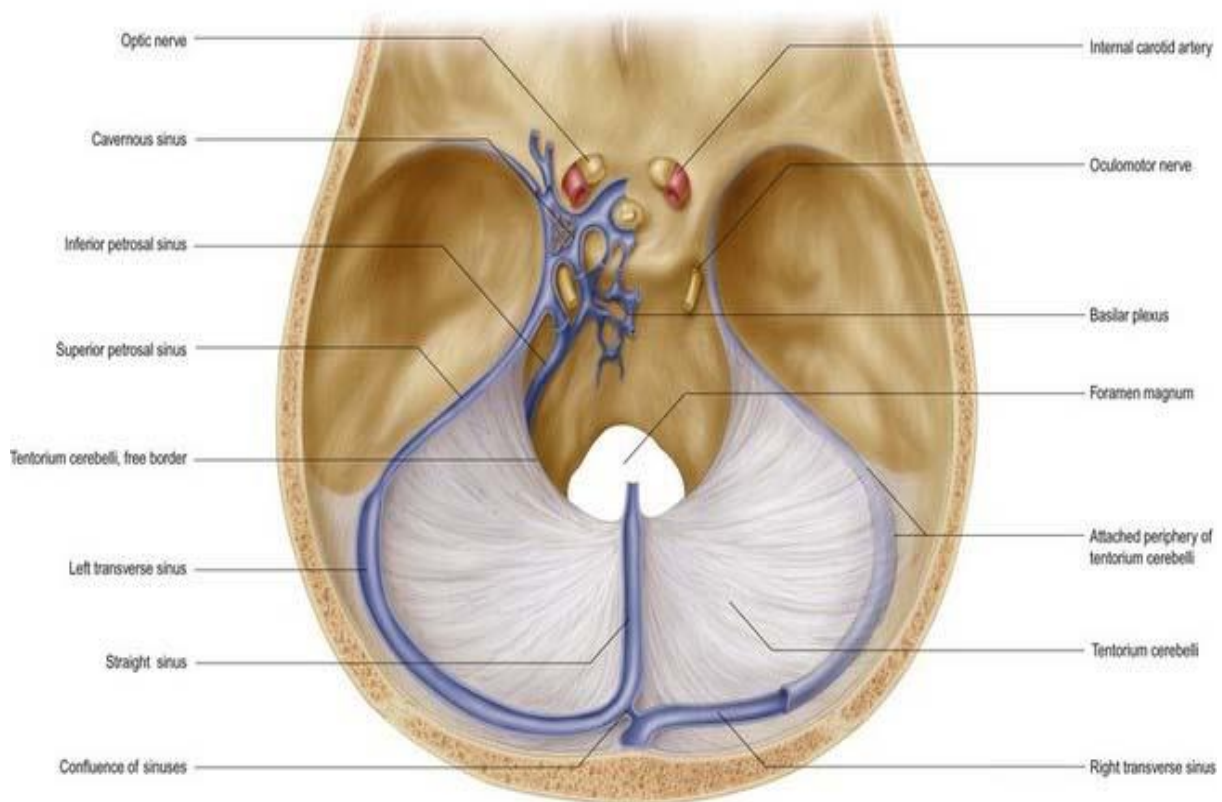


## Cerebellum

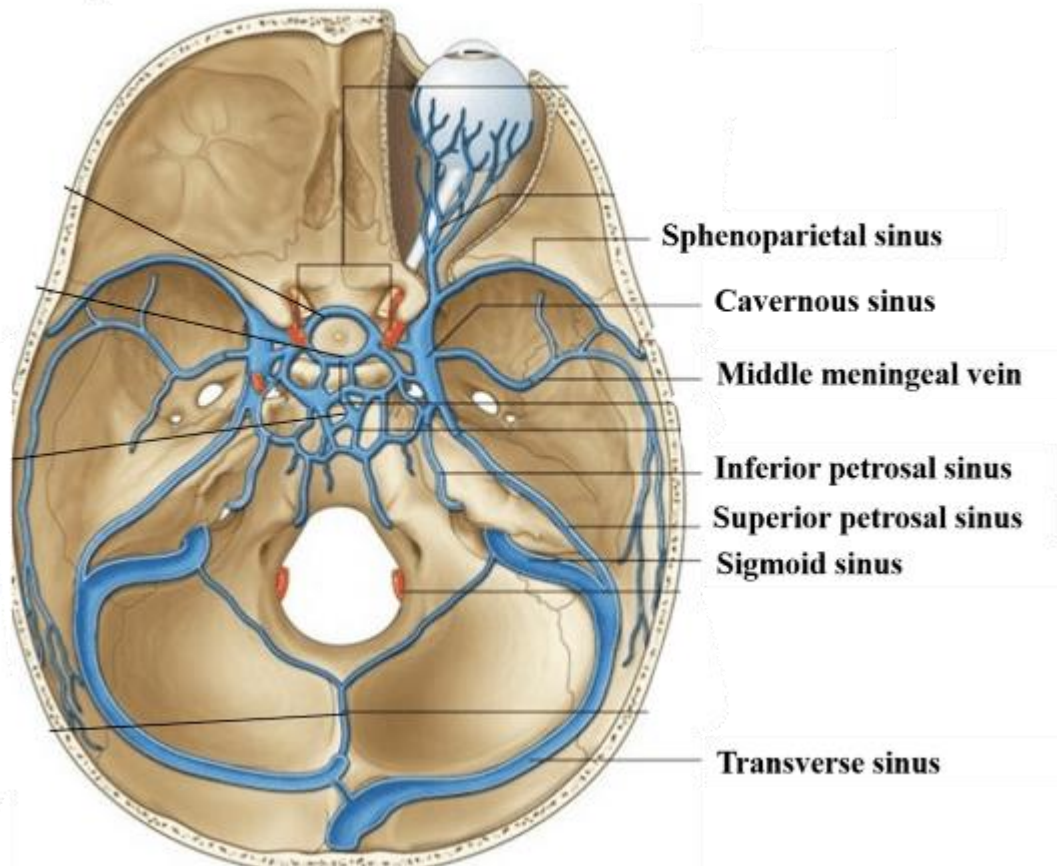
★ It is the largest part of the **hindbrain** (cerebellum, pons & medulla).

★ **Site and Relations:**

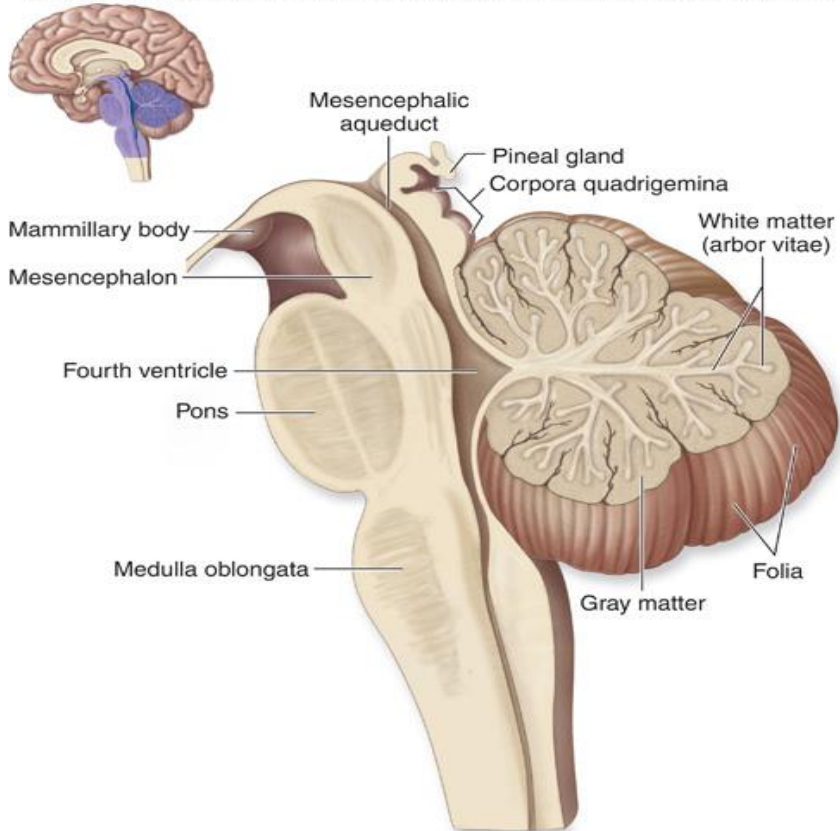
- The cerebellum lies in the lower part of **posterior cranial fossa** and is related:
  - a- **Above:** To the **tentorium cerebelli** separating the cerebellum from the occipital lobes of cerebral hemispheres.
  - b- **In front:** To the back of **pons and medulla** being separated from them by the cavity of the **4<sup>th</sup> ventricle**.
  - c- **Laterally:** To the **sigmoid venous sinus**, mastoid antrum and mastoid air cells.



**Paired Dural Sinuses**



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(a) Midsagittal section

\* Site of Cerebellum

\* Gross Features

Cerebellum consists of

a) Central part: Vermis

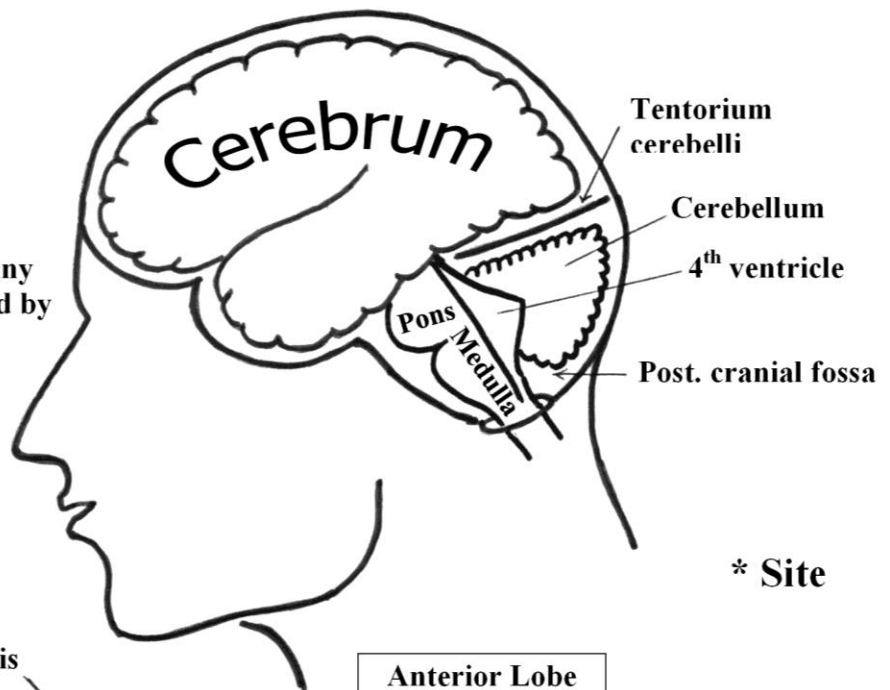
b) Two cerebellar

hemispheres showing many gyri called folia separated by deep fissures (sulci)

\* Vermis is divided into:

1. Sup. Vermis

2. Inf. Vermis



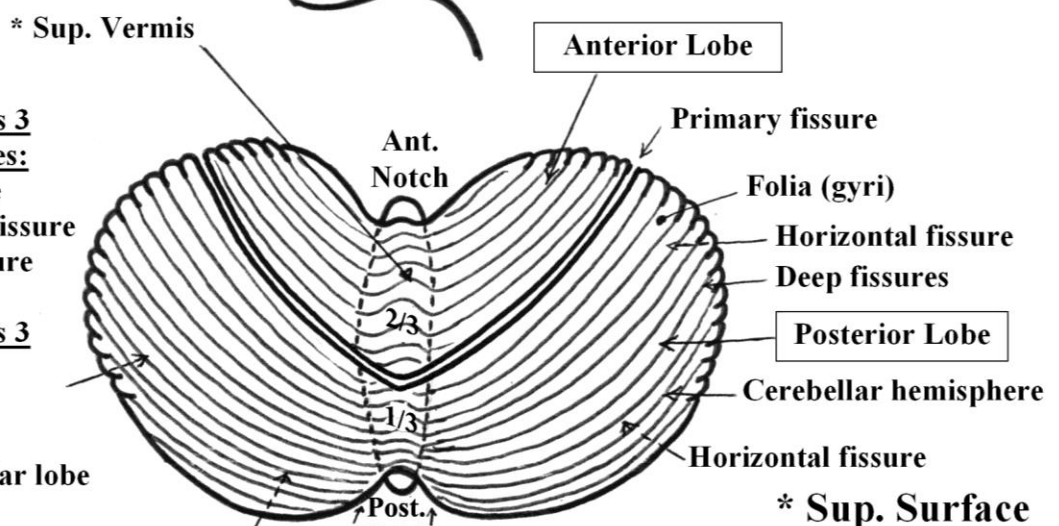
\* Site

\* Cerebellum has 3 important fissures:

- Primary fissure
- Posterolateral fissure
- Horizontal fissure

\* Cerebellum has 3 lobes:

