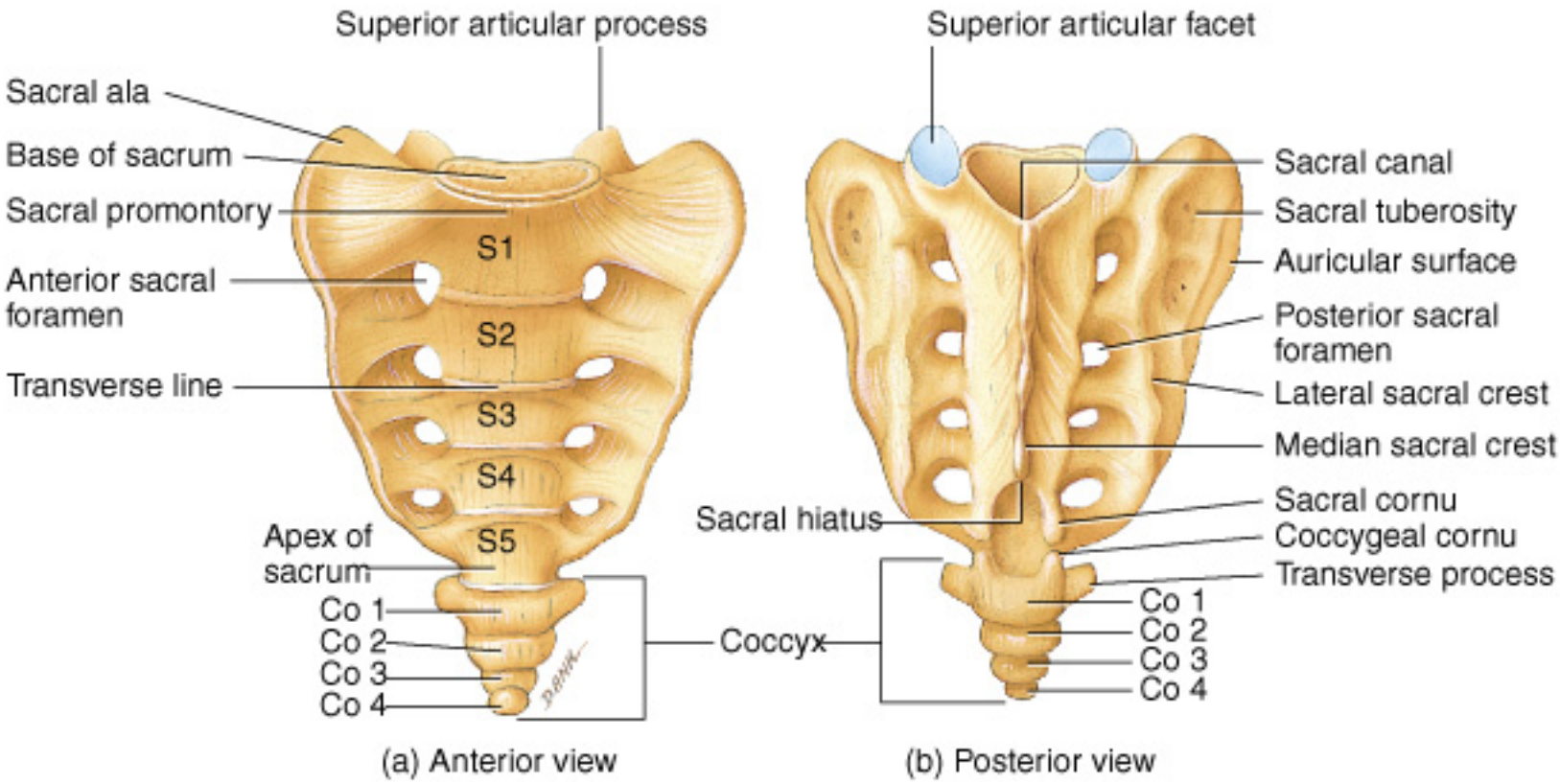


(C) Anterior view of sacrum, sectioned coronally through 1st sacral foramina



(D) Radiograph. Posteroanterior projection, anteroposterior view

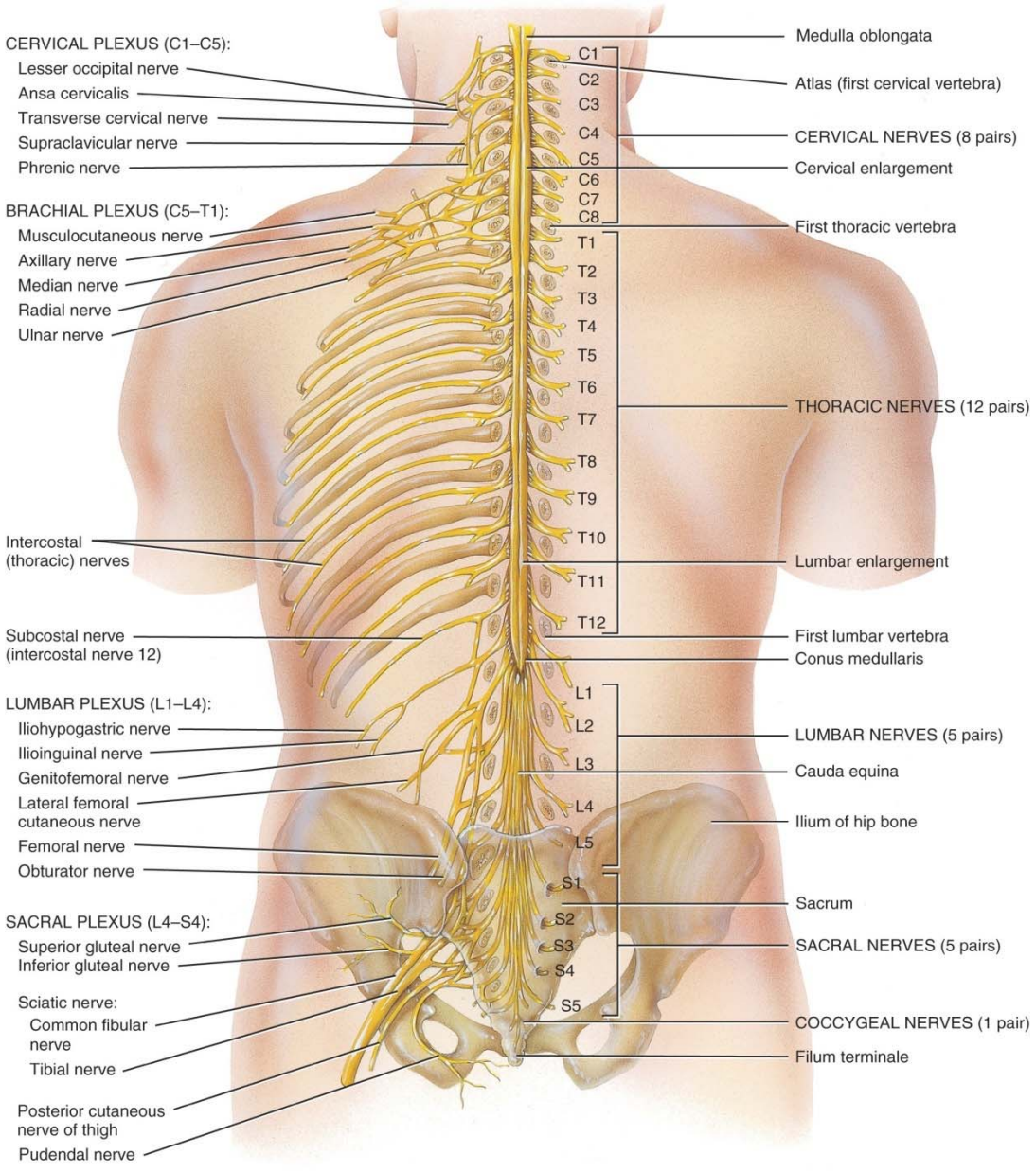
Coccyx



- Shape ..
- Coccygeal cornua
- Union of 4 vertebrae (Co1 - Co4) by age 30

Vertebral Column

Neural Content

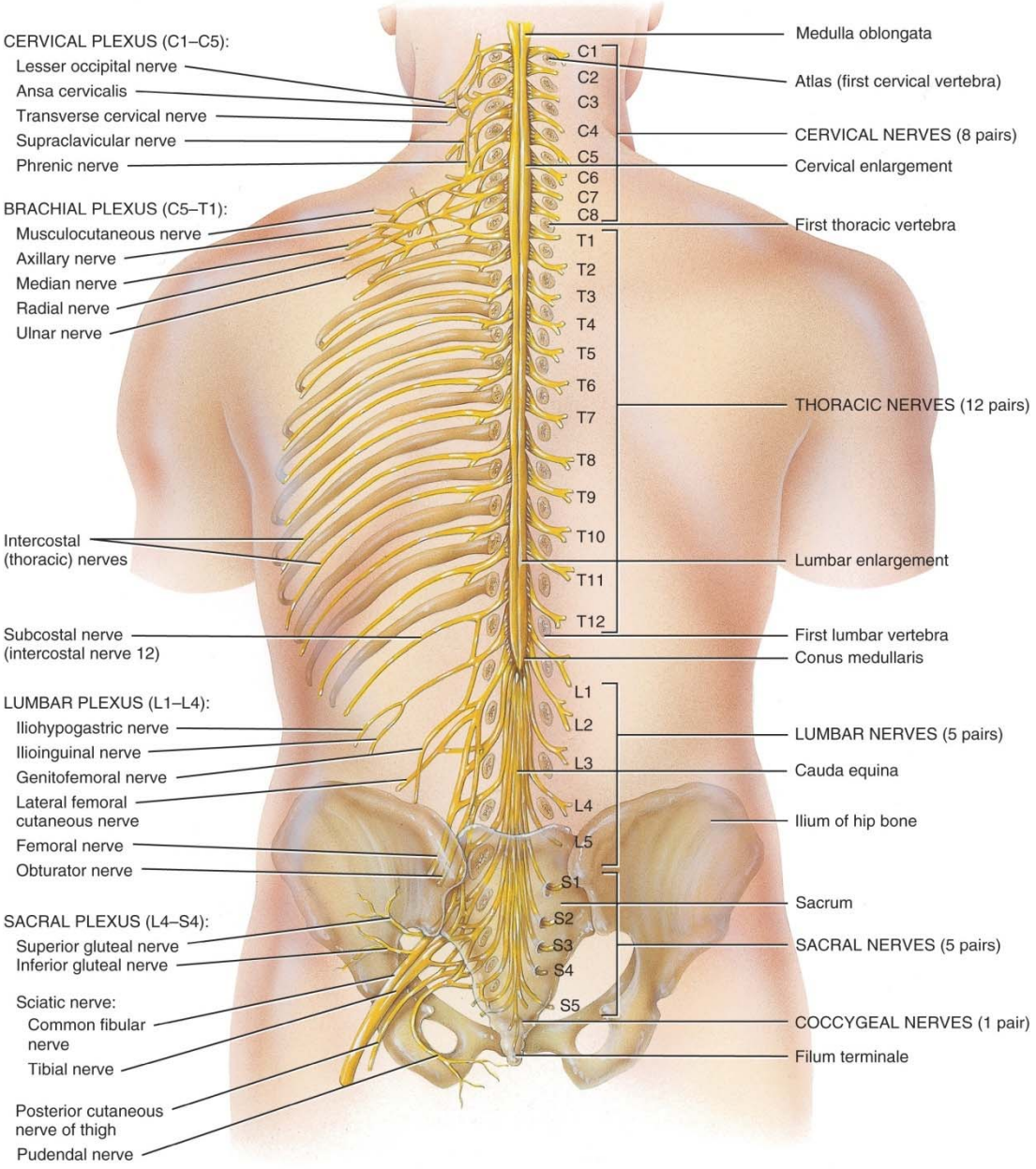


(a) Posterior view of entire spinal cord and portions of spinal nerves

Spinal Cord

- Flattened cylinder
- 16-18 Inches long & 3/4 inch diameter
- In adult ends at L2
- In newborn ends at L4
- Growth of cord stops at age 5
- Cervical enlargement
  - upper limbs
- Lumbar enlargement
  - lower limbs

