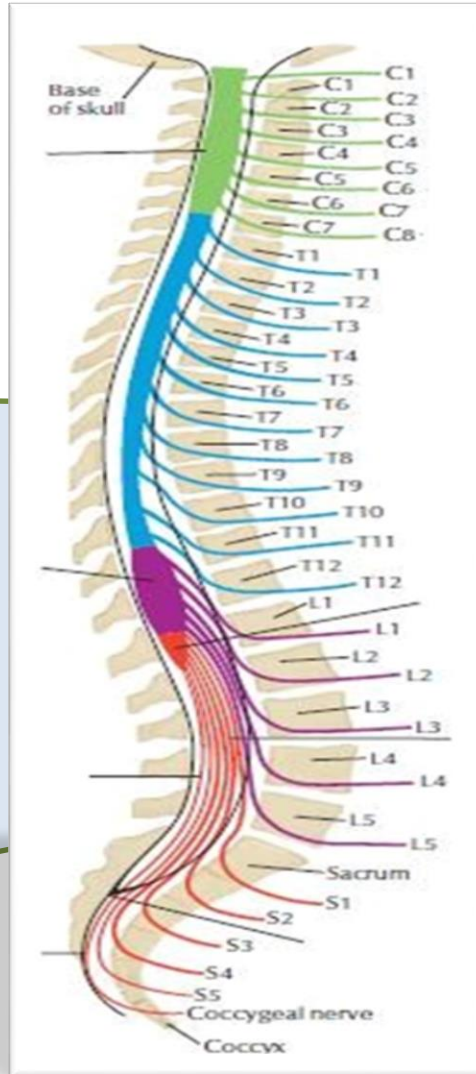


المرحلة : الثاني
المادة : التشريح



جامعة ذي قار / كلية الطب



Spinal Cord Anatomy

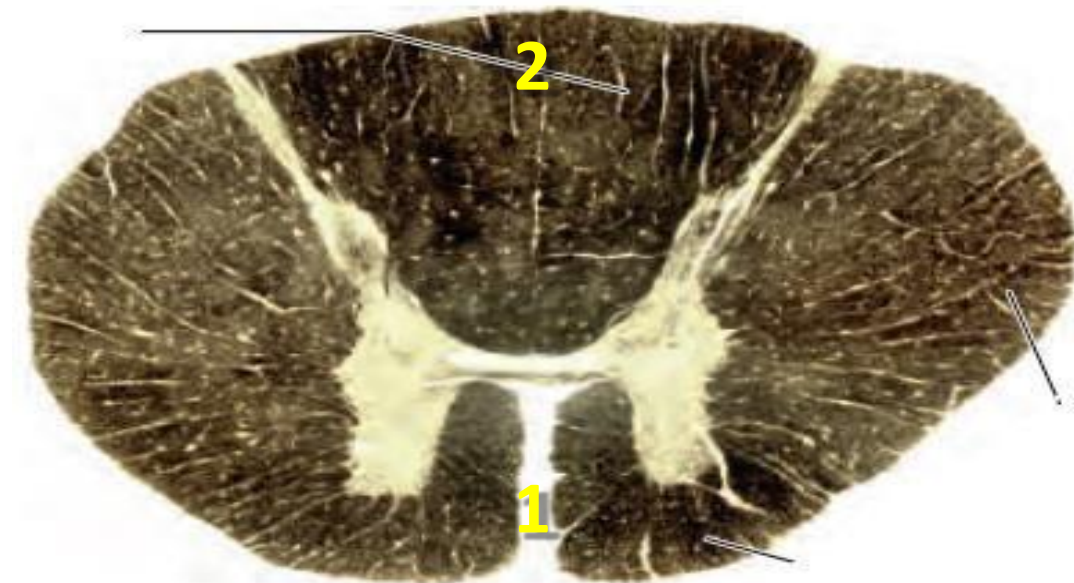


الدكتور
رافد رمثان حسين التميمي
دكتوراه أشعة تشخيصية

Done by
Dr. Rafid Remthan AL-Temimi,
Clinical Radiology ,CAMB ,DMRD,MBCHB,

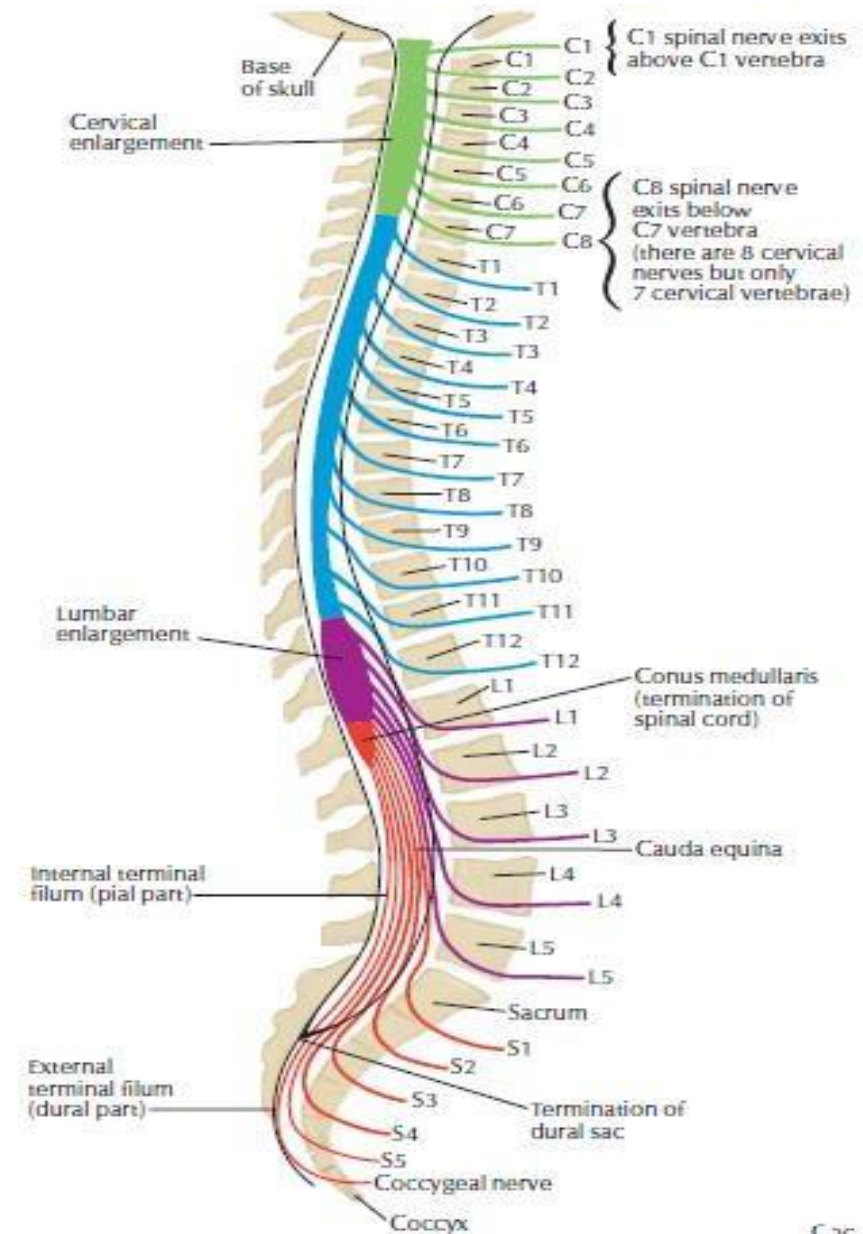
Spinal cord

- Ventrally it possesses a deep midline groove, **the anterior median fissure (1)** , and dorsally it shows a shallow **posterior median sulcus (2)** , from which a posterior median septum of neuroglia extends into its substance.
- **The posterior median septum within the spinal cord is attached to the incomplete posterior median septum of arachnoid in the subarachnoid space.**



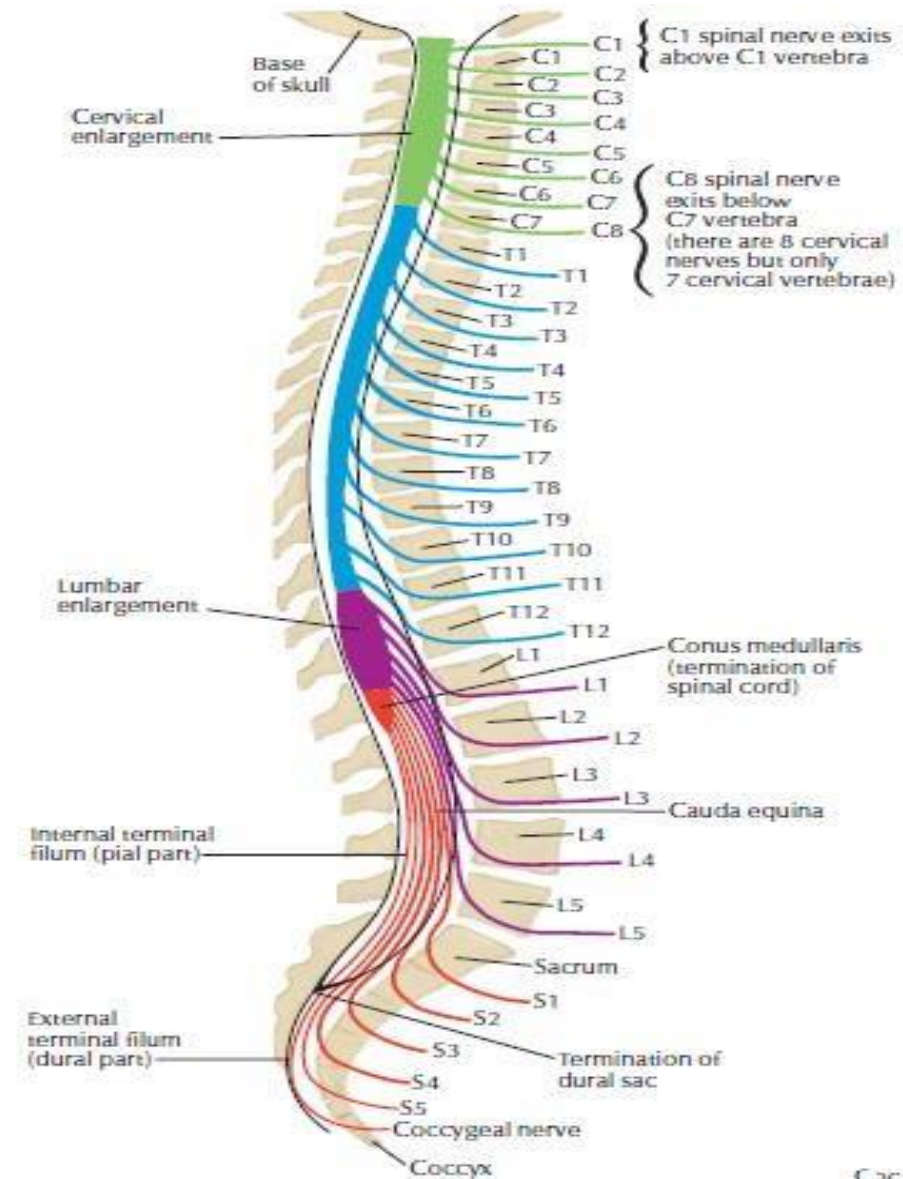
Lower limit of spinal cord

- In the fetus the spinal cord extends to the lower limit of the spinal dura mater at the level of **S2** vertebra.
- The spinal dura remains attached at this level throughout life, but the spinal cord becomes relatively shorter, which is to say that **the bony spinal column and the dura mater grow more rapidly than the spinal cord.**
- **Thus at birth the conus medullaris lies opposite L3 vertebra and does not reach its permanent level opposite L1 or L2 until about the age of 20 years.**
- The spinal nerve roots, especially those of the lumbar and sacral segments, thus come to slope more and more steeply downwards