- 1) Ant. lobe
- 2) Post. lobe
- 3) Flocculonodular lobe

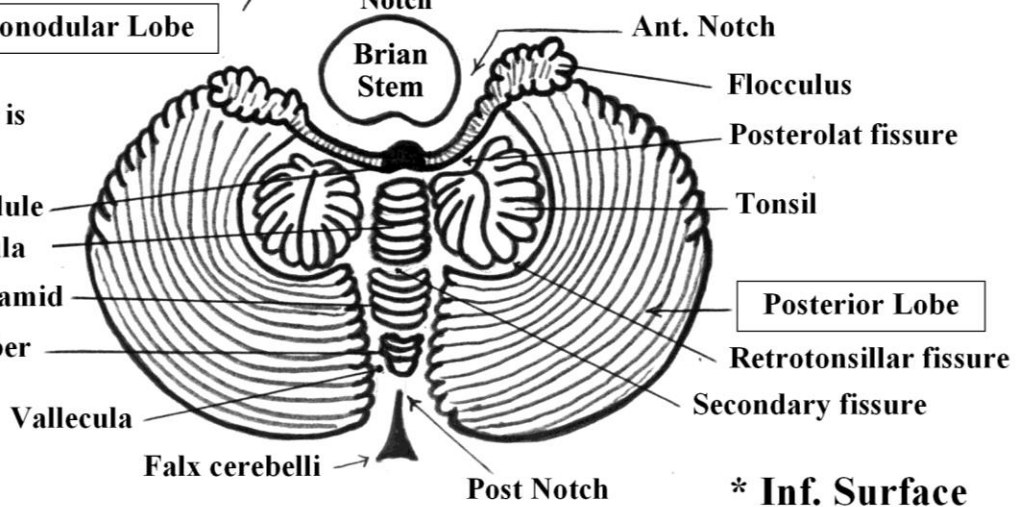


\* **Sup. Surface**

\* Inf. Vermis is formed of

from before backward

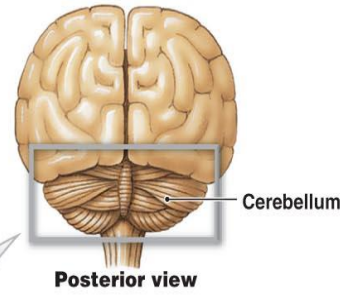
- Nodule
- Uvula
- Pyramid
- Tuber



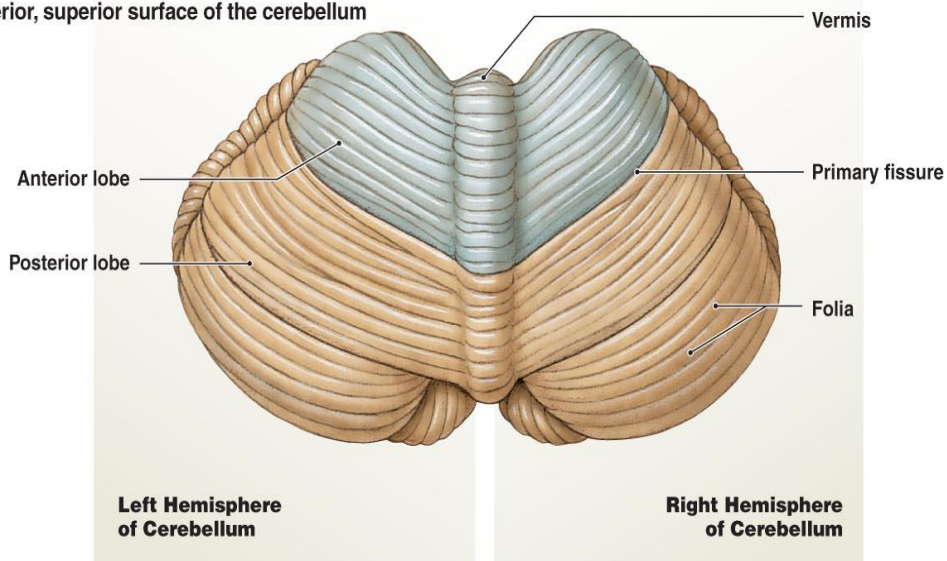
\* **Inf. Surface**

- 
- ★ **Parts of the cerebellum:** Grossly, it is composed of 2 parts:
- a- **2 large lateral cerebellar hemispheres:** (right and left) showing many folds called **folia** separated by **sulci** & deep **fissures**.
  - b- **Vermis:** is a narrow **median** part joining the two cerebellar hemispheres. It is divided into **superior and inferior vermis**.
- ★ **Shape:** The cerebellum has
- **Two notches:** (anterior and posterior)
    - a. **The anterior notch:** is very **wide** and is related to the back of the of **pons & medulla** & receives the 3 **cerebellar peduncles**.
    - b. **The posterior notch:** is narrower and related to the **falx cerebelli**.
  - **Two surfaces:** (superior and inferior).
    - a- **Superior surface:** showing:
      - **Sloping** upper surfaces of the 2 cerebellar **hemispheres**.
      - **Superior vermis:** is a slightly elevated median longitudinal ridge.
      - The **anterior end** of the superior vermis forms a small mass called the **lingula**.
      - **Primary fissure:** is a **V-shaped** fissure passing in the **upper surface** of the cerebellum separating the anterior from the posterior lobes of the cerebellum. Its **apex** is directed **backwards** and **cross the superior vermis** near its posterior end.