Inferior End of Spinal Cord

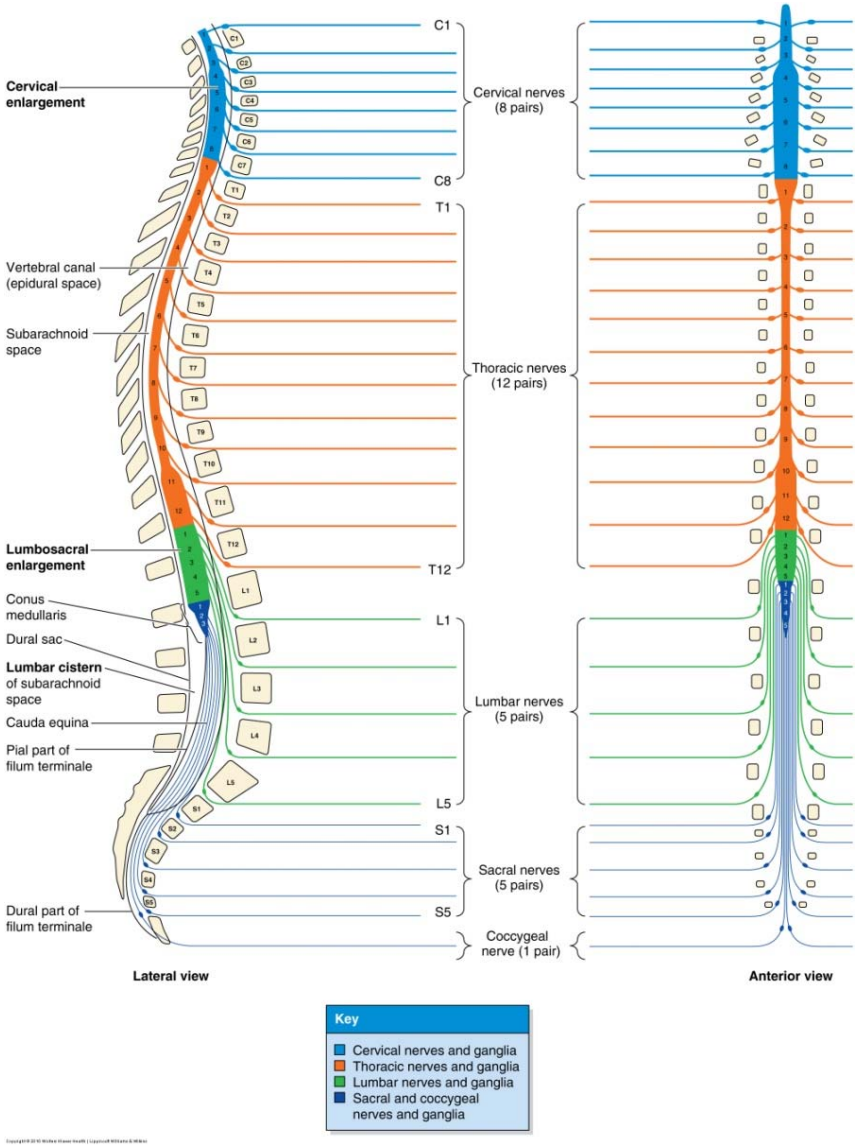


(a) Posterior view of entire spinal cord and portions of spinal nerves

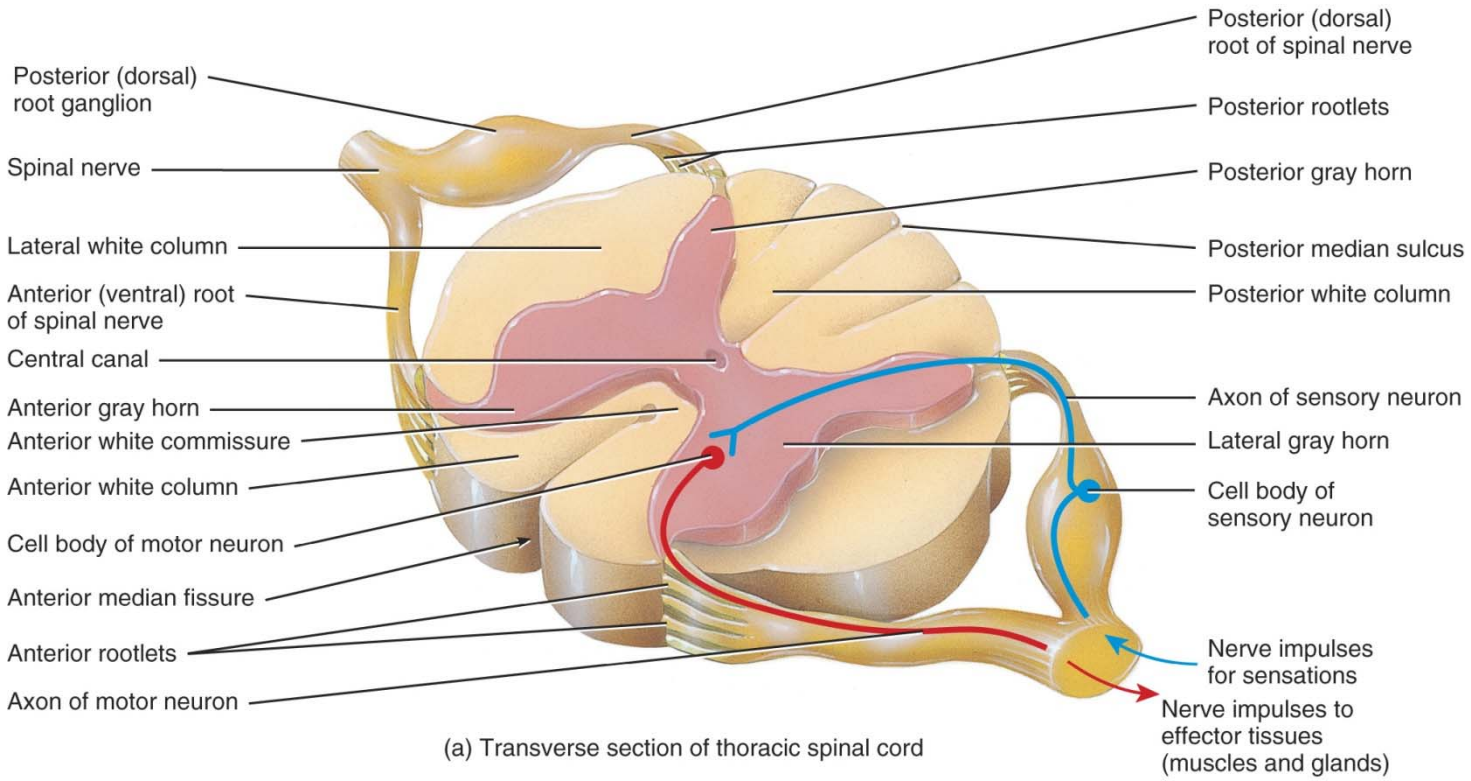
- Conus medullaris
  - cone-shaped end of spinal cord
- Filum terminale
  - thread-like extension of pia mater
  - stabilizes spinal cord in canal
- Caudae equinae (horse's tail)
  - dorsal & ventral roots of lowest spinal nerves
- Spinal segment
  - area of cord from which each pair of spinal nerves arises

Spinal Nerves

- 31 Pairs of spinal nerves
- Named & numbered by the cord level of their origin
  - 8 pairs of cervical nerves (C1 to C8)
  - 12 pairs of thoracic nerves (T1 to T12)
  - 5 pairs of lumbar nerves (L1 to L5)
  - 5 pairs of sacral nerves (S1 to S5)
  - 1 pair of coccygeal nerves
- Exit through the IVF



Spinal Cord & Spinal Nerves



(a) Transverse section of thoracic spinal cord

- Spinal nerves begin as roots
- Dorsal or posterior root is incoming sensory fibers
  - dorsal root ganglion (swelling) = cell bodies of sensory nerves
- Ventral or anterior root is outgoing motor fibers

Spinal Nerves: Level of Exit

- C1-C8
  - C1-C7 exit above the corresponding vertebra
  - C1 exit between the atlas and the occipital bone
  - C8 exit between the C7 and T1 vertebrae
- From T1 to L5, spinal nerves exit from the IVF below their encountered vertebrae
- S1-S4 rami exit from their encountered sacral foramens
- S5 & Co1 exit from sacral hiatus