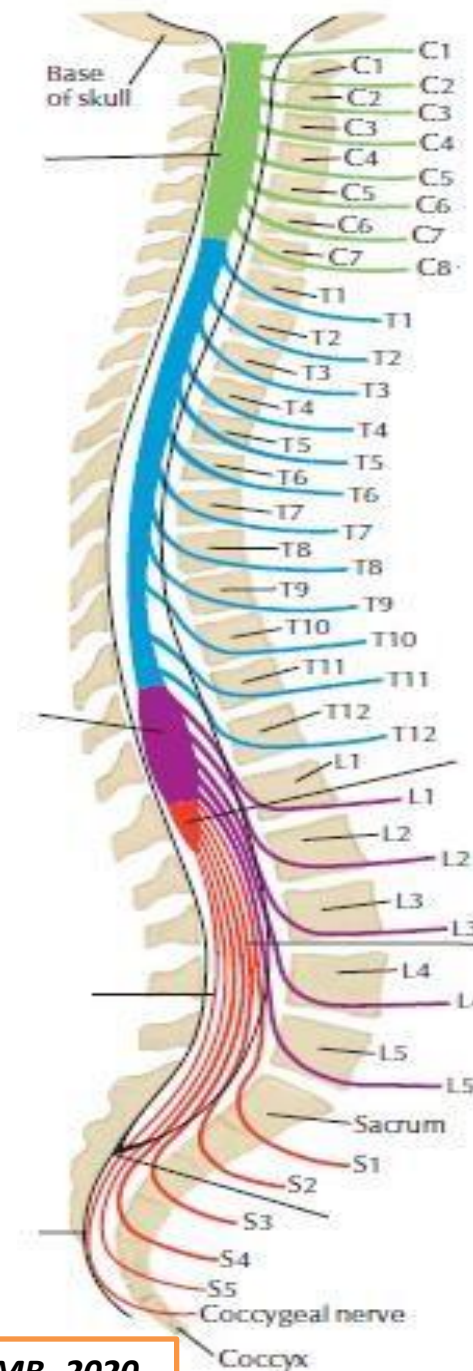
Lower limit of spinal cord

- **In fetus**
 - conus medularis (lower limit of spinal cord) = S2
 - Spinal dura mater = S2
- **At birth**
 - Conus medularis = L3
 - Spinal dura mater = S2
- **In Adults**
 - Conus medularis = L1 or L2
 - Spinal dura mater = S2
 - Subarachnoid space = S2



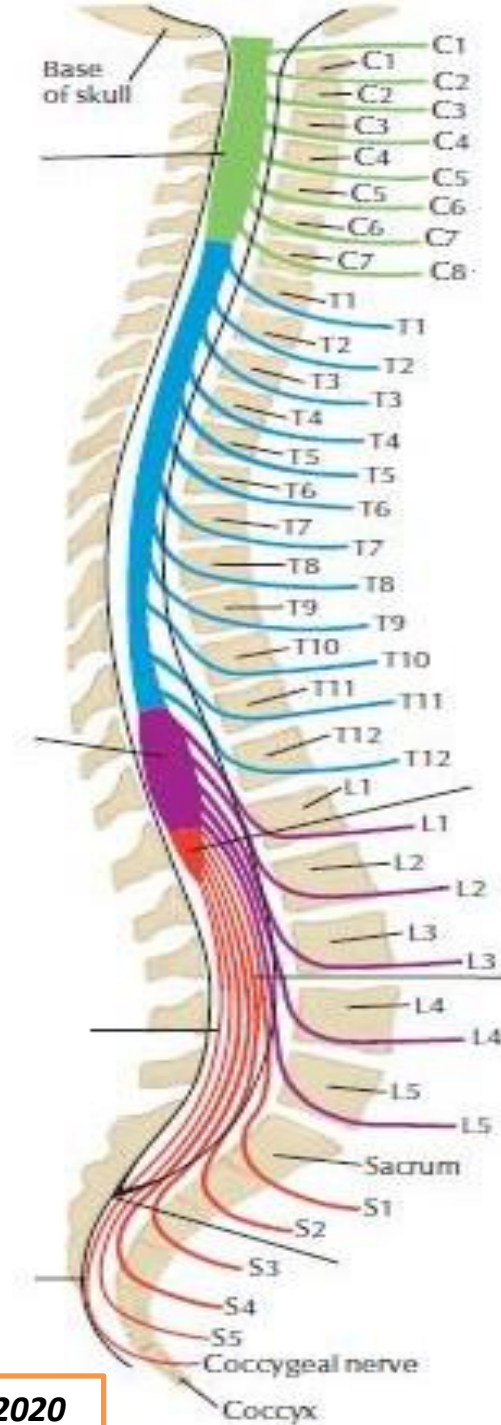
Spinal cord enlargement

- They occupy, in the cord, the segmental levels of the plexuses concerned **C5 to T1** for the cervical enlargement and **L2 to S3** for the lumbosacral enlargement), **but their levels measured by vertebrae are, of course, quite different.**
- Thus the cervical enlargement lies roughly corresponding to the vertebrae **C3 to T1**, but the lumbosacral extends only from **T9 to L1**.
- Both enlargements are due to the greatly **increased mass of motor cells in the anterior horns of grey matter** in these situations.



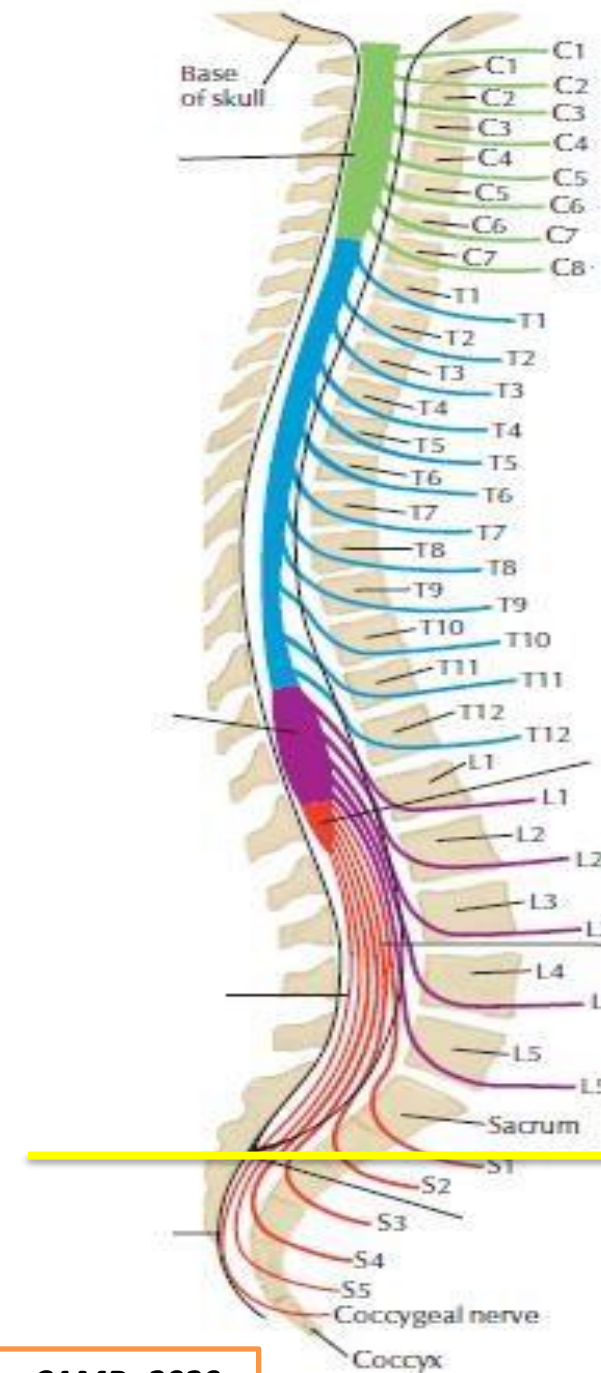
Spinal cord segments

- Spinal cord segments with related to the vertebral levels
- **Cervical = C1-C7**
- **Thoracic = C7-T11**
- **Lumbar = T11-L1**
- **Thoracic = L1-L2**



Spinal dura matter

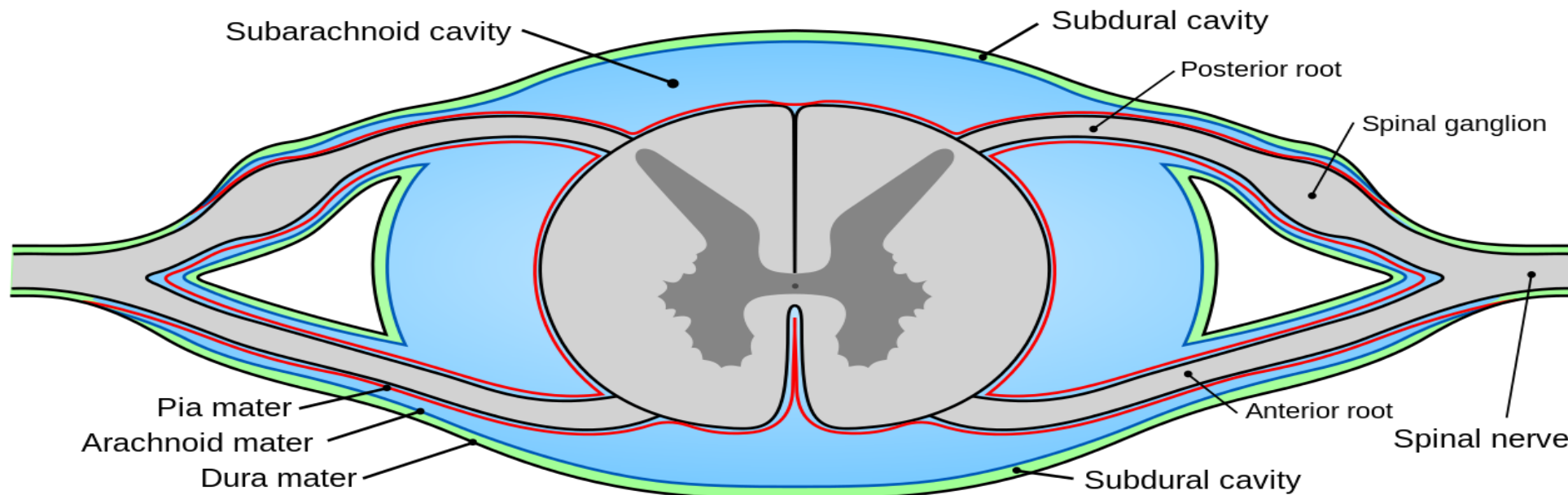
- a prolongation of the inner layer of the dura mater of the posterior cranial fossa.
- It extends downwards through the foramen magnum to the level of **S2** vertebra.
- It is attached rather firmly to the **tectorial membrane (in cochlea)** and to the **posterior longitudinal ligament on the body of the axis vertebra**, but elsewhere in the spinal canal it lies free of bony or ligamentous attachments.
- It is separated from the spinal canal by a layer of fat in which lies the external vertebral venous plexus.
- pierced segmentally by the anterior and posterior roots of the spinal nerves and is prolonged over these roots to form a series of lateral projections, one entering each inter vertebral foramen.
- **Thus the loose-fitting theca is stabilized within the spinal canal.**



