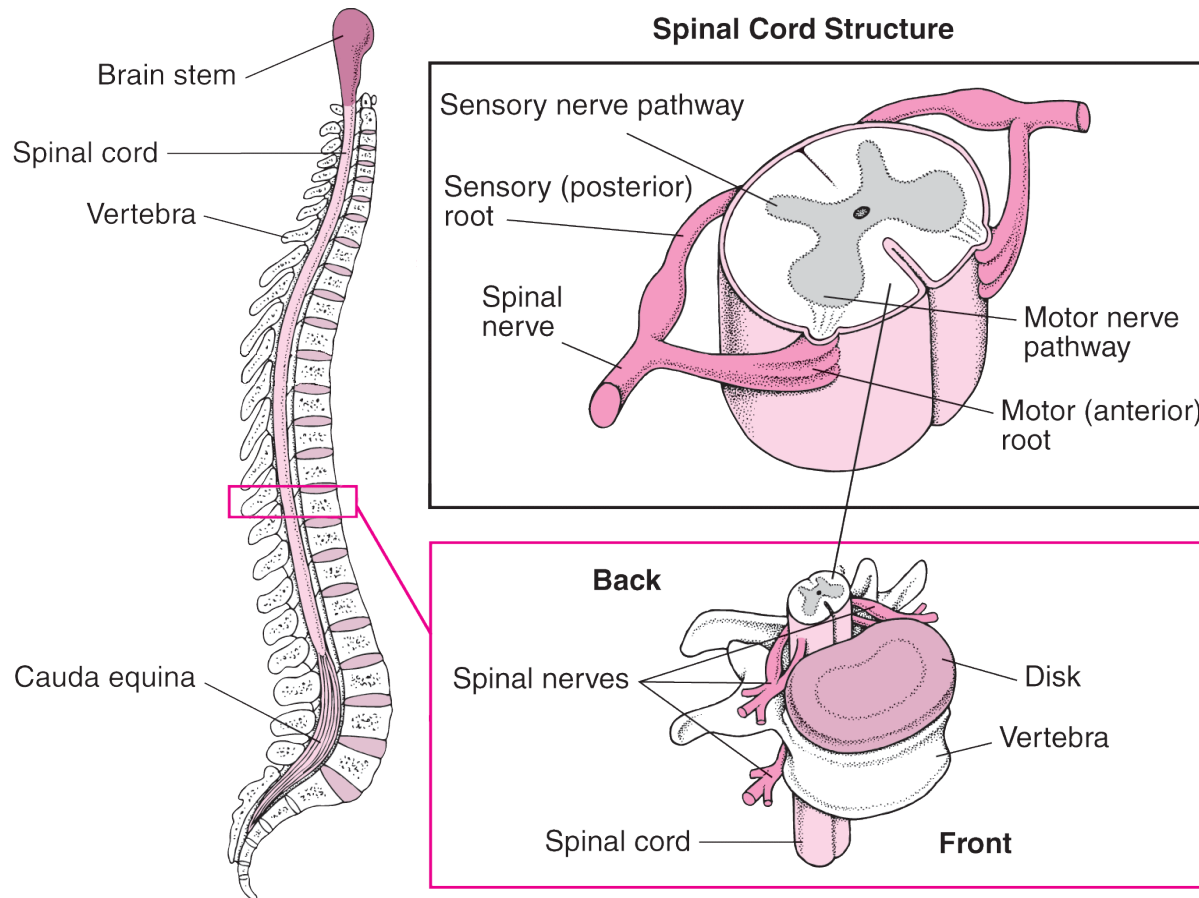


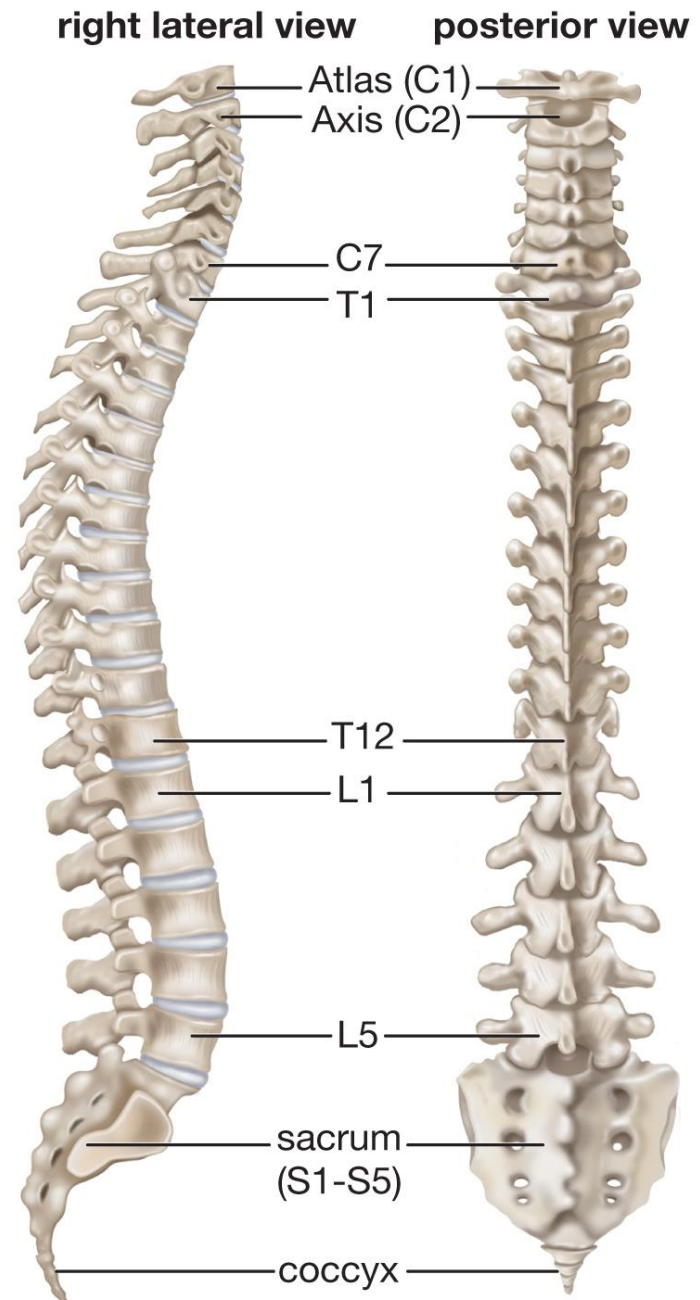
Spinal Cord - 1



Dr. Shantanu Mallick MD

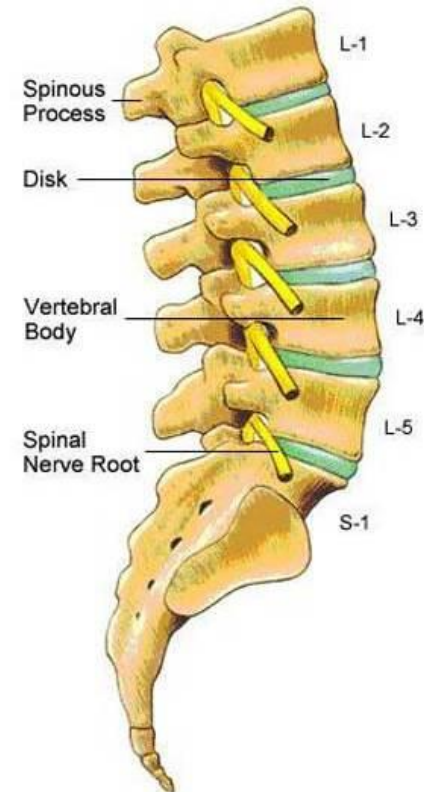
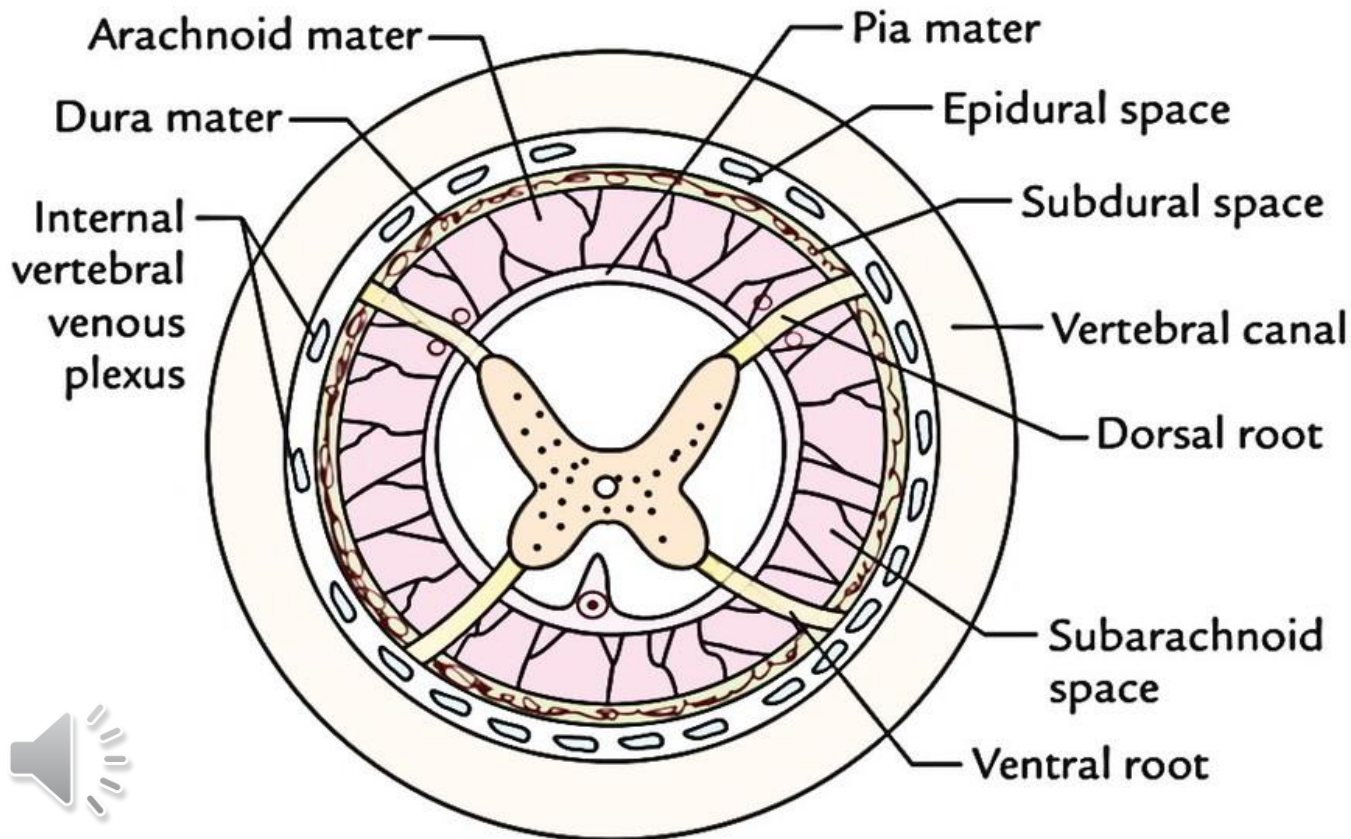
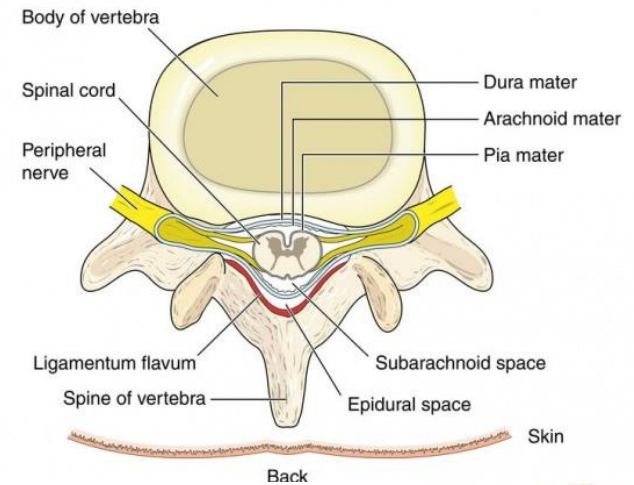
Vertebral canal

