MENINGES

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CNS

- The **Central Nervous System** (**CNS**) is the part of the nervous system consisting of the center most region of nervous system the body.
- The central nervous system is so named because it integrates information it receives from, and coordinates and influences the activity of, all parts of the bodies.
- The central nervous system consists of the two major structures: the brain and spinal cord.

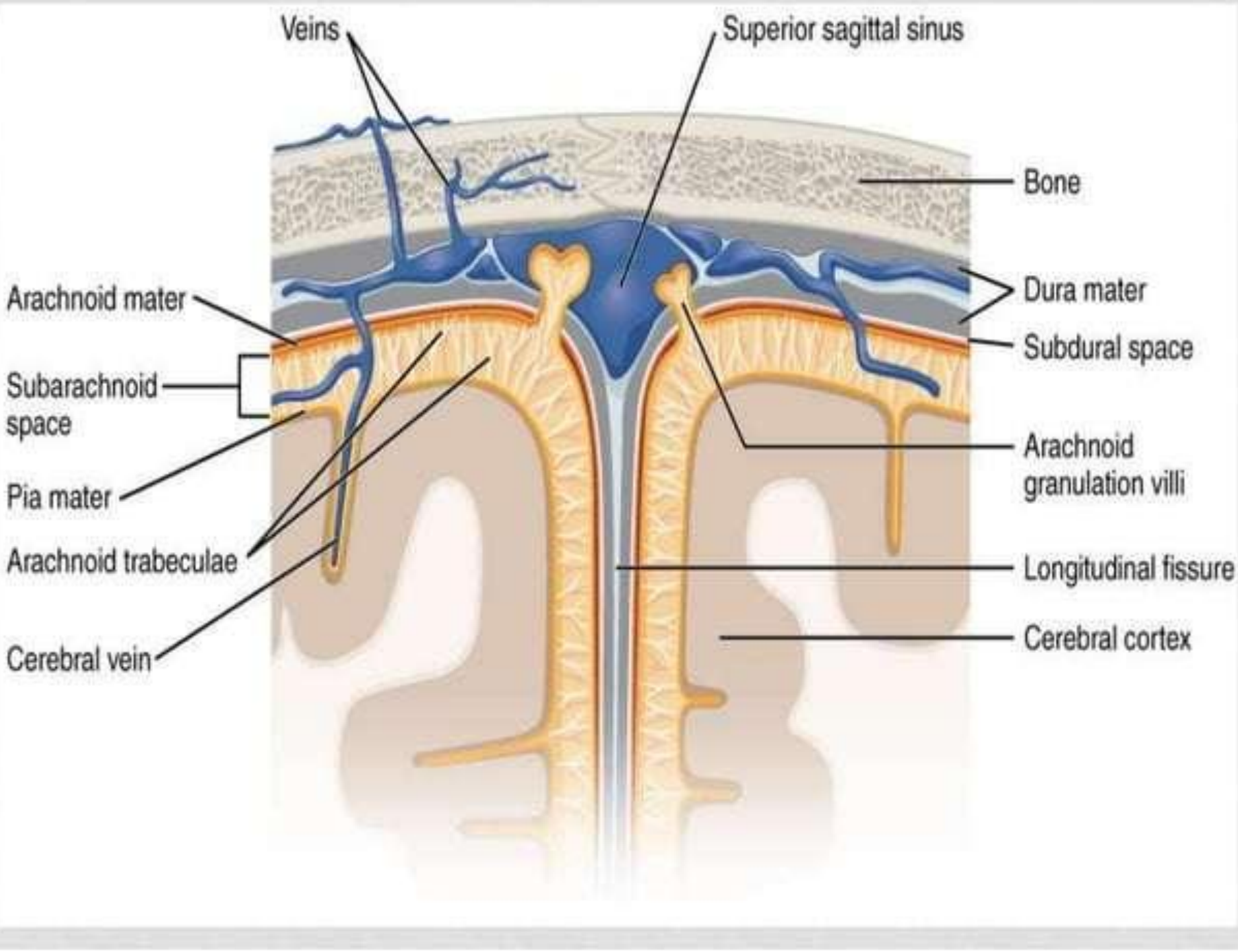
STRUCTURE

- The brain is encased in the skull, and protected by the cranium & the spinal cord is in continuous with the brain and lies caudally to the brain, and is protected by the vertebrae.
- The spinal cord reaches from the base of the skull, continues through or starting below the foramen magnum, and terminates roughly level with the first or second lumbar vertebra, occupying the upper sections of the vertebral canal.

