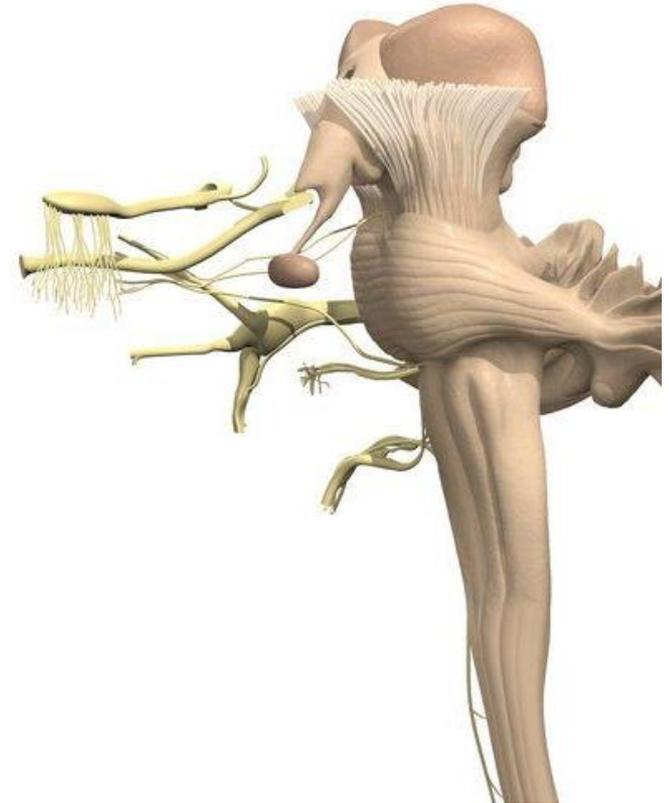


# BRAIN STEM I

BY

**DR. DALIA M.BIRAM**



**Amyotrophic lateral sclerosis (ALS; Lou Gehrig's disease) is a progressive, fatal neurodegenerative disease caused by degeneration**

**of the motor neurons controlling skeletal (voluntary) muscle movement. Postmortem analysis of which of the following**

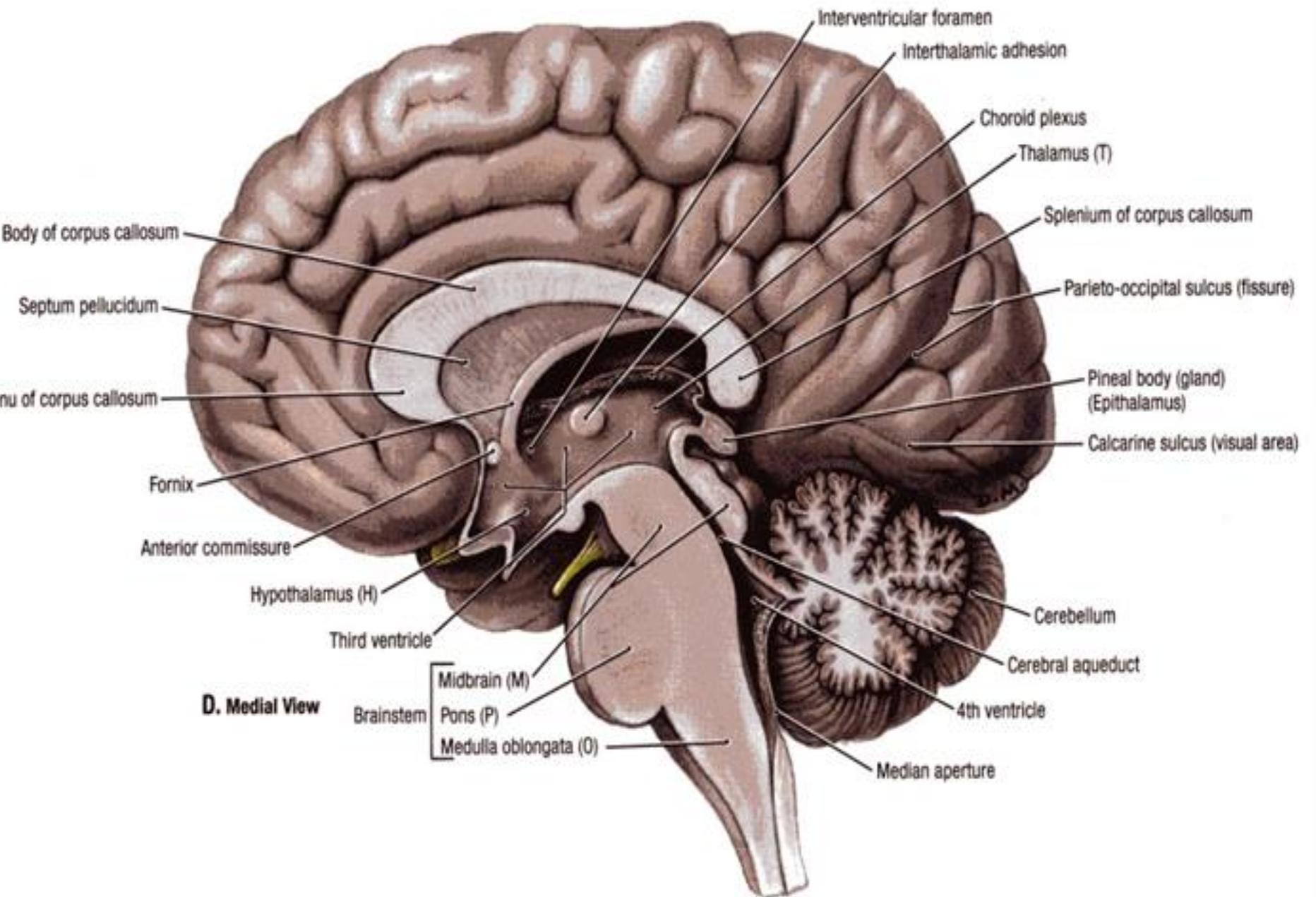
**structures would show the cell bodies of neurons affected by this disease?**