- Vertebral canal is an elongated cavity inside the vertebral column
- Vertebral column consists of 33 segments/vertebrae
 - 7 cervical
 - 12 thoracic
 - 5 lumbar
 - 5 sacral
 - 4 coccygeal
- Vertebral canal is continuous above with cranial cavity and below with sacral canal



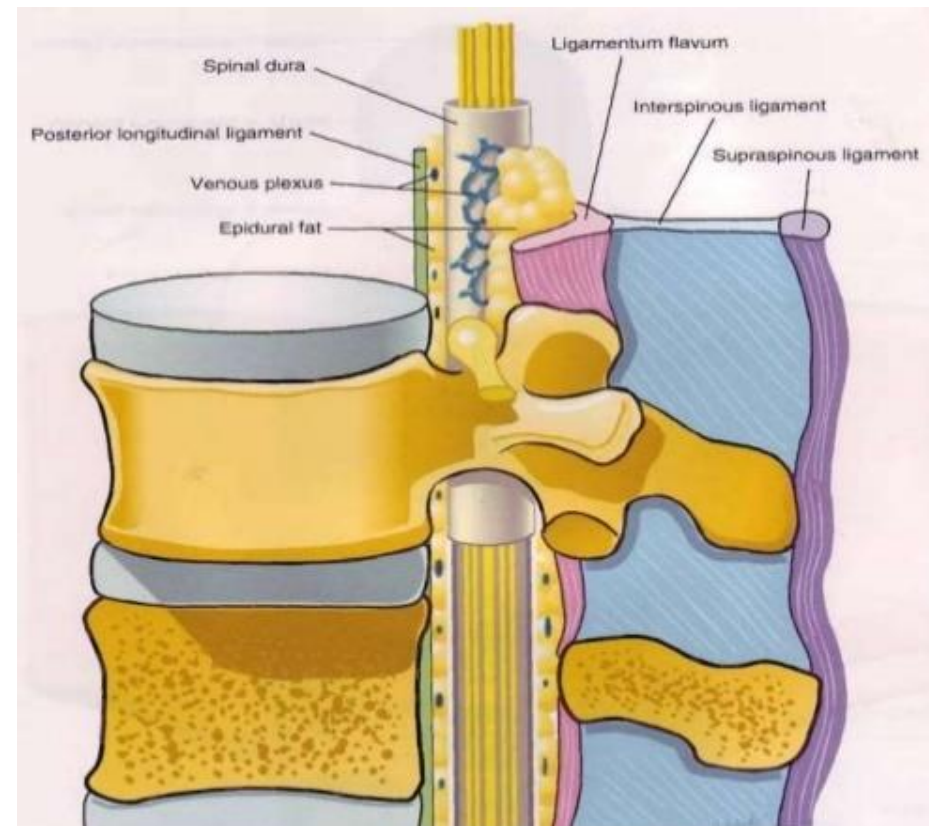
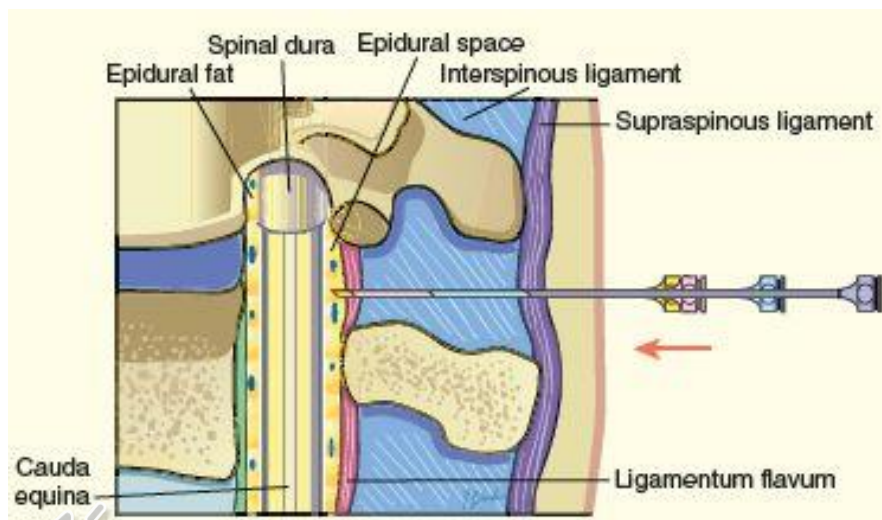
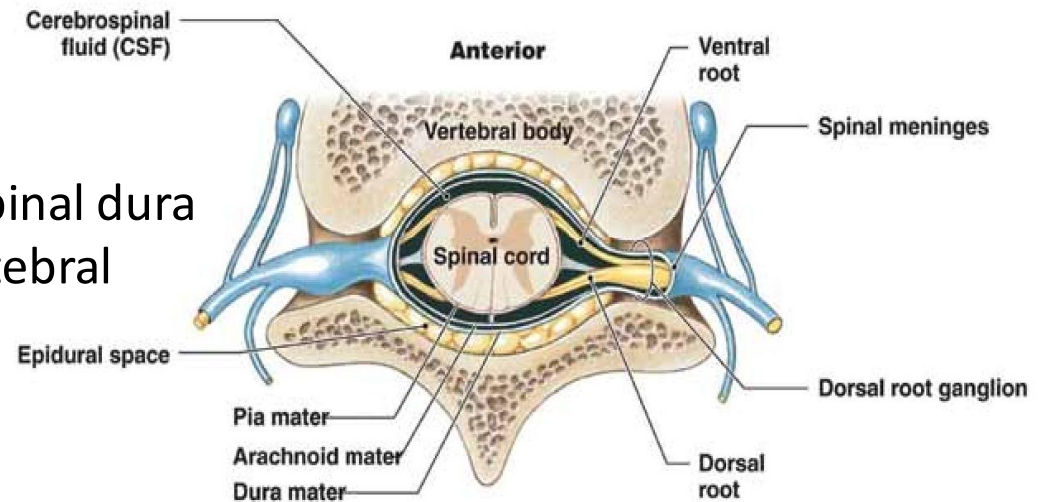
Contents of vertebral canal

- Epidural space
- Spinal meninges
- Spinal cord with its nerve roots



Epidural space

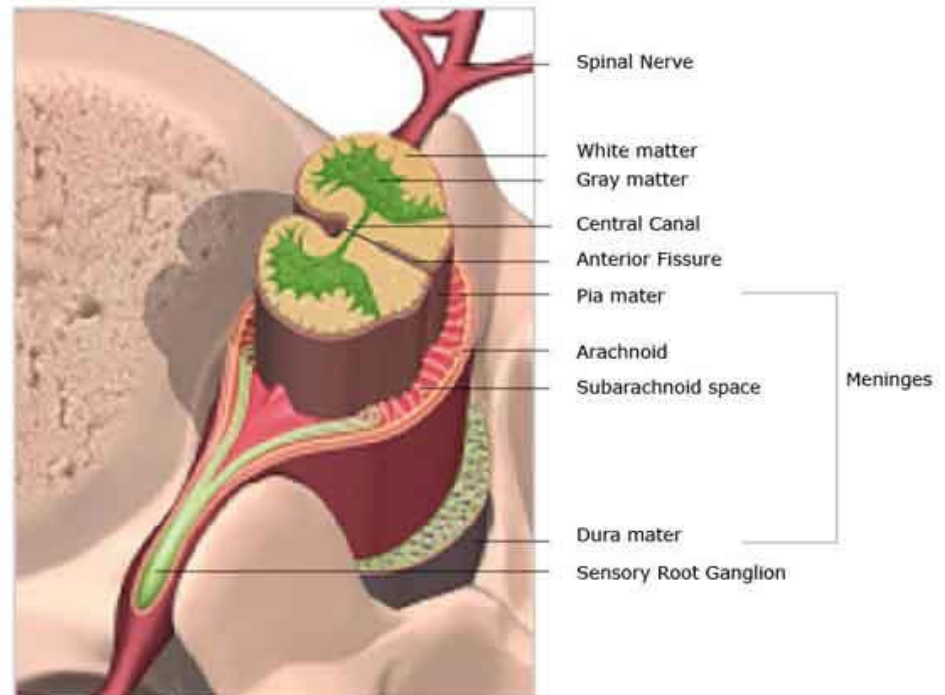
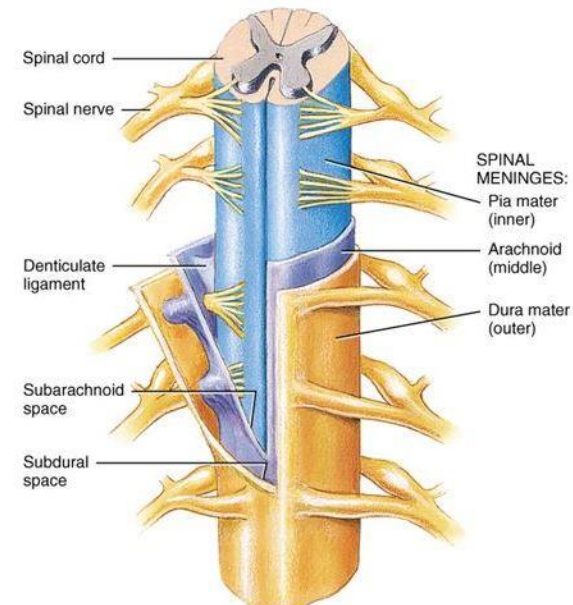
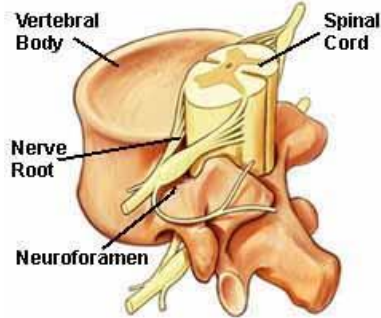
- Epidural space lies between the spinal dura and the periosteum lining the vertebral canal.
- It is filled with
 - *loose areolar tissue*
 - *minute spinal arteries*
 - *internal vertebral venous plexus.*



Epidural Anesthesia / Analgesia

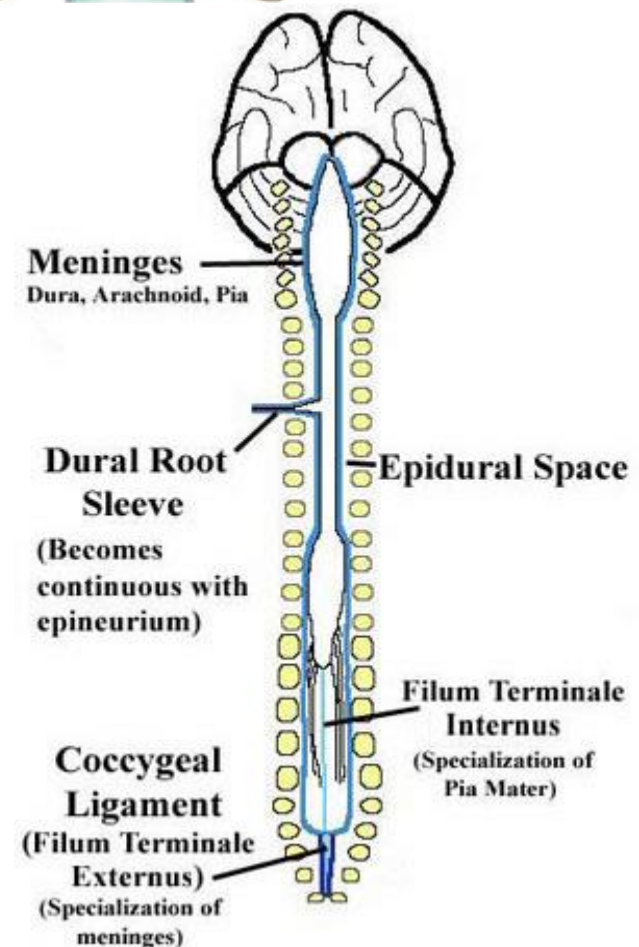
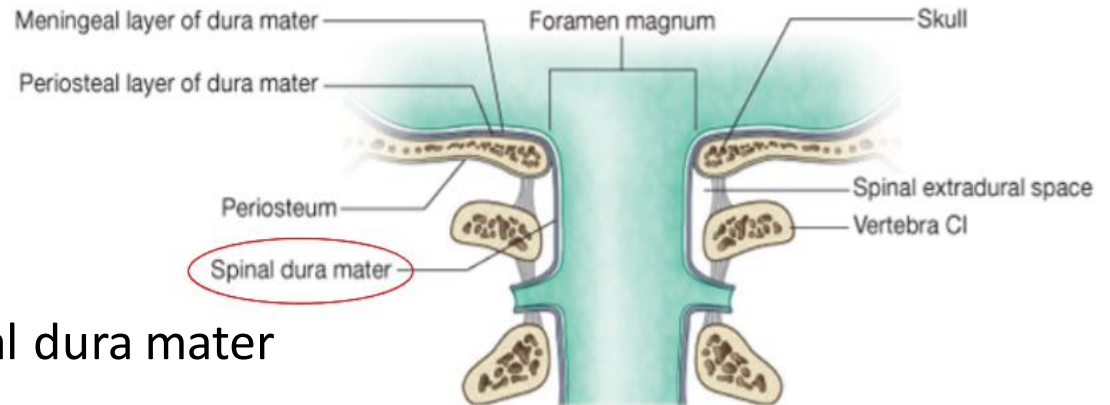
Spinal meninges