S2

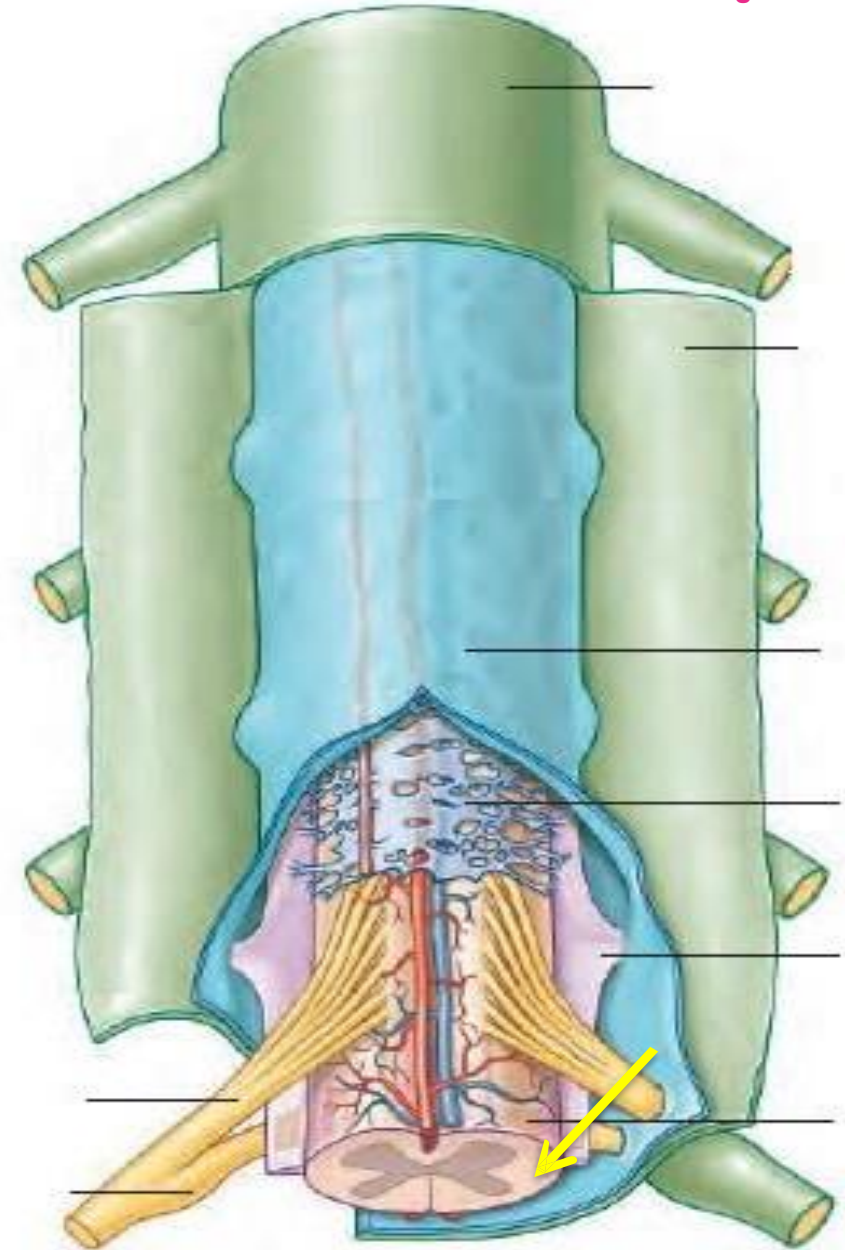
Spinal arachnoid matter

- The spinal arachnoid mater is supported by the inner surface of the spinal dura; nothing but **a thin film of lymph separates these two membranes.**
- The arrangement is similar to that in the skull. Below the level of the spinal cord (i.e. over the cauda equina) the arachnoid is nothing but a delicate membrane that is supported by the dura mater, but over the spinal cord itself the spinal arachnoid sends many delicate web-like processes across the subarachnoid space to the pia mater on the cord.
- They are rather well developed in the posterior midline, where they form an incomplete **posterior median septum.**



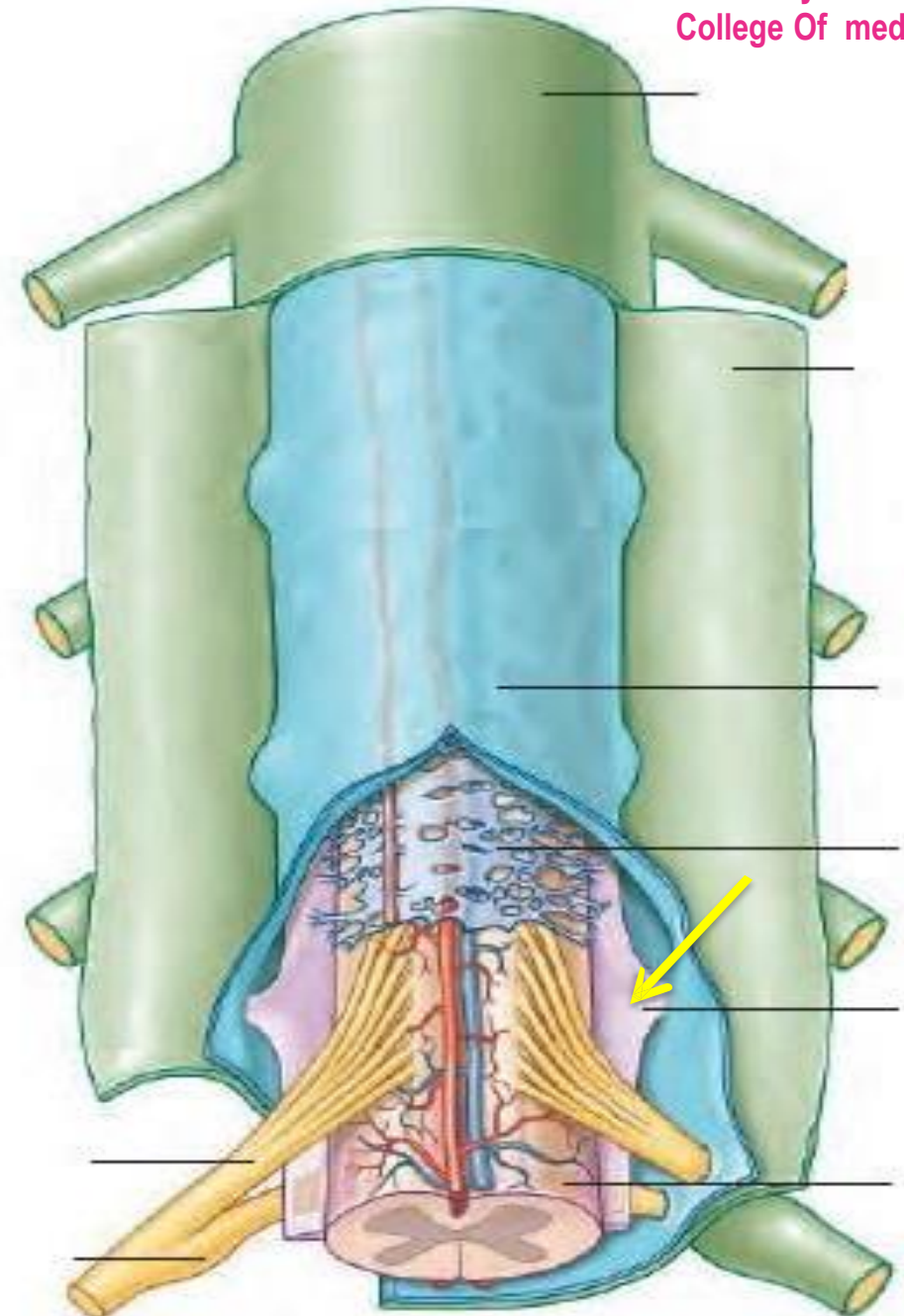
Spinal pia mater

- It clothes the spinal cord and enters to line the anterior median sulcus. It is prolonged over the spinal nerve roots and blends with their epineurium.
- It is projected below the apex of the conus medullaris, whence it extends as **the filum terminale to perforate the spinal dura at the level of S2 vertebra. It then descends to the back of the coccyx .**
- **The filum terminale lies centrally in the cauda equina, but is not classified as part of the cauda which consists of nerve roots only.**