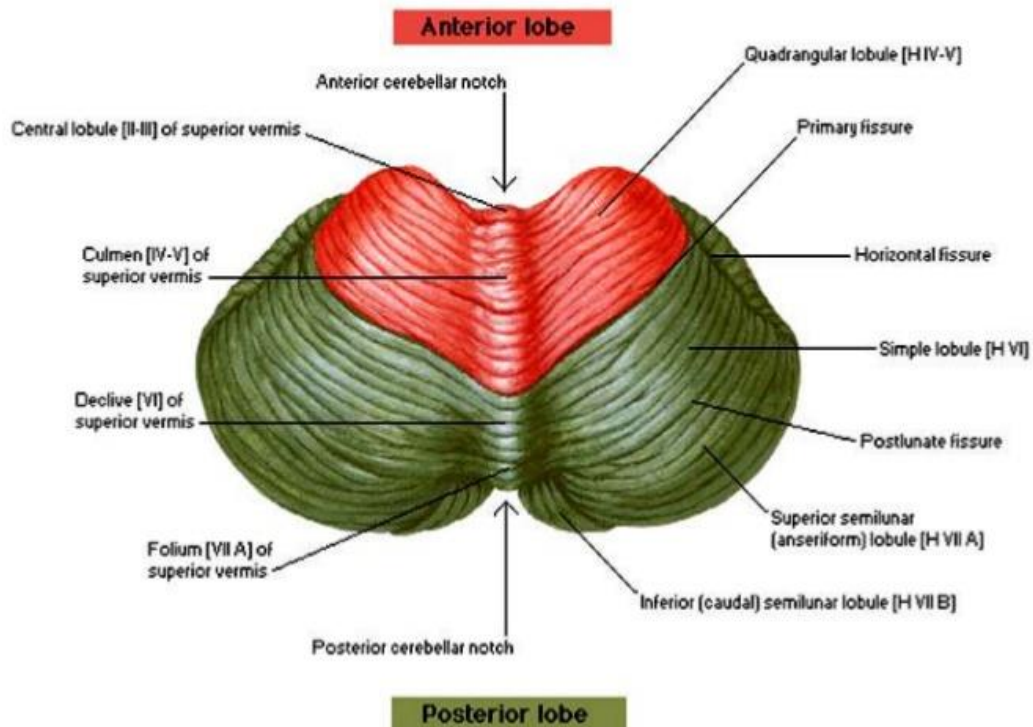
Structural features of the cerebellum



The posterior, superior surface of the cerebellum

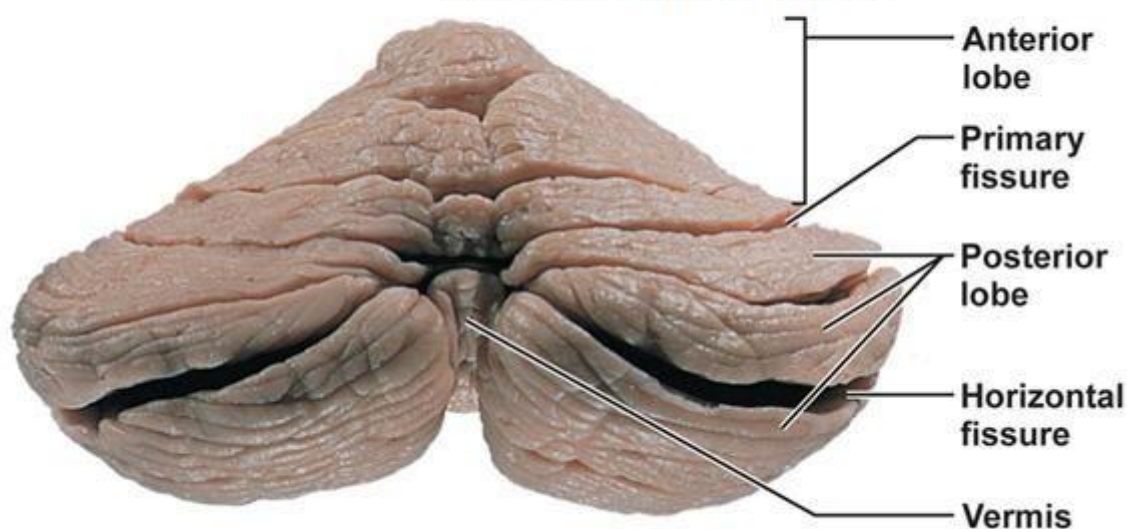


**Cerebellum**  
Superior Surface



## The Cerebellum

2 Hemispheres (Right and Left)  
separated by the Vermis

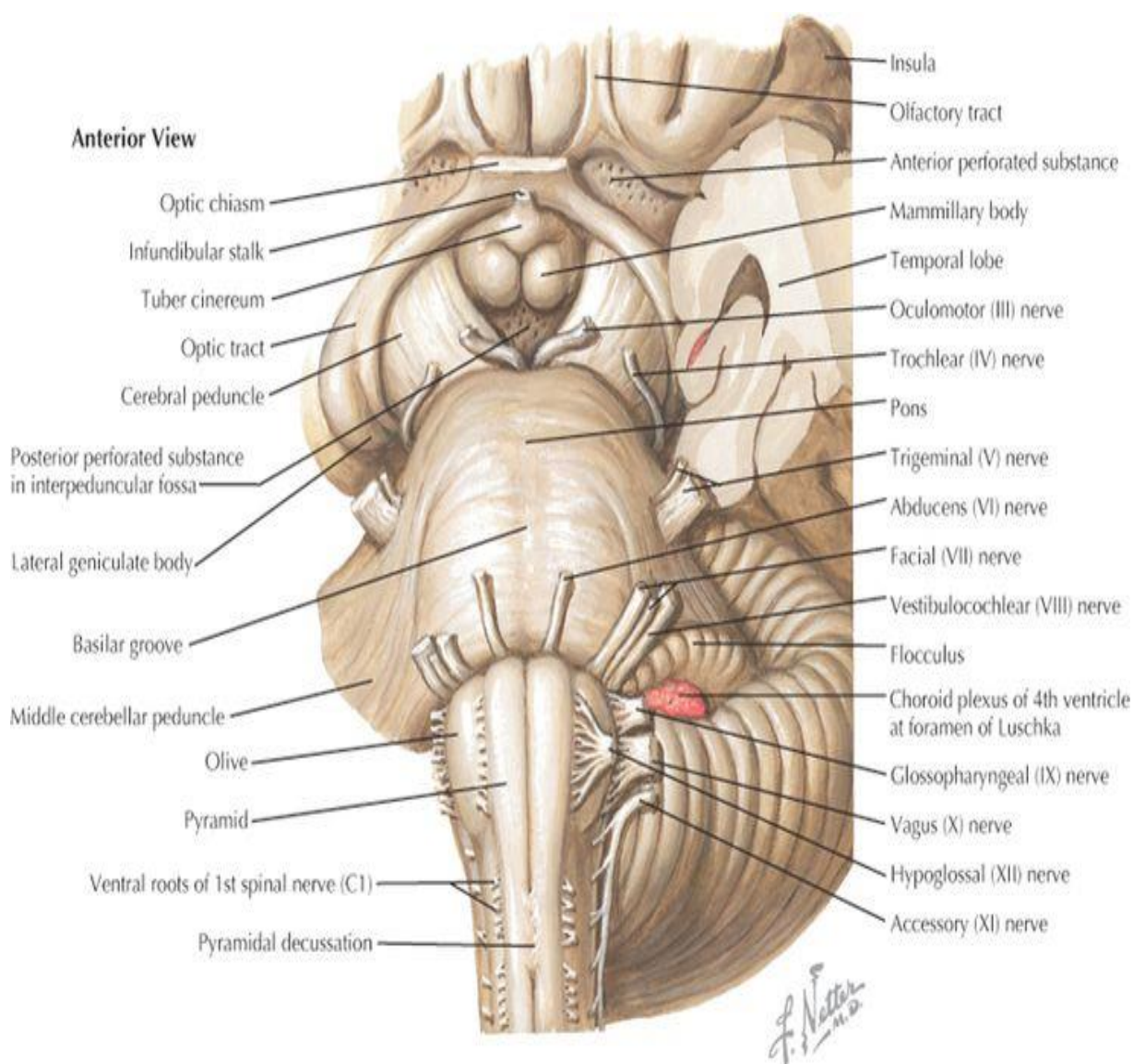


(c) Posterior view

**b- Inferior surface:** shows:

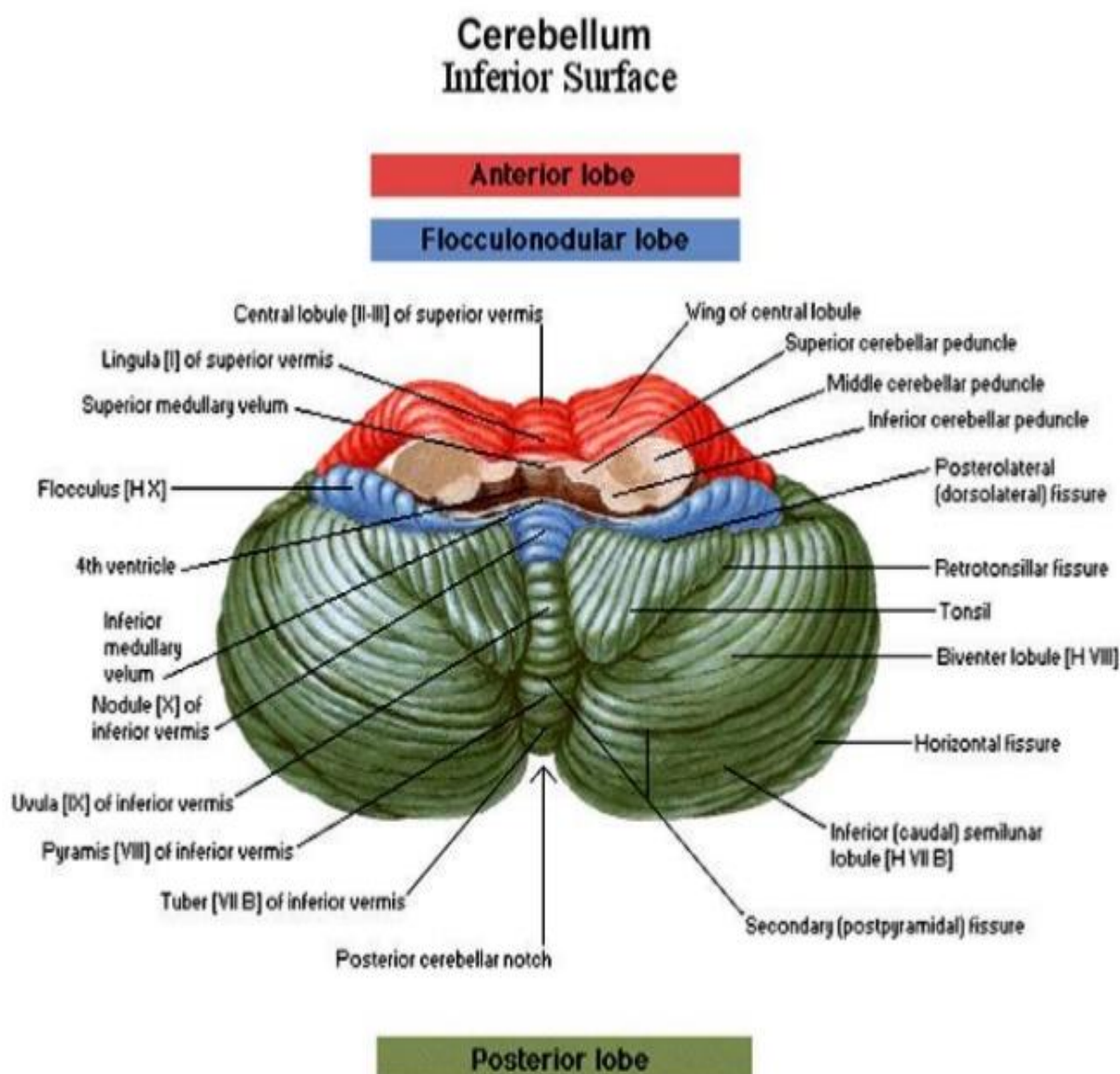
- **Rounded convex** inferior surface of each cerebellar **hemisphere** on each side separated from each other by a deep median longitudinal **groove** called the **vallecula**.
- **Inferior vermis** is a longitudinal ridge lying deeply at the **bottom of the vallecula**.
- The inferior vermis is **divided** from before backwards into 4 parts: **nodule, uvula, pyramid and tuber vermis**.
- **Flocculus** is a small portion, lying on either side, along the **anterior border** of the inferior surface of the cerebellar hemisphere. It is almost completely **isolated** from the main part of the cerebellar hemisphere by the **postero-lateral fissure**.
- The two flocculi are **connected to the nodule** by sheet of white matter called **inferior medullary velum** to form the **flocculo-nodular lobe**.

- Seen from the anterior aspect, the flocculus appears **below the middle cerebellar peduncle** in relation to:
  - The **ponto-cerebellar angle** below the exit of **facial** and **vestibule-cocchlear** nerve.
  - The rootlets of **glossopharyngeal** nerves emerging from the medulla.
  - Lateral end of the **choroids plexus of the 4<sup>th</sup> ventricle** projecting from the **lateral aperture** of the ventricle.



Felten & Shetty: Netter's Atlas of Neuroscience, 2nd Edition.  
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- **Tonsil:** is a small part of the cerebellar hemisphere, **on either side of the uvula** of the inferior vermis. The tonsil is **partly separated** from the inferior surface of the hemisphere by the **retrotonsillar fissure**.
- The latter **continues** across the middle line **as the secondary fissure** which cuts the inferior vermis **between the uvula** (in front) and **the pyramid** (behind).





---

★ **Fissure of the cerebellum:**

**1- Primary fissure:** It is a **V-shaped** fissure crossing the superior surface of the cerebellum (as before).

**2- Postero-lateral fissure:** It **separates the flocculo-nodular lobe** from the main part of the cerebellum.

**3- Retro-tonsillar fissure:** It **separates the tonsile** from the surrounding cerebellar hemisphere.

**4- Secondary fissure:** It is **extension of** retrotonsillar fissure **across the middle line to** cuts the inferior vermis **between** the **uvula** (in front) and the **pyramid** (behind).

**5- Horizontal fissure:**

- It is a **deep** fissure cutting into the cerebellum along the **margins** which **separates** the **superior from the inferior surfaces** of the cerebellum.
- Despite its depth and extent, this fissure has **no** morphological **significance** as it **passes through the posterior lobe**.

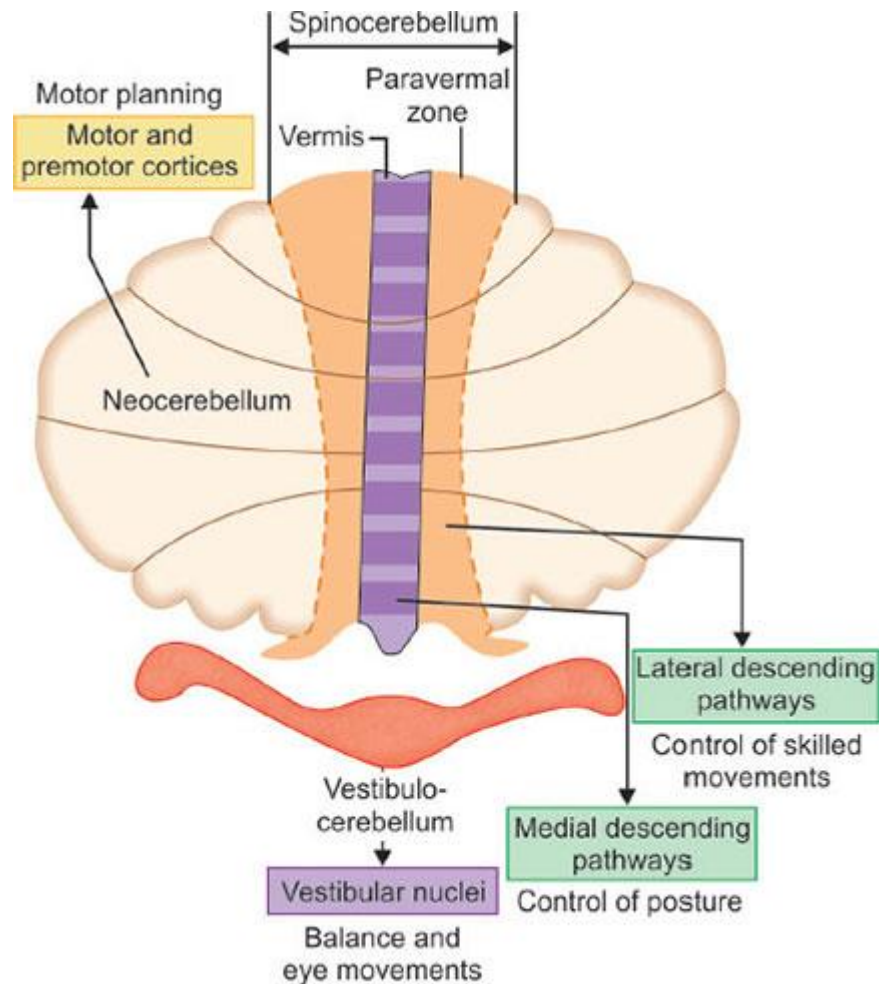
★ **Subdivisions of the cerebellum:**

**A) Anatomical division:** (By fissures into lobes):

- The **true anatomical division** of the cerebellum into **several lobes separated by** deep 2 **transverse fissures**. These fissures cut the vermis transversely and extend laterally into the hemispheres. Therefore, **each lobe** has a **median** part in the vermis and a pair **of lateral** extensions in the hemispheres.
- **Fissures:**

- 
- 1- **Postero-lateral fissure:** lies on the **inferior** surface. It **separates** the **flocculo-nodular lobe** from the main part of the cerebellum.
  - 2- **Primary fissure:** (see before). It **divides** the main part of the cerebellum into a **smaller anterior lobe** (in front of the fissure) and a **larger posterior lobe** (behind the fissure).
- **Lobes:**
    - 1- **Flocculo-nodular lobe:**
      - It consists of **two flocculi** (one on either side) and a median **nodule** connecting them.
    - 2- **The anterior lobe:** is the area, **on the superior surface, in front of the primary fissure**, including the major **anterior part of the superior vermis** and the **adjoining parts of the superior surfaces** of the two cerebellar hemispheres.
    - 3- **The posterior lobe:** is the **large area behind the primary** fissure and **it includes:**
      - The small posterior part of the **superior vermis** and the **adjoining parts of the superior surfaces** of both cerebellar hemispheres.
      - **Almost, the whole inferior surface** including the inferior surfaces of both hemispheres as well as the inferior vermis.
- B) Longitudinal division** of the cerebellum into 3 zones:
- 1- **Vermal zone** connected with vestibular nuclei and spinal cord.

- 2- **Paravermal zone** connected with spinal cord.
- 3- **Lateral zone** connected with cerebral cortex.



**C) Functional division** of the cerebellum into 3 parts:

**1- Vestibular part:** (Archi-cerebellum or the cerebellum of equilibrium)

- It is formed of the **flocculo-nodular lobe** and small part of vermal zone.
- Phylogenetically, it is the **oldest** part of the cerebellum.
- It connected with **vestibular nuclei** by means of the **vestibule-cerebellar and cerebello-vestibular tracts** .
- It is concerned with **equilibrium**.

**2- Spinal part:** (Paleo-cerebellum or cerebellum of proprioception)

- It is **formed by** the vermal and paravermal zones of the cerebellum.
- Phylogenetically, the spinal part **later to evolve** after the flocculo-nodular lobes.
- It **receives** fibers from the **muscles, joints** and the associated structures mainly by means of the **spino-cerebellar tracts** (dorsal and ventral) and **cuneo-cerebellar** fibers.
- It is concerned with **regulation of muscle tone** and muscle **coordination**.

**3- Cerebral part:** (Neo-cerebellum or cortico-cerebellum)

- It is the remaining **largest** lateral part of the cerebellar hemispheres.
- Phylogenetically it is the **last part** of the cerebellum to evolve.
- It is connected **mainly with motor and premotor** cerebral cortex.
- It receives impulses **cortico-ponto-cerebellar** pathway.
- It is concerned with **planning and control** of movements.

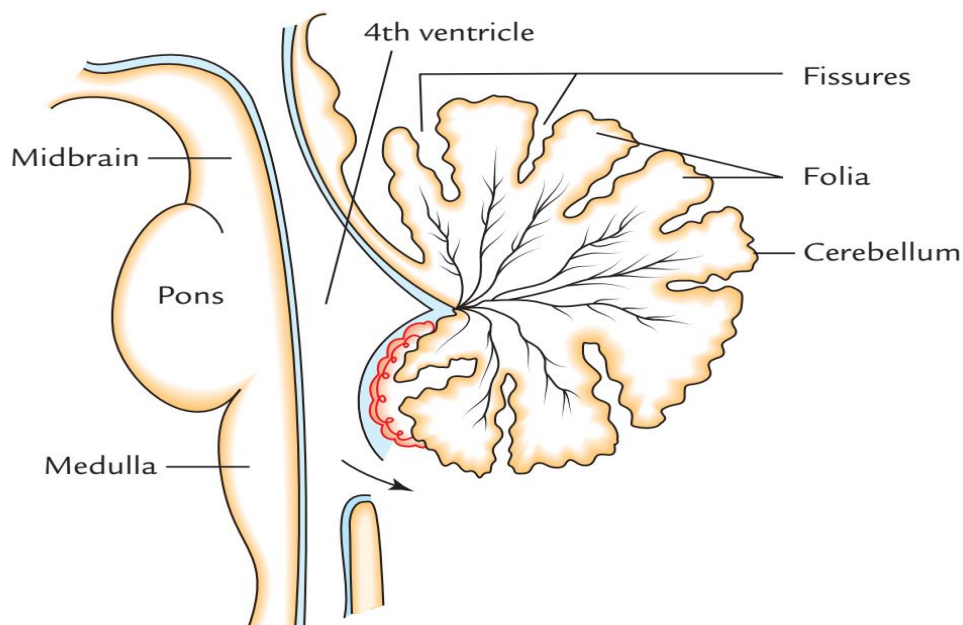
**★ Medullary vela:****A-Superior medullary velum:**

- Is a **thin sheet of white matter** stretching **between** the 2 **superior cerebellar peduncles**, together forming the **upper 1/2 of the roof of the 4<sup>th</sup> ventricle**.

- Its **lower part** is **related** to the **lingula** of the superior vermis while its **upper part** is **pierced by the two trochlear nerve** as they emerge from the back of the midbrain.

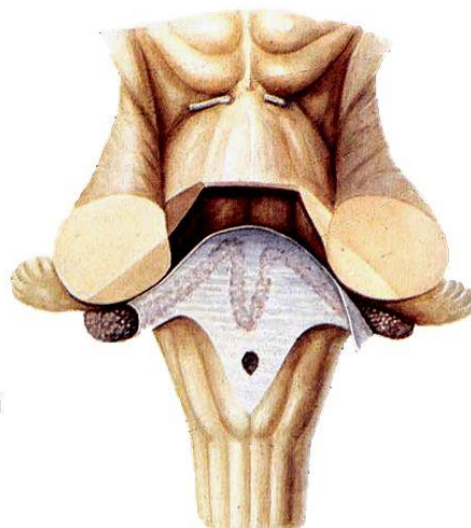
**B-Inferior medullary velum:**

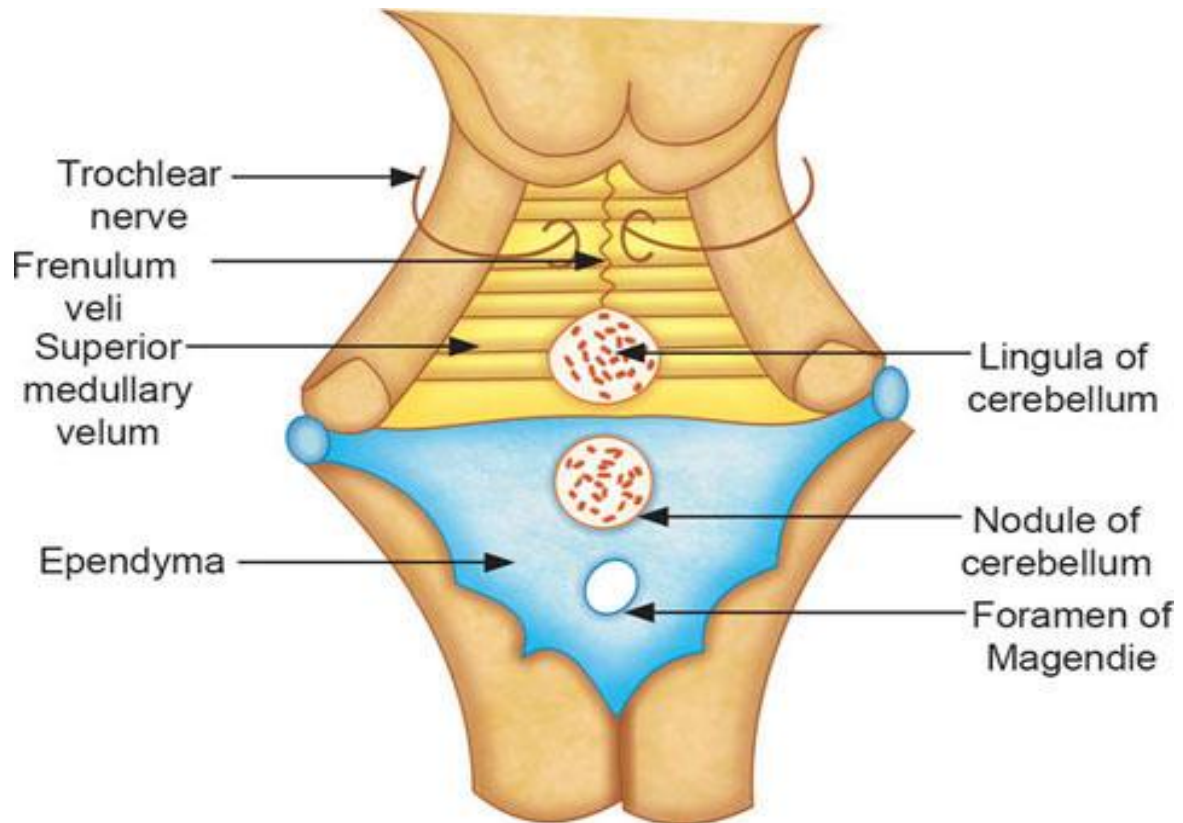
- It is formed of **2 sheets of white matter** on each **side of the nodule** of the inferior vermis together forming the upper part of the **lower 1/2 of the roof** of the 4<sup>th</sup> ventricle.
- It is **covered** on each side by the **tonsil** of the cerebellum