- Spinal cord is surrounded by three coverings called meninges:
 - Spinal **dura mater**
(Latin: Mater means Mother)
 - Spinal **arachnoid mater**
 - Spinal **pia mater**
- The potential space between the dura and arachnoid mater is termed as **subdural space**
- The space between the arachnoid mater and pia mater is known as **subarachnoid space**



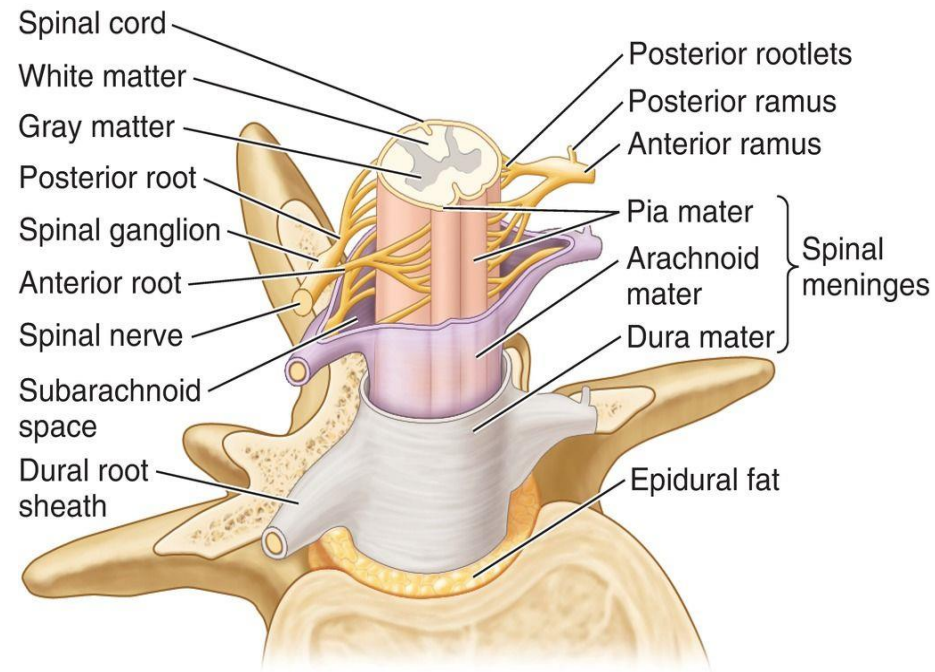
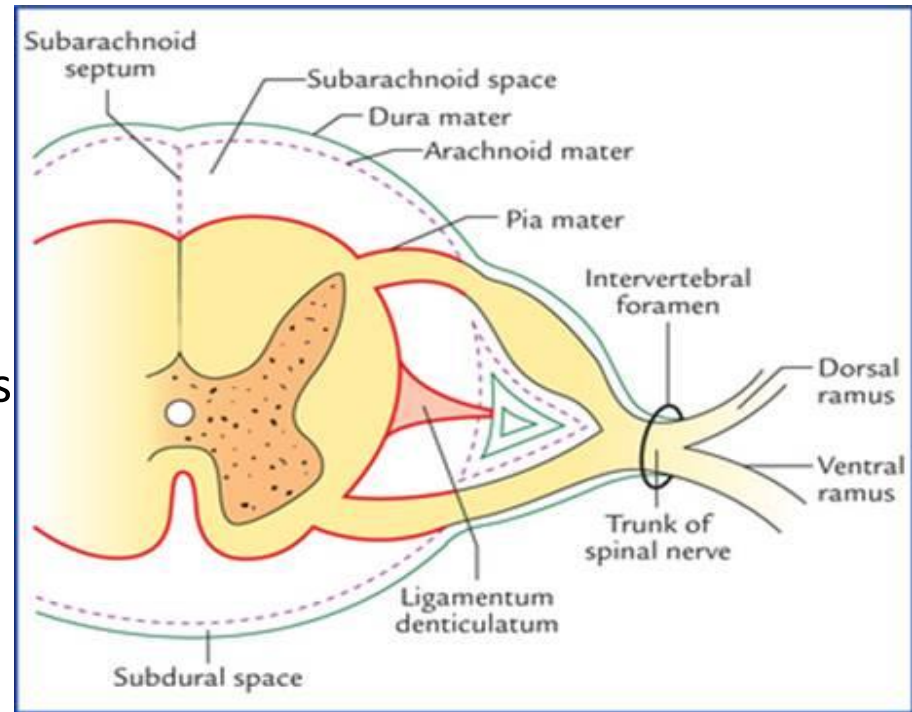
Spinal dura mater

- It is the continuation of Cranial dura mater
- Extends from foramen magnum to the lower border of S2 vertebra.
- It is attached firmly to the foramen magnum, and the body of axis vertebra. Elsewhere it is free in the vertebral canal.
- Lower blind end of dural tube is pierced by filum terminale in its centre.



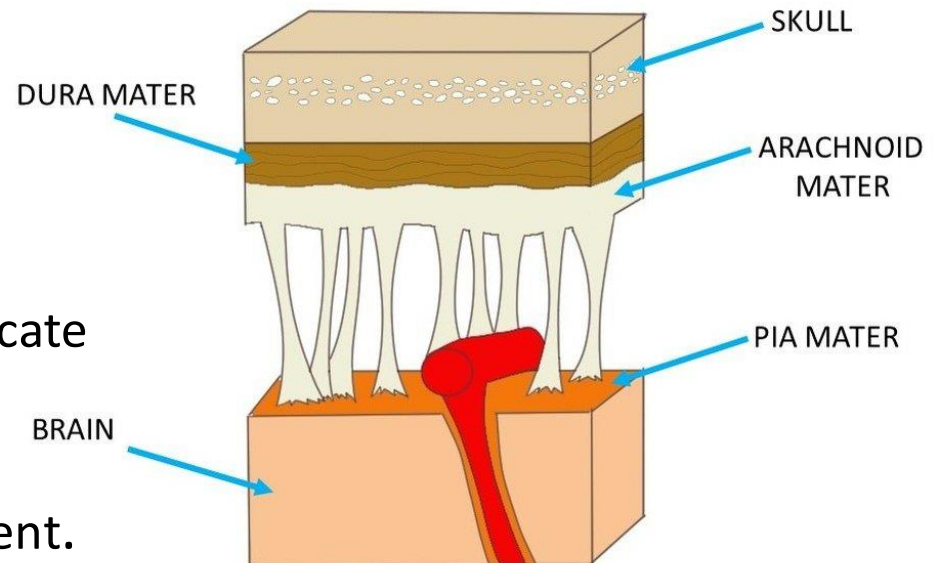
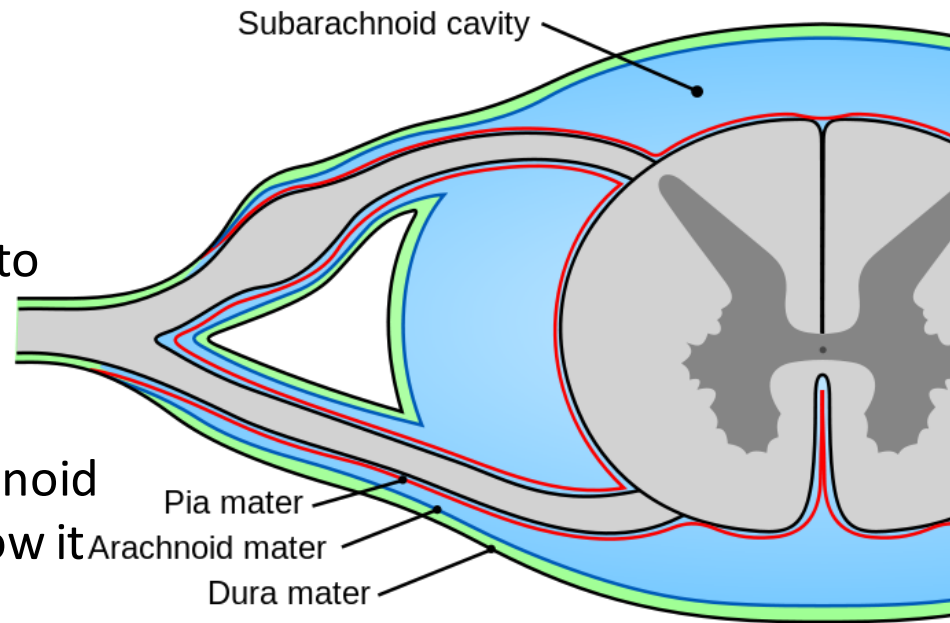
Spinal dura mater

- Spinal dura is pierced segmentally by dorsal and ventral roots of the spinal nerves and prolonged over these roots as sleeve-like projections, which enter the intervertebral foramina and ends by fusing with epineurium of the spinal nerves.
- Subdural space:** it is a potential space between dura and arachnoid mater which contains this film of serous fluid, which acts like lubricant and helps dura mater to move freely over the arachnoid mater.



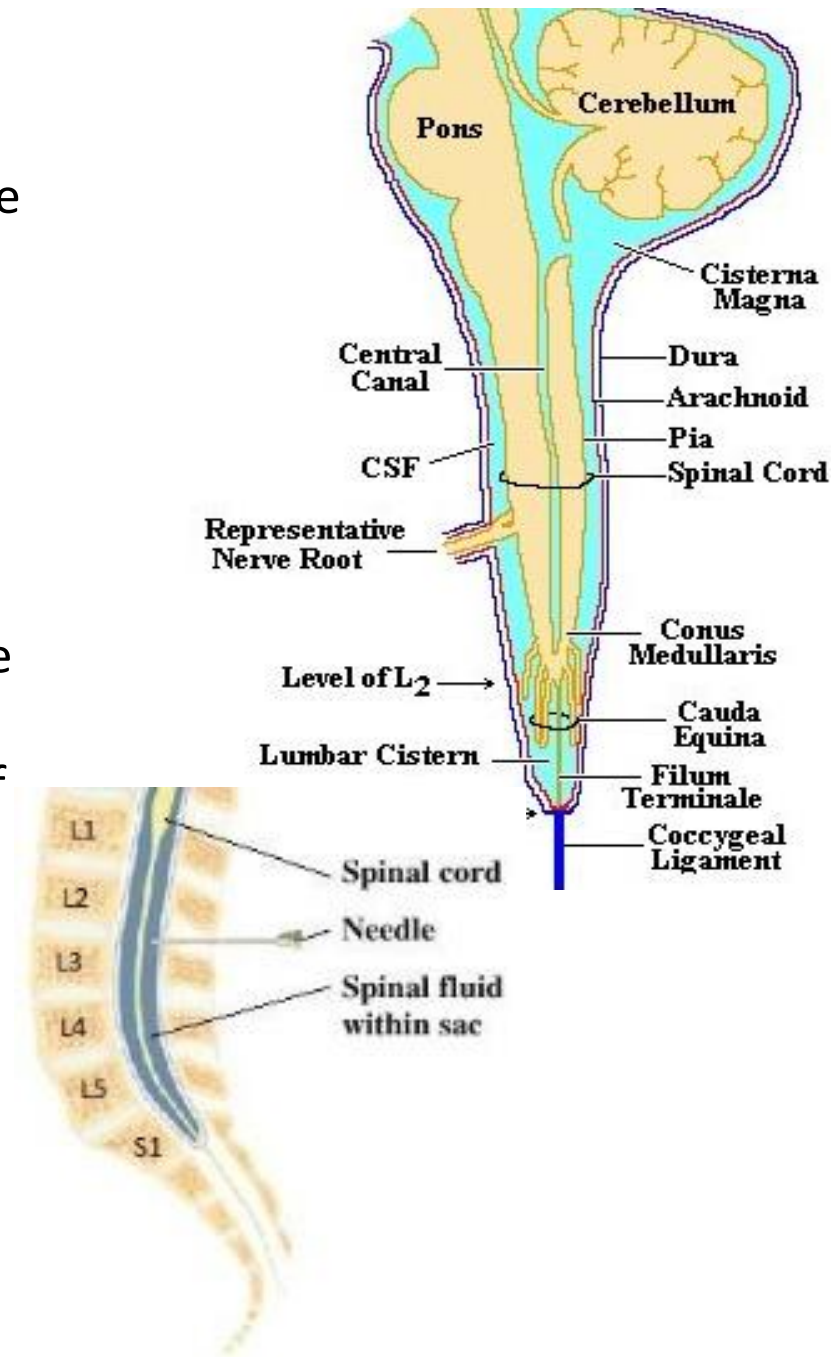
Spinal arachnoid mater

- It is a thin transparent vascular membrane which is loosely attached to spinal cord.
- It is continuous with the cranial arachnoid mater surrounding the brain and below it extends up to the lower border of S2 vertebra.
- It is separated from pia mater by the **subarachnoid space**.
- The arachnoid mater sends many delicate thread-like processes across the subarachnoid space to the pia mater forming a spider's web-like arrangement.
(Latin: arachnoid means spider)