MENINGES

- It is a Greek word, meaning 'membrane'.
- It is the plural form of **meninx.**
- These meninges consist of fibroblasts and collagen fibrils.
- Basically, **meninges** are the three membranes that envelop the brain and spinal cord.
- Thus, the brain and spinal cord are covered and protected by three layers of tissue called **meninges**.

Meninges → Dura mater
Meninges → Arachanoid mater
Meninges → Pia mater

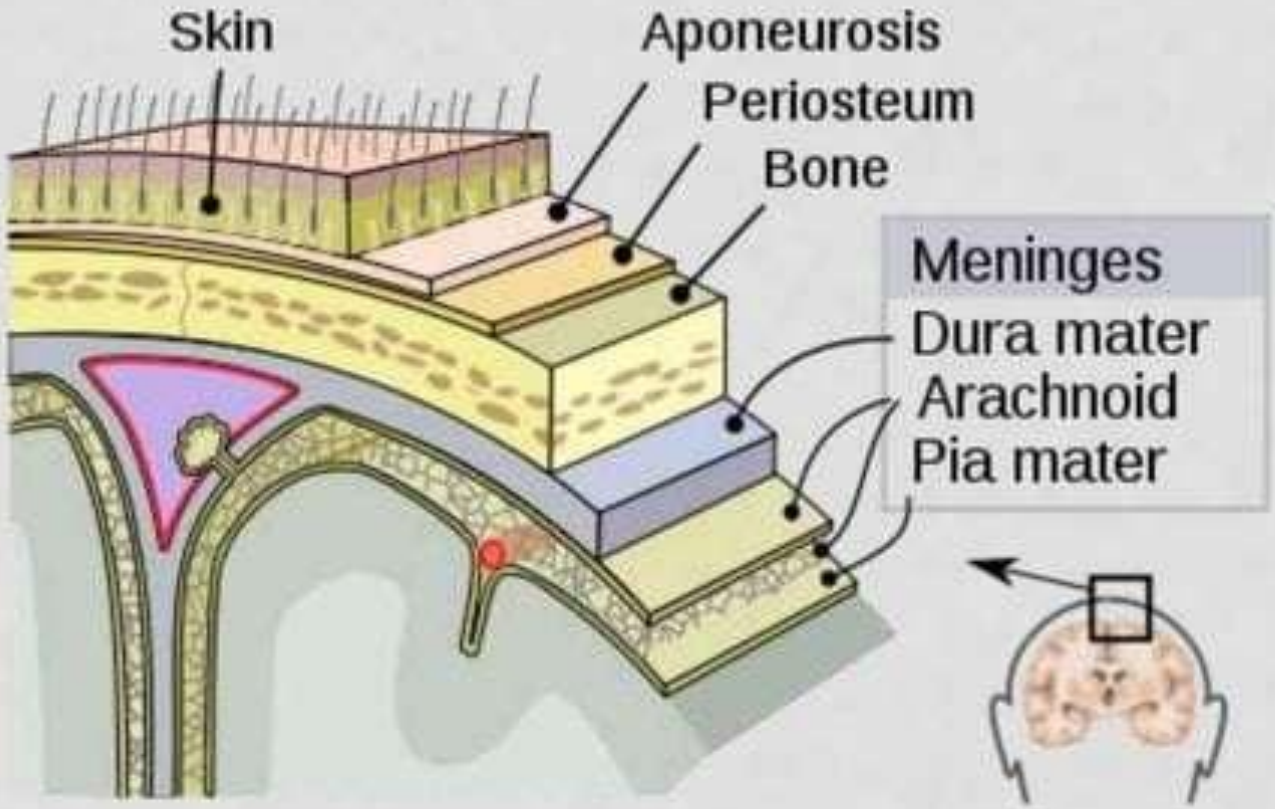

Veins
Superior sagittal sinus
Bone
Dura mater
Subdural space
Arachnoid mater
Subarachnoid space
Pia mater
Arachnoid trabeculae
Cerebral vein
Arachnoid granulation villi
Longitudinal fissure
Cerebral cortex

- But there are several differences in the meninges covering the brain and spinal cord.
- **Like-** the amount of collagen varies in different meningeal layers. **For example**, the dura mater contains copious amounts of collagen fibrils, whereas the arachnoid mater has no collagen.