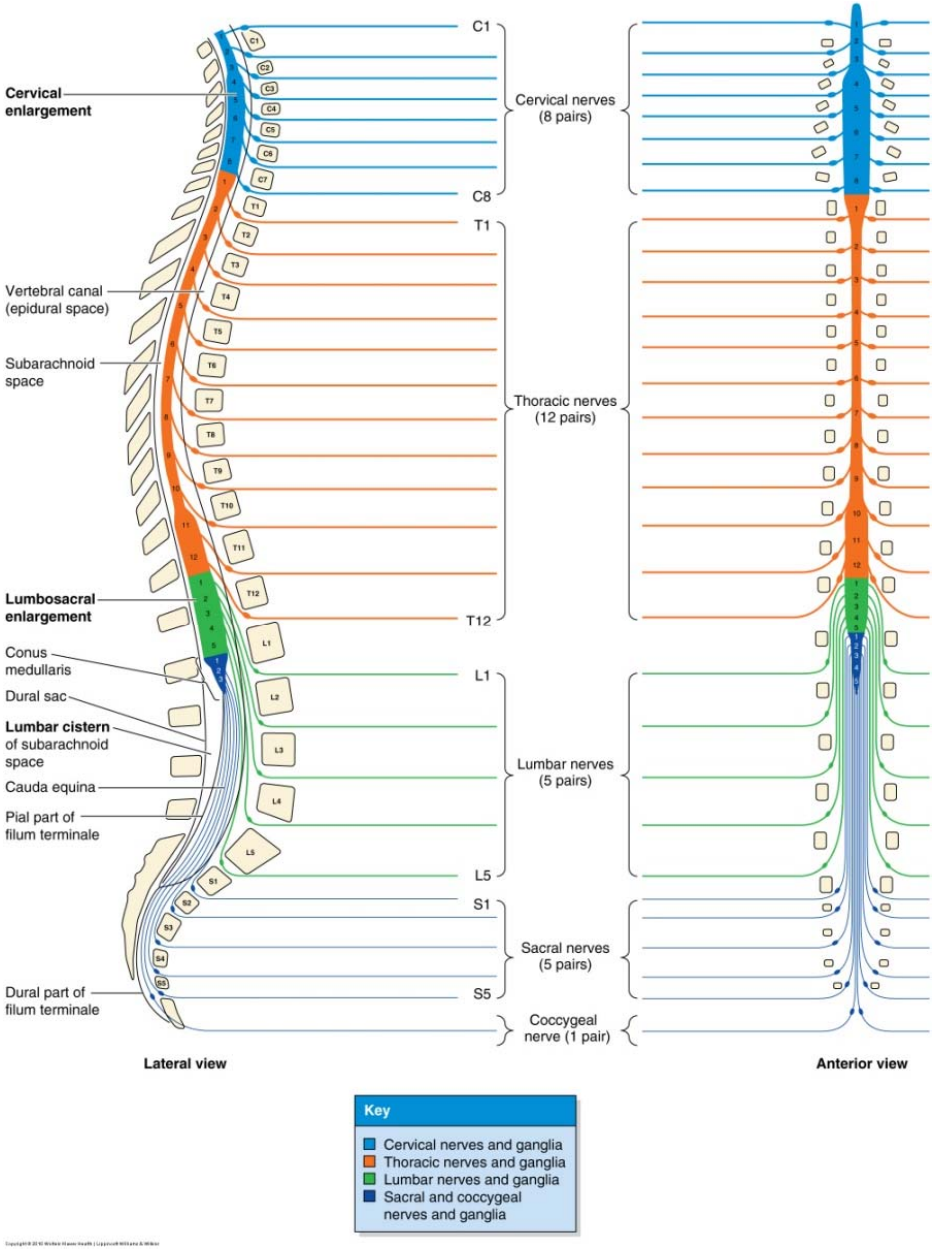


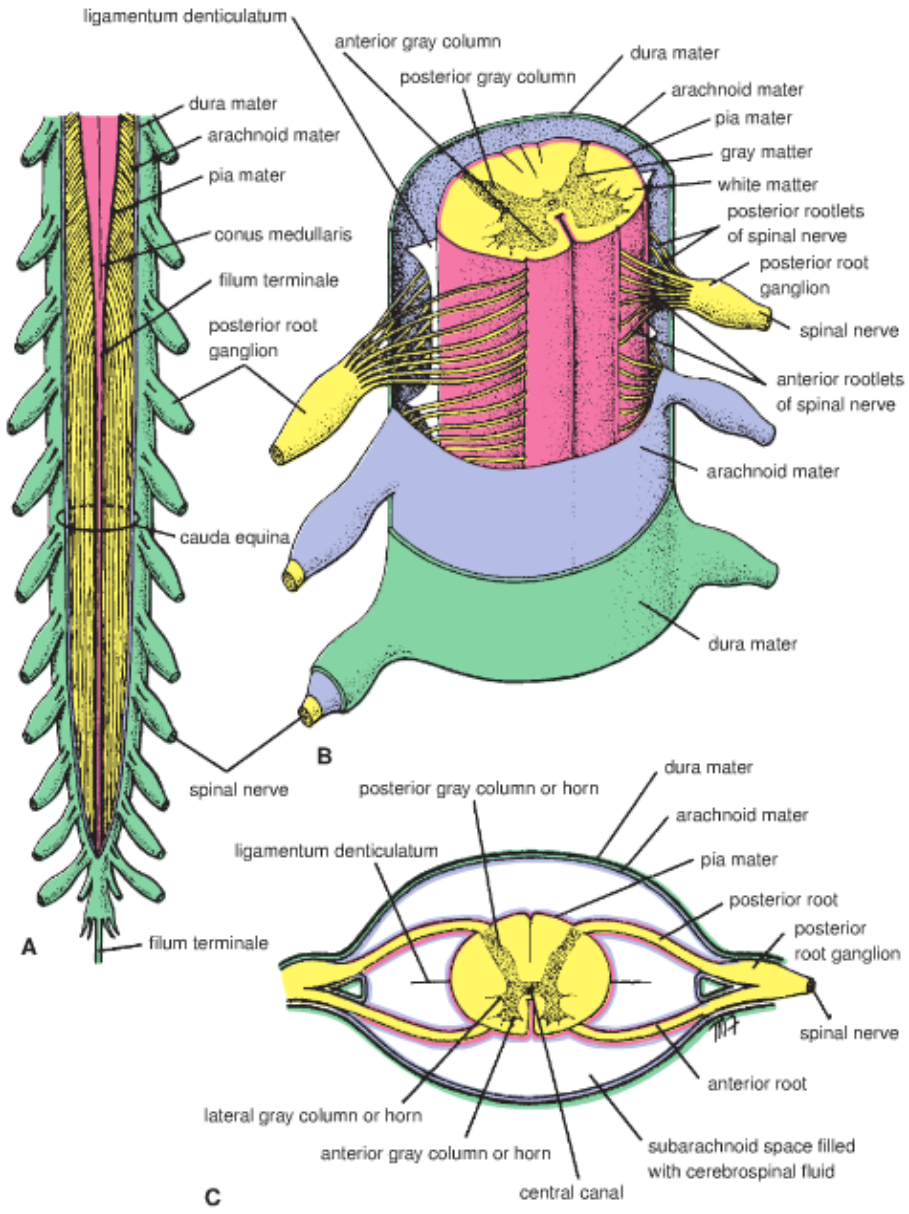
TABLE 4.13. NUMBERING OF SPINAL NERVES AND VERTEBRAE

Segmental Level	Number of Nerves	Level of Exit from Vertebral Column
Cervical	8 (C1–C8)	Nerve C1[a] (suboccipital nerve) passes superior to arch of vertebra C1 Nerves C2–C7 pass through IV foramina superior to the corresponding vertebrae Nerve C8 passes through the IV foramen between vertebra C7 and T1
Thoracic	12 (T1–T12)	Nerves T1–L5 pass through IV foramina inferior to the corresponding vertebrae
Lumbar	5 (L1–L5)	
Sacral	5 (S1–S5)	Nerves S1–S4 branch into anterior and posterior rami within the sacrum, with the respective rami passing through the anterior and posterior sacral foramina
Coccygeal[a]	1 (Co1)	The 5th sacral and coccygeal nerves pass through the sacral hiatus

[a]The first cervical nerves lack posterior roots in 50% of people, and the coccygeal nerves may be absent.

(Modified from *Barr's The Human Nervous System.*)

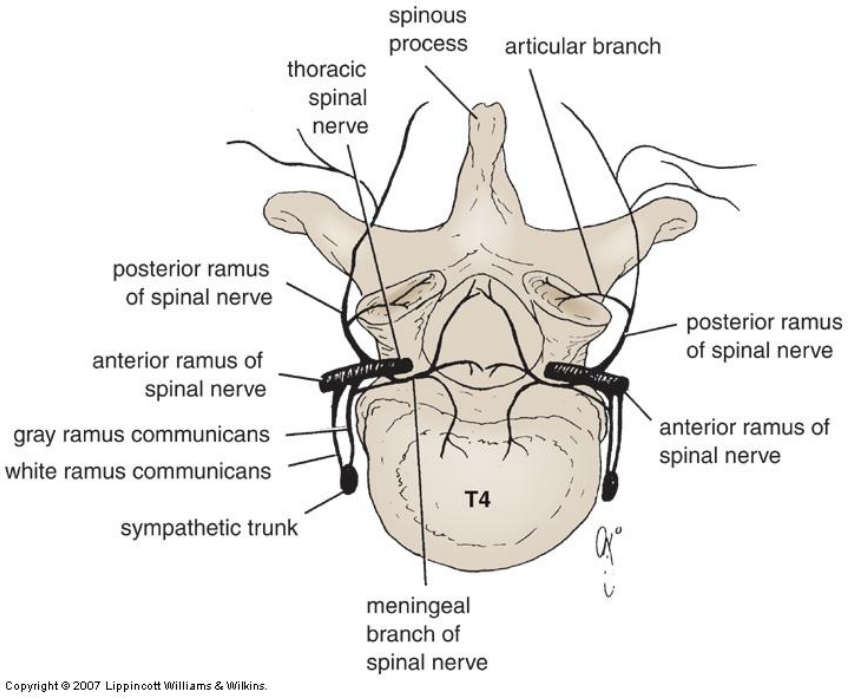
Structures Covering the Spinal Cord



- Vertebrae
- Epidural space filled with fat
- Dura mater
  - Dense irregular CT tube
  - Ends at the lower border of S2
  - Follows the nerve roots and become continuous with epineurium
- Subdural space filled with interstitial fluid
- Arachnoid = spider web of collagen fibers
  - Ends at the lower border of S2
  - Follows the nerve roots into the IVF
- Subarachnoid space = CSF
  - Lumbar cistern (enlargement in subarachnoid space)
    - L2-S2
- Pia mater
  - Thin layer covers BV
  - Denticulate ligaments hold SC in place

Innervation of the Back

- Posterior rami of the spinal nerves
  - Cutaneous branches innervate the skin of the back
  - Muscular branches innervate the back muscles
- Dura matter innervated by the recurrent meningeal branches of the spinal nerves
  - Afferent and sympathetic fibers
- IVD is innervated by the meningeal branches
- Zygapophysial joints is innervated by the articular branches of the posterior rami

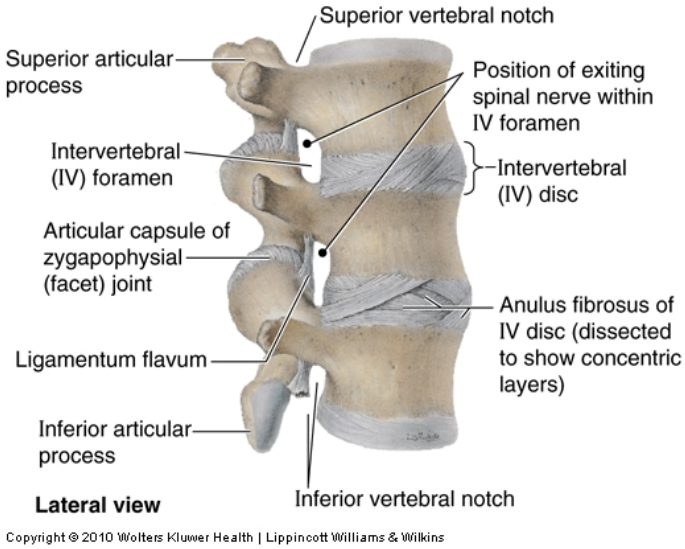


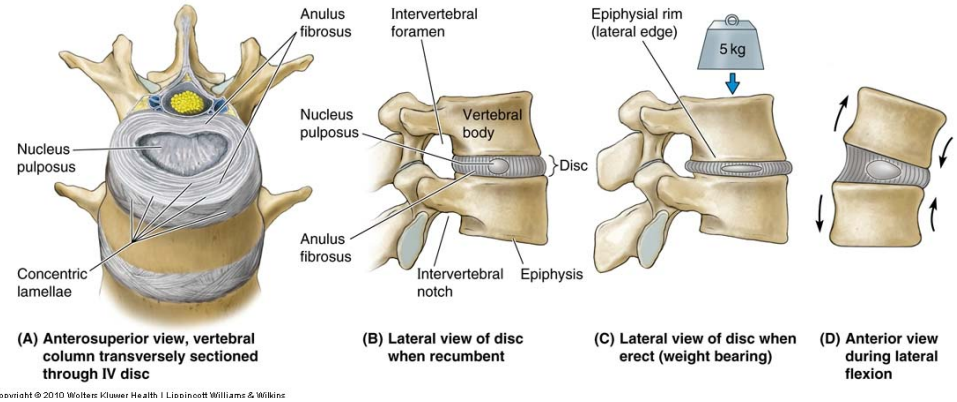
Vertebral Column

Joints

Joints of Vertebral Bodies

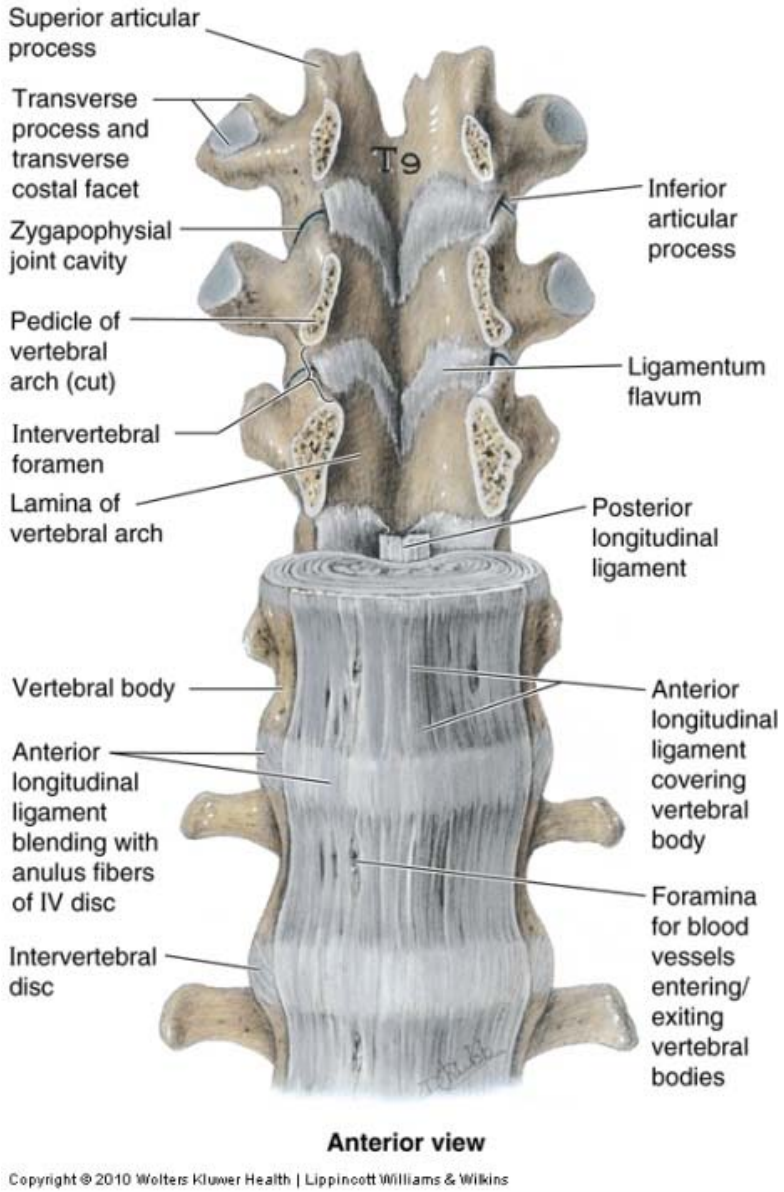
- Cartilaginous joint- Symphysis
- Vertebral bodies covered with thin plates of hyaline cartilage
- IVD
- Nerve supply: meningeal branches of the spinal nerves