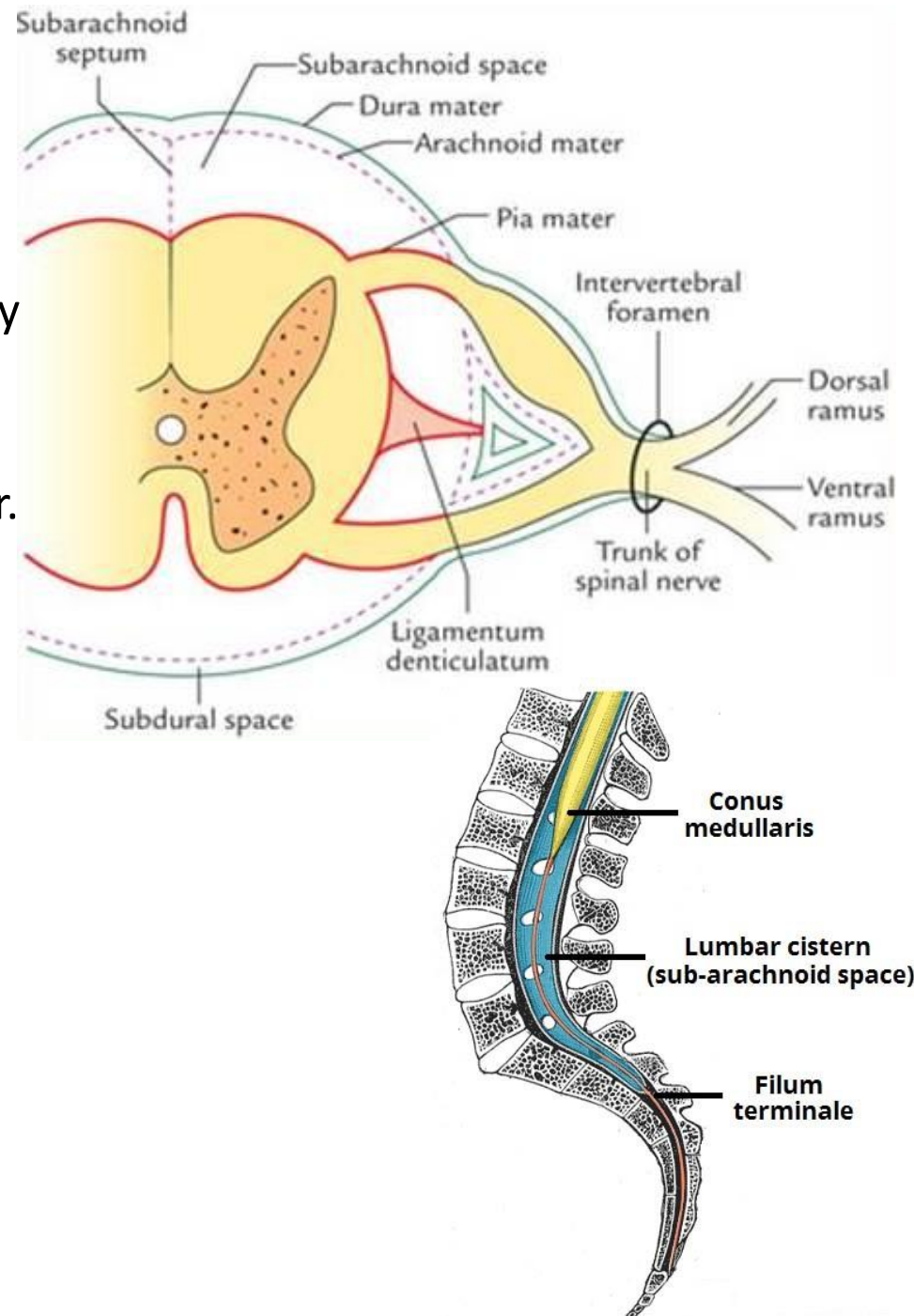
Spinal arachnoid mater

- **Subarachnoid space**: it is relatively large space than subdural space which is filled with cerebrospinal fluid (CSF) and it contains almost half of the total volume of CSF (75ml out of 150ml)
- It is continuous with subarachnoid space around the brain and below the space is quite roomy (**lumbar cistern**) which contains only cauda equina and filum terminale in a pool of CSF.
- That's why **lumbar puncture or spinal anesthesia** is done between L2 to L4 level as spinal cord ends at L1 vertebra.



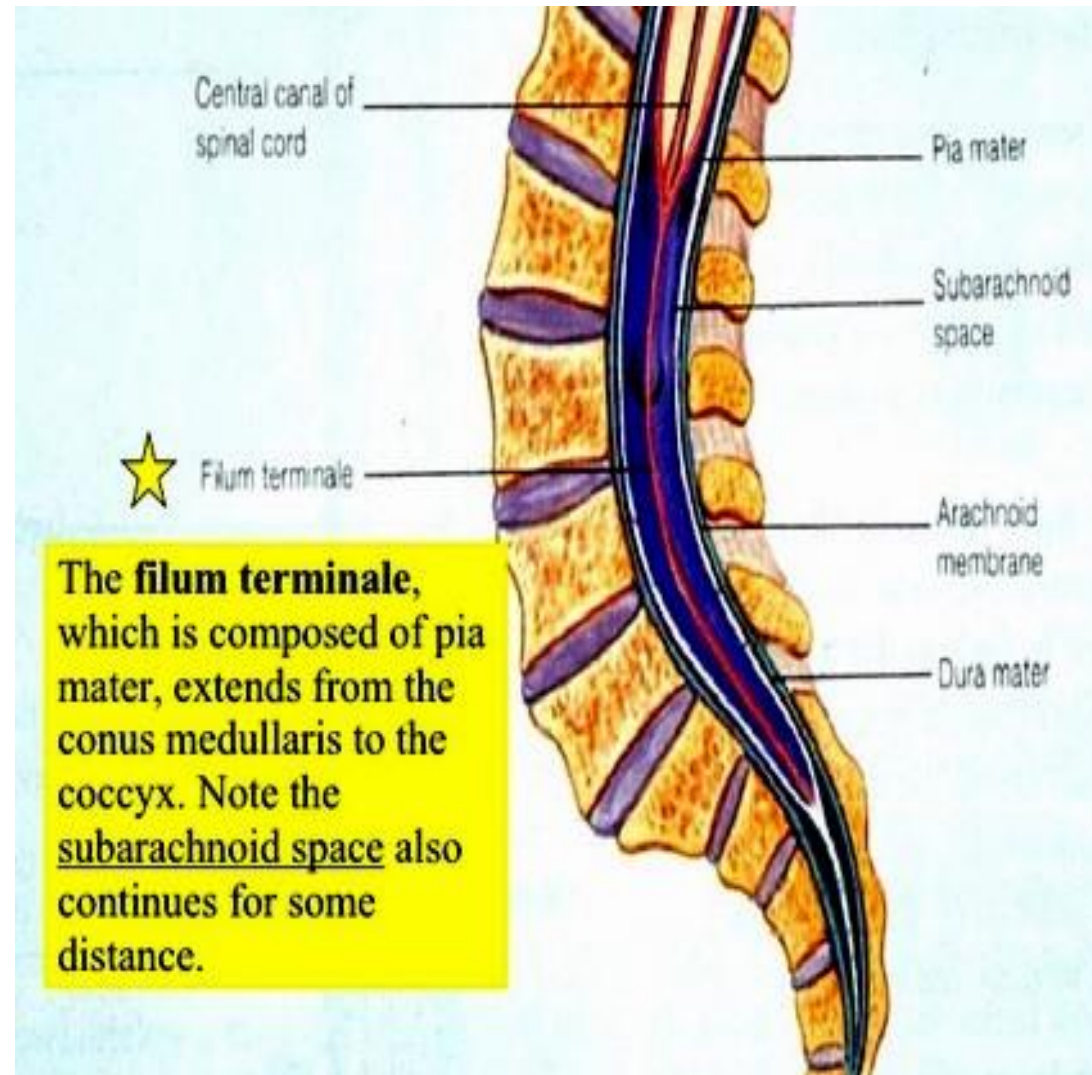
Spinal pia mater

- It is the vascular membrane that closely covering the spinal cord.
- Pia mater is modified in some places which are called processes of pia mater.
 - Filum terminale
 - Ligamenta denticulata
 - Linea splendens
 - Subarachnoid septum



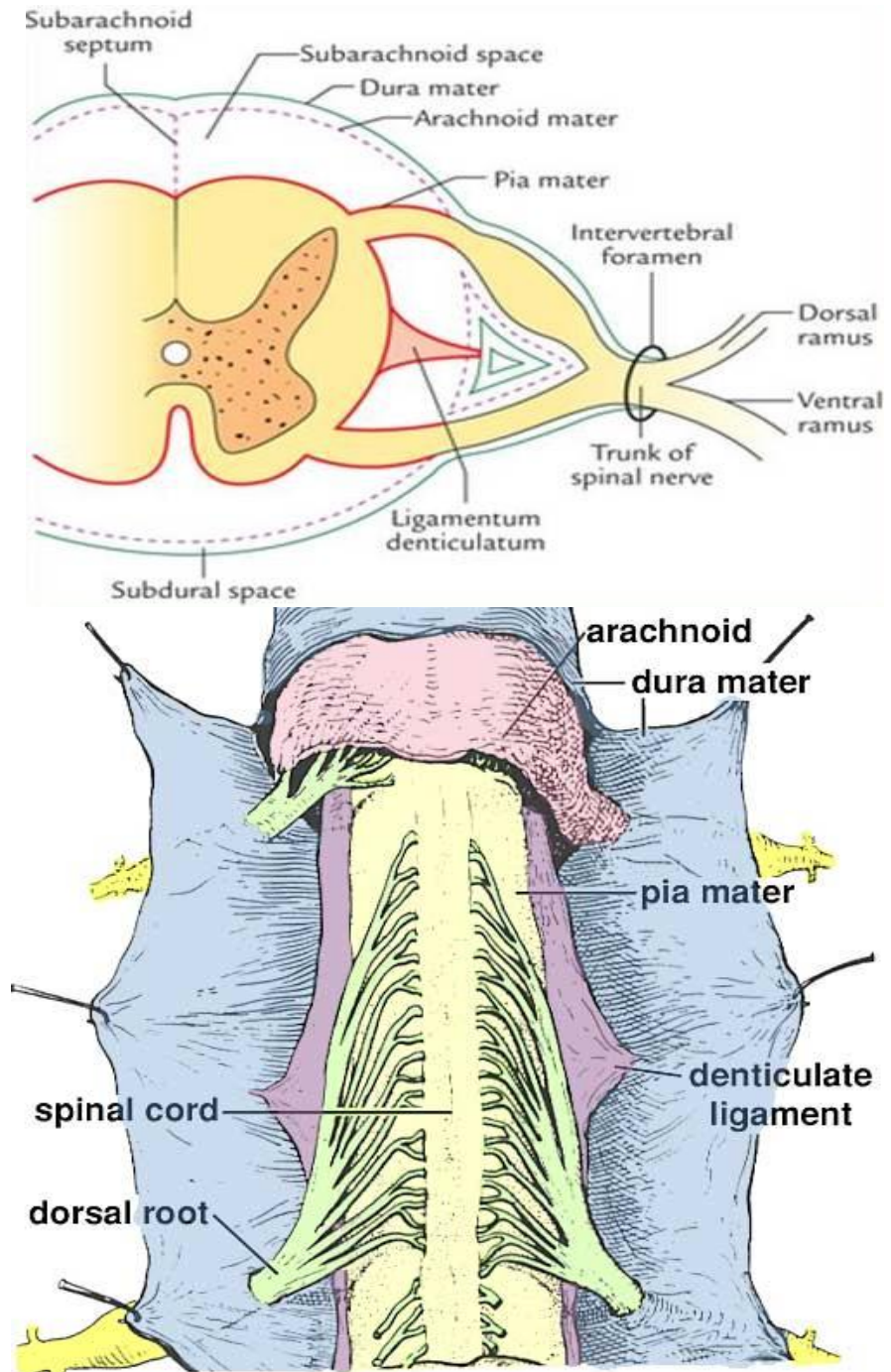
Filum terminale

- It is a thin thread-like prolongation of pia mater beyond the conus medullaris
- It extends up to base of the coccyx.
- It is 20 cm long and divided into two parts
 - Filum terminale internum
 - Filum terminale externum