- From the outermost layer of meninges, from inward they are: the dura mater, arachnoid mater, and pia mater.

Function- Its function is to protect the central nervous system.

LAYERS OF MENINGES



1. DURA MATER

- The dura mater is a Latin word meaning 'tough mother' or hard & and inflexible.
- It is also called as '**meninx fibrosa**' or '**pachymeninx**'.
- It is the outermost part, thick & durable membrane, closest to the skull and vertebrae.
- And is made up of loosely arranged, fibro-elastic layer of cells. But its middle region is a mostly fibrous portion.
- It is characterized by- multiple interdigitating (interlock like the fingers) cell processes,
  - no extracellular collagen, and
  - significant extracellular spaces.
- It consists of two layers:

- Its two layers, the periosteal dura and meningeal dura, are fused and separate to form venous sinuses.

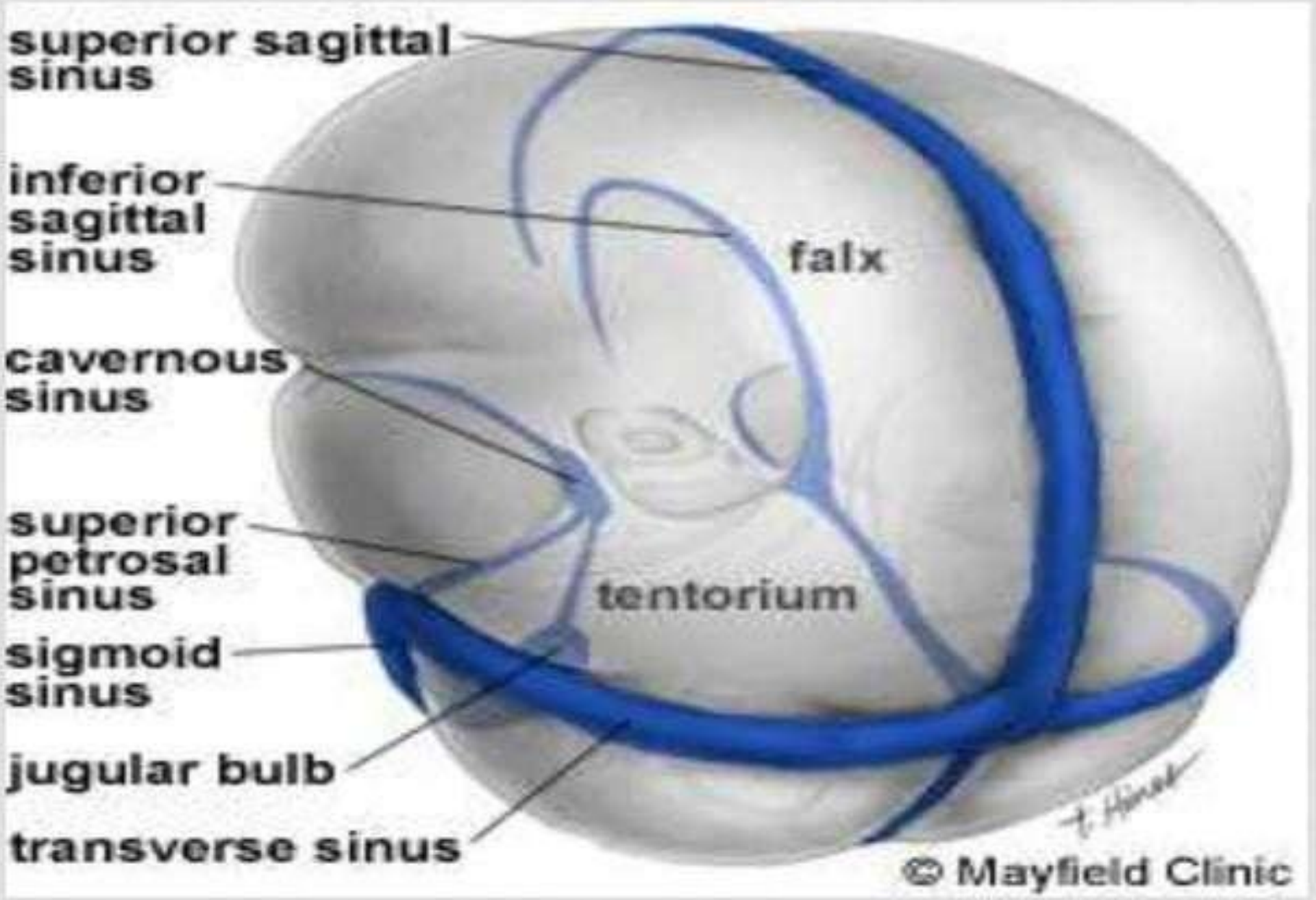
Layers of dura
- Periosteal dura
- Meningeal dura