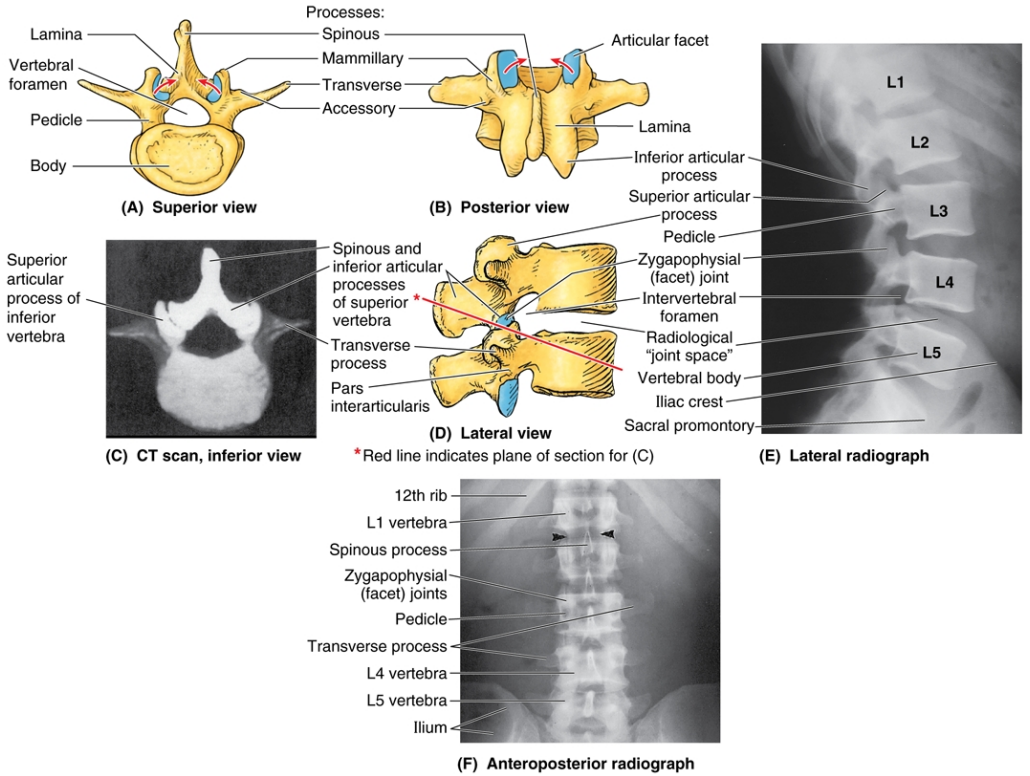
Joints of Vertebral Bodies

- Ligaments
  - Anterior longitudinal ligaments
    - Wider & stronger
    - Attached to the vertebral bodies and the IVD
  - Posterior longitudinal ligaments
    - Weak and narrow



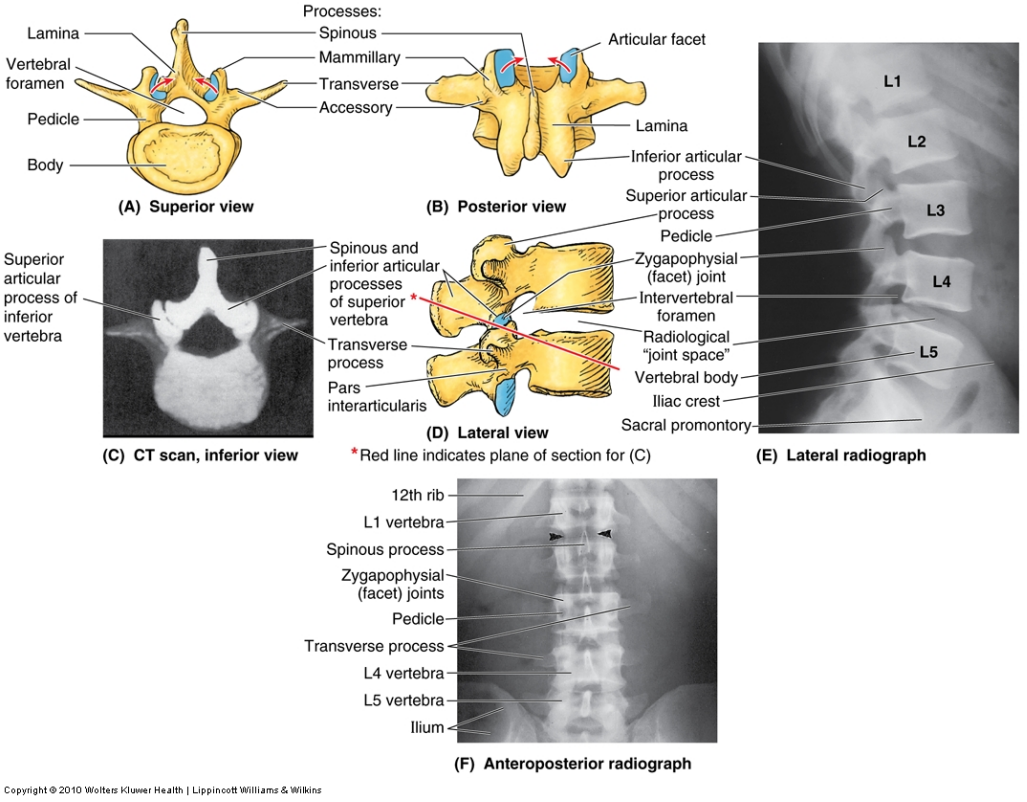
Lumbar IVF

- IVF become narrower from L1 to L5
- Spinal nerves become larger from L1 to L5
- Increase the chance of nerve encroachment in the lower vertebrae due to IVF stenosis



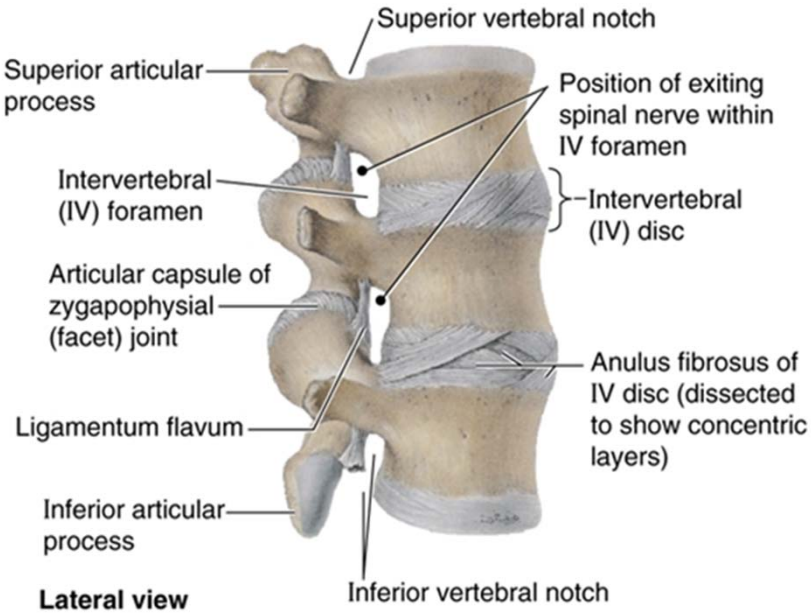
Lumbar IVD

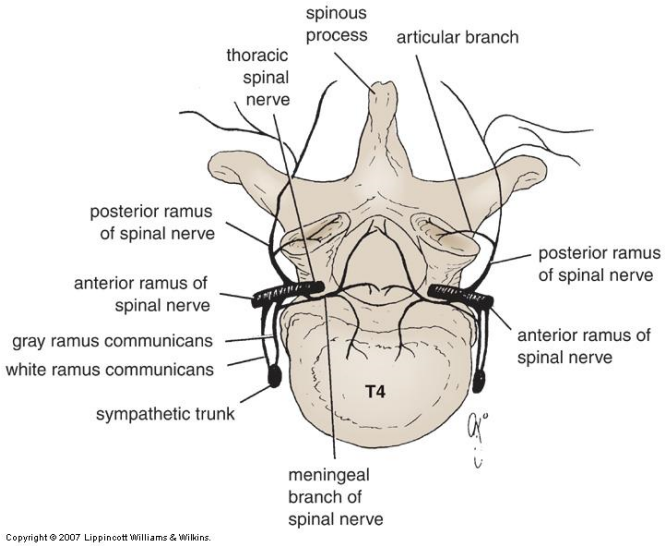
- Lumbar IVD are thicker compared with other regions
- Relative thickness of lumbar and cervical IVDs to the vertebral bodies are higher than thoracic ones
- Lumbar IVDs are thicker anteriorly to cope with the curvature
- Nucleus pulposus is more posteriorly located from the center
  - Posterior part of the annulus fibrosus is weaker
  - Herniation of IVD is mostly posterolateral
    - Mostly affected IVD between L4-L5 or L5-S1



Joints of Vertebral Arches

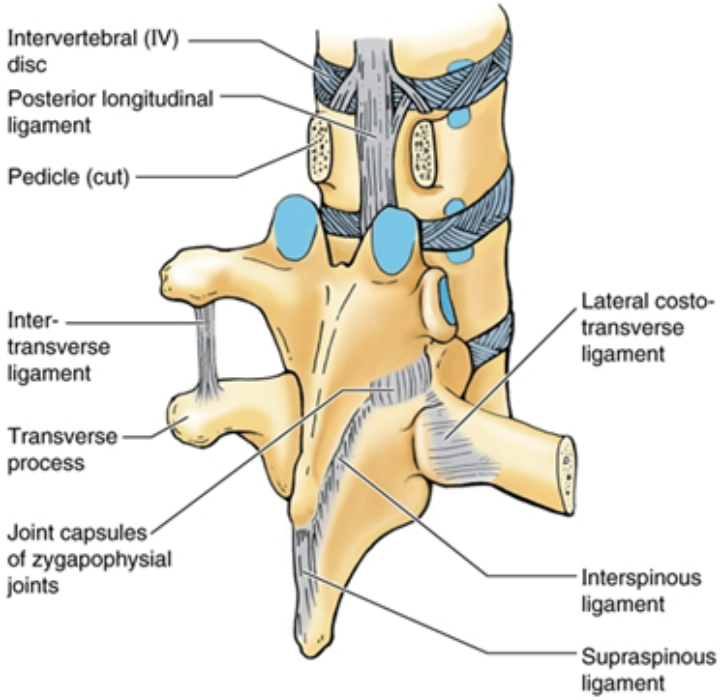
- Also called zygapophysial joints
- Plane synovial joint between the superior & inferior articular processes
  - Articular facets
  - Capsular ligament
- Nerve supply: articular branches from posterior rami of the spinal nerves