Ligamenta denticulata

- On each side between the dorsal and ventral nerve roots the pia mater forms narrow ribbon-like transparent bands called ligamenta denticulata.
- Lateral margin of each ligamenta denticulata sends 21 teeth-like projections, which pass through the subarachnoid space and arachnoid mater to get attachments on the inner surface of the dural tube between the points of emergence of two adjacent nerve roots.
- Ligamenta denticulata helps to anchor the spinal cord in the middle of the subarachnoid space.
- The first tooth of ligamenta denticulatum is the level of the foramen magnum and the last tooth lies between T12 and L1 spinal nerves.

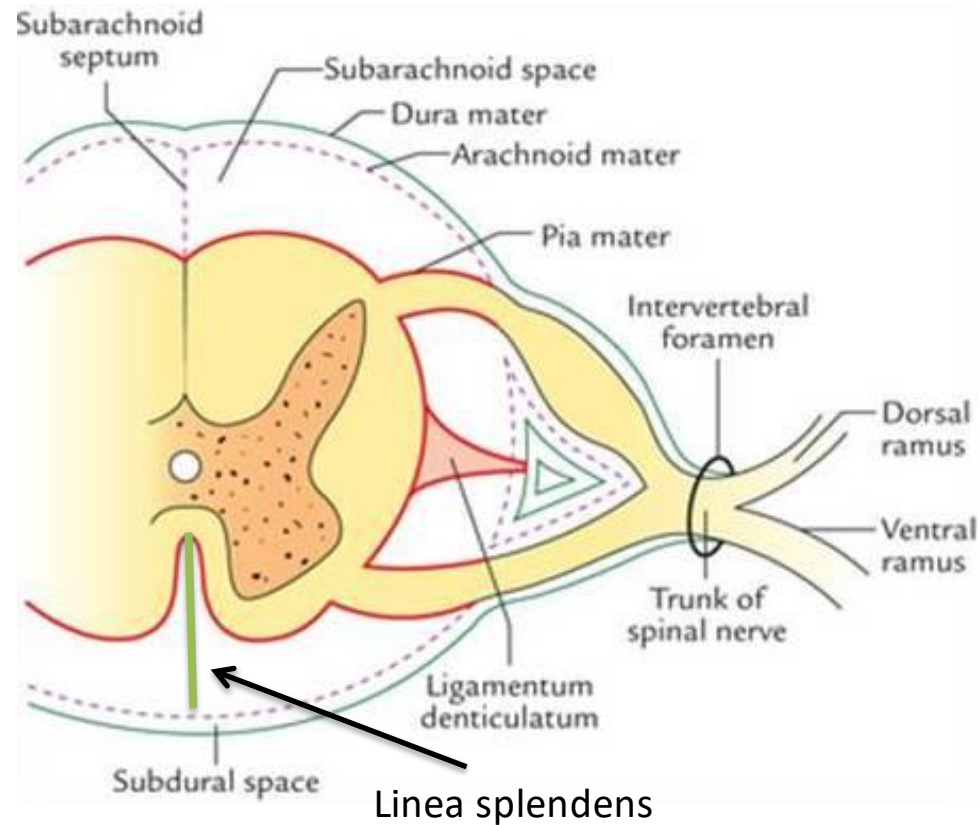


Linea splendens

- It is the thickened band of pia mater along the anterior median fissure to the spinal cord.

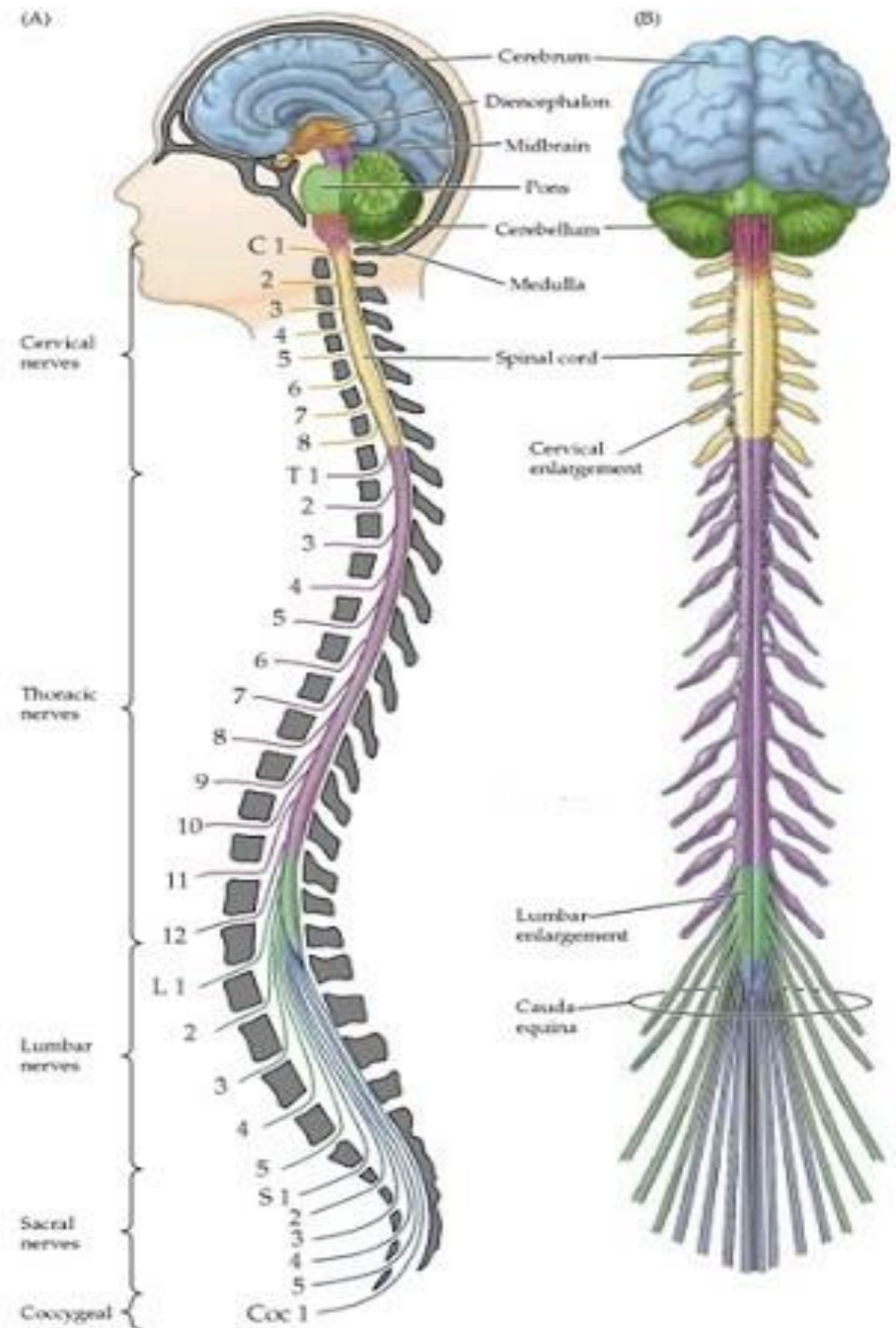
Subarachnoid septum

- It is a fenestrated pia septum in the mid-sagittal plane which connects the pia mater with the arachnoid mater posteriorly.
- Posteriorly the pia mater is also attached to the posterior median septum of the spinal cord.



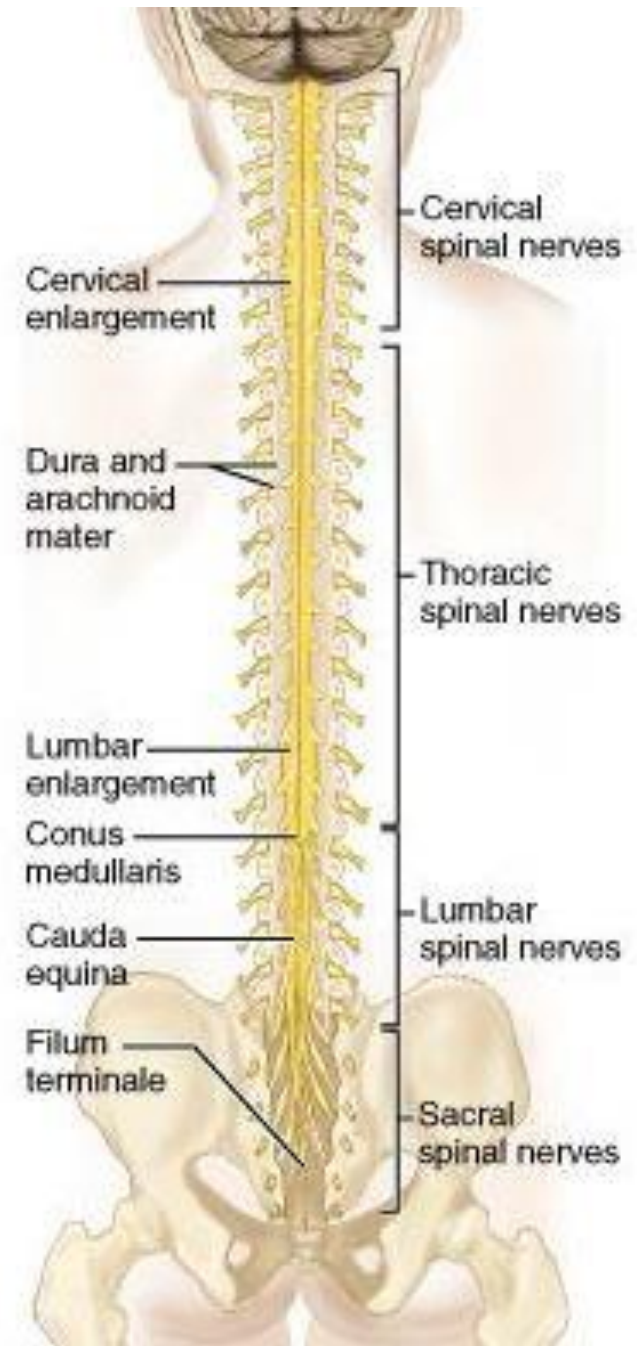
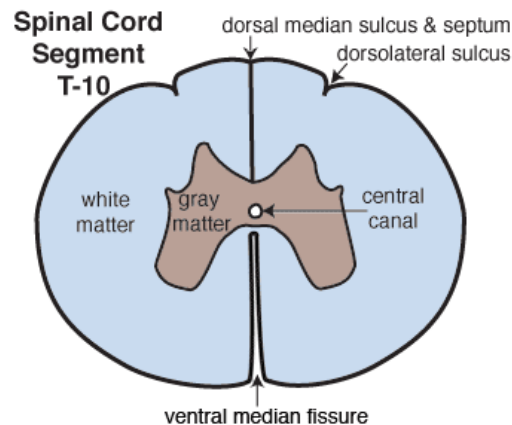
Spinal cord & nerve roots