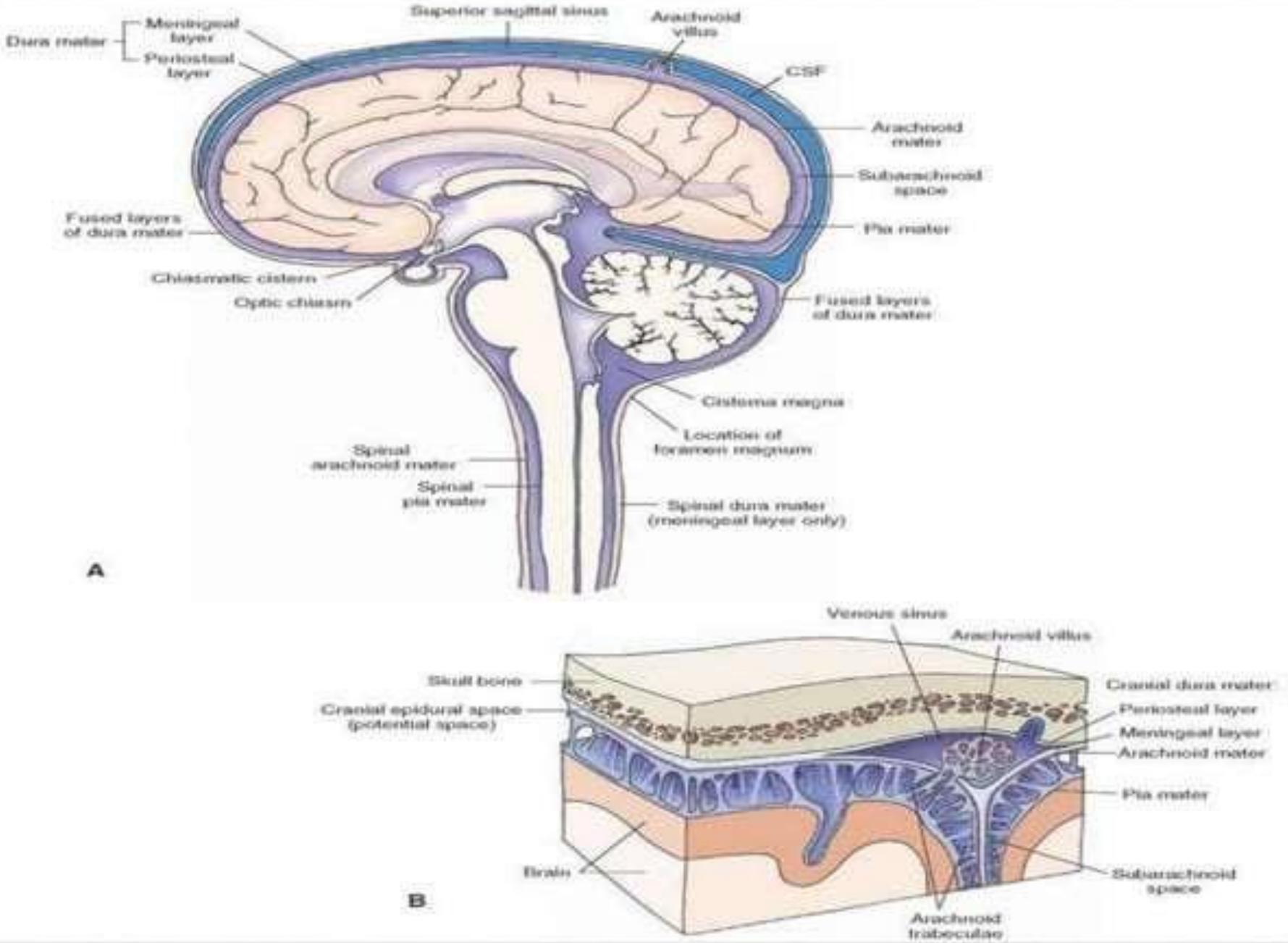
- The dura creates two little folds or compartments.