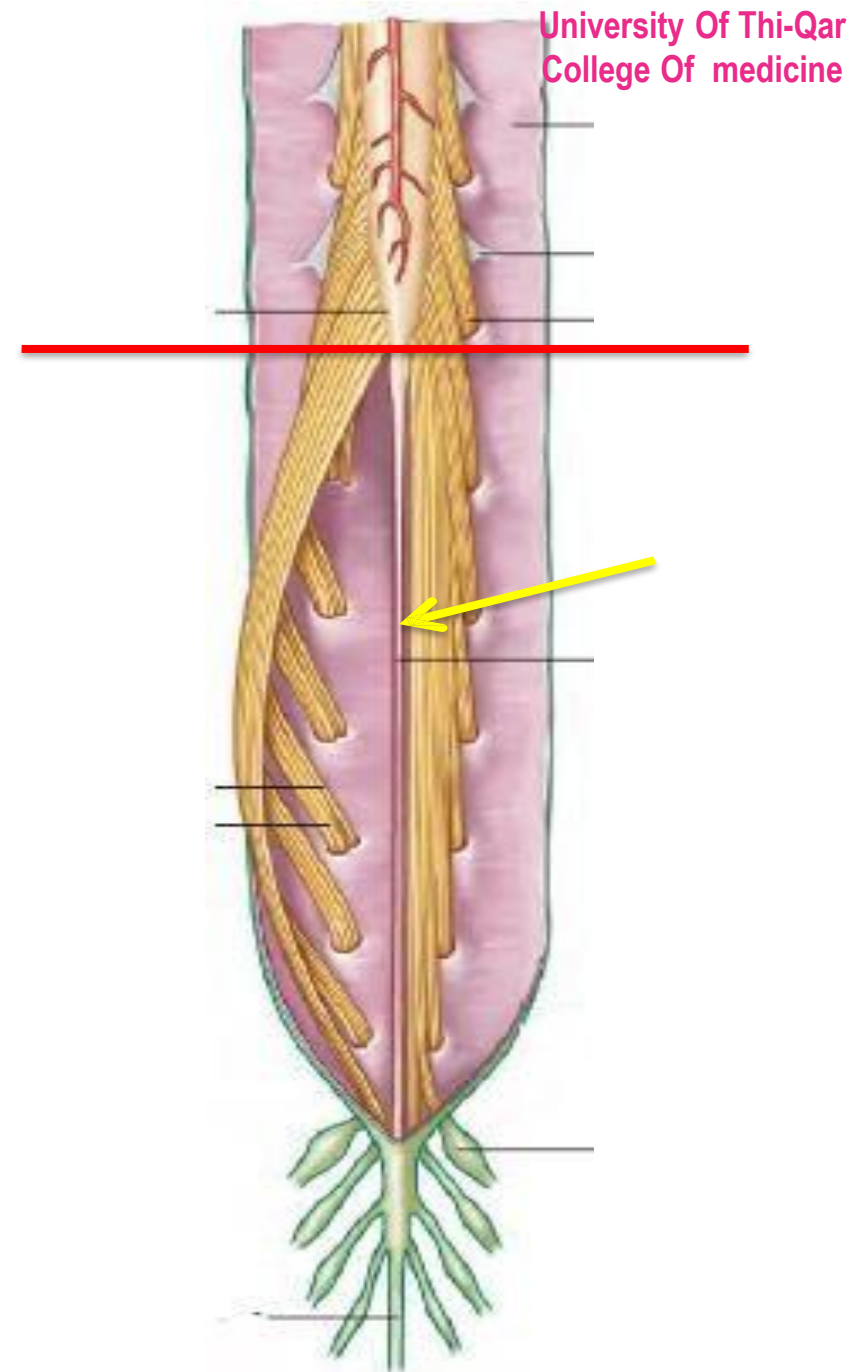
Spinal pia mater

- A lateral projection of pia mater on each side forms the **denticulate ligament**. This forms a flange which crosses the subarachnoid space and, piercing the arachnoid, **connects the side of the spinal cord to the dura mater**.
- Pia mater is attached in an unbroken line along the spinal cord from the foramen magnum to the conus medullaris, but its lateral edge is connected to the spinal dura by a series of 'teeth', which are attached to the spaces between the issuing nerve roots.
- The root of L1 lies at the lowest denticulation.
- The **denticulate ligament, filum terminale and the attached nerve roots** serve to stabilize the loose-fitting spinal cord within the spinal dura mater



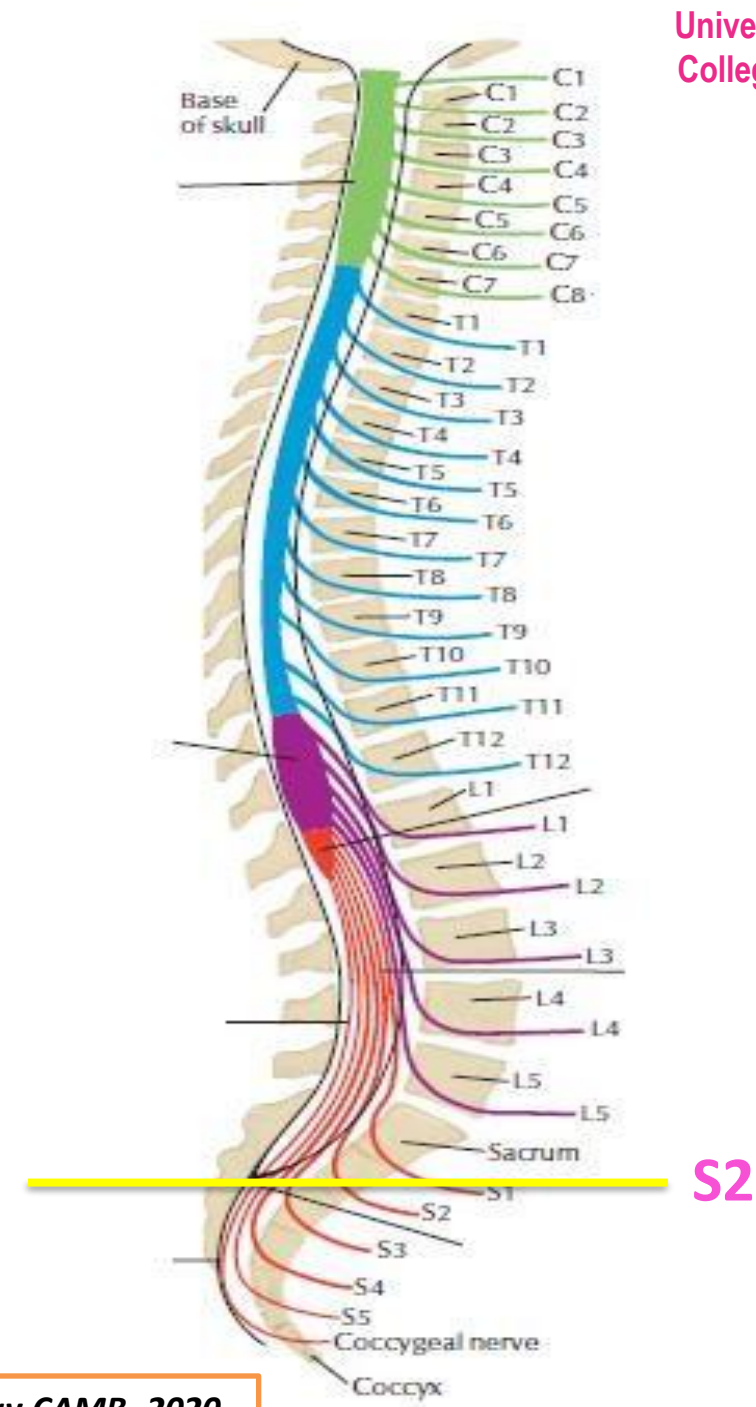
L1 / L2 level

**Arrow is on filum
terminale !**



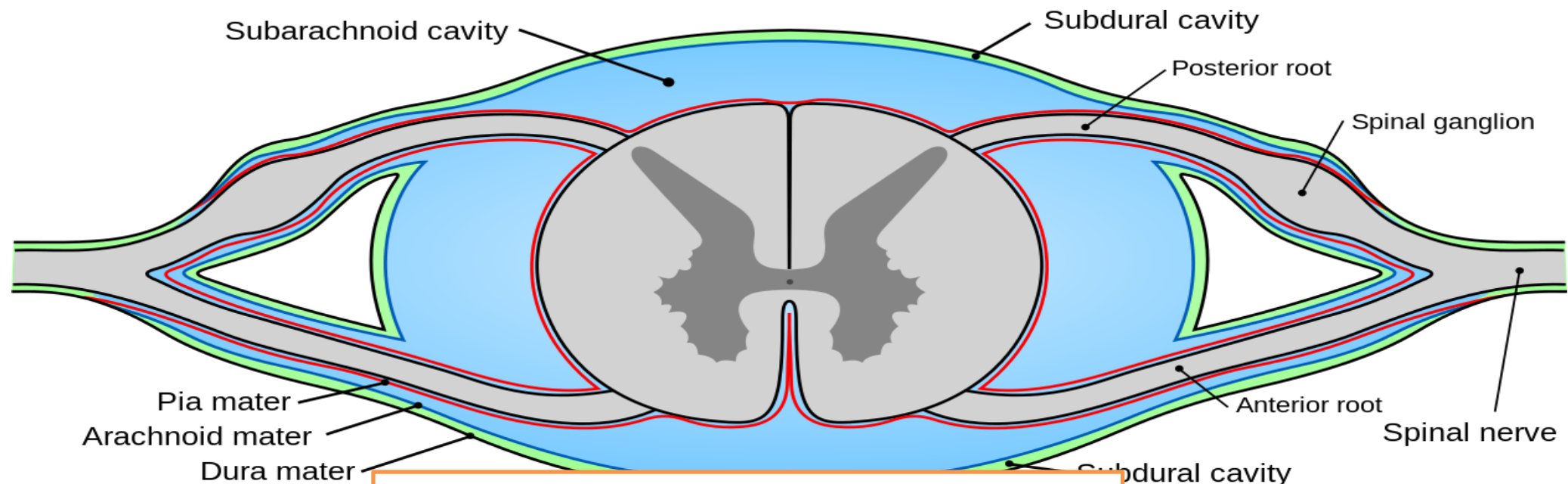
Spinal dura matter

- In summary , the stabilizing factors of theca (dura mater) in bony column ..
1. Attaching to Tectorial membrane
 2. Attaching to PLL in level of axis
 3. Segmentally piercing of anterior and posterior spinal roots in their way to pass through the intervertebral foramina.
 4. denticulum ligament
 5. Filum terminale