- It is the 45 cm long (average length) lower cylindrical part of central nervous system occupying the upper 2/3rd of vertebral canal.
- Functions:
 - Transmission of information to and from between body and brain
 - Execution of simple reflexes



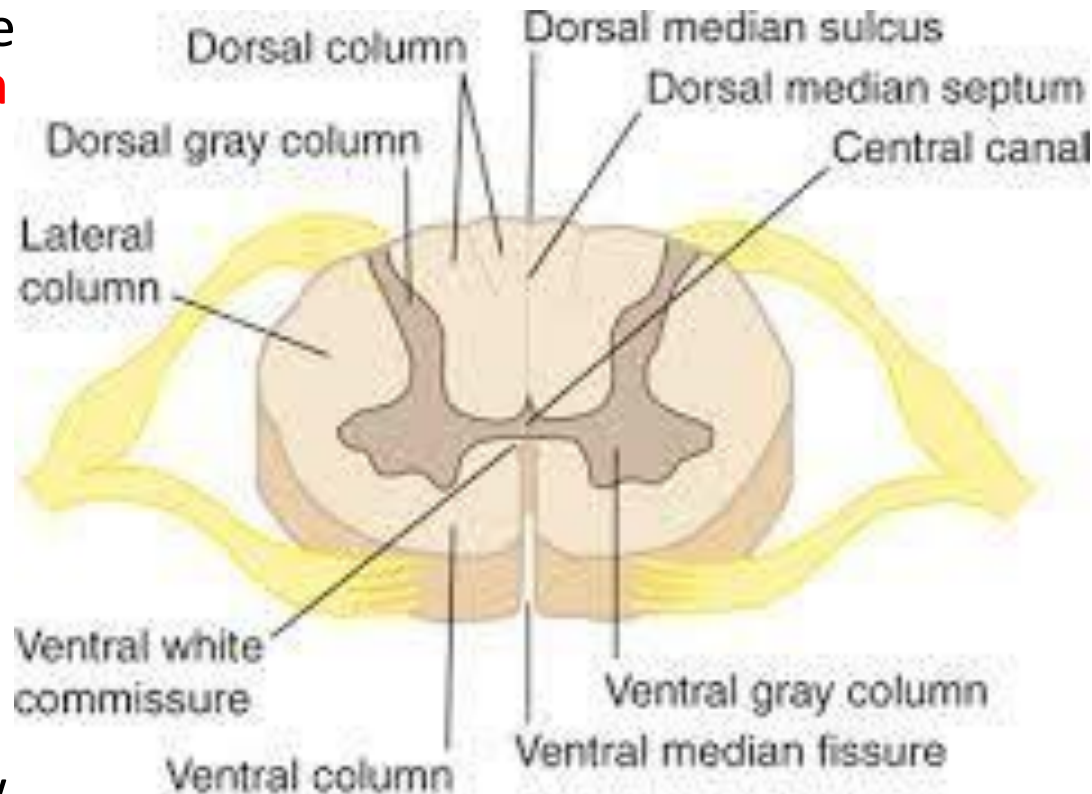
External features

- The spinal cord gives origin of **31 pairs of spinal nerves**
- The girth of spinal cord increases in the regions that gives large nerves of the limbs.
 - **Cervical swelling/enlargement**
 - **Lumbar swelling/enlargement**
- Fissures and sulci



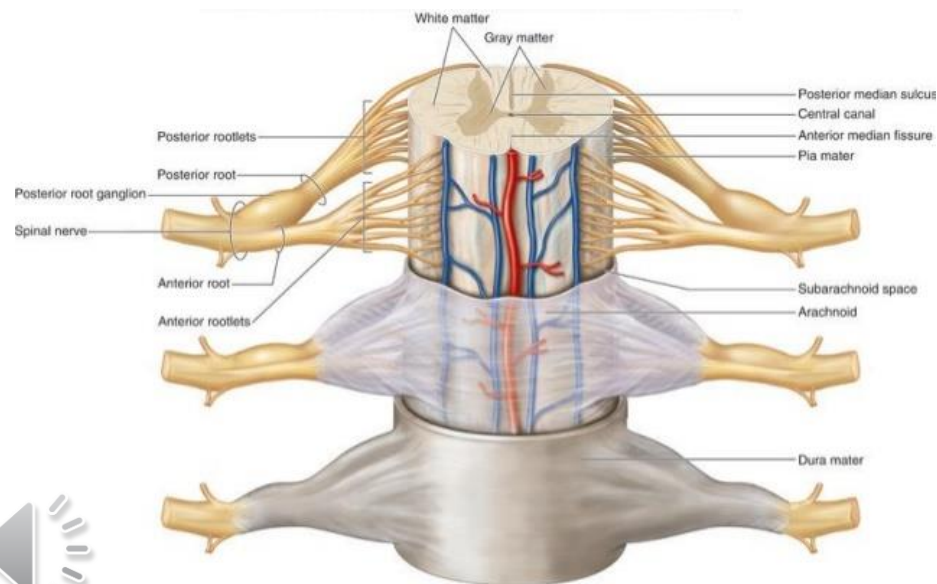
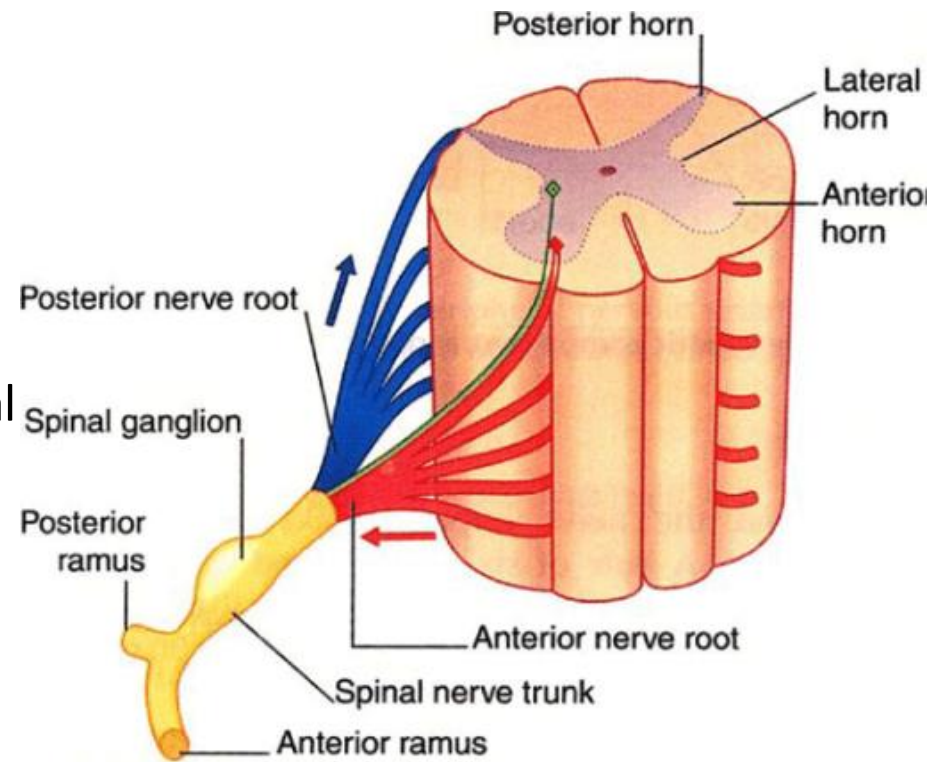
Fissure and sulci

- The anterior aspect of spinal cord possesses a deep midline groove called **anterior median fissure**.
- It extends along the entire length of the spinal cord.
- On the either side of the anterior median fissure it presents **antero-lateral sulci**.
- The posterior aspect of the spinal cord presents a shallow **posterior median sulcus**, from which posterior median septum of neuroglial tissue extends into the substance of the cord to variable extent.



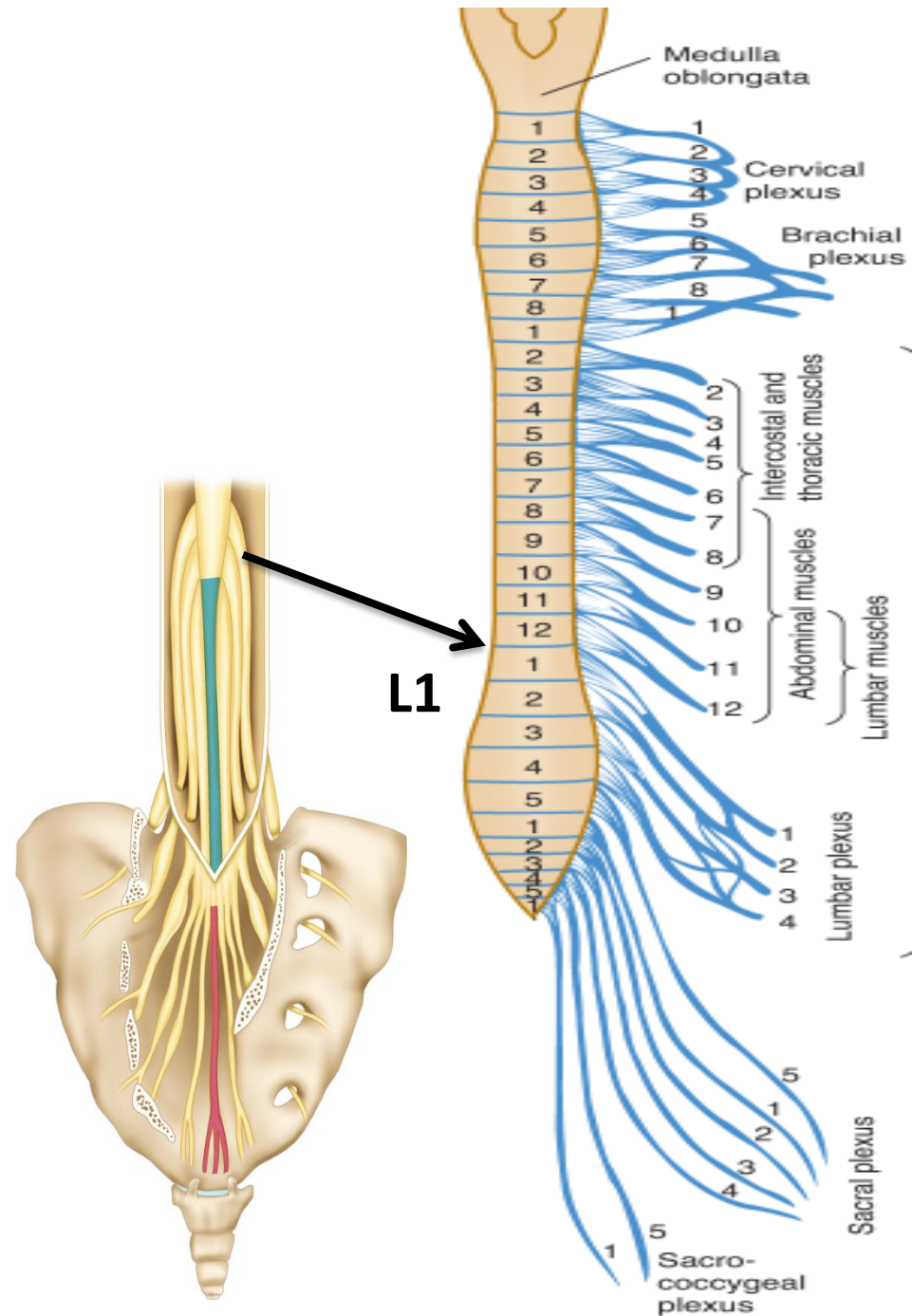
Spinal nerve roots

- The anterior and posterior roots of the spinal nerve unite within the intervertebral foramina.
- The anterior root is formed by 3 or 4 rootlets, which emerge the anterolateral sulcus of the spinal cord.
- Posterior root is formed by several rootlets, which are attached to the postero-lateral sulcus.
- A short distance from the cord, the rootlets unite and form a single root.
- The ganglion (**Dorsal Root Ganglion**) on the posterior root lies in the intervertebral foramen.
- From C1 to L1 vertebrae, the anterior and posterior nerve root pass in front and behind the **ligamentum denticulatum**.
- The portion of the spinal cord which gives origin to a pair of spinal nerves is termed **spinal segment**.