**Roof**

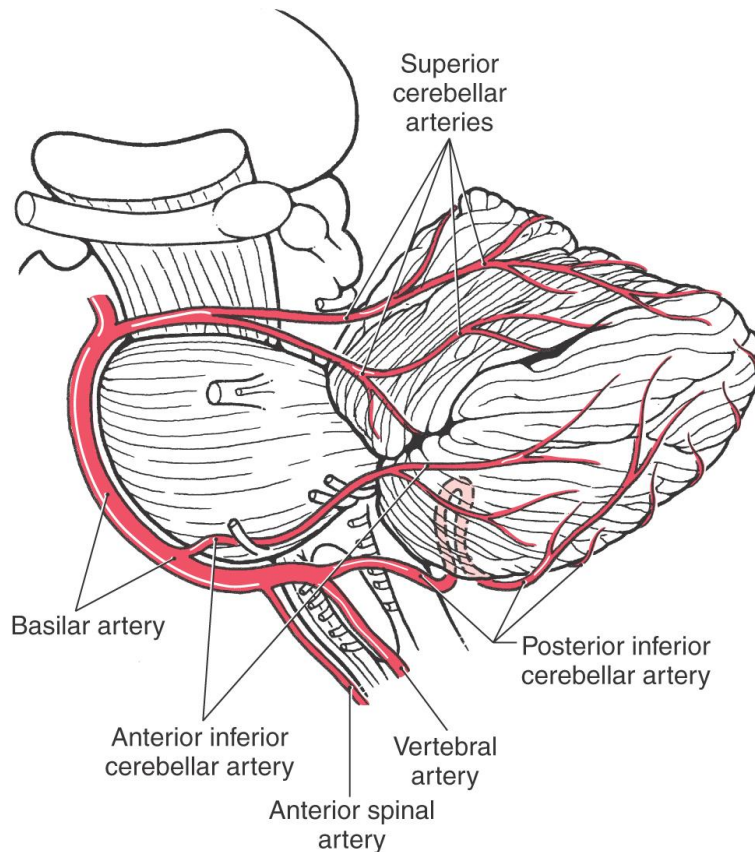
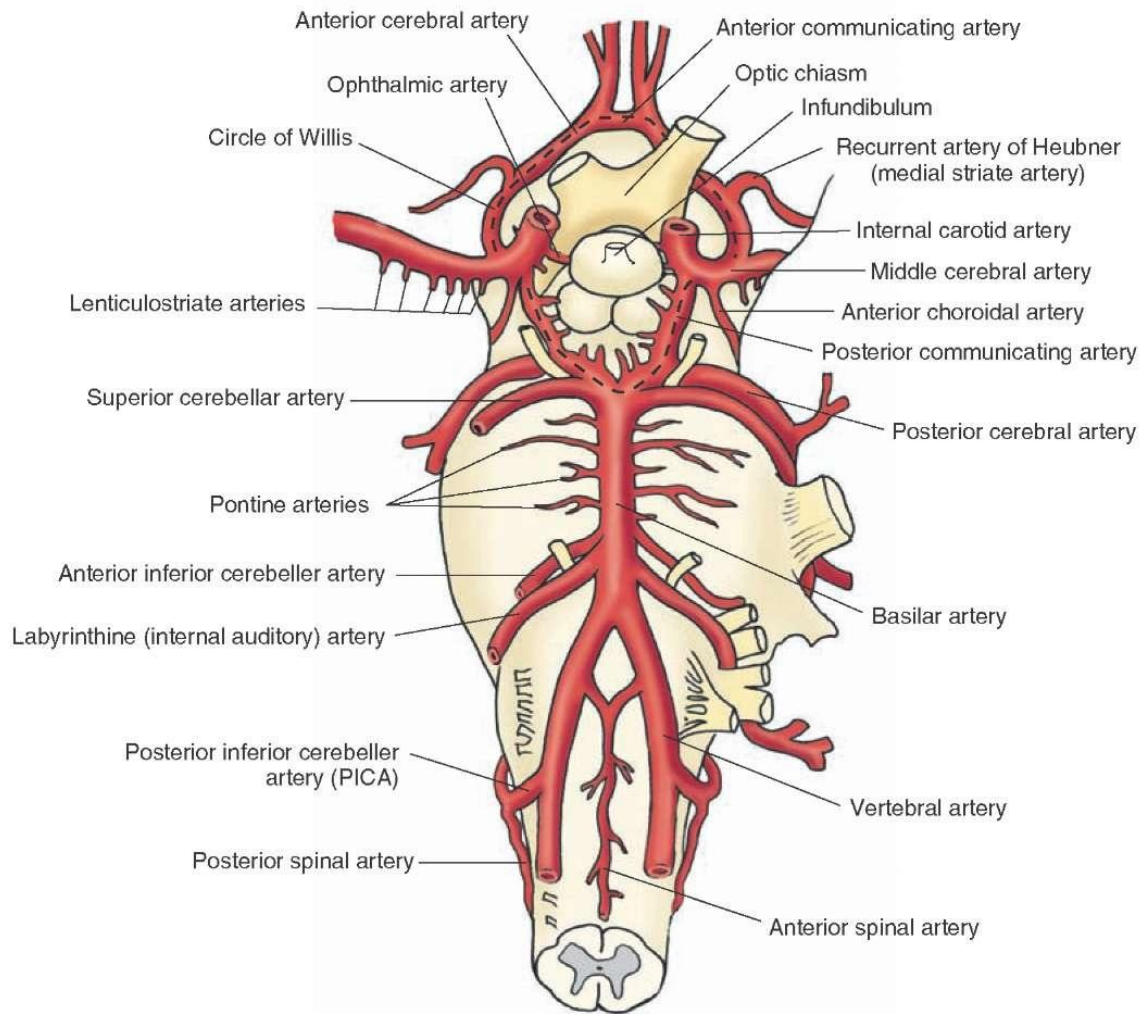
- Anterior part: formed by **superior cerebellar peduncle** and **superior medullary velum**
- Posterior part: formed by **inferior medullary velum** and **choroid plexus of fourth ventricle**
- Three apertures
  - **Median aperture of fourth ventricle**
  - **Two lateral apertures of fourth ventricle**





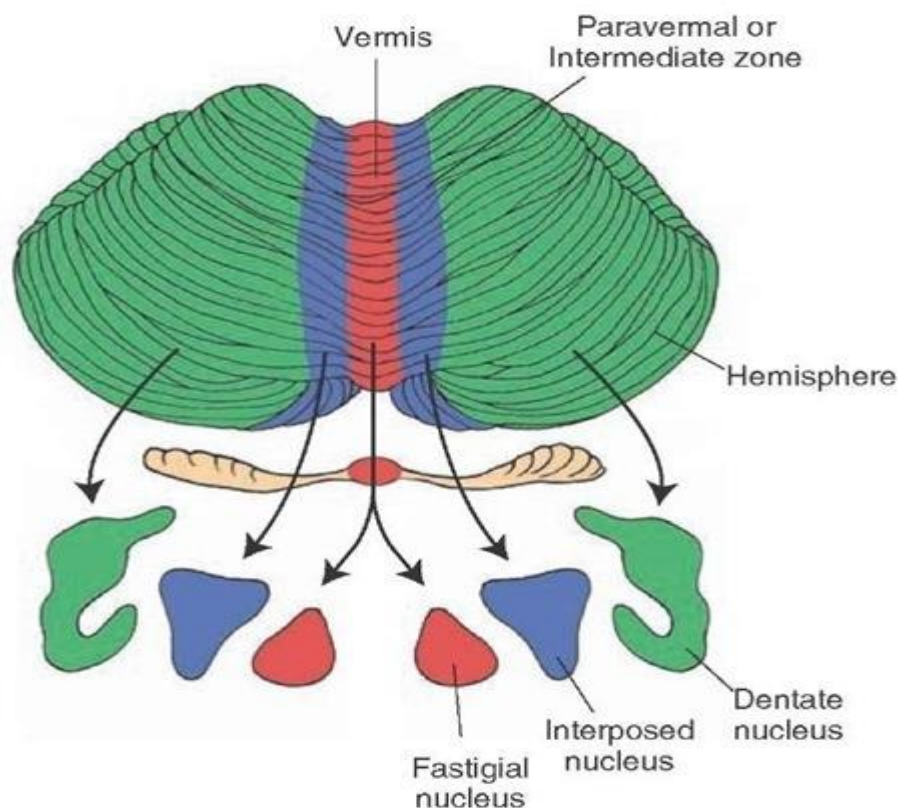
★ **Arterial supply:**

1. **Superior cerebellar artery:** arises from basilar artery and supplies superior surface
2. **Anterior inferior cerebellar artery:** arises from lower part of basilar artery and supplies small anterior part of the inferior surface
3. **Posterior inferior cerebellar artery:** arises from vertebral artery and supplies large posterior part of inferior surface



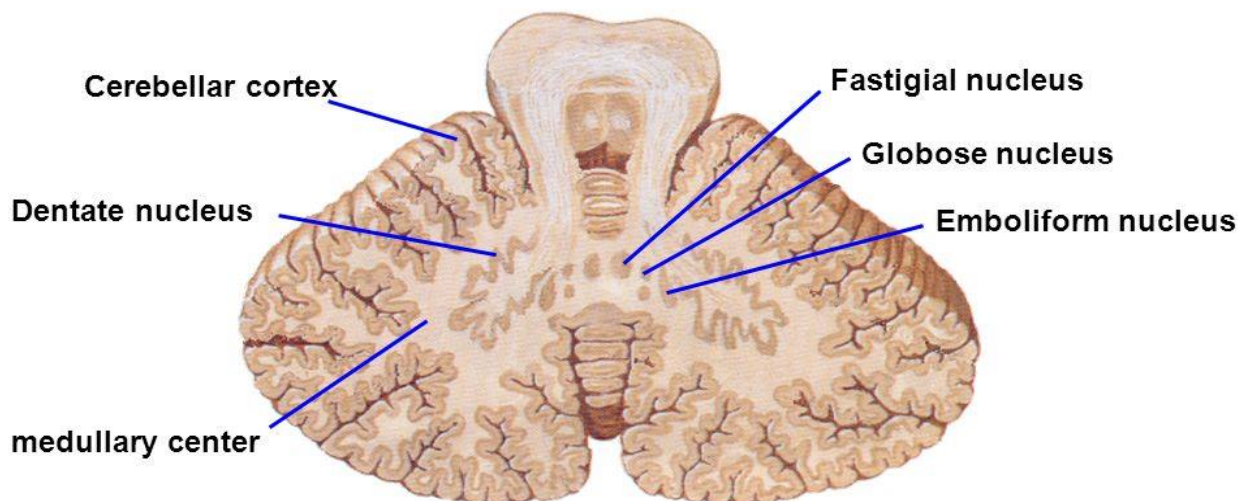
**★ Internal structure:**

- The **gray matter** is placed on the surface forming the cerebellar cortex.
- The **white matter** is placed centrally forming the core of the cerebellar hemispheres.
- **The white matter core** of the cerebellum contains **3 pairs of nuclei** arranged as follows:
  - 1) **Fastigial nucleus** (medially): linked functionally with the vermal zone i.e. vestibulo-cerebellum & spino-cerebellum.
  - 2) **Interposed nucleus** (in between): is formed of globose and emboliform nuclei and linked functionally with the paravermal zone i.e. spino-cerebellum.
  - 3) **Dentate nucleus** (laterally): It is the largest and appears as folded mass of gray matter and linked functionally with the lateral zone i.e. neo-cerebellum.