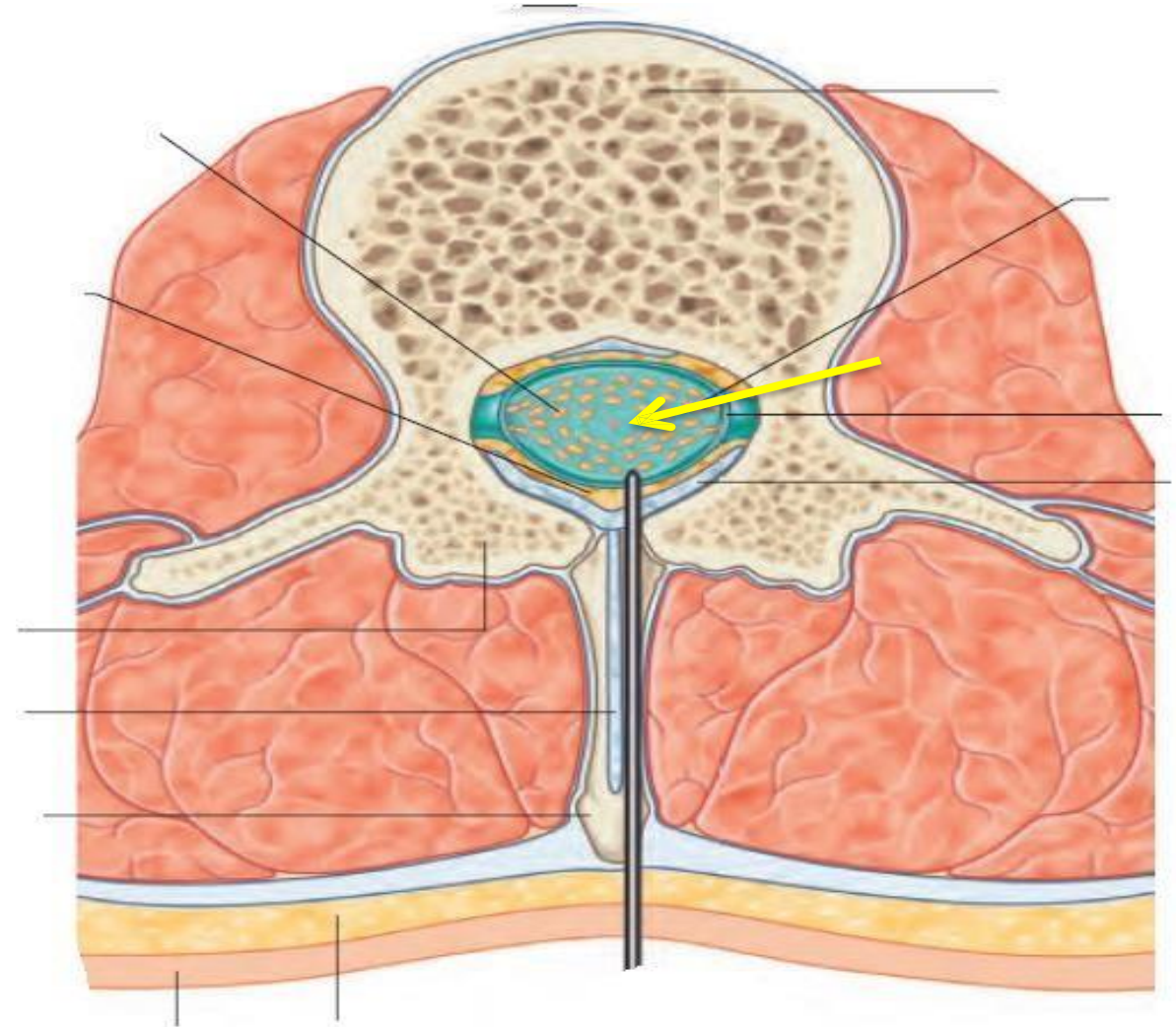
Subarachnoid space

- The spinal subarachnoid space is relatively large, **accommodating about half of the total volume of cerebrospinal fluid (75 ml out of 150 ml).**
- It communicates through the foramen magnum with the subarachnoid space of the posterior cranial fossa.
- Some cerebrospinal fluid percolates away along the meningeal sheaths of the spinal nerves.
- **Below the level of the conus medullaris it contains only the cauda equina and filum terminale, and it ends at the level of S2 vertebra.**



Lumbar puncture

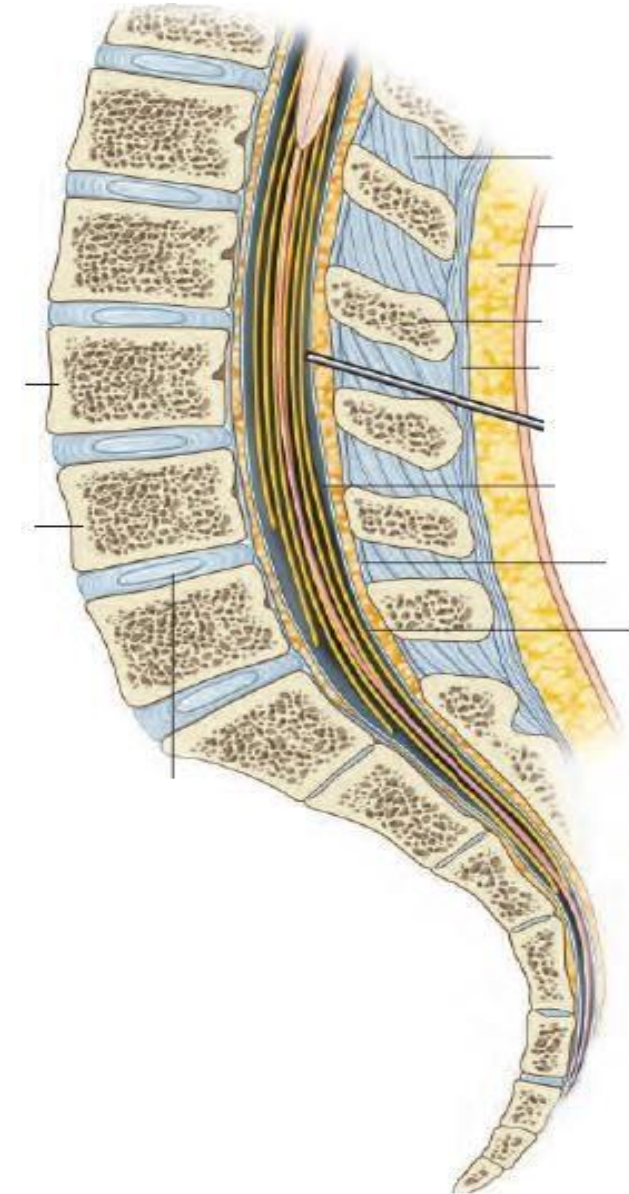
- When no spinal cord is exist !
- When the larger volume is the subarachnoid space !
- When vertebrae are flexed !



*Arrow is on filum terminale

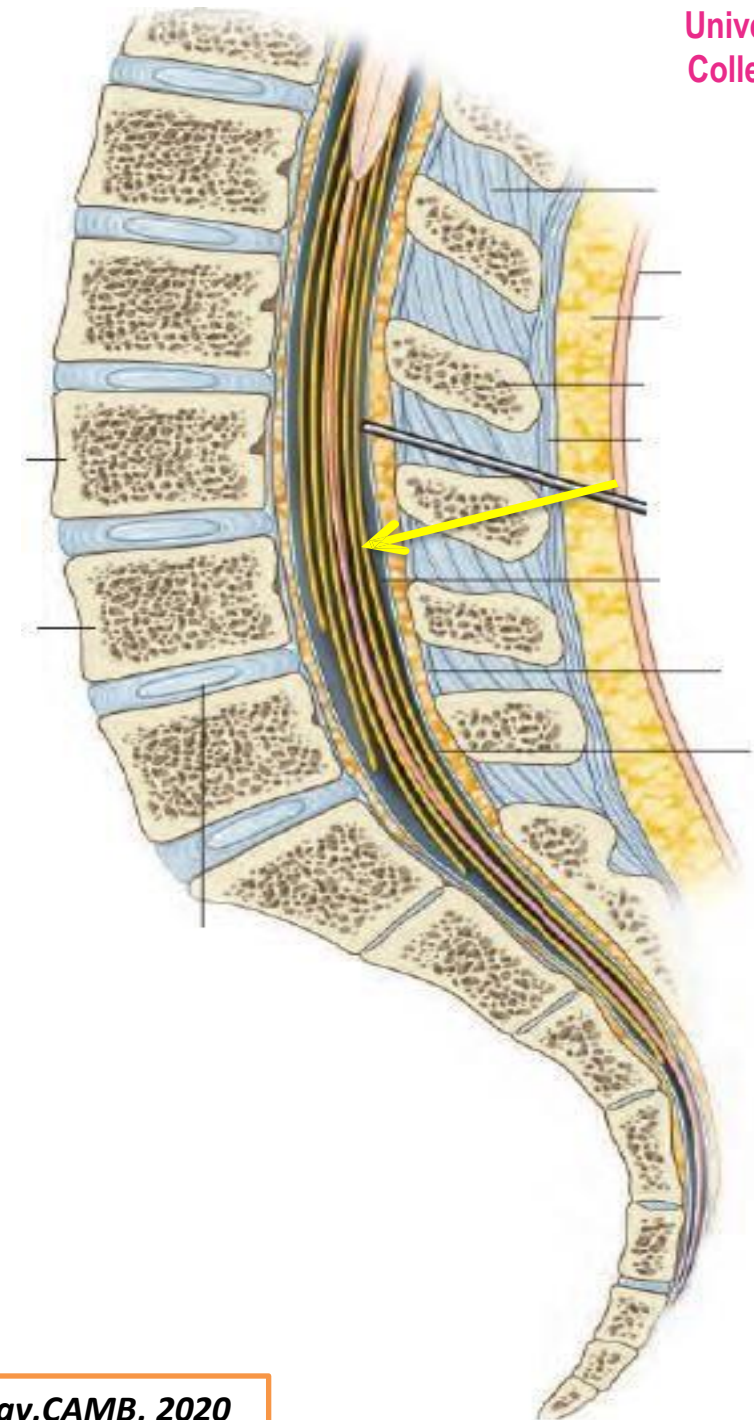
Lumbar puncture

- In lumbar puncture the needle is inserted between the spines of **L3 and L4** or **L4 and L5** vertebrae when the patient's back is flexed, usually when curled up lying on one side.
- The needle passes through the **supraspinous and interspinous ligaments and through or between ligamenta flava** before reaching the dura which is penetrated with a characteristic 'give'.
- Since the spinal cord ends at the level of L1 vertebra, it is in no danger.
- Lumbar puncture do not penetrate the posterior longitudinal ligament.