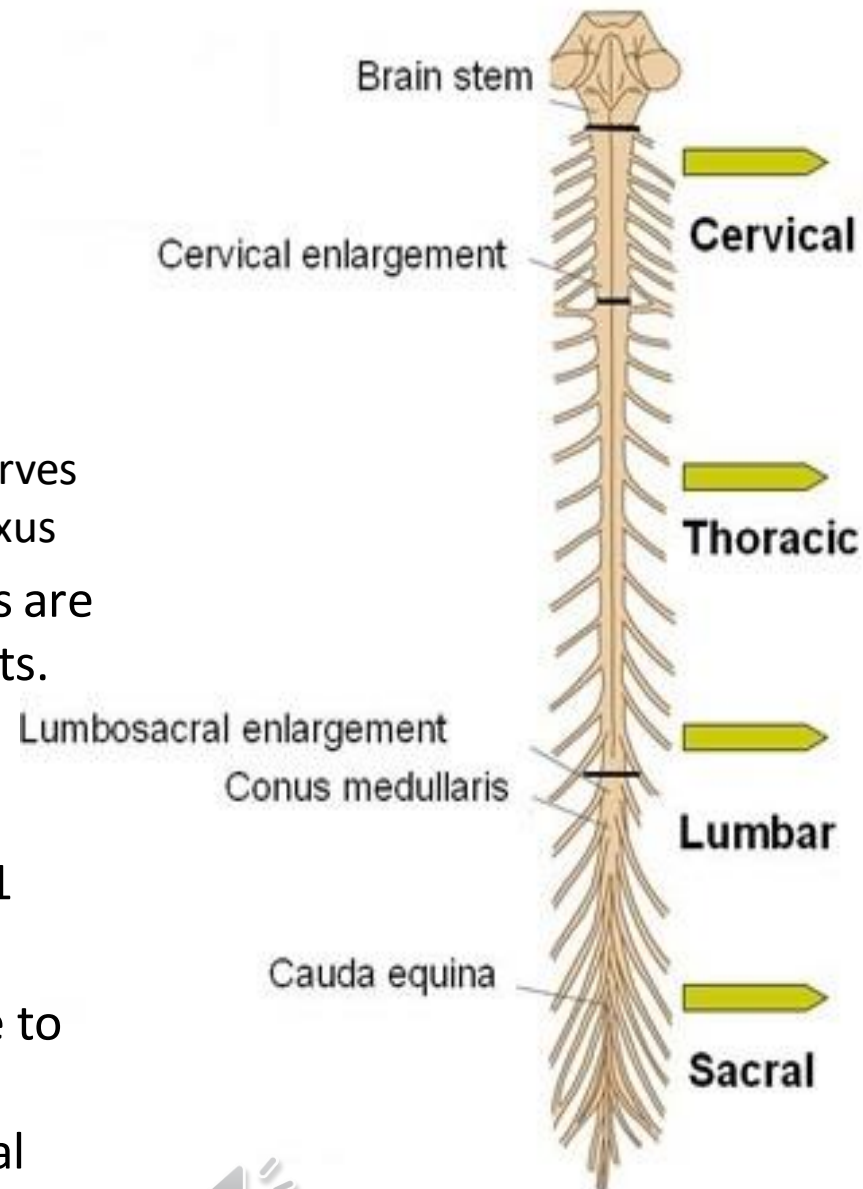
Spinal nerve roots

- Since the spinal cord is shorter than vertebral canal, there are variations of the spinal nerve roots in the vertebral canal, to reach the appropriate intervertebral foramina.
- Upper cervical root pass almost horizontally, the thoracic nerve root pass obliquely and lumbar and sacral nerve roots descend almost vertically downwards forming **cauda equina**. (cauda=tail, equina=horse)



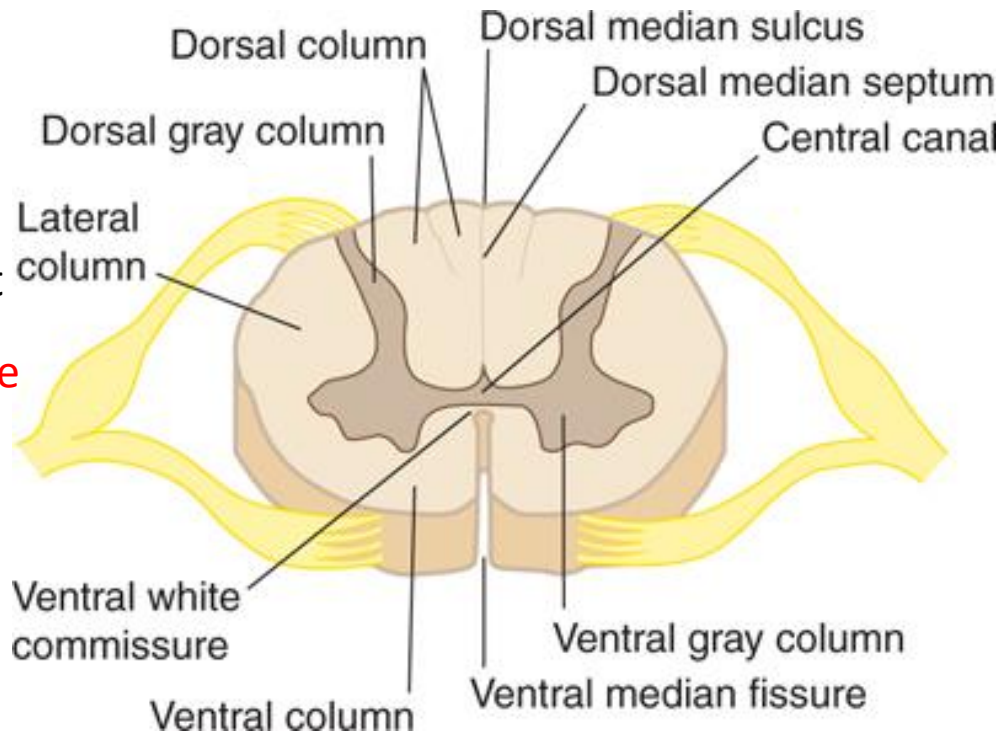
Enlargement of spinal cord

- **Cervical enlargement**
 - Region of C5 to T1 spinal segment
 - The nerves arising from this segment form brachial plexus
- **Lumbar enlargement**
 - Region of L2 to S3 spinal segments. The nerves arising from this segment form lumbar plexus
- The vertebral levels of these enlargements are quite different from that of spinal segments.
- Cervical segment lies opposite C3 to T1 vertebrae
- Lumbar enlargement lies opposite T9 to L1 vertebrae
- These enlargements in spinal cord are due to greatly increase mass of motor cells in the anterior horn of grey matter in these spinal segments.



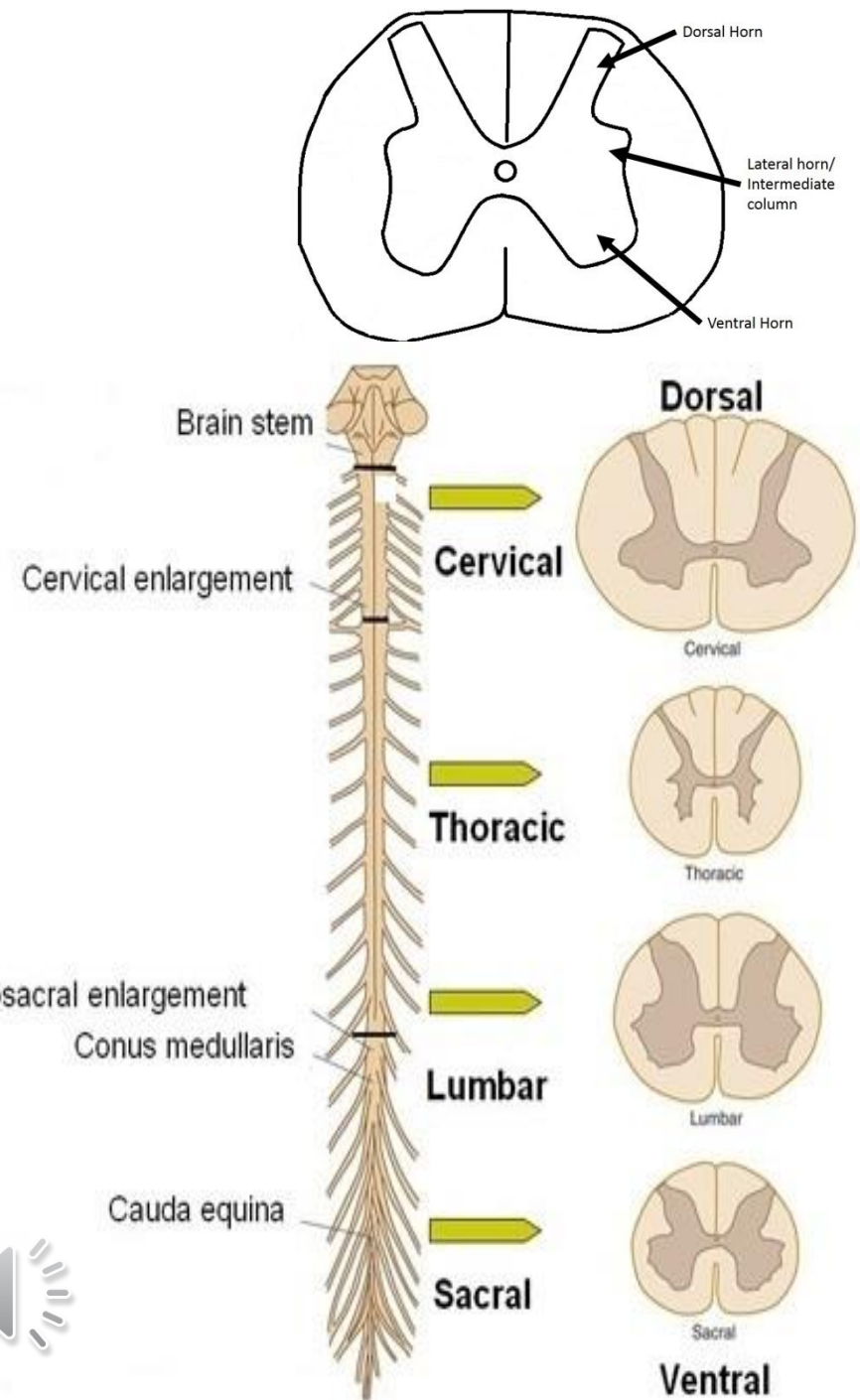
Internal structures

- Spinal cord consists of a central mass of **grey matter** made up of nerve cells and peripheral mass of **white matter** made up of fiber tracts.
- In cross section grey matter is **"H"-shaped** or butterfly shaped.
- It is divided into symmetrical right and left comma-shaped masses which are connected across the midline by **transverse grey commissure**.
- The **central canal** of the cord passes through the center of the grey commissure.
- The lateral comma-shaped mass of grey matter has elongated posterior horn and broad anterior horn.
- The posterior horn is extended almost to the surface of the cord but anterior horn falls short.



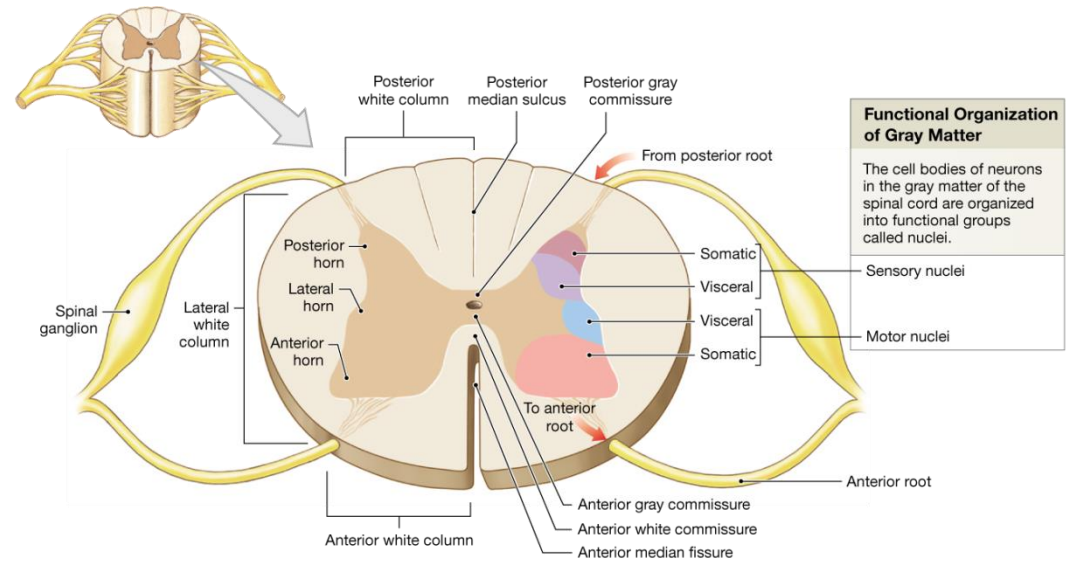
Internal structures

- In the thoracic segments and upper two lumbar segments (T1 to L2), a triangular projection comes out from the lateral side of grey matter between anterior and posterior horn which is called **lateral horn**.
- Posterior horn is connected to the surface by a gelatinous substance called **substantia gelatinosa**.
- The anterior grey horns are largest in the cervical and lumbar enlargements as more nerve cells are there.
- Posterior column are largest in the cervical region.