Two special dural folds
- Falx (The falx separates the right and left hemispheres of the brain).
- Tentorium (The tentorium separates the cerebrum from the cerebellum).

FUNCTION

- Dura mater forms several structures that separate the cranial cavity into compartments and protect the brain from displacement.
  - The **falx cerebri** (separates the hemispheres of the cerebrum).
  - The **falx cerebelli** (separates the lobes of the cerebellum).
  - The **tentorium cerebelli** (separates the cerebrum from the cerebellum).
- The dura mater also forms several vein-like sinuses that carry blood (which has already given its supply of oxygen and nutrients to the brain) back to the heart.

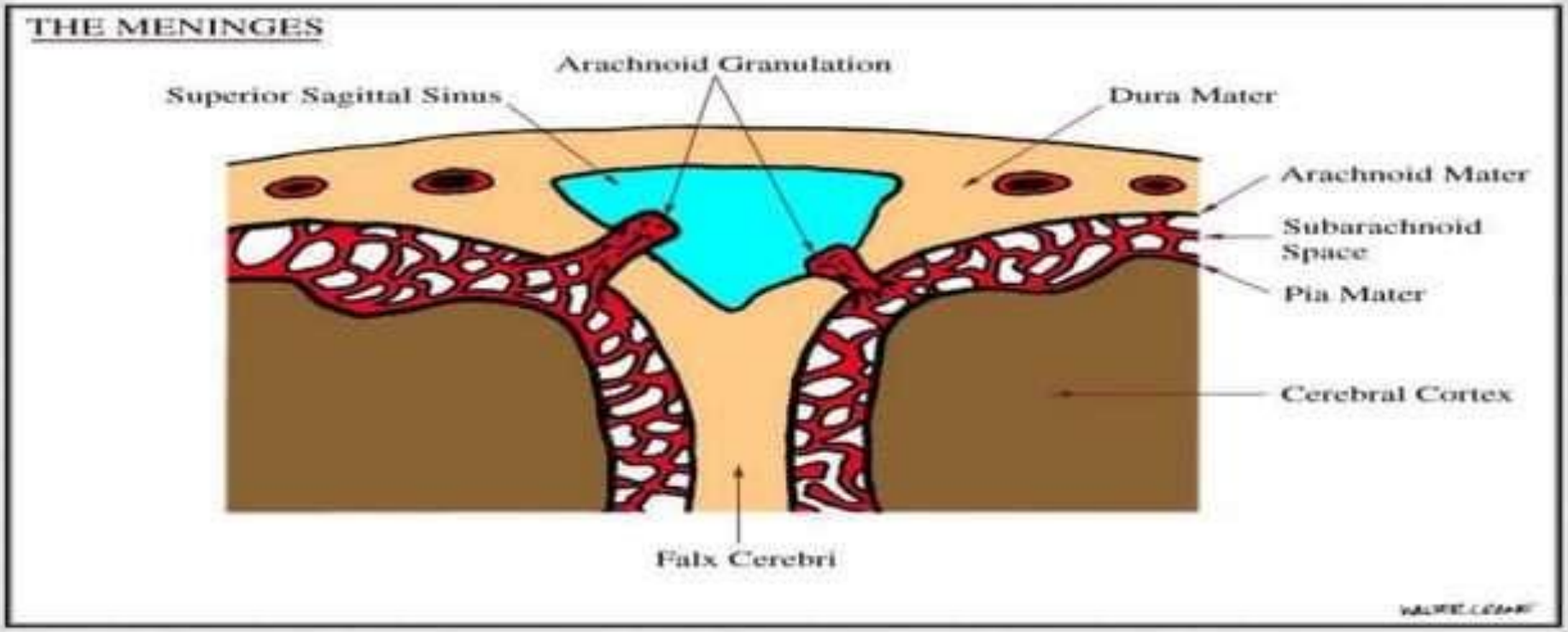

superior sagittal sinus
inferior sagittal sinus
falx
cavernous sinus
superior petrosal sinus
tentorium
sigmoid sinus
jugular bulb
transverse sinus
© Mayfield Clinic