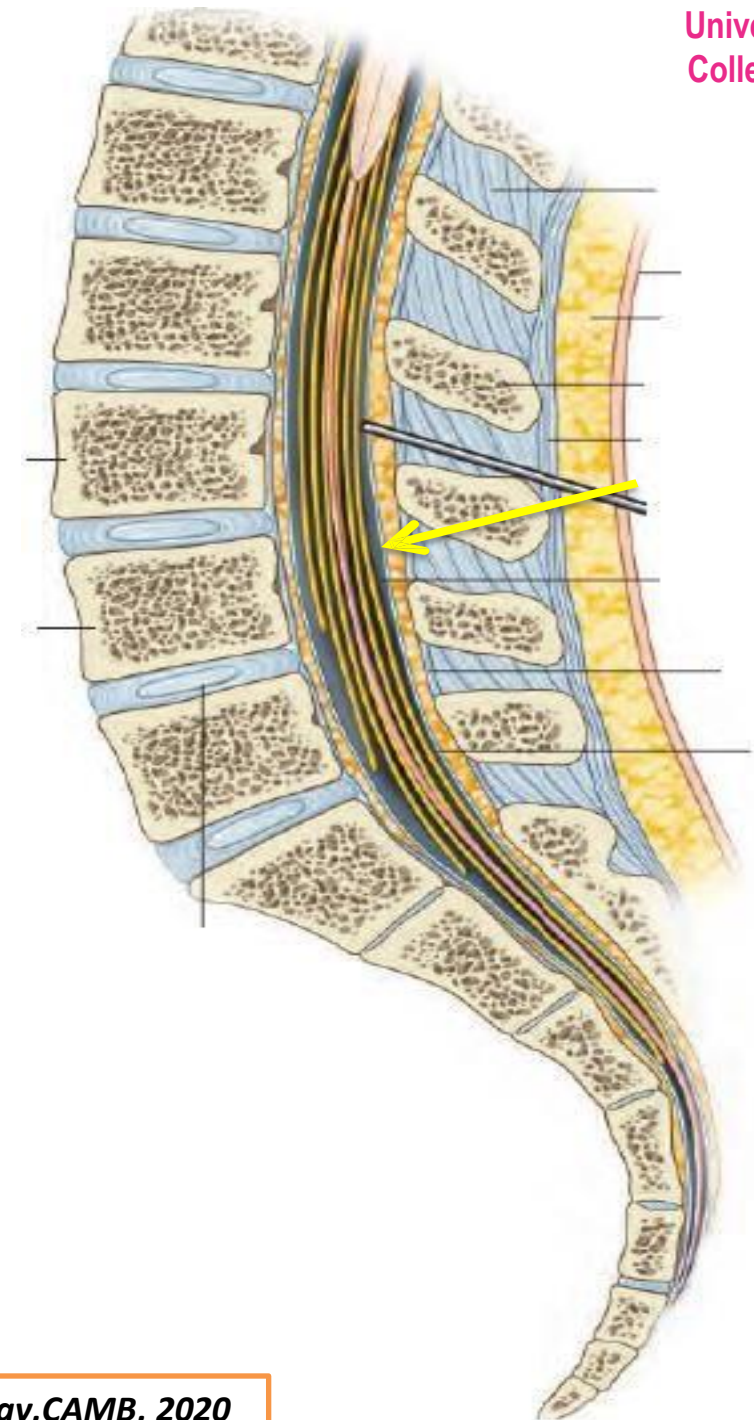
Spinal anesthesia

- In spinal anaesthesia, **the anaesthetic solution is injected into the subarachnoid space** (with the needle in a similar position to that used for lumbar puncture), so mixing with the cerebrospinal fluid surrounding the nerve roots and percolating into them



Epidural anesthesia

- In epidural anaesthesia (commonly used in child birth), **the solution is injected into the epidural (extradural) space without penetrating as far as the dura**, so that the solution can infiltrate through the meningeal sheaths containing the lumbar and sacral nerve roots.
- The approach is similar to that for lumbar puncture, but formerly (though less common now) an alternative approach was into the sacral canal through the sacral hiatus.

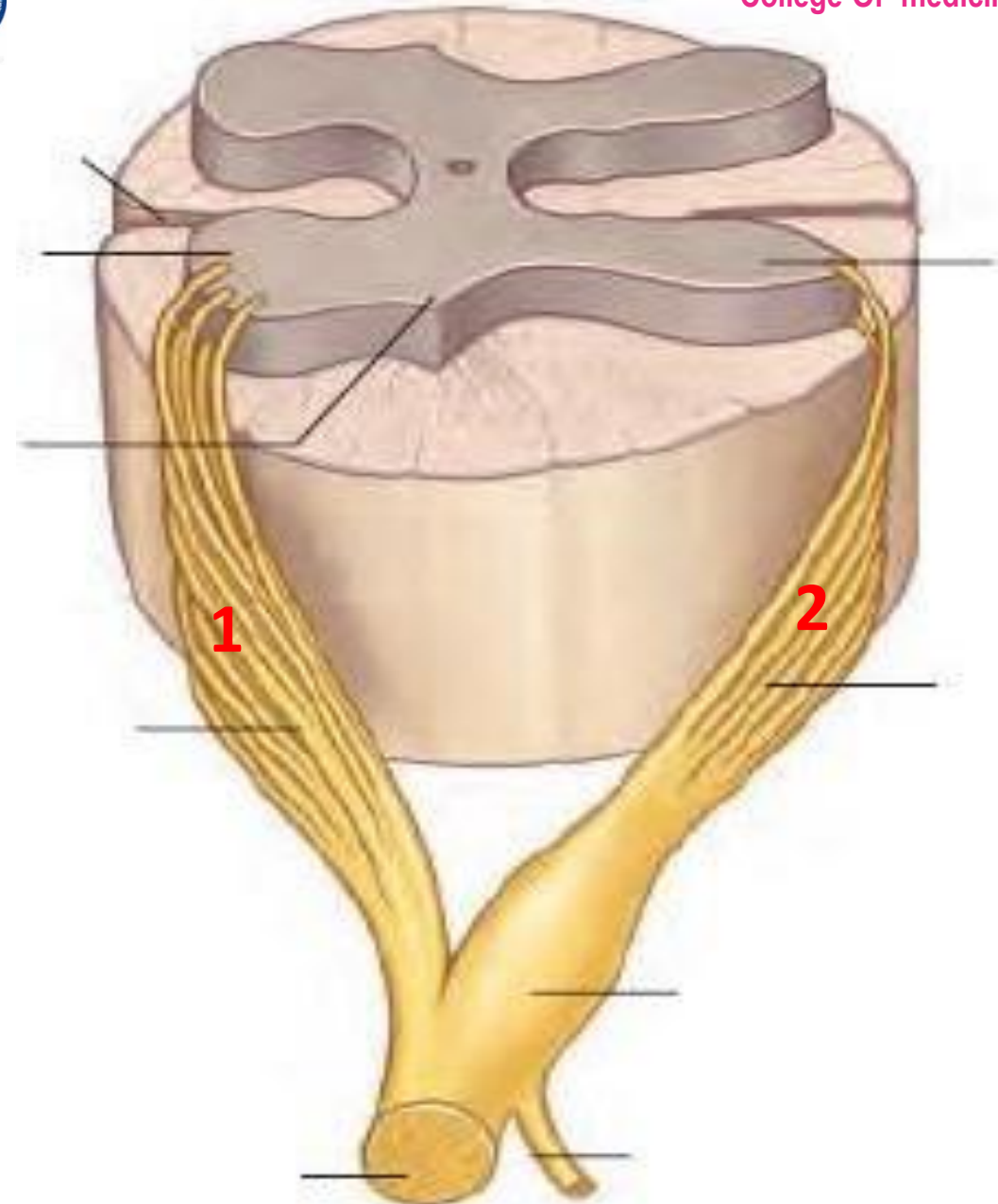


Spinal nerves roots

- No spinal nerves lie inside the spinal theca (dura) ; indeed, no nerve lies, strictly speaking, within the vertebral canal.
- The anterior and posterior roots of the spinal nerves **unite within the intervertebral foramina**.
- **Within the subarachnoid space** the nerve roots are attached to the spinal cord each by a series of **rootlets**.
- Each **anterior root** is formed by three or four rootlets which

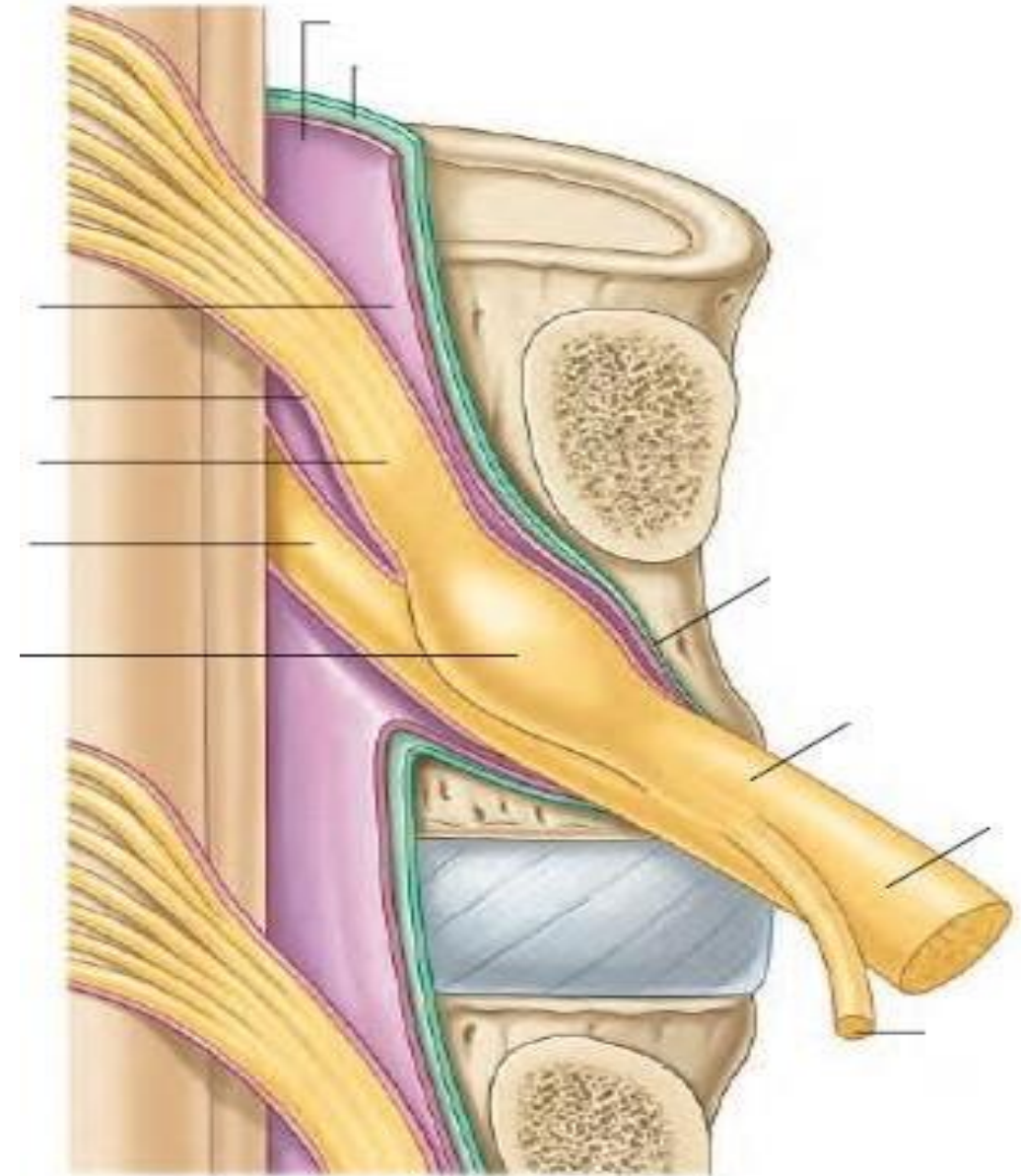
emerge irregularly along the anterolateral surface of the spinal cord. (**see 1**)

- Each **posterior root** is formed by several rootlets, attached vertically to the posterolateral surface of the cord. (**see 2**)