## Internal structures

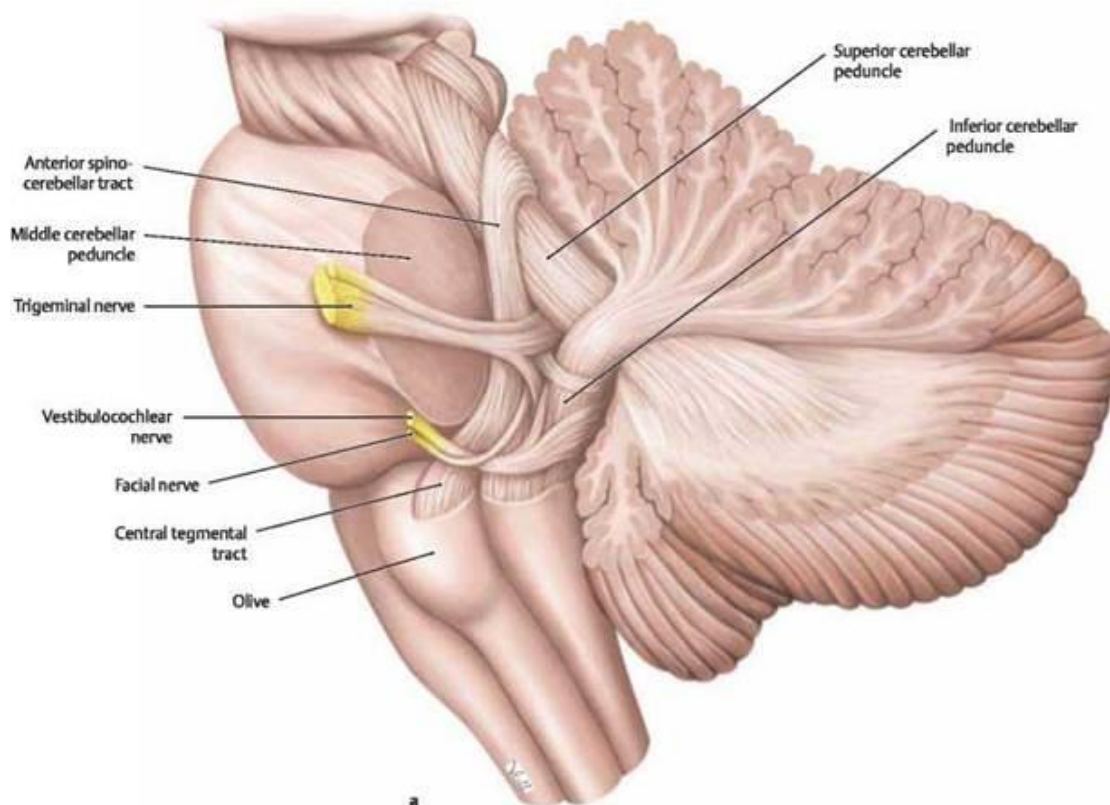


### ★ Cerebellar peduncles and connections:

- The cerebellum is **linked with** the **cerebrum**, the nuclei of the **brain stem** and the **spinal cord** by **afferent and efferent** tracts, which are **collected** into three large bundles of nerve fibers on each side, called **cerebellar peduncles**.
- These peduncles enter the cerebellum through its **anterior notch** with the **middle** cerebellar peduncle **most lateral**, **superior** cerebellar peduncle **most medial** and the **inferior** cerebellar peduncle **in between**.
- The 3 pairs of cerebellar peduncles **connect** the cerebellum with the 3 parts of the **brain stem as follows**:

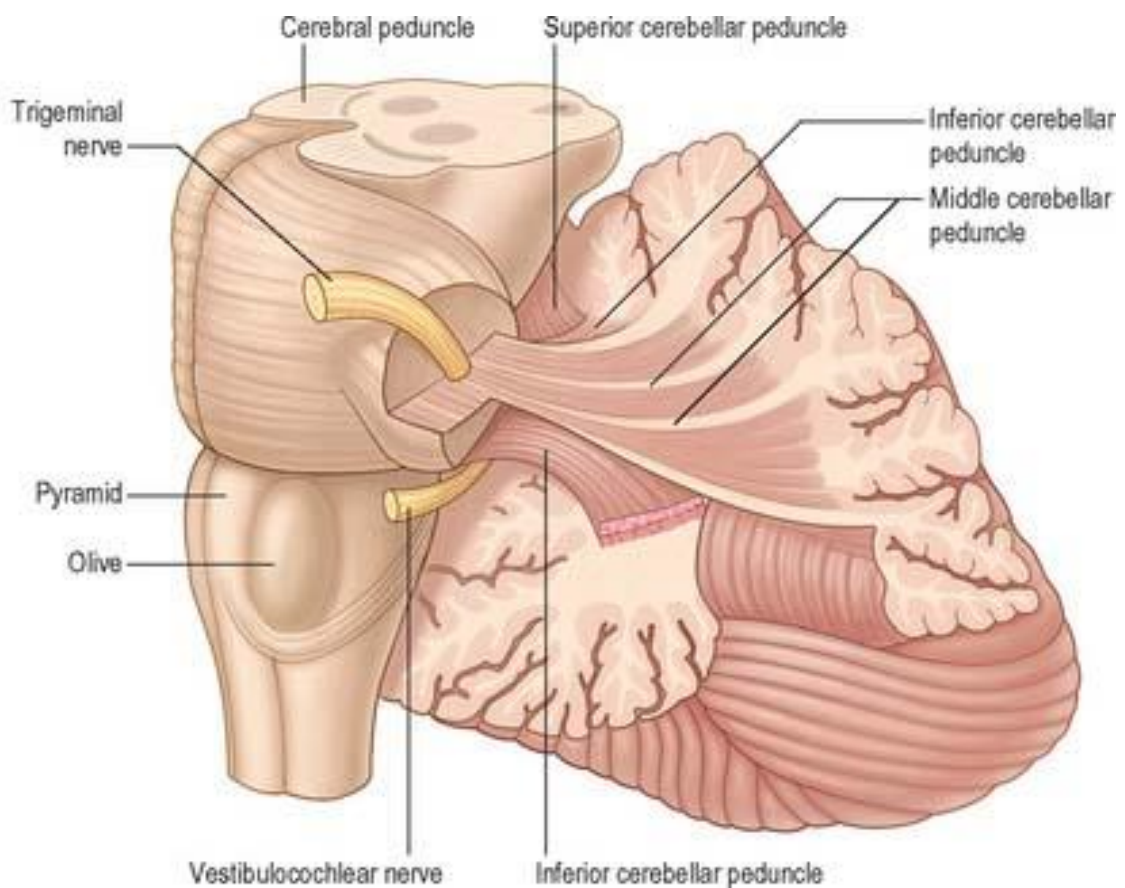
**A) Inferior cerebellar peduncle:**

- **It connects** the **cerebellum** with the **medulla** oblongata.
- It lies on the dorso-lateral aspect of the **open medulla** along the sides of the **lower part of 4<sup>th</sup> ventricle** till they reach the lower border of the pons where each peduncle **bends sharply** backwards between the middle cerebellar peduncle (laterally) and the superior cerebellar peduncle (medially) **to enter** the corresponding **cerebellar hemisphere**.
- **Afferents and efferent fibers: (see histology).**



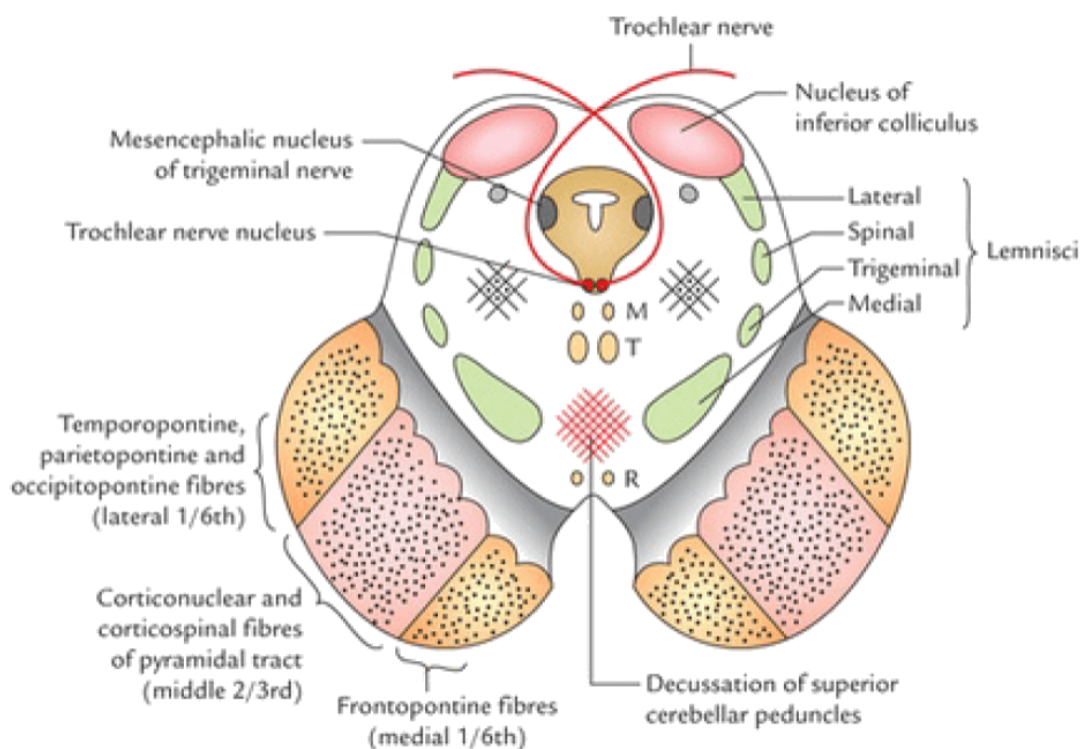
**B) Middle cerebellar peduncle:**

- **It connects** the **cerebellum** with the pons.
- It emerges from the pons lateral to the exit of 5<sup>th</sup> cranial nerve.
- Then curves backwards to enter the corresponding cerebellar hemisphere as the **largest** and **most lateral** of the three cerebellar peduncles.
- It contains **only afferent** fibers which are **ponto-cerebellar fibers** as part of the cortico-ponto-cerebellar pathway.

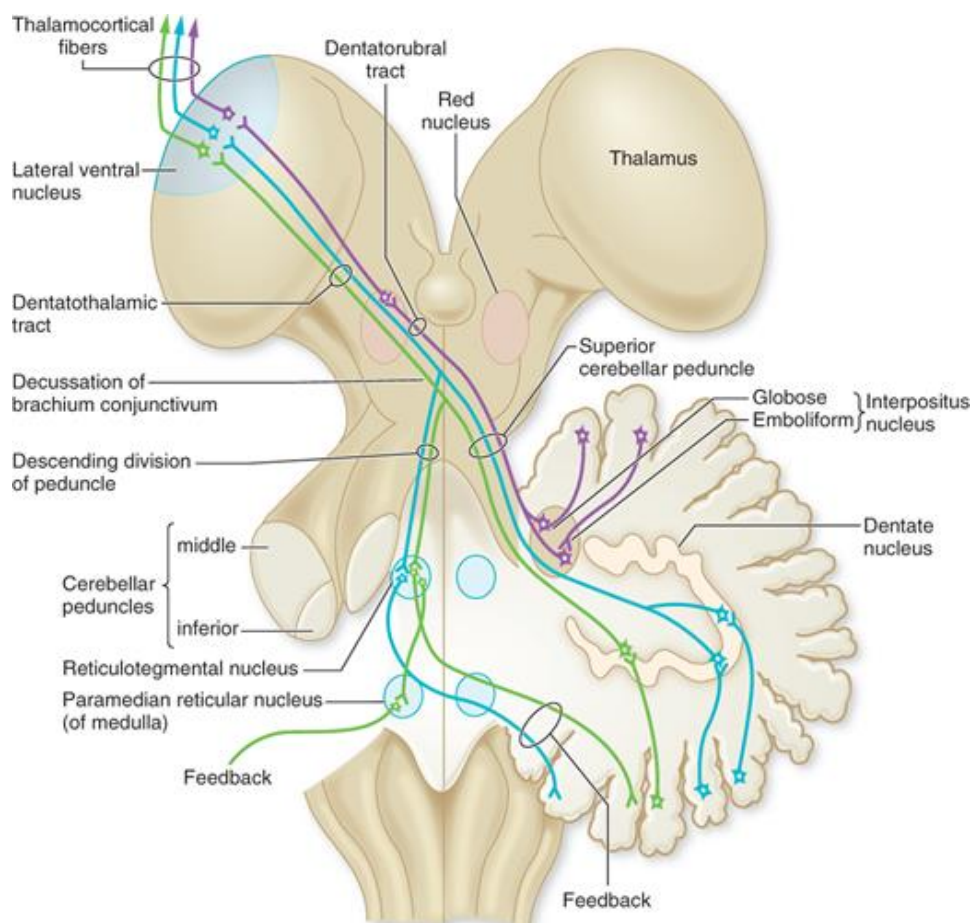


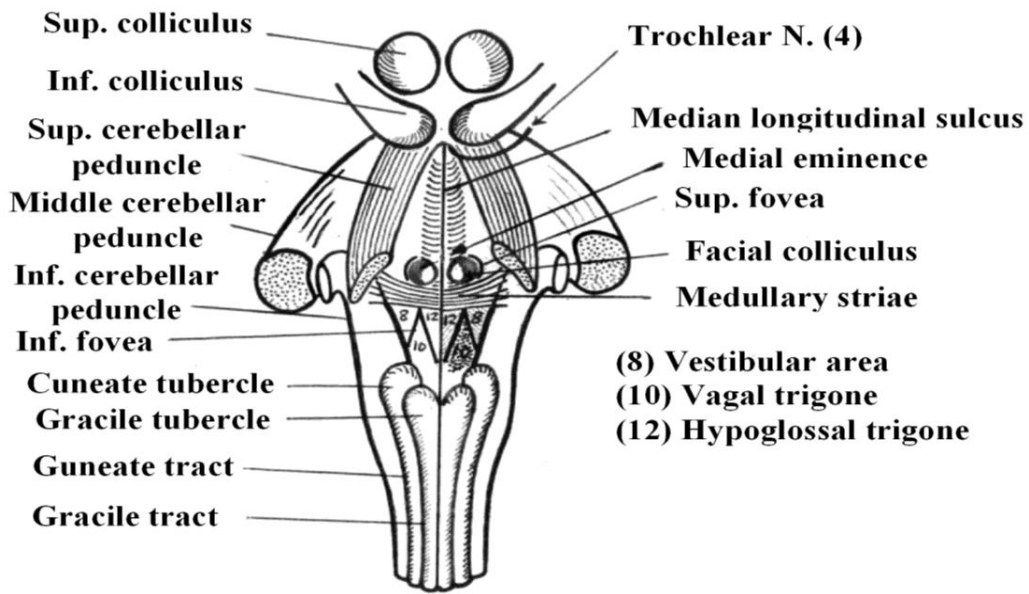
**C) Superior cerebellar peduncle:**

- **It connects** the **cerebellum** with the midbrain.
- It **emerges** from the back of the midbrain immediately **below** the **inferior colliculus**.
- The 2 superior cerebellar peduncles **run** downwards, backwards and laterally along the **sides** of the **upper part** of the **4<sup>th</sup>** ventricle to **enter** the cerebellar hemisphere as the most **medial of the three peduncles**.
- The **superior medullary velum** stretches **between** the 2 superior cerebellar peduncles together **forming** the **upper 1/2** of the **roof** of the **4<sup>th</sup>** ventricle.
- The **efferent fibers** passing in the superior cerebellar peduncles are **mainly** the axons of the **dentate** nucleus, which on **entering** the **tegmentum of the lower part** of the midbrain, they **cross** the middle line forming the **decussation of the superior cerebellar peduncle**. On reaching the opposite side, **these fibers ends** in the intermediate ventral nucleus of thalamus, red nucleus, reticular formation of the brain stem and olivary nucleus in the medulla.