Dura mater
Meningeal layer
Periosteal layer
Superior sagittal sinus
Arachnoid villus
CSF
Arachnoid mater
Subarachnoid space
Pia mater
Fused layers of dura mater
Chiasmatic cistern
Optic chiasm
Fused layers of dura mater
Cisterna magna
Location of foramen magnum
Spinal arachnoid mater
Spinal pia mater
Spinal dura mater (meningeal layer only)
A
Venous sinus
Arachnoid villus
Skull bone
Cranial epidural space (potential space)
Cranial dura mater
Periosteal layer
Meningeal layer
Arachnoid mater
Pia mater
Brain
Subarachnoid space
Arachnoid trabeculae
B

- The **epidural space** is a **potential space** between the dura mater and the skull. (If there is hemorrhaging in the brain, blood may collect here. Adults are more likely than children to bleed here as a result of closed head injury.)
- The **subdural space** is another **potential space.** It is between the dura mater and the middle layer of the meninges, the arachnoid mater. (When bleeding occurs in the cranium, blood may collect here and push down on the lower layers of the meninges. If bleeding continues, brain damage will result from this pressure. Children are especially likely to have bleeding in the subdural space in cases of head injury.)

2. ARACHNOID MATER

- The arachnoid mater is a middle thin, spider web-like membrane that covers the entire brain.
- The term arachnoid refers to the spider web like appearance of the blood vessels within the space.
- The arachnoid is made of flat elastic tissue which is impermeable to fluid.
- It looks like a loosely fitting sac.
- In some areas, it projects into the sinuses (cavity) formed by the dura mater.
- These projections are the **arachnoid granulation/ arachnoid villi**.



- The **subarachanoid space** lies between the arachnoid and pia mater. It is filled with cerebrospinal fluid. All blood vessels entering the brain, as well as cranial nerves pass through this space. **Function-** They transfer cerebrospinal fluid from the ventricles back into the bloodstream.

3. PIA MATER

- The pia mater is a Latin word meaning tender mother or soft mother.
- It is a very delicate & the innermost membrane.
- It is the meningeal envelope that firmly adheres to the surface of the brain and spinal cord, following all of the brain's outlines (the gyri and sulci).
- It is a very thin membrane composed of fibrous tissue covered on its outer surface by a sheet of flat cells thought to be impermeable to fluid.
- The pia mater is pierced by blood vessels to the brain and spinal cord, and its capillaries nourish the brain.

- Unlike the other layers, this tissue adheres closely to the brain, running down into the sulci and fissures of the cortex.
- It fuses with the **ependyma**, the membranous lining of the ventricles to form structures called the **choroid plexes** which produce cerebrospinal fluid.

LEPTOMENINGES

- The arachnoid and pia mater together are sometimes called the leptomeninges, which means "thin meninges" (Greek: leptos - thin).
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SPACES