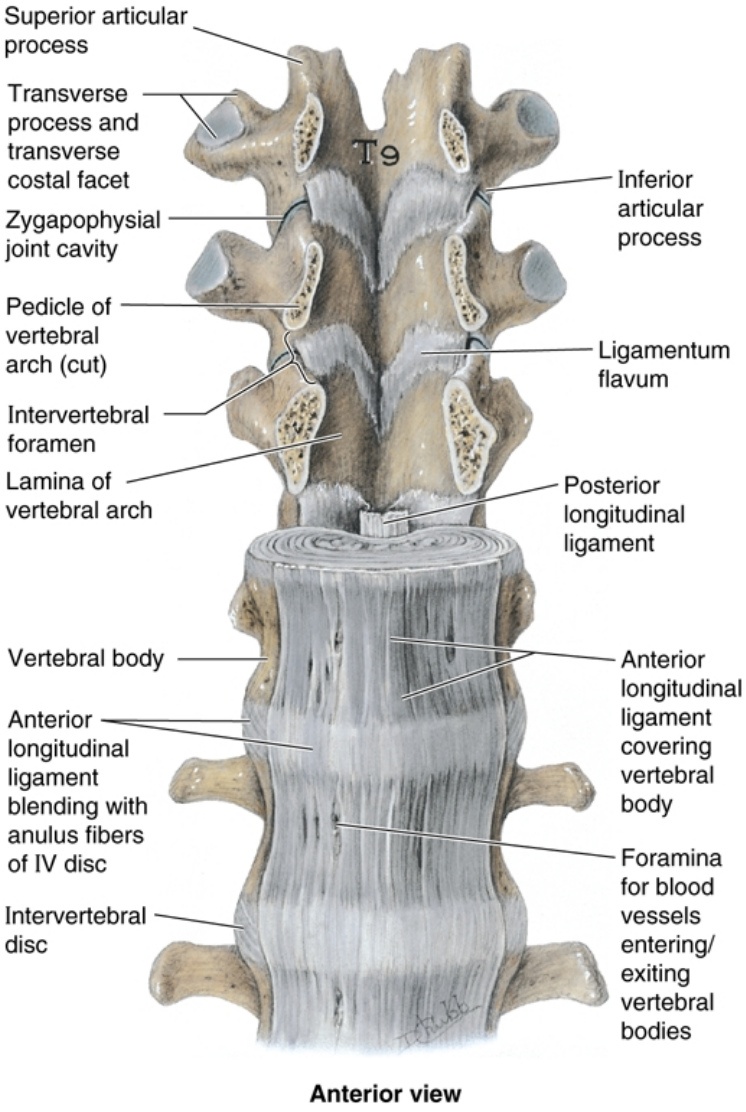




Joints of Vertebral Arches

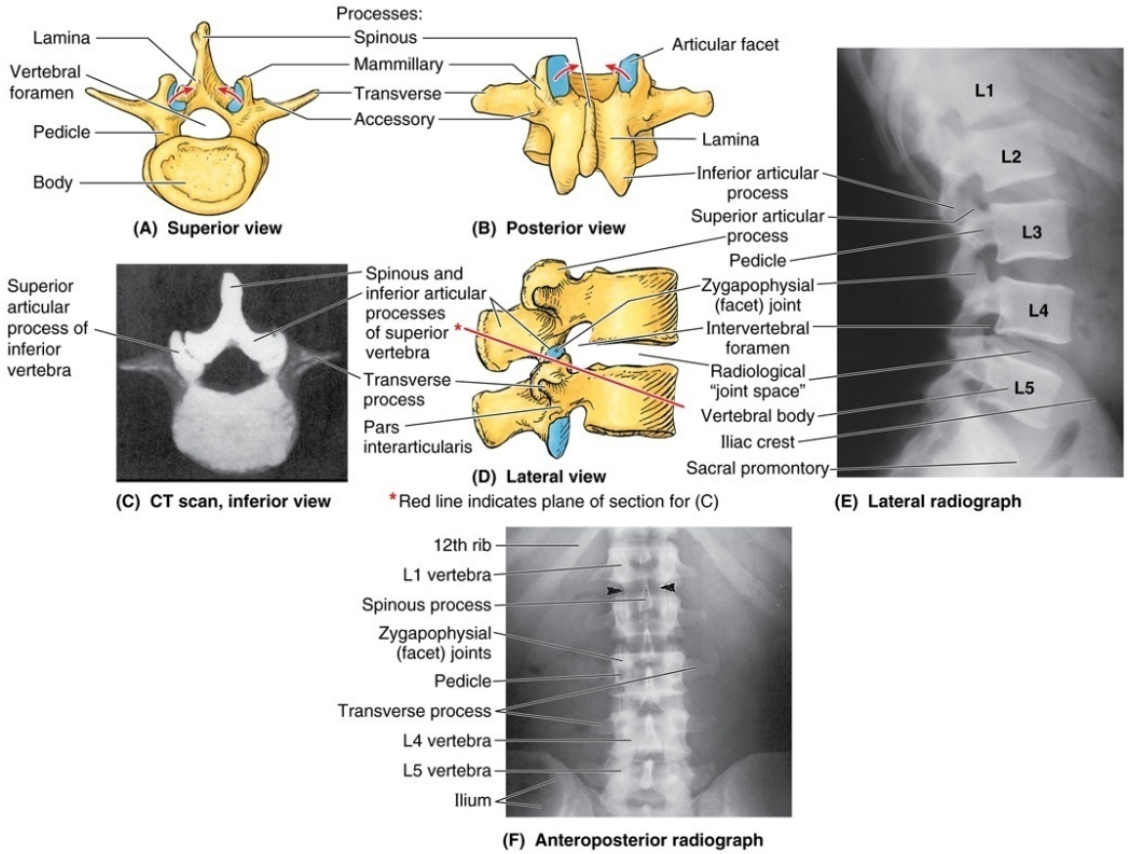
- Ligaments
  - Supraspinous ligament (Between tips of spines)
  - Interspinous ligament (Between spines)
  - Intertransverse ligaments (Between transverse) processes
  - Ligamentum flavum (Between laminae)





Lumbar Zygapophysial Joints

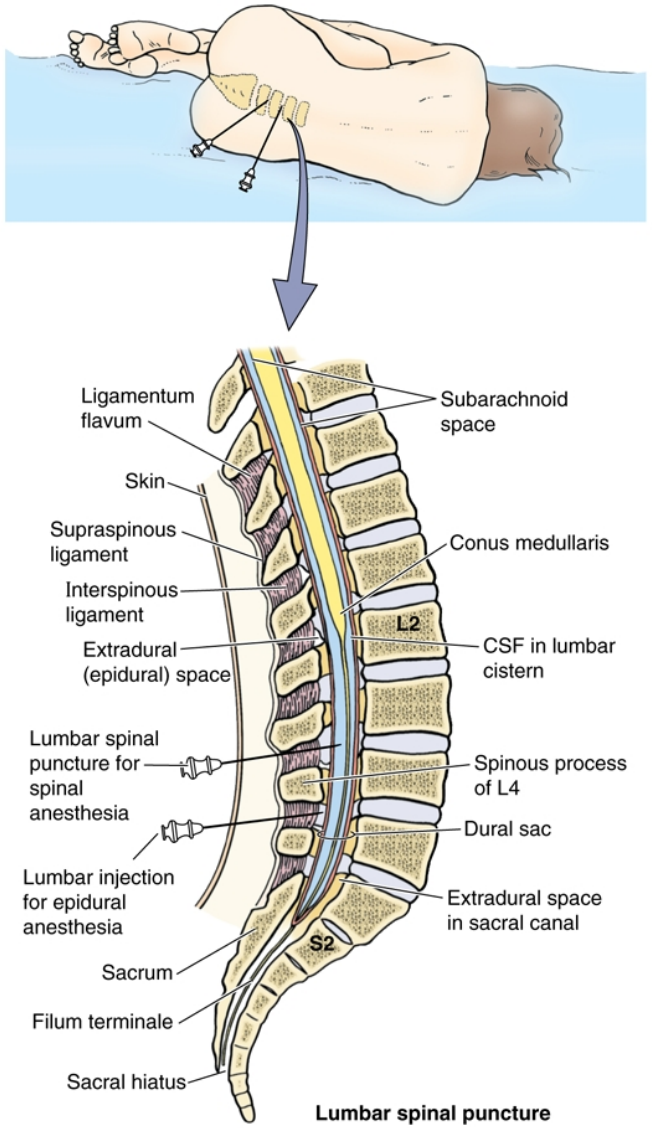
- Superior articular processes face medially
  - Rotate medially with successive vertebrae until it faces posteriorly
- T12-L1 Zygapophysial Joints are sagittally oriented
- L5-S1 Zygapophysial Joints are coronally oriented



Lumbar Puncture

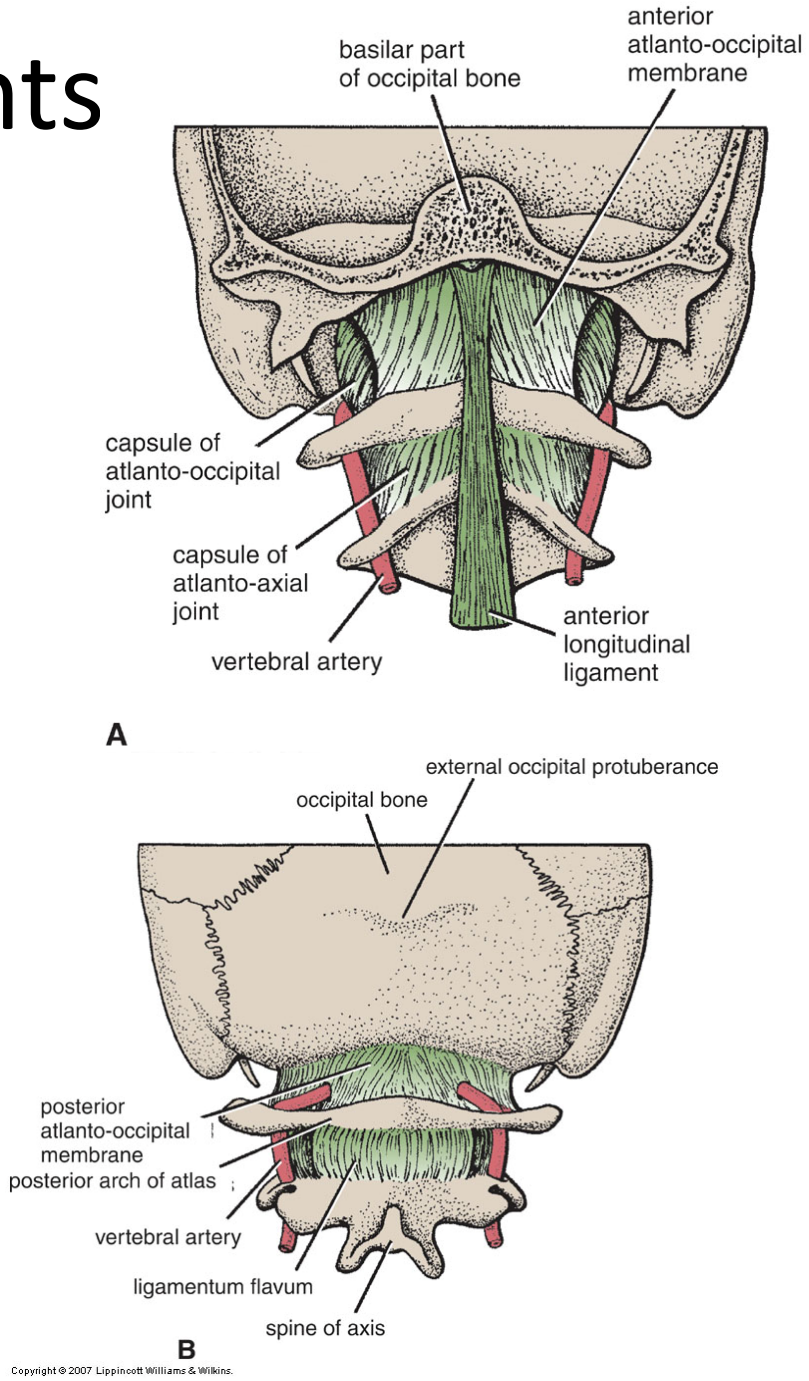
- Lumbar puncture is used to withdraw CSF for diagnostic purposes
- LP performed from lumbar cistern to avoid the damage to the spinal cord
- LP approached mostly in L3-L4 or L4-L5

- Epidural anesthesia
  - Target the epidural space
  - Same approach as LP
  - Could be approached from the sacral hiatus



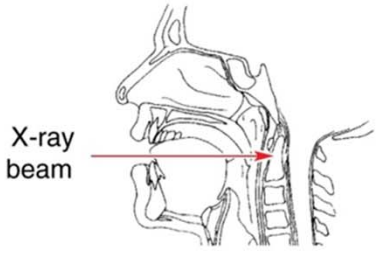
Atlanto-Occipital Joints

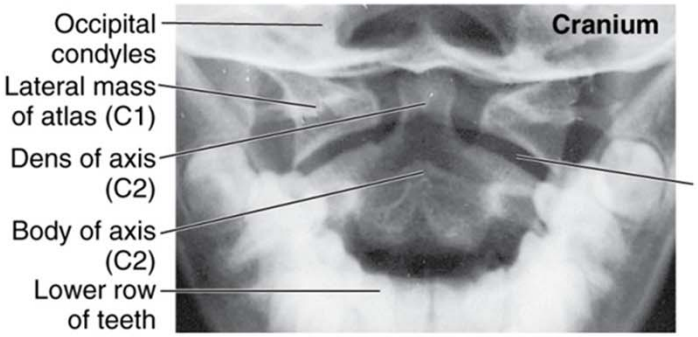
- Between occipital condyles and lateral masses of atlas
- Synovial joints
- Flexion & extension
- Ligaments
  - Anterior atlanto-occipital membrane
    - Continuation of anterior longitudinal ligament
    - Between anterior arch of atlas & margin of foramen magnum
  - Posterior atlanto-occipital membrane
    - Connects posterior arch with the margin of foramen magnum