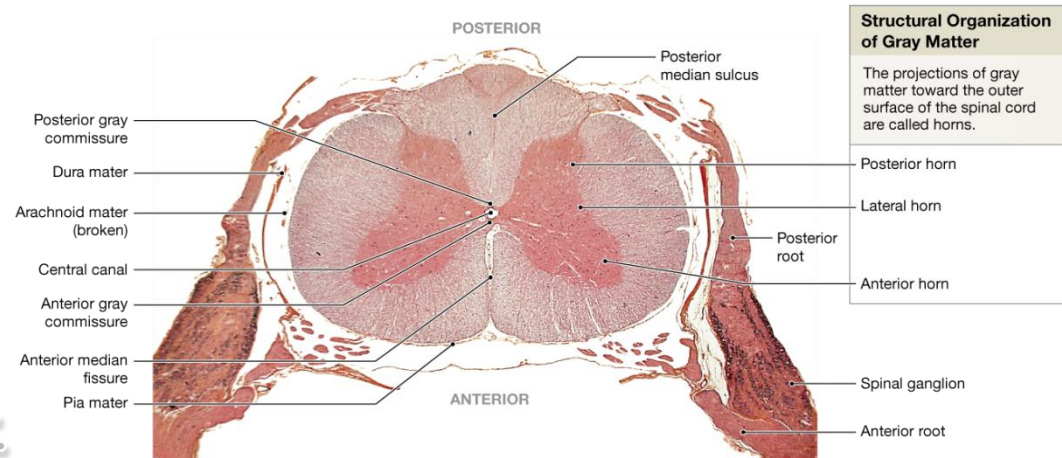


Grey and white matters

- Grey matter of spinal cord consists of
 - Nerve cells (motor and sensory neurons)
 - Neuroglia
 - Blood vessels
- White matter mainly consists of nerve fibers and large portion of them are myelinated giving it a white appearance.
- In general posterior white column is sensory, anterior column is motor and lateral column is mixed



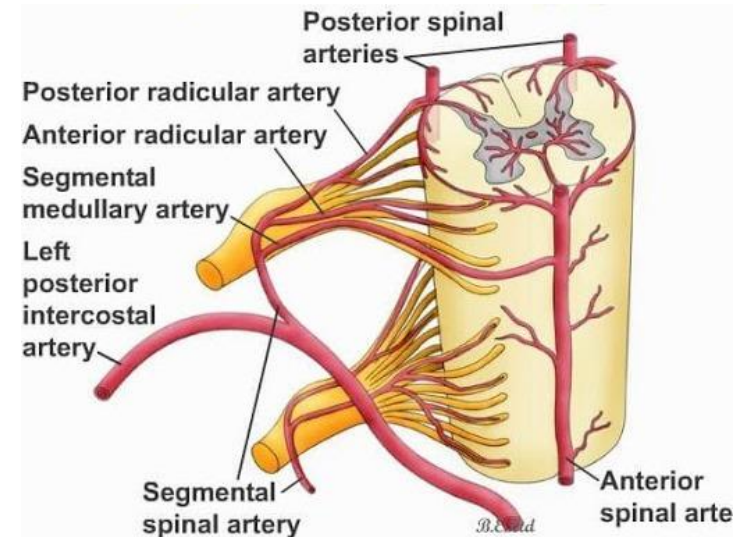
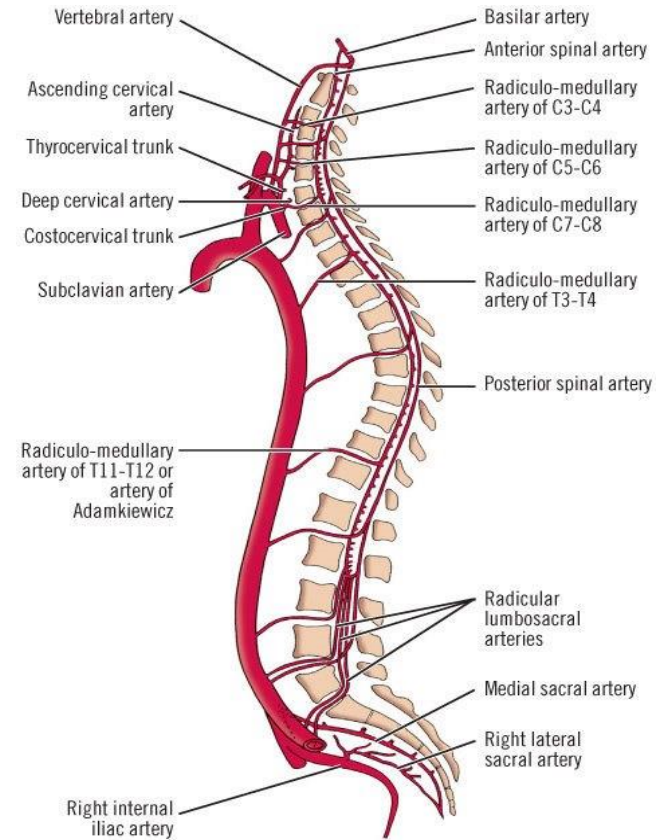
a The left half of this sectional view shows important anatomical landmarks, including the three columns of white matter. The right half indicates the functional organization of the nuclei in the anterior, lateral, and posterior horns. The red arrows represent sensory input from the posterior root and motor output to the anterior root.



b A micrograph of a transverse section through the spinal cord, showing major landmarks in and surrounding the cord.

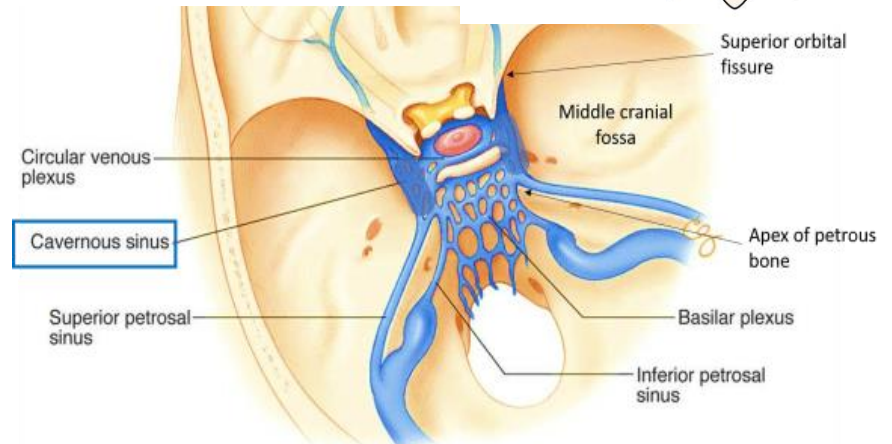
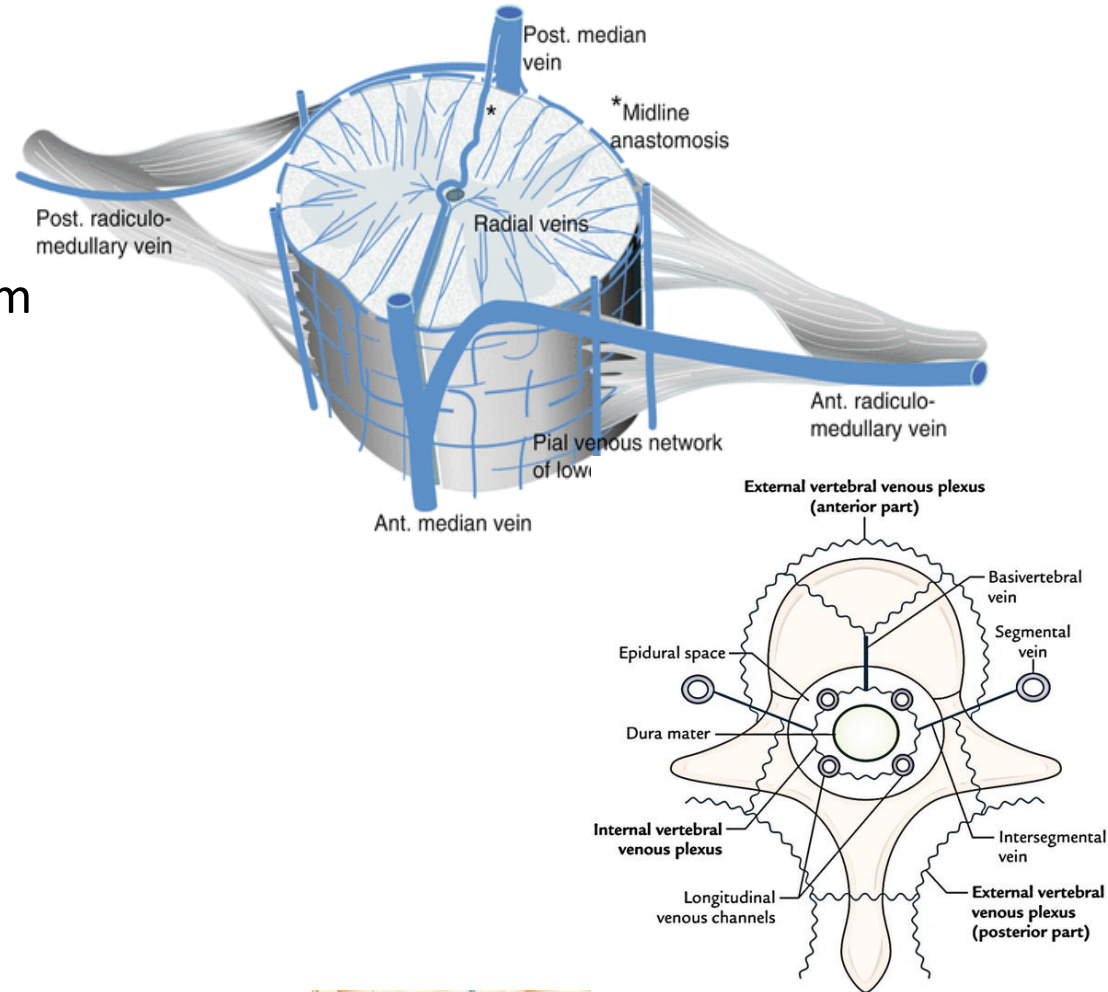
Blood supply

- The spinal cord is supplied by
 - Anterior spinal artery
 - Posterior spinal artery
 - Segmental arteries
- Anterior spinal artery:**
 - It is formed by union of two small spinal branches of right and left vertebral artery in the upper cervical canal.
- Posterior spinal artery:**
 - Two posterior arteries arise from vertebral artery or posterior inferior cerebellar artery.
- Segmental arteries:**
 - These arteries are reinforced by the segmental arteries (feeder arteries) to form five arterial trunks.
- Largest segmental arteries (radicular artery) are at the T1 and T11th segmental levels are called arteria radicularis magna or **arteries of Adamkiewicz**.



Blood supply

- Venous drainage:
 - The veins drain the cord from six longitudinal venous channels around the cord.
 - Two median longitudinal
 - Two antero-lateral
 - Two postero-lateral
- These longitudinal venous channels communicate with the internal vertebral basilar venous plexus.
- The internal vertebral venous plexus communicates above with the basilar venous plexus.



**Applied anatomy
will be discussed at the end of
Spinal cord – 2 lecture**

I...learn...anatomy not from books
but from dissections,
not from the tenets
of Philosophers
but from the
fabric of nature.

—William Harvey

Thank you