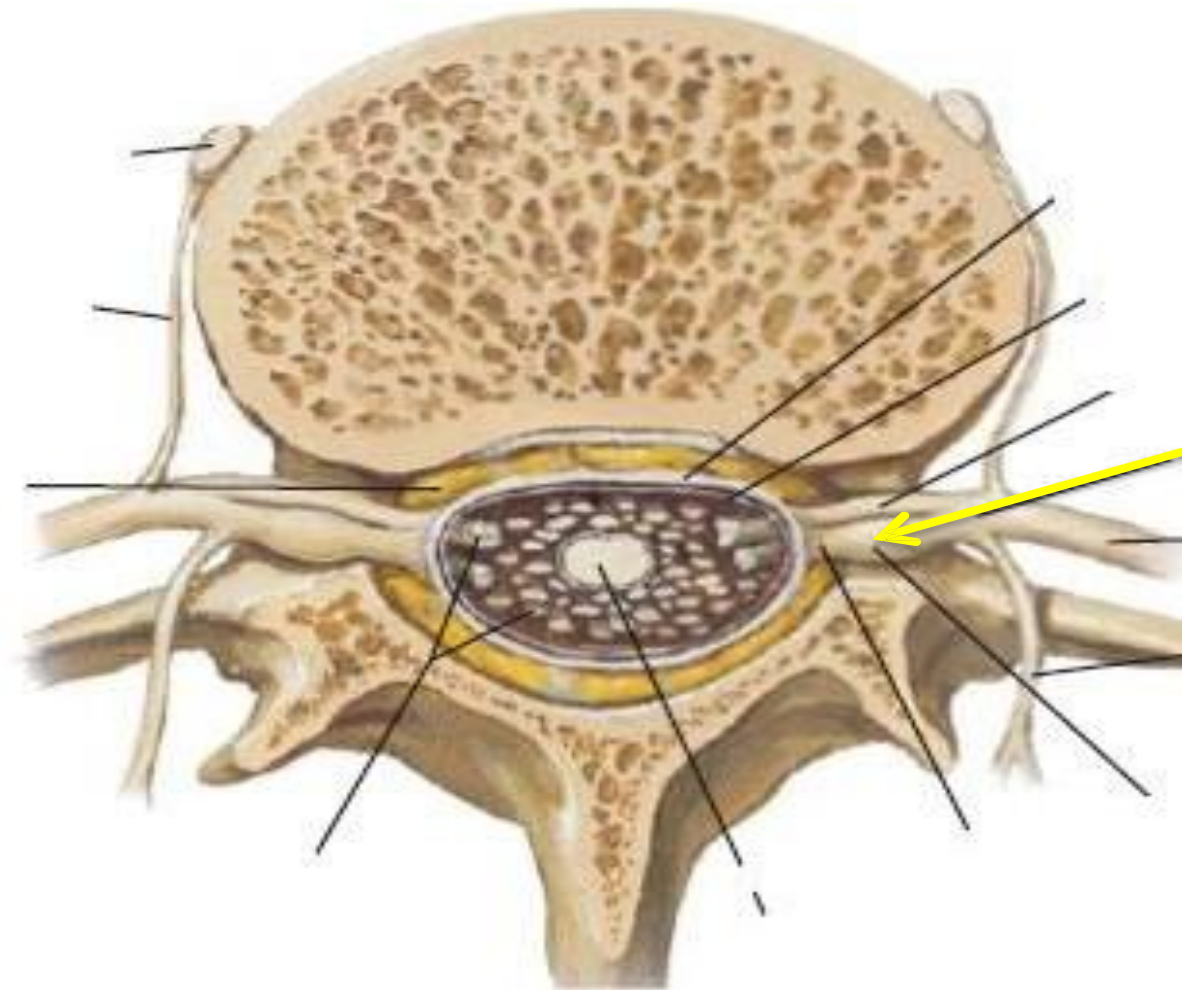
Spinal nerves roots

- The anterior and posterior roots pass from the cord to their appropriate intervertebral foramina, where **each evaginates the dura mater separately** before uniting to form the mixed spinal nerve.



Posterior root ganglion

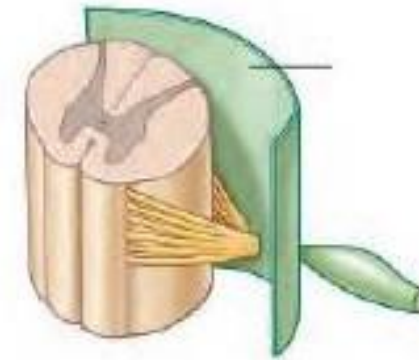
- The ganglion on the posterior nerve root **lies in the intervertebral foramen**, within the tubular evagination of dura and arachnoid immediately proximal to the point of union of anterior and posterior nerve roots.
- **the posterior root ganglia of cervical nerves lie just lateral to the intervertebral foramina, in contact with the vertebral artery !!**



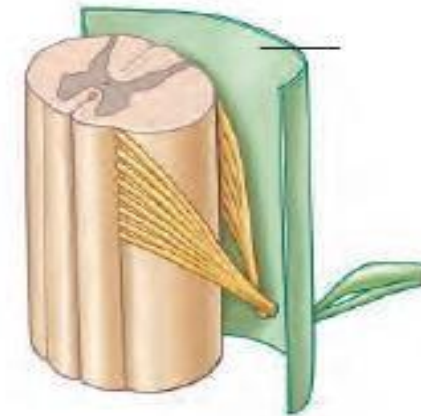
Spinal nerves roots

- all levels from C1 to L1 vertebrae the anterior and posterior nerve roots **pass in front of and behind the denticulate ligament** respectively, and evaginate the dura mater between the denticulations
 - In conformity with the shortness of the spinal cord, **the lower a nerve root the more steeply it slopes down to the intervertebral foramen.**
- The upper cervical roots are horizontal, the upper thoracic roots first slope down to their point of evagination of the meninges only to become kinked upwards at an angle to reach their foramen

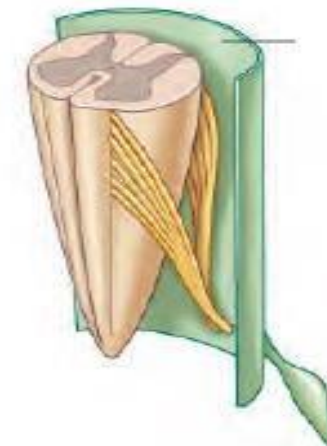
C1



T1



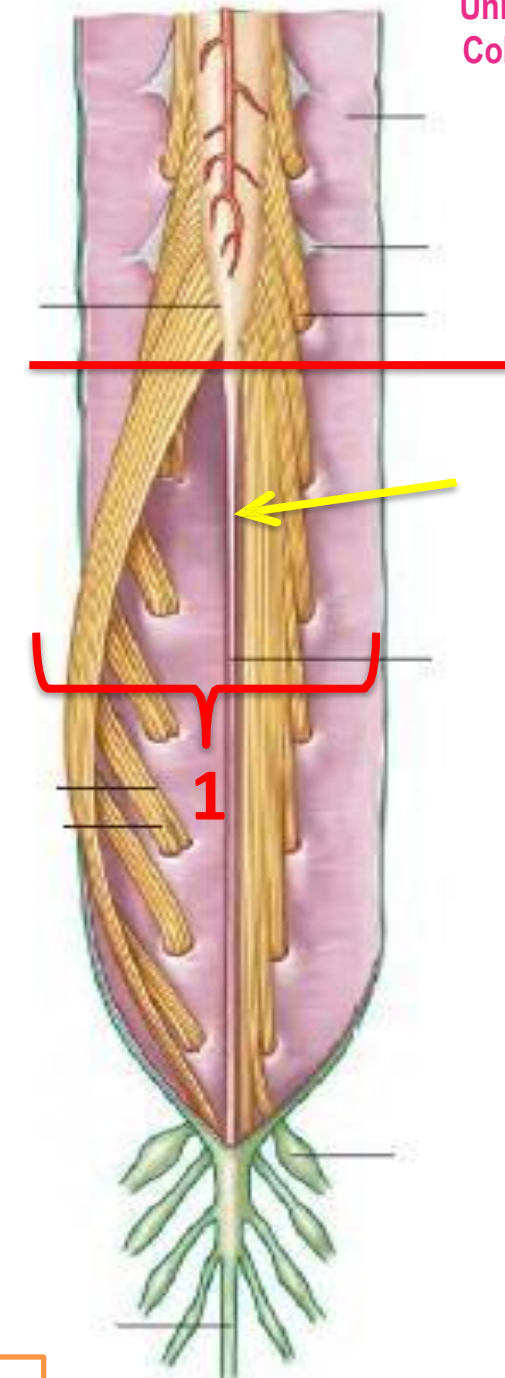
L1



Spinal nerves roots

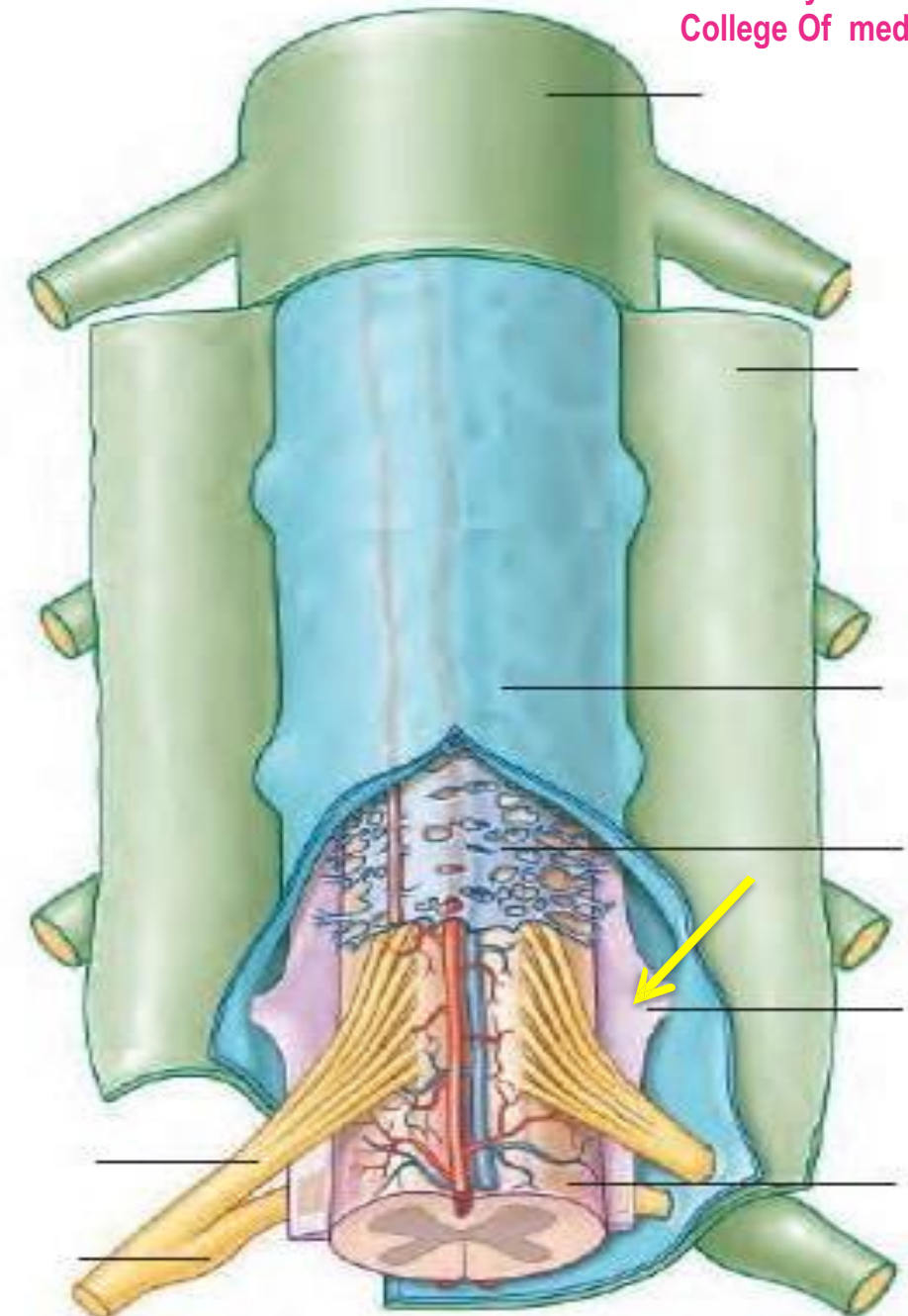
- Below L1 vertebra the roots pass almost vertically downwards through the subarachnoid space, forming the **cauda equina (1)**
- note that this consists NOT of spinal nerves but of nerve roots.
- The **filum terminale (pia matter's derivatives) (arrow)** extends down from the tip of the conus medullaris among the nerve roots of the cauda (but is not classified as part of the cauda).
- The roots of the spinal part of the accessory nerve emerge from the lateral surface of the upper five or six segments of the cord, **behind the denticulate ligament**. They unite into a single trunk which passes upwards through the foramen magnum into the cranium to join the cranial root