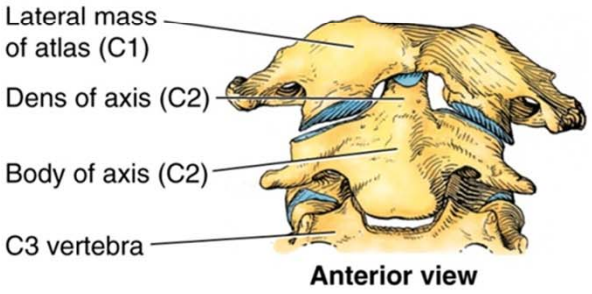
Atlanto-Axial Joints

- Three synovial joints
  - Between the dens of axis & anterior arch
  - Between the lateral masses
- Rotation movement



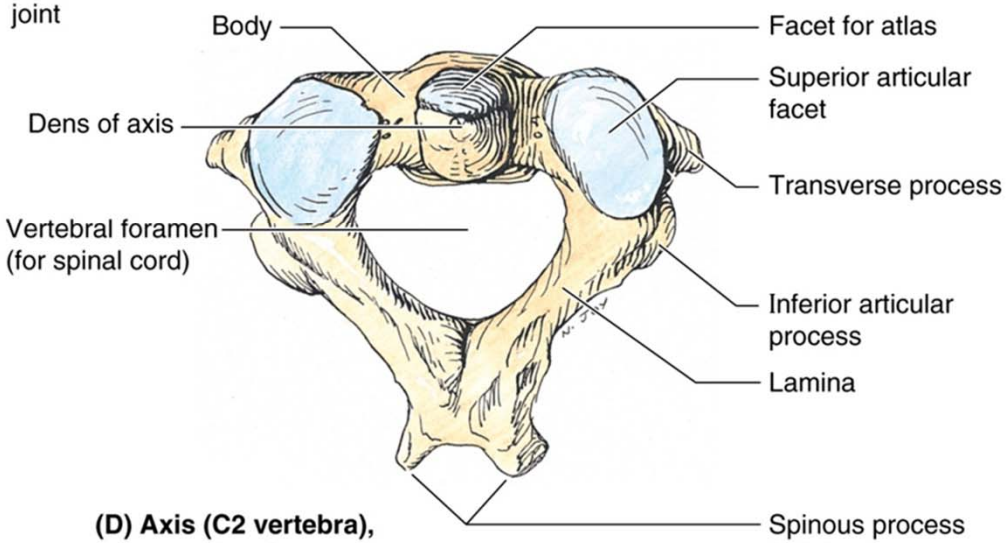


Anteroposterior radiograph of C1 and C2 (taken through open mouth)



Anterior view

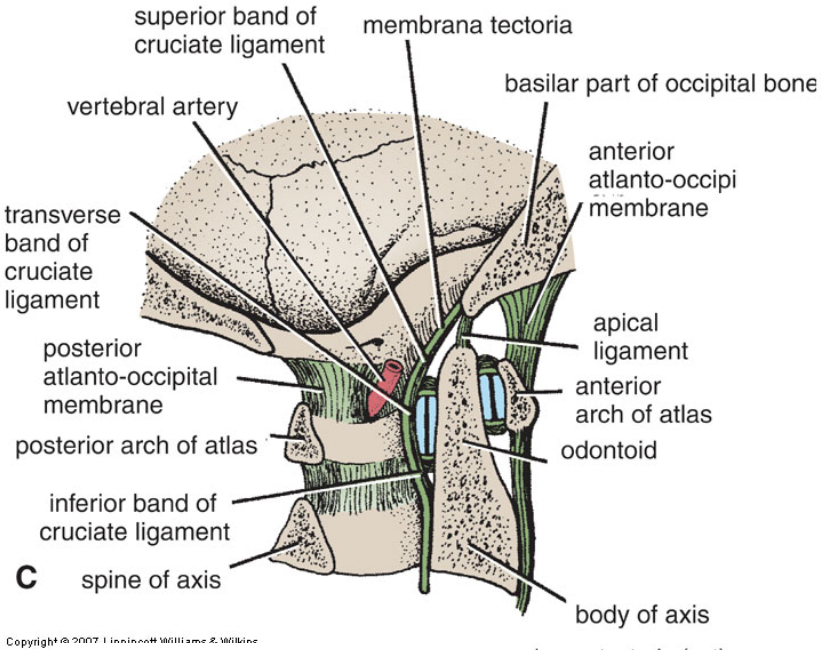
(E) Articulating atlas and axis (C1 and C2 vertebra) as viewed radiographically

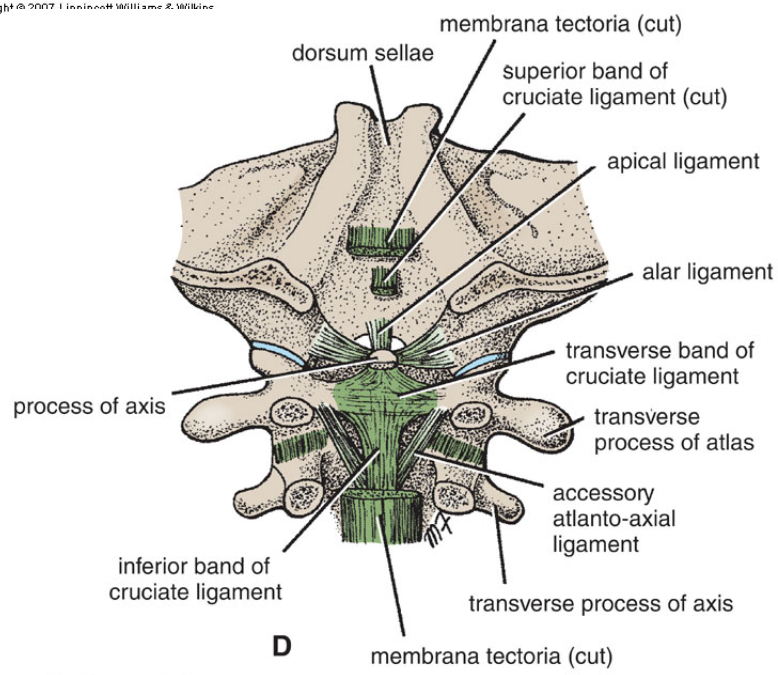


(D) Axis (C2 vertebra), superior view

Atlanto-Axial Joints

- Ligaments
  - Apical ligament
    - Between apex of dens & margin of foramen magnum
  - Alar ligament
    - Lateral to the apical ligament
    - Between dens & occipital condyles
  - Cruciate ligament
    - Transverse band
      - Connects the lateral masses of atlas
    - Vertical band
      - Between the body of axis (posteriorly) to the margin of foramen magnum (anteriorly)
  - Membrana tectoria
    - Continuation of the posterior longitudinal ligament
    - Posterior to dens of axis & apical, alar, & cruciate ligaments



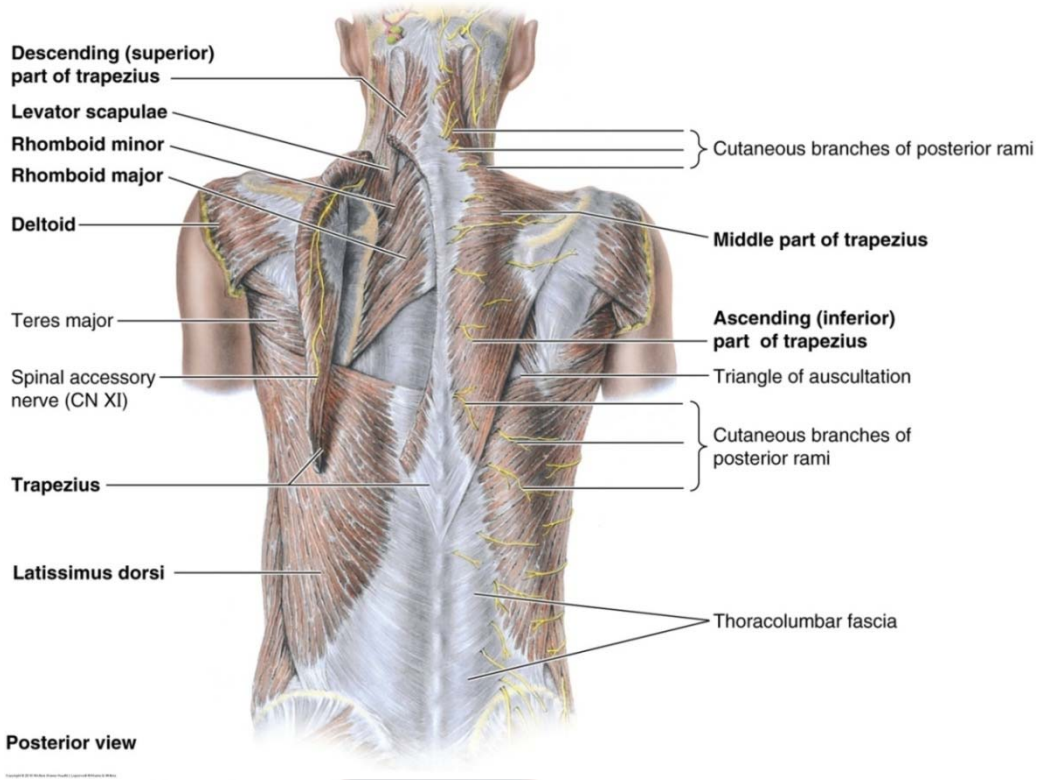


Vertebral Column

Muscles

Extrinsic Back Muscles

- Superficial layer
  - ➢ Axioappendicular mm.
  - – Trapezius m.
  - – Latissimus dorsi m.
  - – Levator scapulae m.
  - – Rhomboids mm.
- Intermediate layer
  - ➢ Respiratory muscles
  - – Serratus posterior superior m.
    - Deep to rhomboids
    - Nerve supply: 1-4 intercostal nerves
  - – Serratus posterior inferior m.
    - Deep to latissmus dorsi
    - Nerve supply: last 4 intercostal nerves



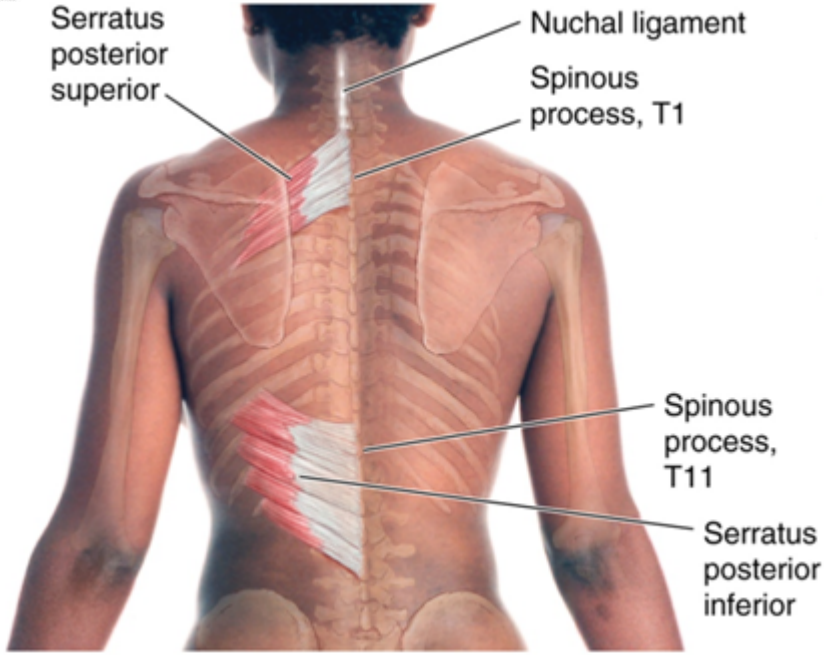


Table 13-10 Muscles Connecting the Upper Limb to the Vertebral Column

Muscle	Origin	Insertion	Nerve Supply	Nerve Roots[a]	Action
Trapezius	Occipital bone, ligamentum nuchae, spine of seventh cervical vertebra, spines of all thoracic vertebrae	Upper fibers into lateral third of clavicle; middle and lower fibers into acromion and spine of scapula	Spinal part of accessory nerve (motor) and C3 and 4 (sensory)	XI **cranial nerve** (spinal part)	Upper fibers elevate the scapula; middle fibers pull scapula medially; lower fibers pull medial border of scapula downward
Latissimus dorsi	Iliac crest, lumbar fascia, spines of lower six thoracic vertebrae, lower three or four ribs, and inferior angle of scapula	Floor of bicipital groove of humerus	Thoracodorsal nerve	C6, **7**, 8,	Extends, adducts, and medially rotates the arm
Levator scapulae	Transverse processes of first four cervical vertebrae	Medial border of scapula	C3 and 4 and dorsal scapular nerve	C3, 4, 5	Raises medial border of scapula
Rhomboid minor	Ligamentum nuchae and spines of seventh cervical and first thoracic vertebrae	Medial border of scapula	Dorsal scapular nerve	**C4,** 5	Raises medial border of scapula upward and medially
Rhomboid major	Second to fifth thoracic spines	Medial border of scapula	Dorsal scapular nerve	**C4**, 5	Raises medial border of scapula upward and medially