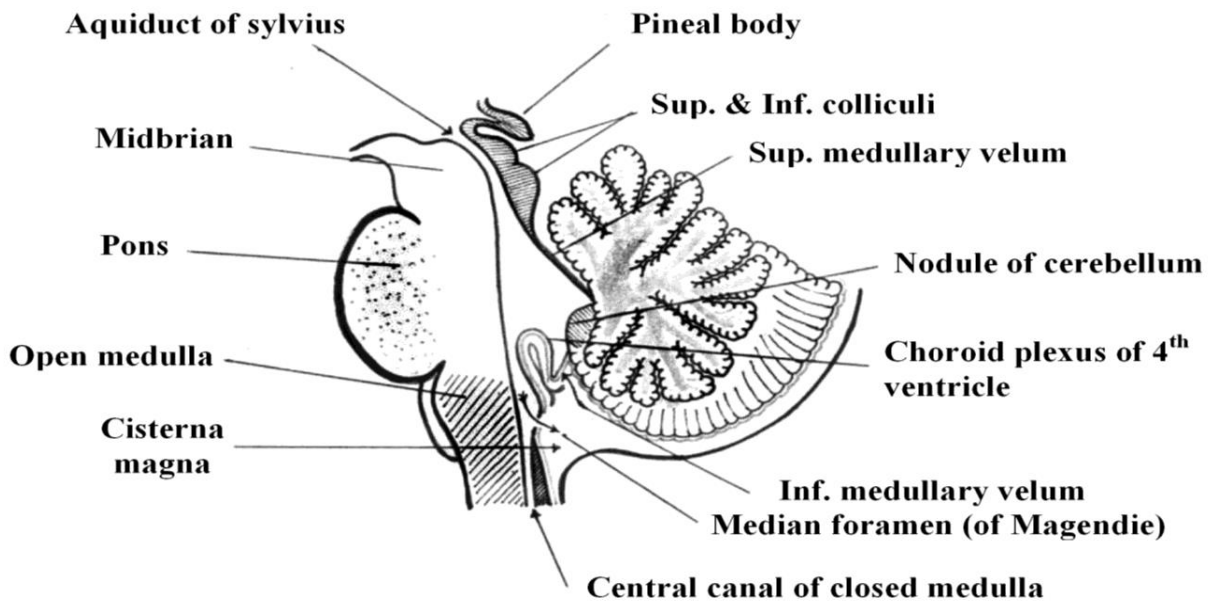


- The **afferent fibers** passing in the superior cerebellar peduncles are anterior spino-cerebellar and tecto-cerebellar fibers.



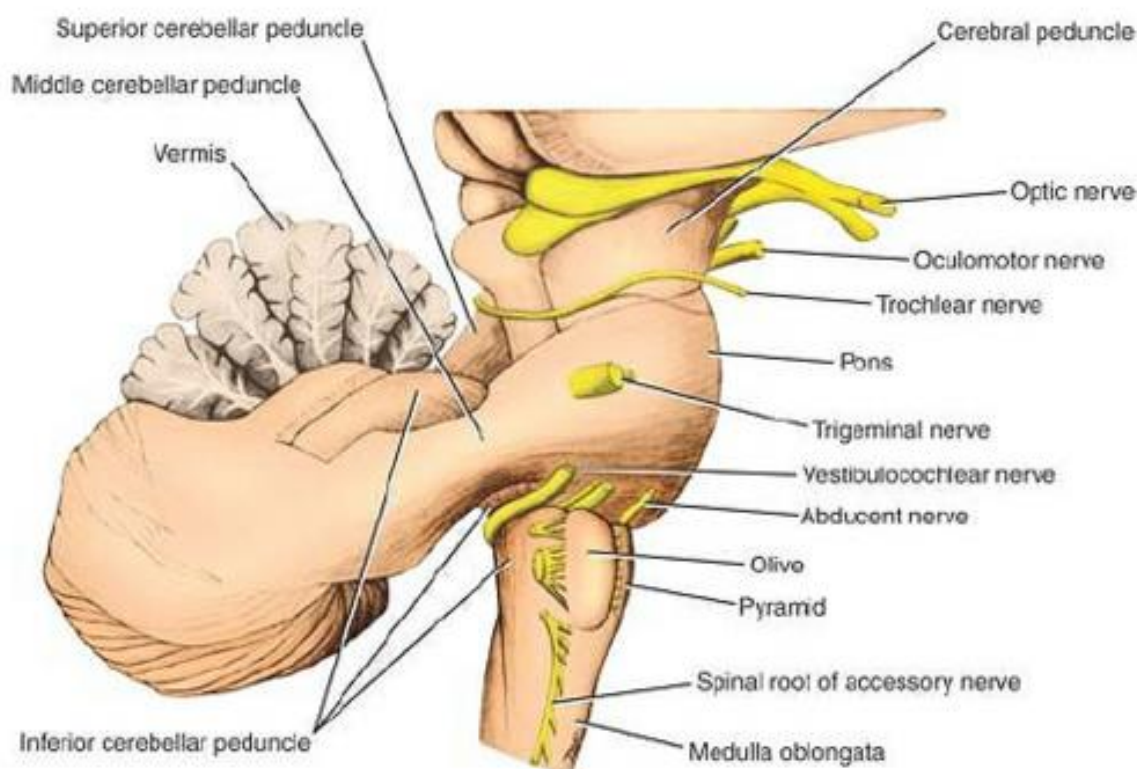
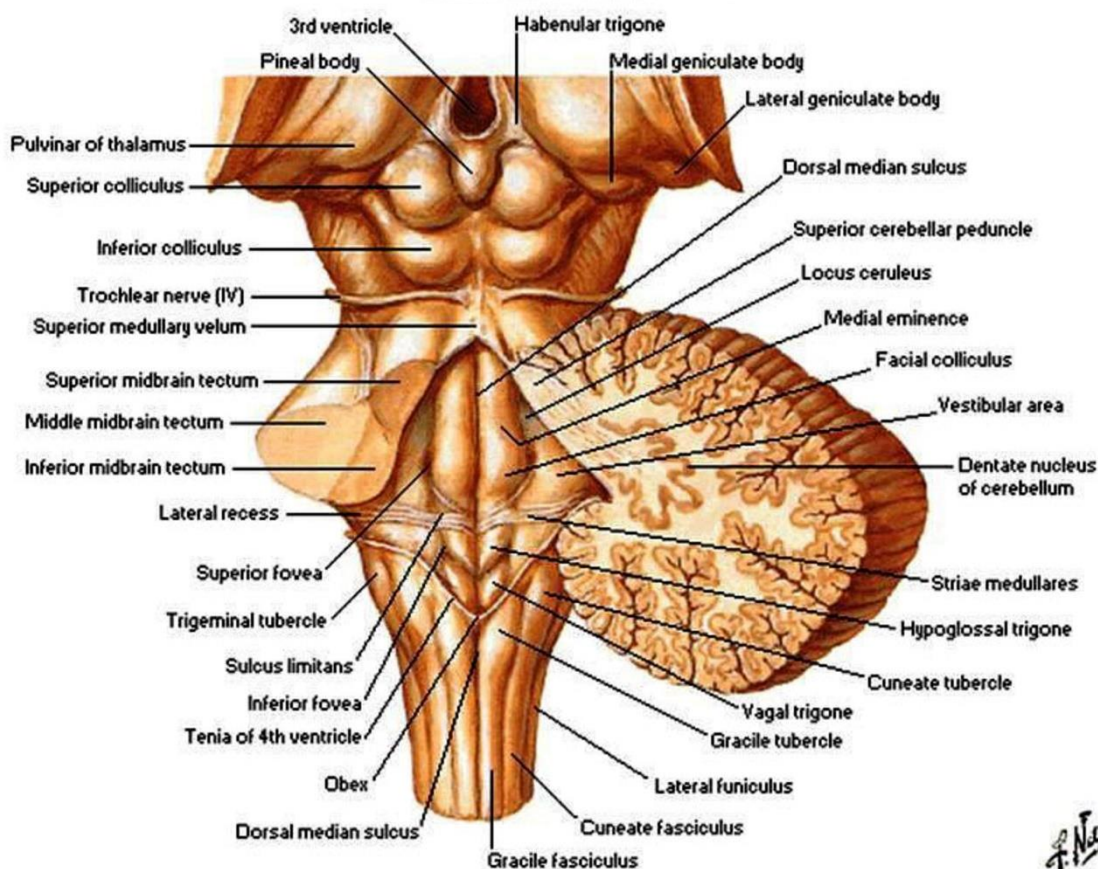


**Floor of 4<sup>th</sup> Ventricle**



**Roof of 4<sup>th</sup> Ventricle**

Posterior View Medulla



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## Fourth Ventricle

### ★ Site:

- It is the **cavity of the hindbrain**.
- It is situated **between** the **cerebellum** (anterior) and the **pons** and the **open medulla** (posterior).

### ★ Shape:

- It is diamond or rhomboid-shaped when seen **from behind** but is tent-shaped when seen **from the side**.
- It has **four angles**:
  - **Upper angle**: continuous with the aqueduct of sylvius
  - **Lower angle**: continuous with the central canal of the closed medulla.
  - **2 lateral angles**: each angle lies at the meeting of the superior and inferior cerebellar peduncles.

### ★ Boundaries:

**I) Lateral boundaries:** It is bounded on each side by:

- **Above and lateral**: Superior cerebellar peduncles.
- **In the middle the lateral angles** forming lateral recesses. .
- **Below and lateral**: Inferior cerebellar peduncle, cuneate and gracile tubercles.

**II) Floor of 4<sup>th</sup> ventricle:**

- It is **diamond or rhombic** shaped.
- It is formed above by the **posterior surface** of the **pons** and below by the posterior surface of the **open medulla**.
- The floor is **divided longitudinally** into 2 similar halves by a **median longitudinal sulcus**.



- The floor is **divided transversely** at the **ponto-medullary junction** by transverse nerve bundles called the **medullary stria**, into upper (pontine) and lower (medullary) parts.

**A) The medullary part:** on either side of the middle line it presents:

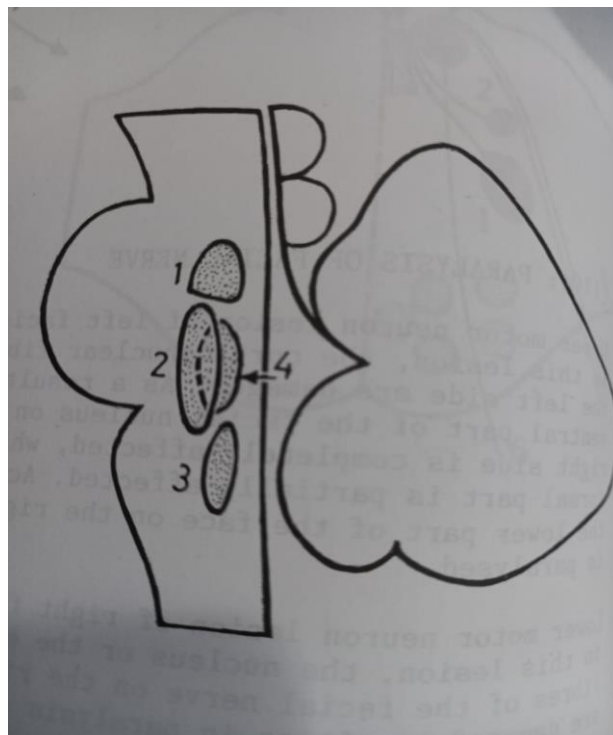
1- A small inverted **V-shaped depression** called the **inferior fovea**, placed with its apex directed upwards, close to the medullary stria.

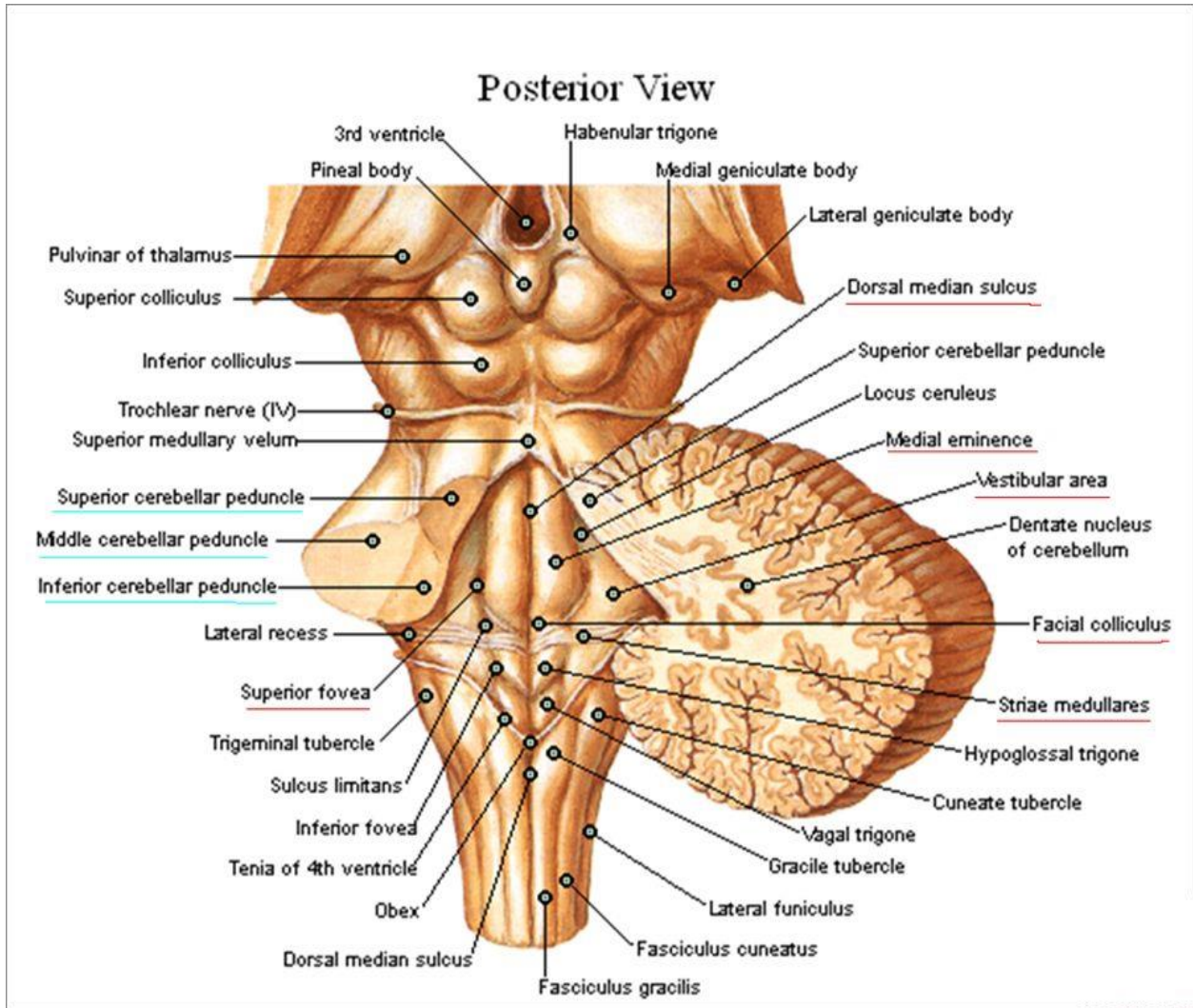
2- The inferior fovea **divides** the medullary part into **3 triangular areas**, from medial to lateral:

a- **Hypoglossal trigone:** medial to the inferior fovea; overlies the nucleus of the 12<sup>th</sup> (hypoglossal) nerve.