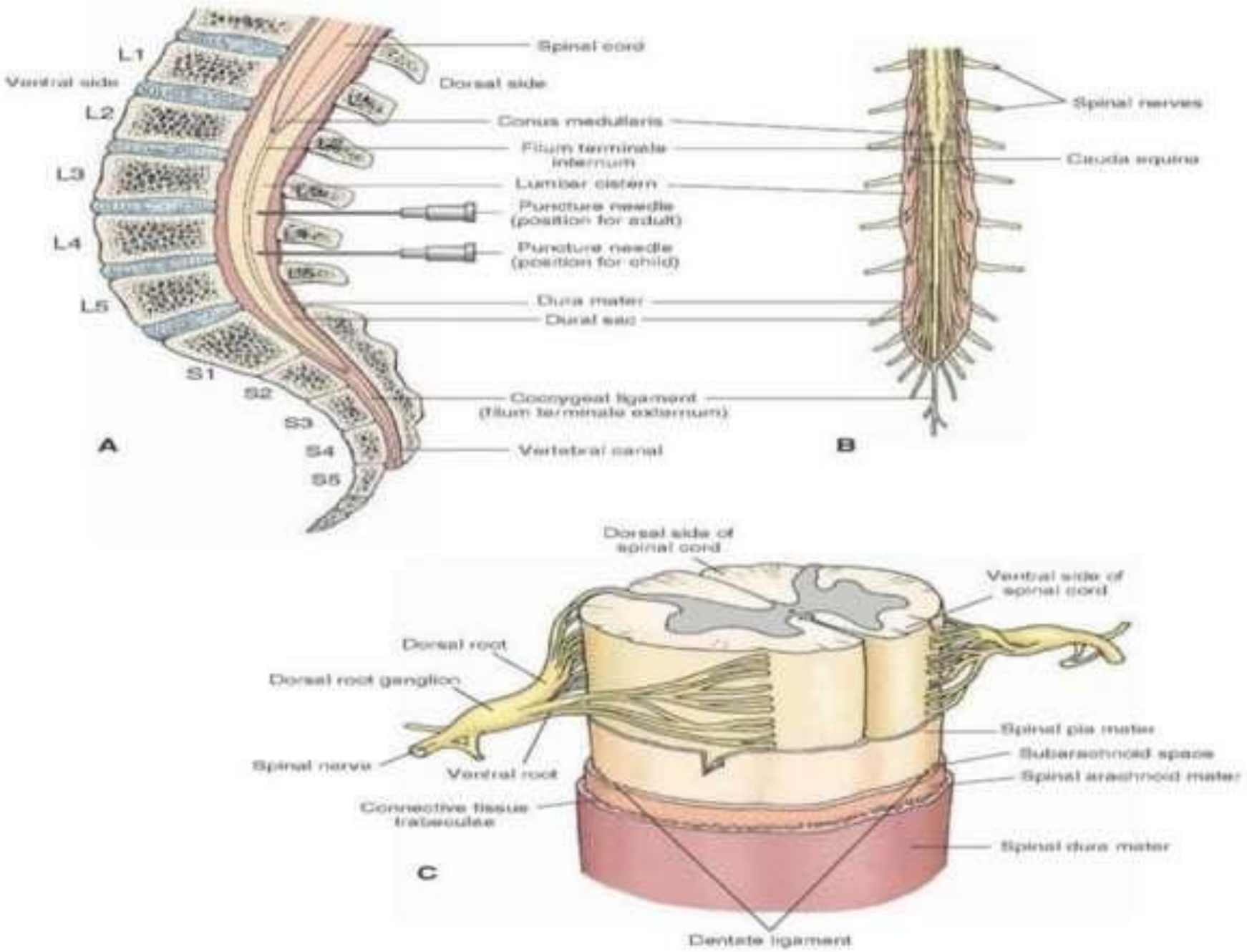
- The **subarachnoid space** is the space between the arachnoid and the pia mater, which is filled with cerebrospinal fluid.
- The **epidural space** is a **potential space** between the dura mater and the skull. The **subdural space** is between the dura mater and the middle layer of the meninges, the arachnoid mater. The dura mater is attached to the skull, whereas in the spinal cord, the dura mater is separated from the bone (vertebrae) by a space called the epidural space, which contains fat and blood vessels. The arachnoid is attached to the dura mater.
- There is a **subpial space** underneath the pia mater that separates it from the glia limitans.

SPINAL DURA MATER

- **The spinal dura mater consists of only the meningeal** layer and lacks the periosteal layer of the cranial dura.
- The spinal dura joins the meningeal layer of the cranial dura at the margins of the foramen magnum.
- The spinal epidural space separates the spinal dura from the periosteum of the vertebra and is filled with fatty connective tissue and plexuses of veins.
- Caudally, the spinal dura ends at the level of the second sacral vertebra.
- As mentioned earlier, at this level, it becomes a thin extension (the coccygeal ligament or filum termi-nale externum) and serves to anchor the fluid-filled spinal dural sac to the base of the vertebral canal.