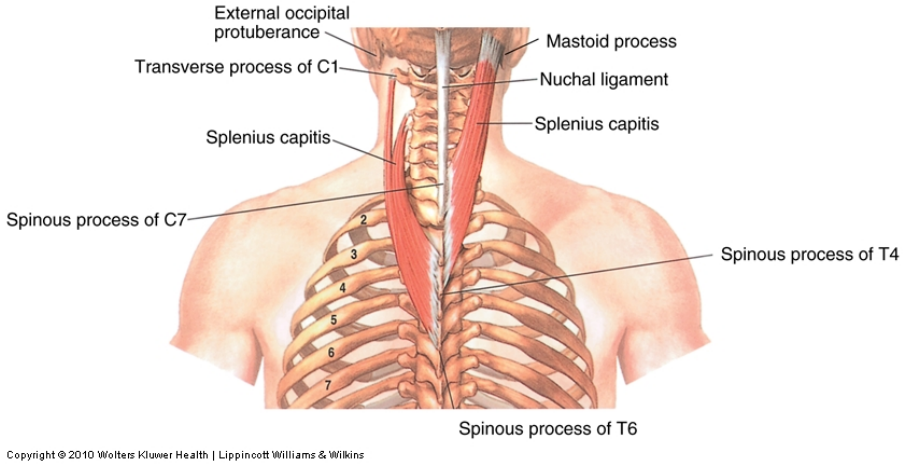
[a]The predominant nerve root supply is indicated by boldface type.
From Snell RS: Clinical Anatomy. 7th Ed. Philadelphia: Lippincott Williams & Wilkins, 2004, p. 499.

Table 13-4 **Muscles of the Thorax**

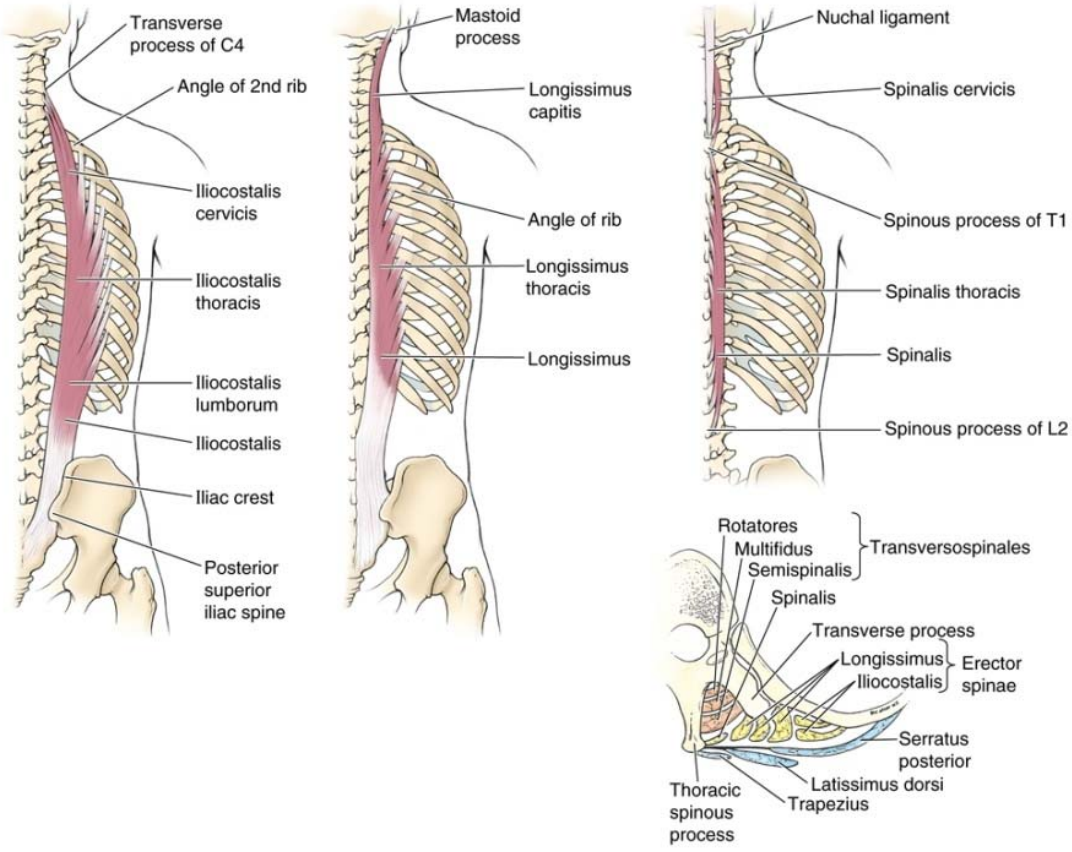
Name of Muscle	Origin	Insertion	Nerve Supply	Action
Serratus posterior superior	Lower cervical and upper thoracic spines	Upper ribs	Intercostal nerves	Raises ribs and therefore inspiratory muscles
Serratus posterior inferior	Upper lumbar and lower thoracic spines	Lower ribs	Intercostal nerves	Depresses ribs and therefore expiratory muscles

From Snell RS: Clinical Anatomy. 7th Ed. Philadelphia: Lippincott Williams & Wilkins, 2004, p. 68.

Intrinsic (Deep) Back Muscles



- Nerve supply: posterior rami of spinal nerves
- Control movements of vertebral column and maintain posture
- Three layers
  - Superficial
  - Intermediate
  - Deep



Intrinsic (Deep) Back Muscles

- Superficial layer
  - Splenius mm.
    - Splenius cervicis m.
    - Splenius capitis m.

➢ extend the head and neck, and laterally flex and rotate the head

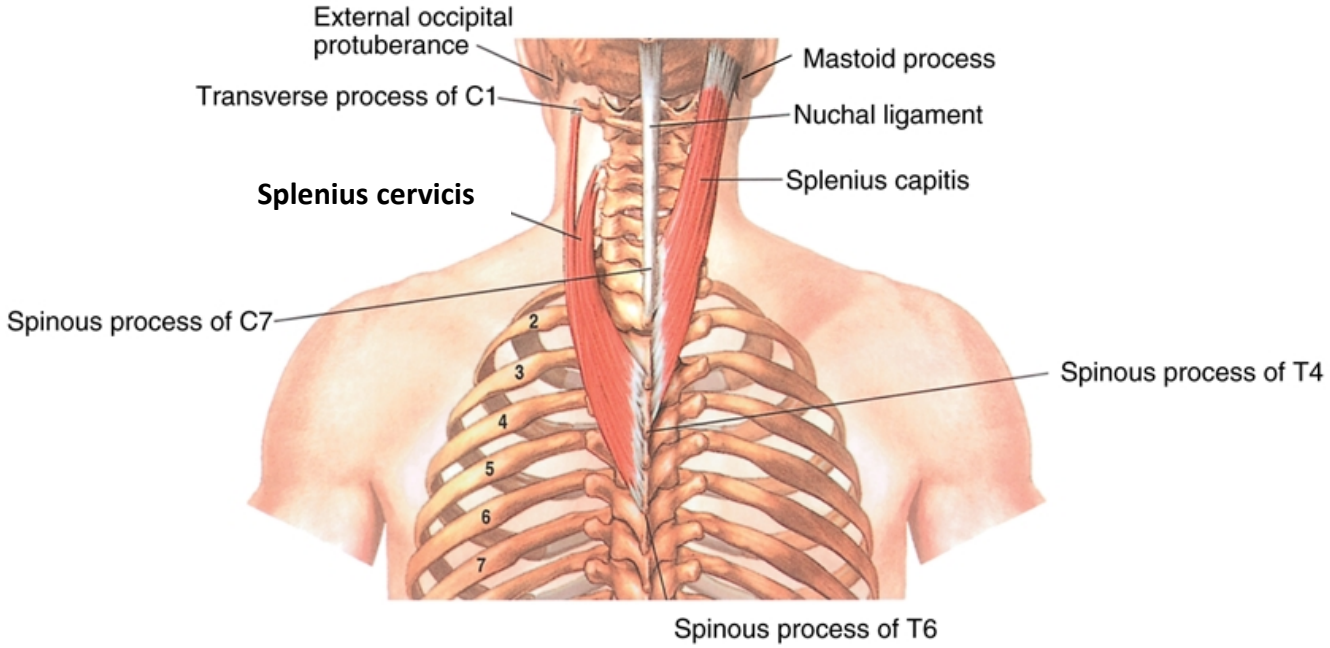
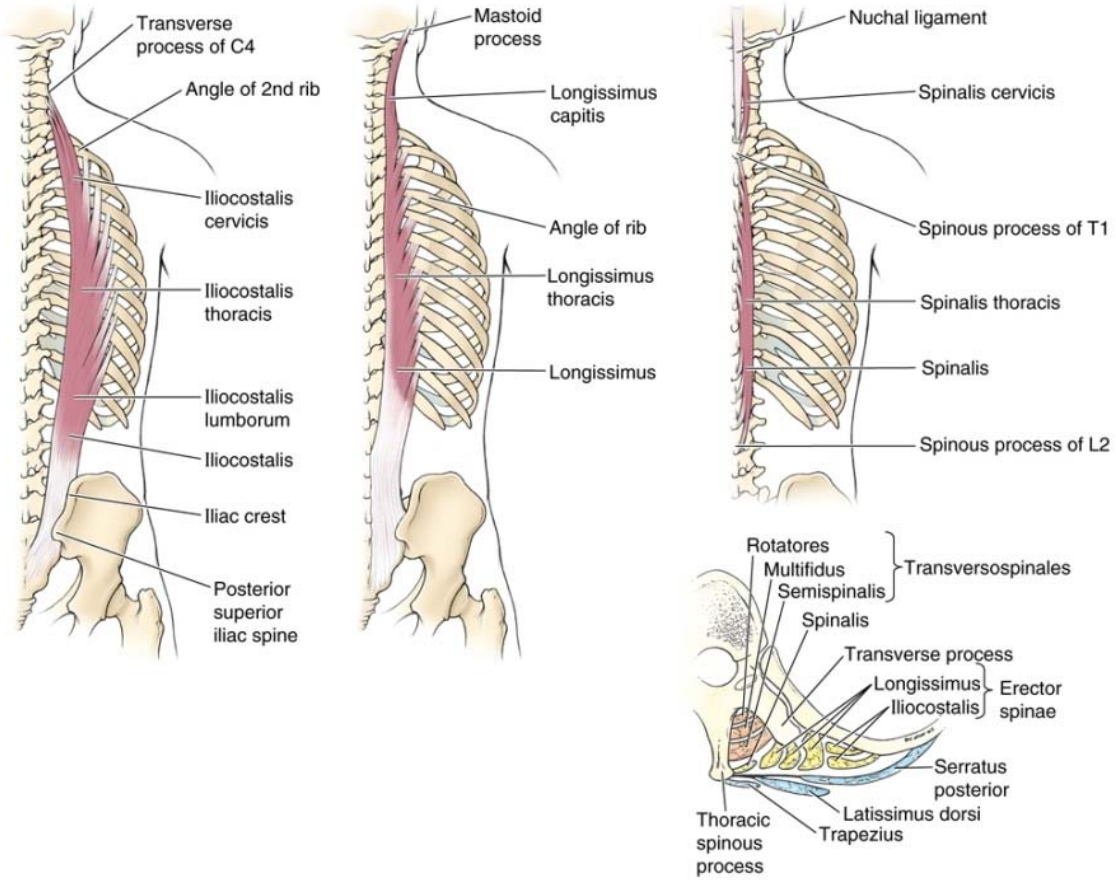


TABLE 4.4. SUPERFICIAL LAYER OF INTRINSIC BACK MUSCLES

Muscle	Proximal Attachment	Distal Attachment	Nerve Supply	Main Action(s)
Splenius	Nuchal ligament and spinous processes of C7–T3 or T4 vertebrae	*Splenius capitis:* fibers run superolaterally to mastoid process of temporal bone and lateral third of superior nuchal line of occipital bone *Splenius cervicis:* tubercles of transverse processes of C1–C3 or C4 vertebrae	Posterior rami of spinal nerves	*Acting alone:* laterally flex neck and rotate head to side of active muscles *Acting together:* extend head and neck