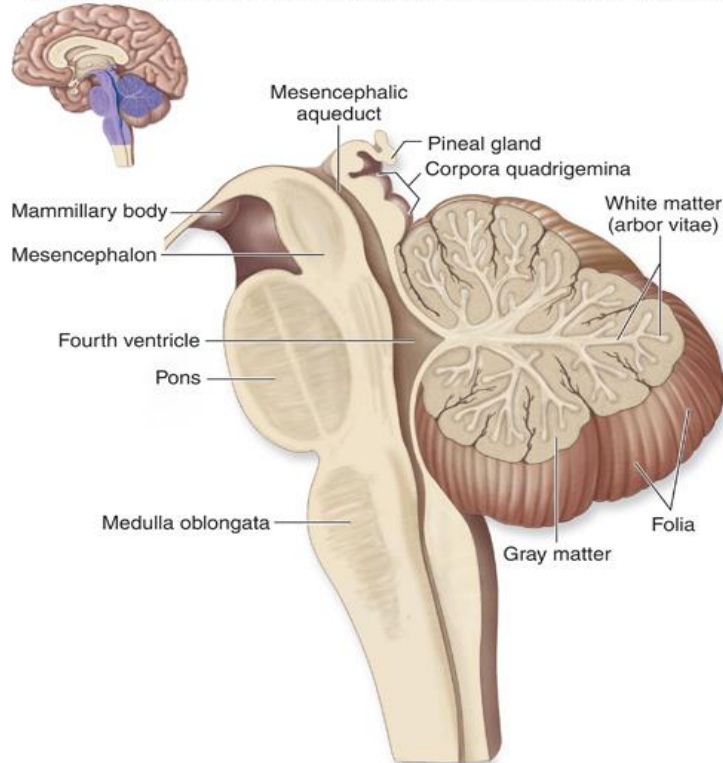
b- **Vagal trigone:** between the limbs of the inferior fovea; overlies the dorsal nucleus of the 10<sup>th</sup> (vagus) nerve.

c- **Lower vestibular area:** lateral to the inferior fovea; overlies the inferior and lower 1/2 of medial vestibular nuclei.

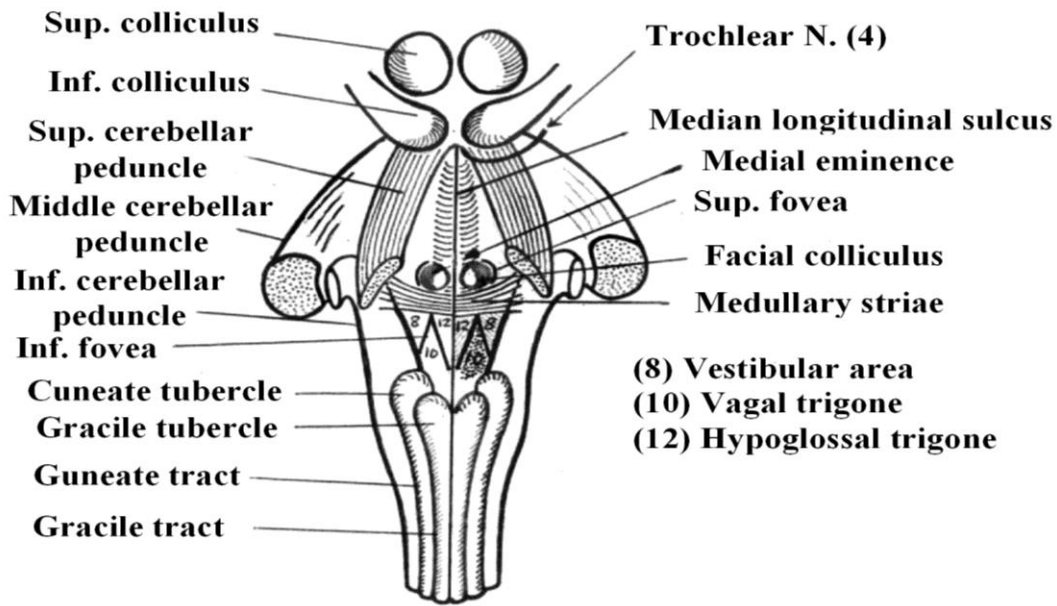




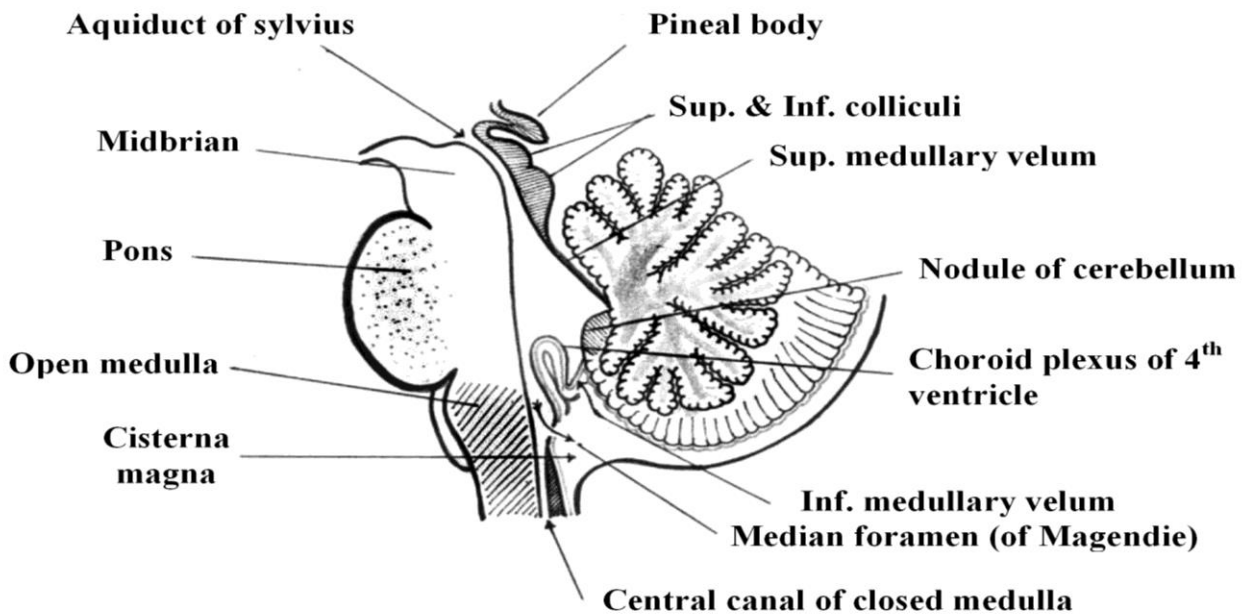
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(a) Midsagittal section



**Floor of 4<sup>th</sup> Ventricle**



**Roof of 4<sup>th</sup> Ventricle**

**B) Pontine part:** presents

- 1-** A smooth longitudinal elevation on either side of the median sulcus called the **medial eminence**.
- 2-** On the medial eminence just above the medullary stria there is a small rounded elevation called the **facial colliculus** which is caused by the facial nerve fibres as they turn around the abducent nucleus.
- 3- Sulcus limitans:** lies **lateral to medial eminence** and its **upper part** form area called **locus seruleus**.
- 4-** The facial colliculus is bounded **laterally** by the **lower part of sulcus limitans** which form a crescentic depression called-the **superior fovea**.
- 5- Upper vestibular area:** lies lateral to the superior fovea. It overlies superior, lateral and upper 1/2 of medial vestibular nuclei.

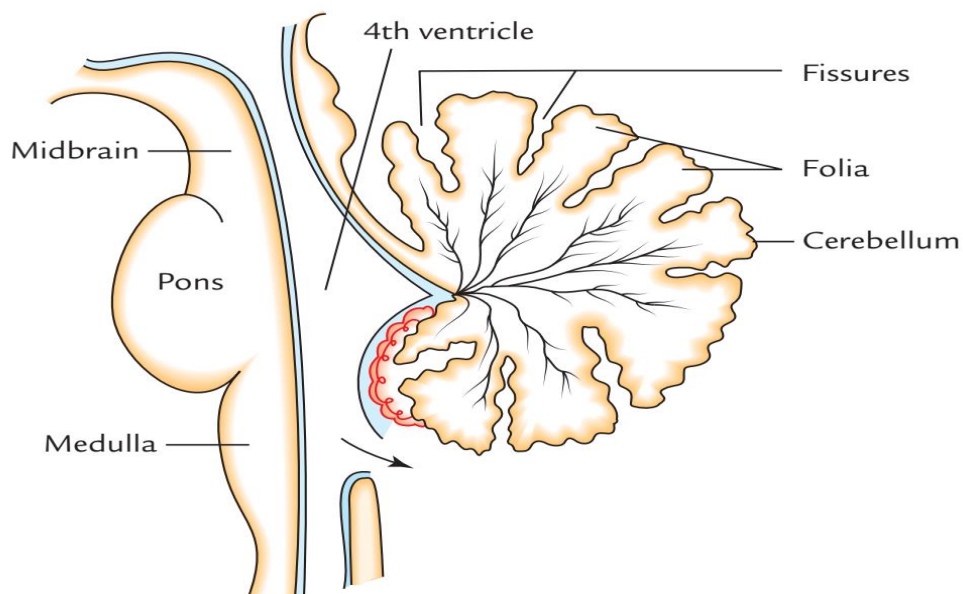
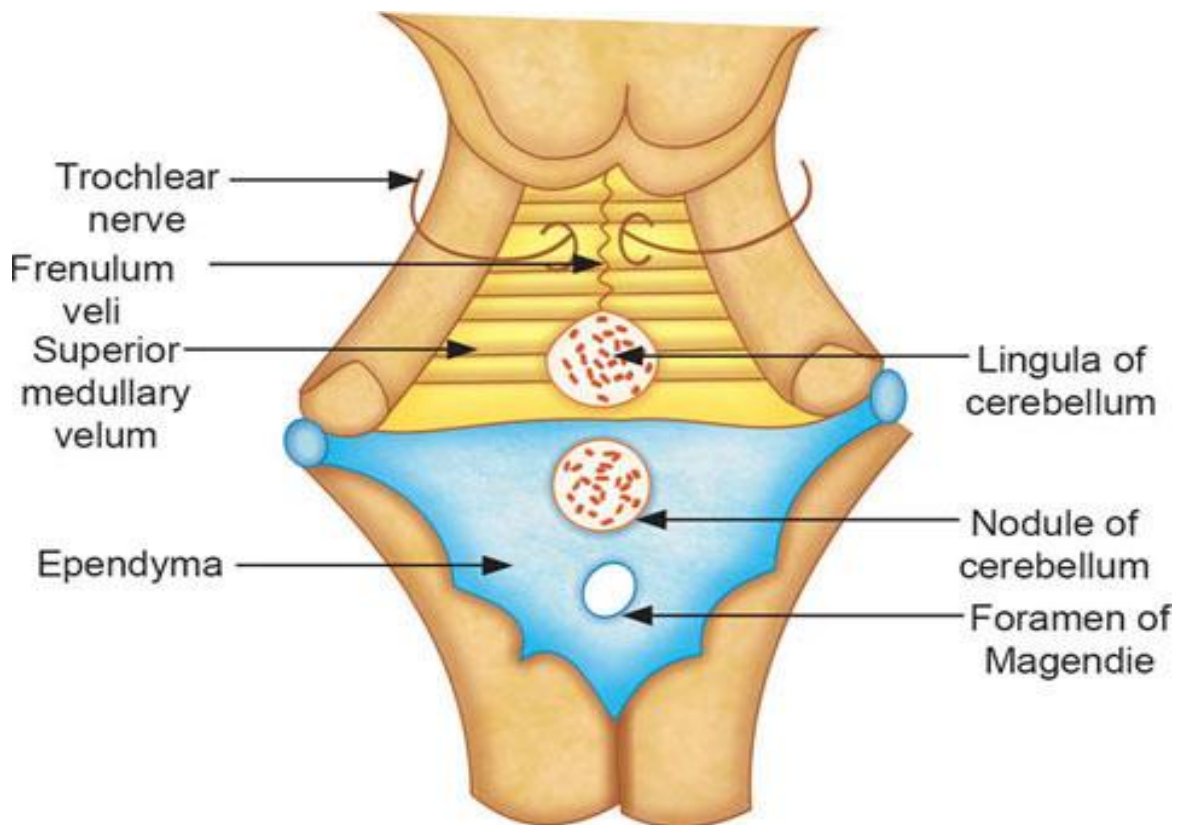
**III) The roof of the 4<sup>th</sup> ventricle:****A) The upper part of the roof:** consists of