SPINAL ARACHNOID MATER

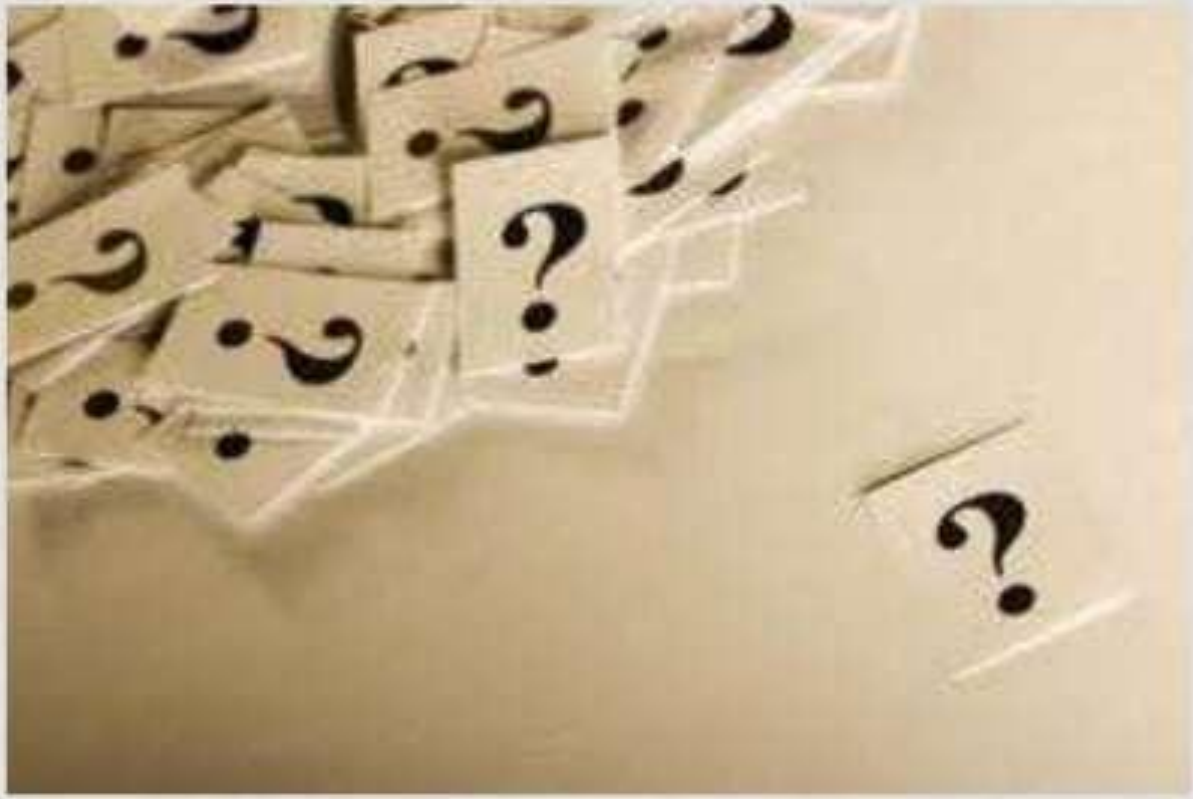
- The spinal arachnoid mater invests the spinal cord and is connected to the dura via connective tissue trabeculae (line) (Fig. C).
- It passes through the foramen magnum to join the cranial arachnoid, and caudally it surrounds the cauda equina.
- The cauda equina consists of a bundle of nerve roots of all the spinal nerves caudal to the second lumbar vertebra (Fig. B).


L1
Ventral side
L2
L3
L4
L5
S1
S2
S3
S4
S5
A
Spinal cord
Dorsal side
Conus medullaris
Filum terminale internum
Lumbar cistern
Puncture needle (position for adult)
Puncture needle (position for child)
Dura mater
Dural sac
Coccygeal ligament (filum terminale externum)
Vertebral canal
B
Spinal nerves
Cauda equina
Dorsal side of spinal cord
Ventral side of spinal cord
Dorsal root
Dorsal root ganglion
Spinal nerve
Ventral root
Spinal pia mater
Subarachnoid space
Spinal arachnoid mater
Connective tissue trabeculae
Spinal dura mater
C
Dentate ligament

SPINAL PIA MATER

- The spinal pia mater (Fig. C) is thicker than the cranial pia mater.
- It is a vascular membrane and projects into the ventral fissure of the spinal cord.
- At intervals, toothed ligaments of pia tissues, called dentate ligaments, extend from the lateral surfaces of the spinal cord; these ligaments serve to anchor the spinal cord to the arachnoid and the inner surface of the dura.

ANY QUERY???????????




Thank
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