Intrinsic (Deep) Back Muscles

- Intermediate layer
  - Errector spinae mm.
    - Iliocostalis (lateral column)
    - Longissimus (intermediate column)
    - Spinalis (medial column)
  - ➢ Run longitudinally
  - ➢ Major extensor of the vertebral column



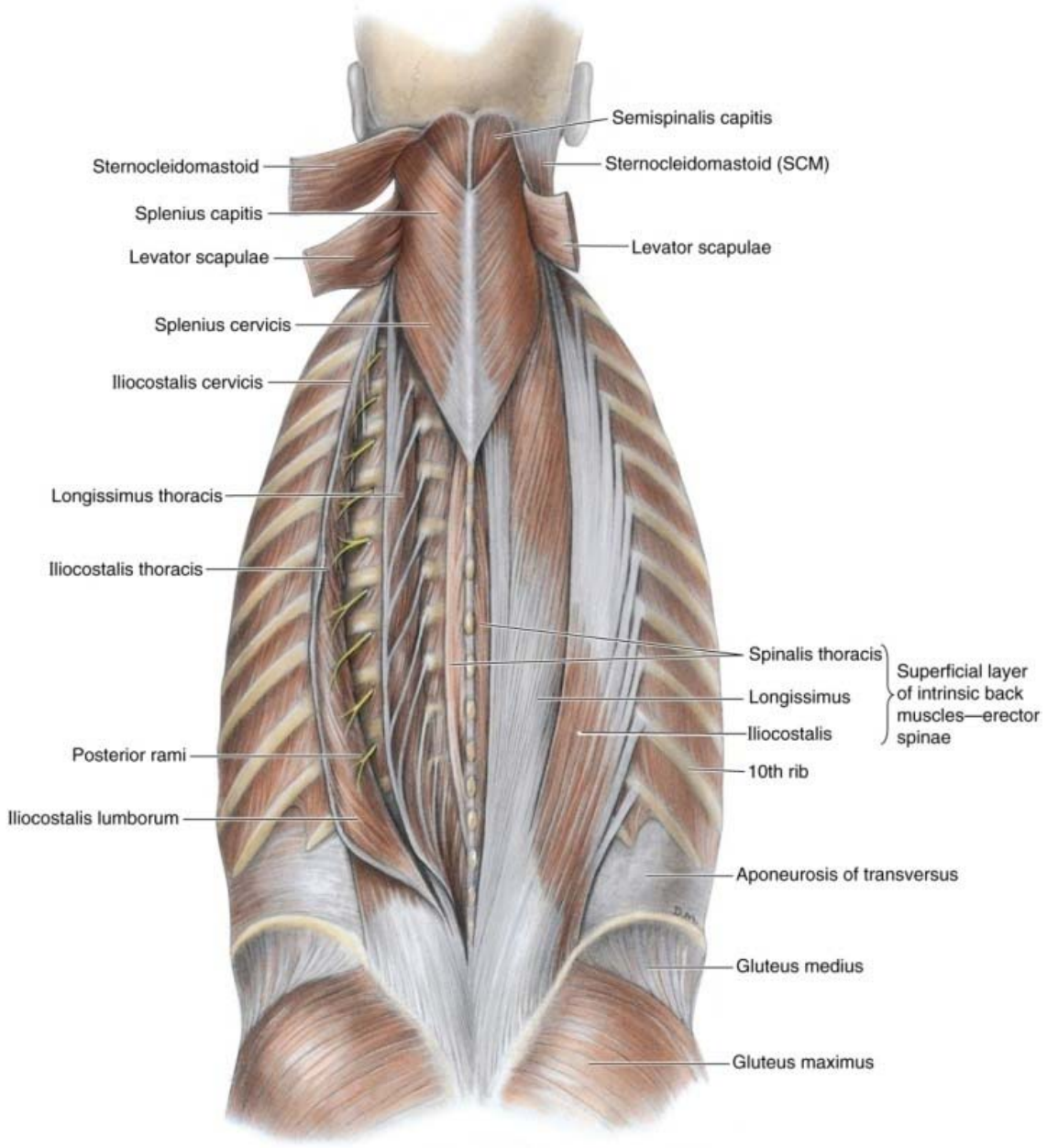
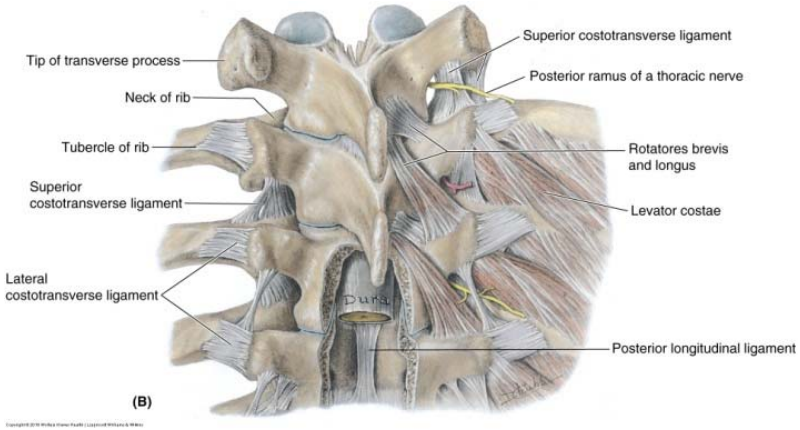

Semispinalis capitis
Sternocleidomastoid
Sternocleidomastoid (SCM)
Splenius capitis
Levator scapulae
Levator scapulae
Splenius cervicis
Iliocostalis cervicis
Longissimus thoracis
Iliocostalis thoracis
Spinalis thoracis
Longissimus
Iliocostalis
Superficial layer of intrinsic back muscles—erector spinae
Posterior rami
10th rib
Iliocostalis lumborum
Aponeurosis of transversus
Gluteus medius
Gluteus maximus

TABLE 4.5. INTERMEDIATE LAYER OF INTRINSIC BACK MUSCLES

Muscle	Proximal Attachment	Distal Attachment	Nerve Supply	Main Action(s)
Erector spinae Iliocostalis Longissimus Spinalis	Arises by a broad tendon from posterior part of iliac crest, posterior surface of sacrum, sacroiliac ligaments, sacral and inferior lumbar spinous processes, and supraspinous ligament	*Iliocostalis:* lumborum, thoracis, cervicis; fibers run superiorly to angles of lower ribs and cervical transverse processes *Longissimus:* thoracis, cervicis, capitis; fibers run superiorly to ribs between tubercles and angles to transverse processes in thoracic and cervical regions, and to mastoid process of temporal bone *Spinalis:* thoracis, cervicis, capitis; fibers run superiorly to spinous processes in the upper thoracic region and to cranium	Posterior rami of spinal nerves	*Acting bilaterally:* extend vertebral column and head; as back is flexed, control movement via eccentric contraction *Acting unilaterally:* laterally flex vertebral column

Intrinsic (Deep) Back Muscles

- Deep layer
  - Transversospinalis muscle group
    - Run from transverse process to spine of vertebrae above
    - Help rotate and extend vertebrae
    - Semispinalis
      - Semispinalis capitis, thoracis, and cervicis
    - Multifidus
    - Rotators
  - Deepest mm.: Interspinales, intertransversarii, levators costorum



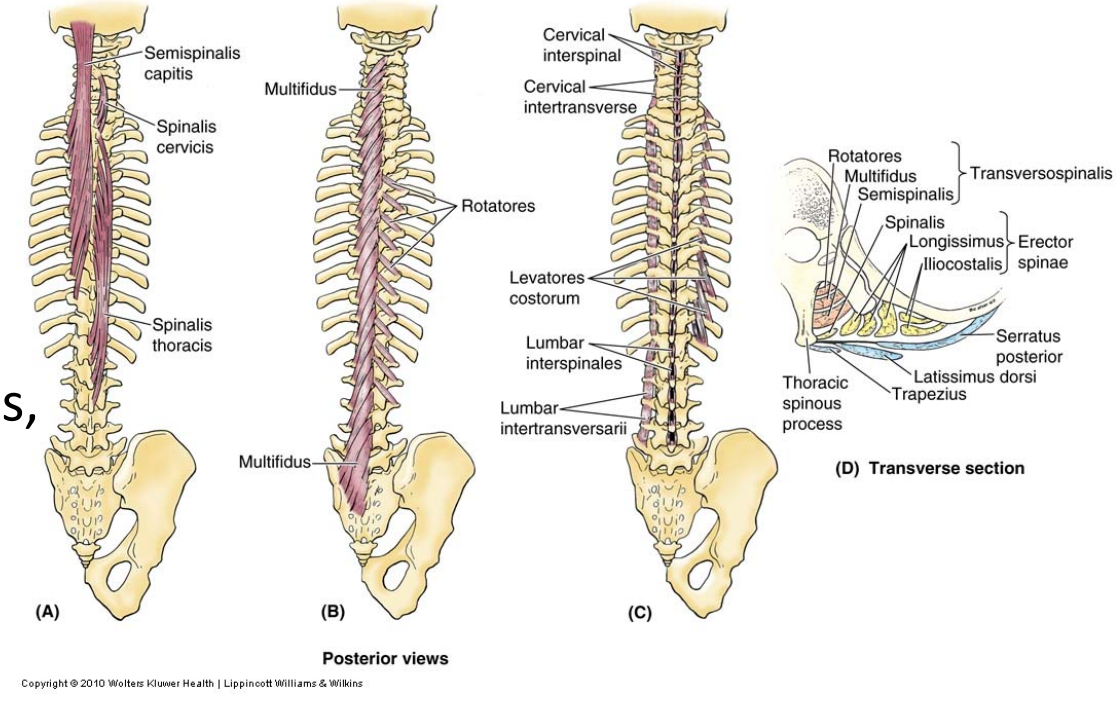


TABLE 4.6. DEEP LAYERS OF INTRINSIC BACK MUSCLES

Muscle	Proximal Attachment	Distal Attachment	Nerve Supply	Main Action(s)
Deep layer				
Transversospinalis Semispinalis Multifidus Rotatores (brevis and longus)	Transverse processes *Semispinalis:* arises from transverse processes of C4–T12 vertebrae *Multifidus:* arises from posterior sacrum, posterior superior iliac spine of ilium, aponeurosis of erector spinae, sacroiliac ligaments, mammillary processes of lumbar vertebrae, transverse processes of T1–T3, articular processes of C4–C7 *Rotatores:* arise from transverse processes of vertebrae; best developed in thoracic region	Spinous processes of more superior vertebrae *Semispinalis:* thoracis, cervicis, capitis; fibers run superomedially to occipital bone and spinous processes in thoracic and cervical regions, spanning 4–6 segments *Multifidus:* thickest in lumbar region; fibers pass obliquely superomedially to entire length of spinous processes, located 2–4 segments superior to proximal attachment *Rotatores:* fibers pass superomedially to attach to junction of lamina and transverse process or spinous process of vertebra immediately (brevis) or 2 segments (longus) superior to vertebra of attachment	Posterior rami of spinal nerves[a]	Extension *Semispinalis:* extends head and thoracic and cervical regions of vertebral column and rotates them contralaterally *Multifidus:* stabilizes vertebrae during local movements of vertebral column *Rotatores:* stabilize vertebrae and assist with local extension and rotatory movements of vertebral column; may function as organs of proprioception
Minor deep layer				
Interspinales	Superior surfaces of spinous processes of cervical and lumbar vertebrae	Inferior surfaces of spinous processes of vertebra superior to vertebra of proximal attachment	Posterior rami of spinal nerves	Aid in extension and rotation of vertebral column
Intertransversarii	Transverse processes of cervical and lumbar vertebrae	Transverse processes of adjacent vertebrae	Posterior and anterior rami of spinal nerves[a]	Aid in lateral flexion of vertebral column; acting bilaterally, stabilize vertebral column
Levatores costarum	Tips of transverse processes of C7 and T1–T11 vertebrae	Pass inferolaterally and insert on rib between tubercle and angle	Posterior rami of C8–T11 spinal nerves	Elevate ribs, assisting respiration; assist with lateral flexion of vertebral column

[a]Most back muscles are innervated by posterior rami of spinal nerves, but a few are innervated by anterior rami. Anterior intertransverse muscles of the cervical region are supplied by anterior rami.