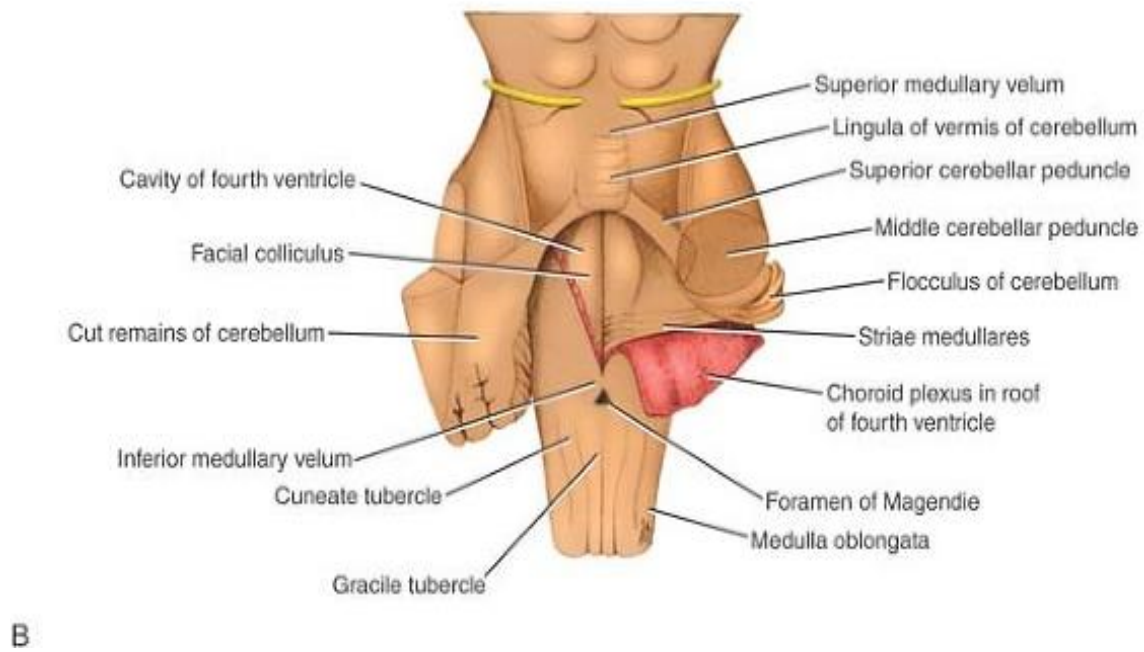
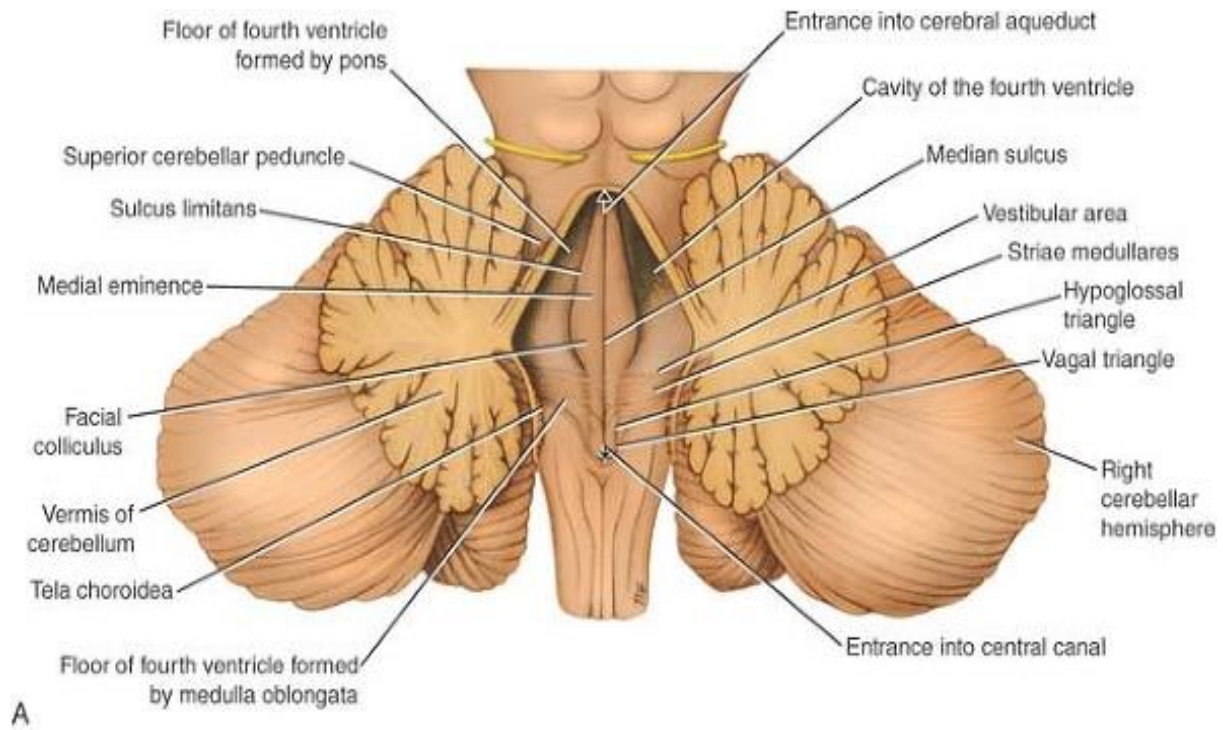
- The superior medullary velum stretched between the 2 superior cerebellar peduncles.

**B) The lower part of the roof:** It is divided into 2 areas:

- **Upper area** formed by the **nodule** of the cerebellum (in the median plane) and the **inferior medullary velum** on each side of the nodule.
- **Lower area** consists of:
  - **Ependyma and pia mater** in contact with each other.

- This thin area is **invaginated** into the cavity of the ventricle by the **choroids plexus** of the 4<sup>th</sup> ventricle.
- The lowest part of this area of the roof show a **median aperture** (foramen of Magendi) which connects the 4<sup>th</sup> ventricle to the subarachnoid space.





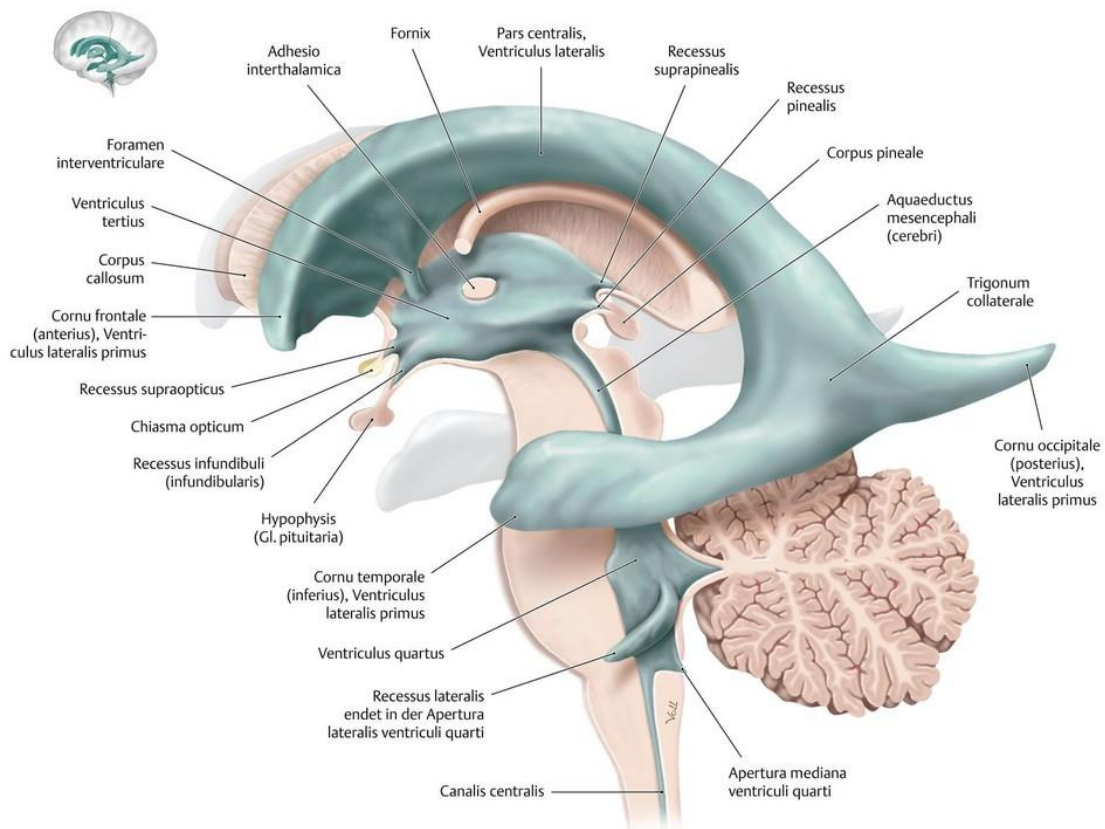
**C) Recesses of the roof of 4<sup>th</sup> ventricle:**

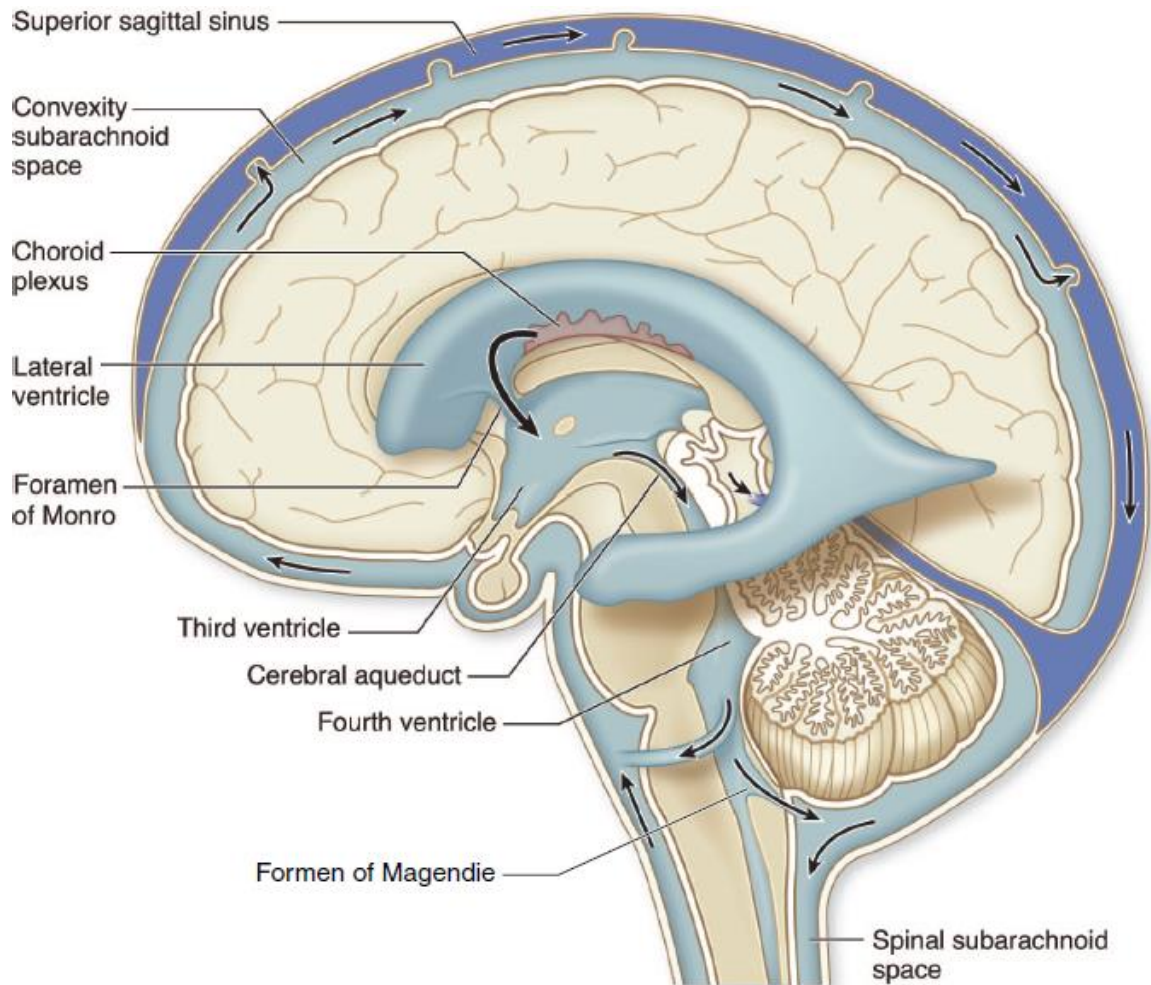
**1) Median recess:**

- The **roof** of the 4<sup>th</sup> ventricle **extends backwards** towards the cerebellum; forming a **median recess**.
- The **upper wall** of the median recess is formed by the lower end of the **superior Medullary velum** and its **lower wall** formed by the **nodule** of the cerebellum.

**2) Two lateral recesses:**

- At the lateral angles of the 4<sup>th</sup> ventricle, the roof is drawn laterally and forwards to form tubular pouch on either side called the lateral recess.
- Each lateral recess opens at its extremity into the subarachnoid space by a lateral aperture (foramen of Luschka).





Source: A. H. Ropper, M. A. Samuels, J. P. Klein, S. Prasad: Adams and Victor's Principles of Neurology, 11th Edition  
 www.neurology.mhmedical.com  
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### ★ Communications of the 4<sup>th</sup> ventricle:

- a- **At its upper angle**, the 4<sup>th</sup> ventricle is connected to the **cerebral aqueduct of sylvius** which connects the 4<sup>th</sup> ventricle with the **3<sup>rd</sup> ventricle** above.
- b- **At its lower angle**, the 4<sup>th</sup> ventricle is connected to the **central canal of the closed medulla** which is continuous below with the central canal of the spinal cord.
- c- **At its roof**, the 4<sup>th</sup> ventricle is connected to the subarachnoid space by:
  - The **median apertures** which open in the **cisterna magna**.



- **2 lateral apertures** which open in the **ponto-medullary cisterna**.

★ **Choroid plexus of the 4<sup>th</sup> ventricle :**

- **Site:** it invaginates the lowermost area of the roof of 4<sup>th</sup> ventricle above the median aperture of magendie.
- **Shape: T shaped** with a median stem and 2 arms extending to the lateral recess
- **Blood supply: posterior inferior cerebellar** arteries