L1 / L2 level



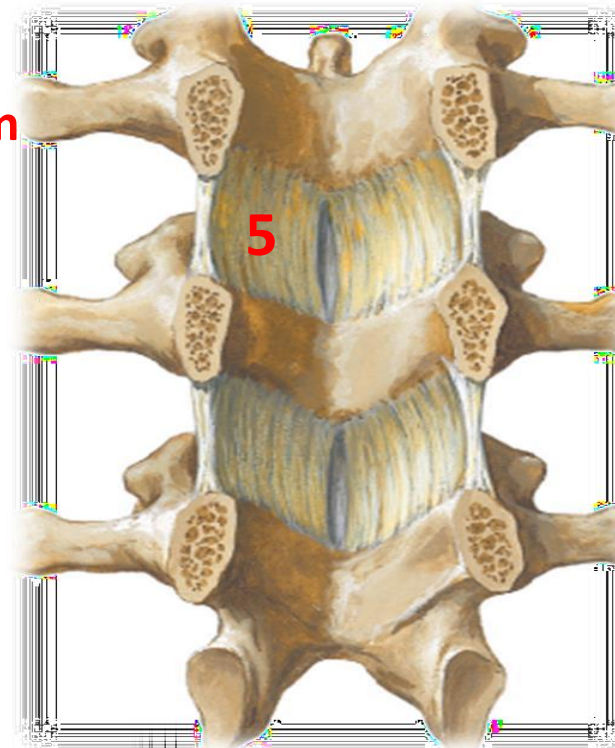
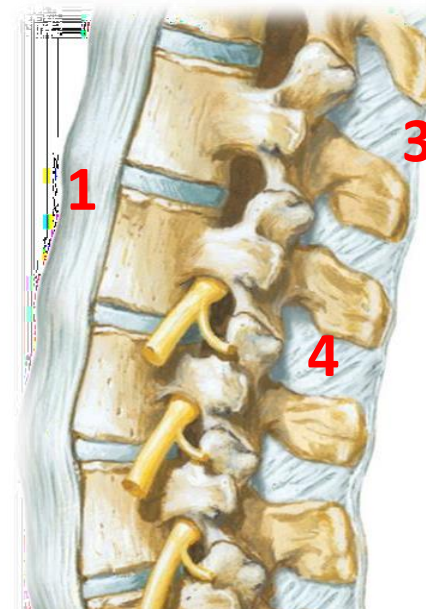
Remember !

- all levels from C1 to L1 vertebrae the anterior and posterior nerve roots **pass in front of and behind the denticulate ligament** respectively, and **evaginate the dura mater between the denticulations.**
- The roots of the spinal part of the accessory nerve emerge from the lateral surface of the upper five or six segments of the cord, **behind the denticulate ligament.**



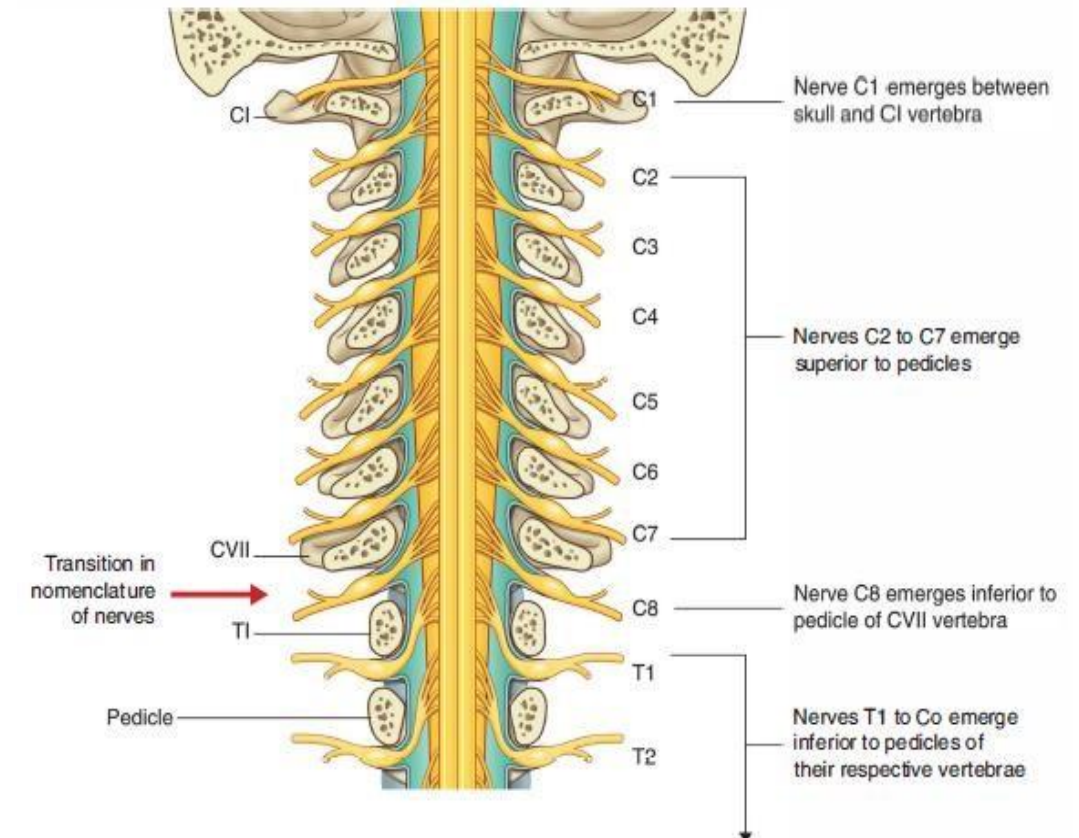
Important ligaments in the spine

1. Anterior longitudinal ligament (ALL)
2. Posterior longitudinal ligament (PLL)
3. Supraspinous ligament
4. Intraspinous ligament
5. Ligamentum flavum (between pedicles - between spinous and transverse processes)



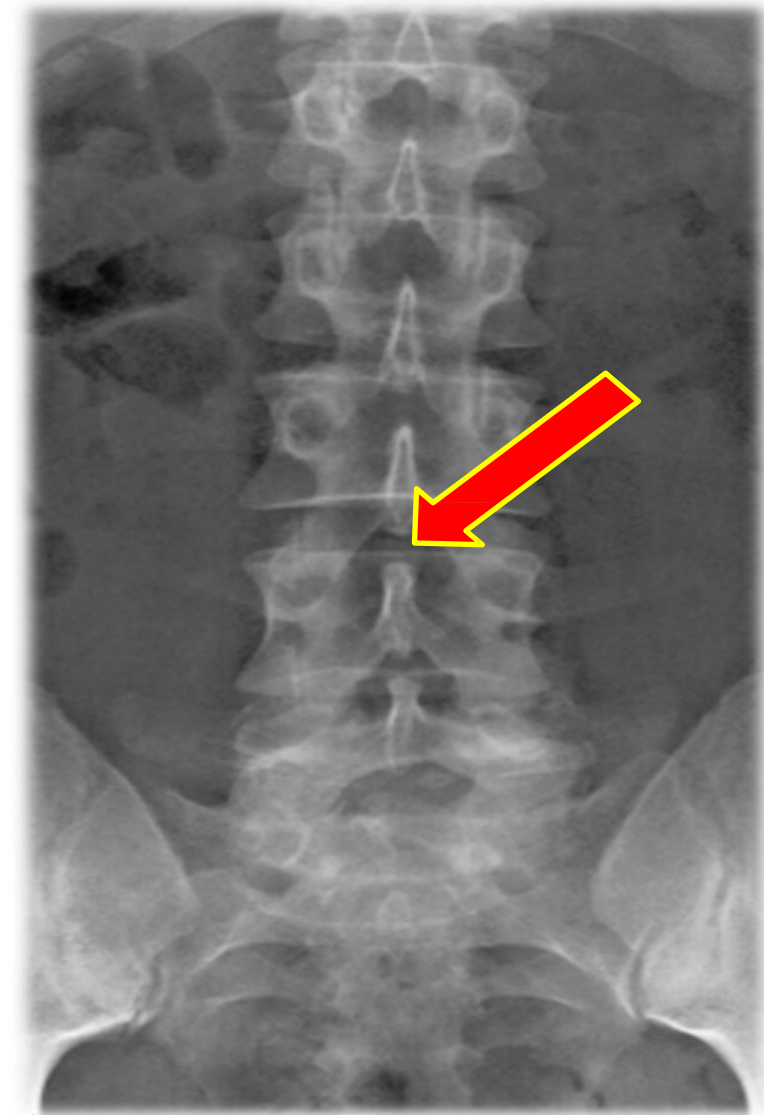
Nomenclature of spinal nerves

- Notice this C1 nerve root exit above C1 vertebra
- C8 nerve root exit below C7 vertebra
- Also, T1 nerve root exit below T1 vertebra



Quiz

- If there is herniation for nucleus pulposus in the level showed by the arrow , which nerve root will be affected ?!
- Answer is **L3**





Thank you



Done by
Dr. Rafid Remthan AL-Temimi, Clinical Radiology ,CAMB ,DMRD,MBCHB,