- (A) Anterior gray horn of the spinal cord**
- (B) Lateral gray horn of the spinal cord**
- (C) Posterior gray horn of the spinal cord**
- (D) Spinal ganglia**
- (E) Lateral column of spinal cord white matter**

**A 34-year-old man fell 25 ft out of a barn loft, landing on his back. He was found unconscious and taken to the ER. The given sagittal CT reformat image reveals a T9 spinal fracture dislocation, as noted by the black arrow. The patient had unequivocal clinical findings indicating spinal cord transection. Given the results of this CT image and the clinical information, what deficits will the patient incur?**



- (A) Quadriplegia and incontinence**
- (B) Paraplegia and incontinence**
- (C) Incontinence only**
- (D) Loss of only sensory information below the lesion**
- (E) Loss of only motor function below the lesion**



# BRAIN STEM

## ❑ SITE:

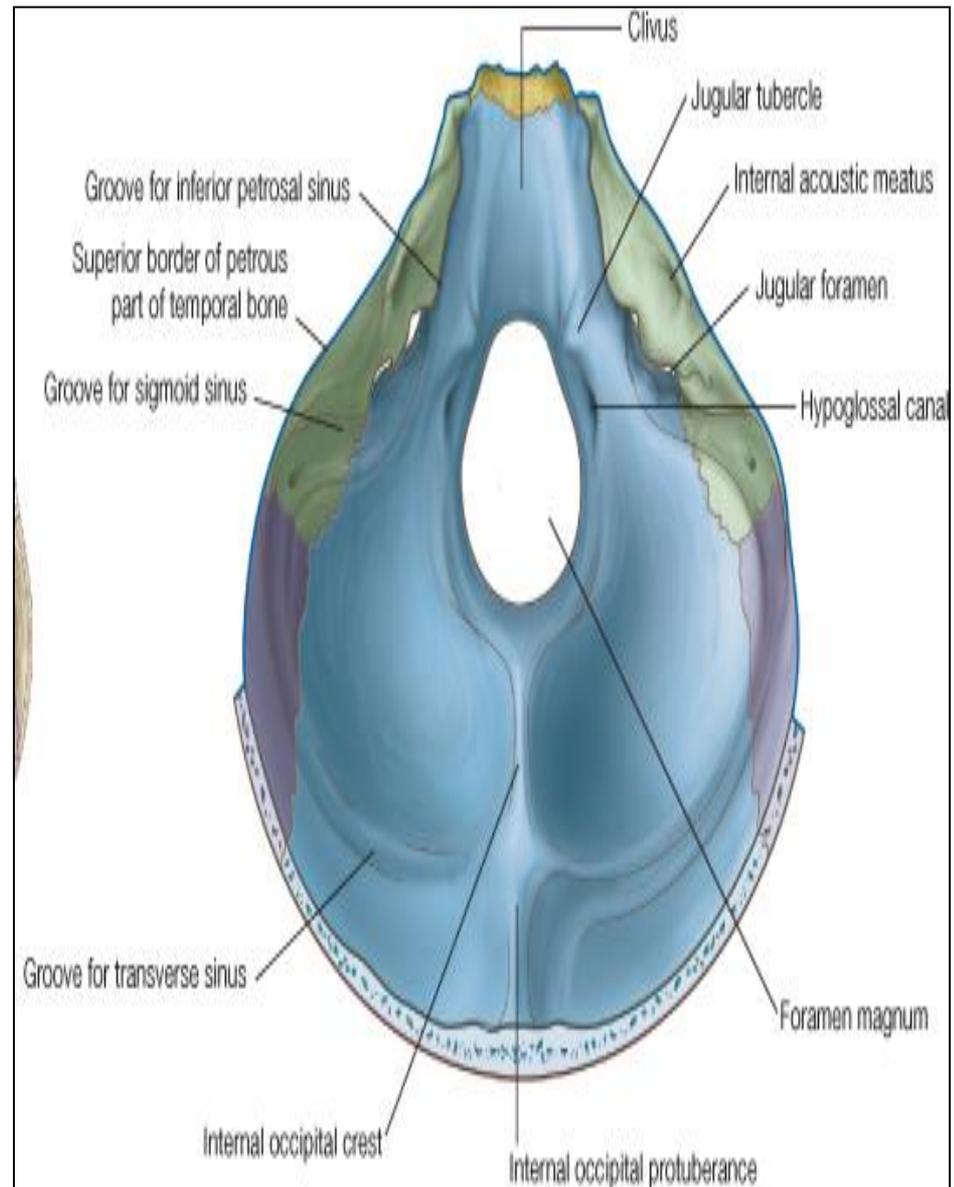
- It lies posterior to the basilar part of occipital bone (clivus).

## ❑ PARTS: *From above downwards:*

- *Mid brain, pons & medulla oblongata*

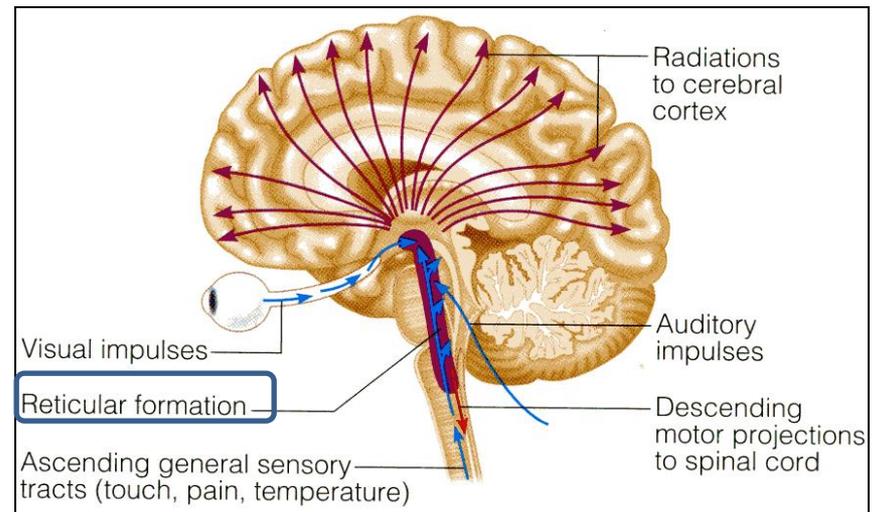
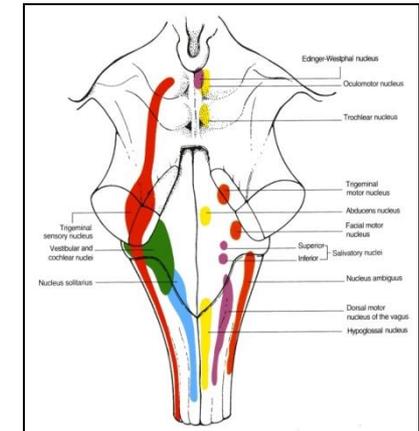
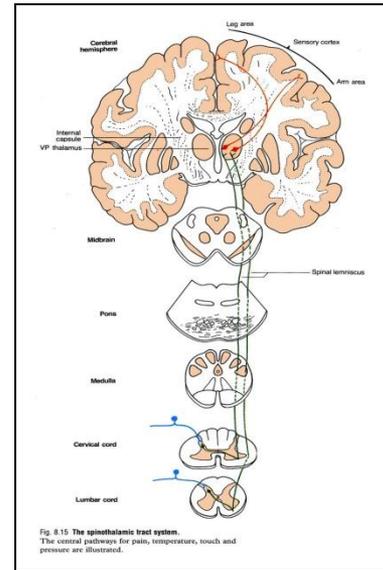
## ❑ CONNECTIONS WITH CEREBELLUM:

- Each part of the brain stem is connected to cerebellum by cerebellar peduncles (superior, middle & inferior).



# FUNCTIONS OF BRAIN STEM

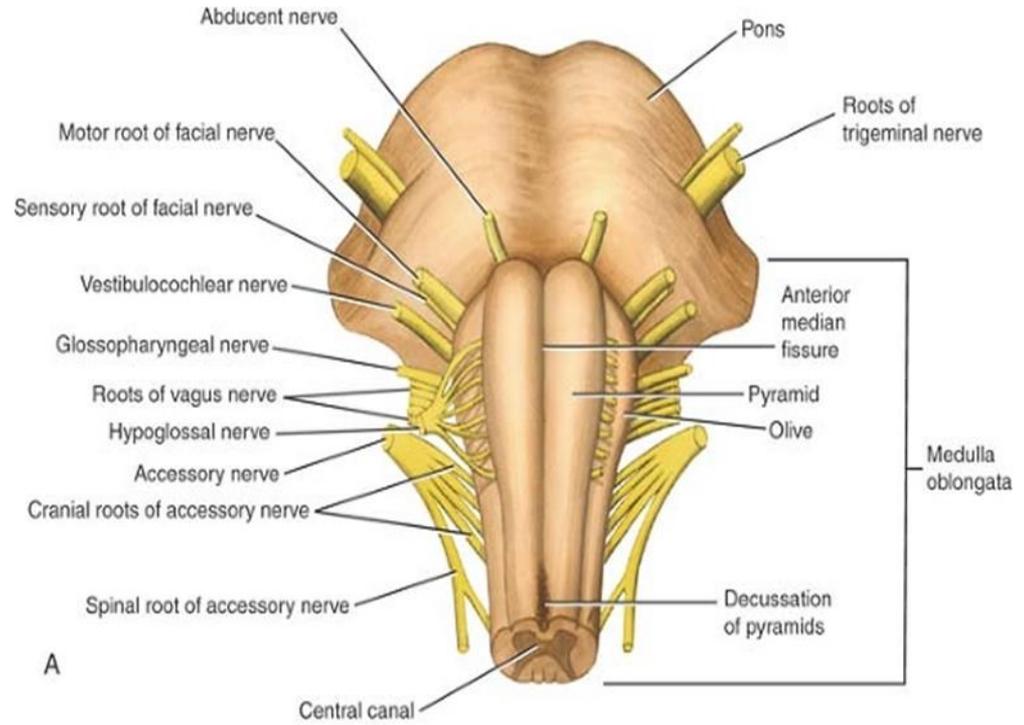
1. Pathway of tracts between cerebral cortex & spinal cord.
2. Site of origin of nuclei of cranial nerves (from 3<sup>rd</sup> to 12<sup>th</sup>).
3. Site of emergence of cranial nerves (from 3<sup>rd</sup> to 12<sup>th</sup>).
4. Contains groups of nuclei & related fibers known as reticular formation responsible for: *control of level of consciousness, perception of pain, regulation of cardiovascular & respiratory systems.*



# External features of the medulla

**A. Ventral surface:** It presents the following features :

- **Anteromedian fissure** which is an upward extension of the anteromedian fissure of the spinal cord. In the lower part of the medulla, the anteromedian fissure is traversed by the decussating fibers of the pyramidal tract (**motor decussation**).

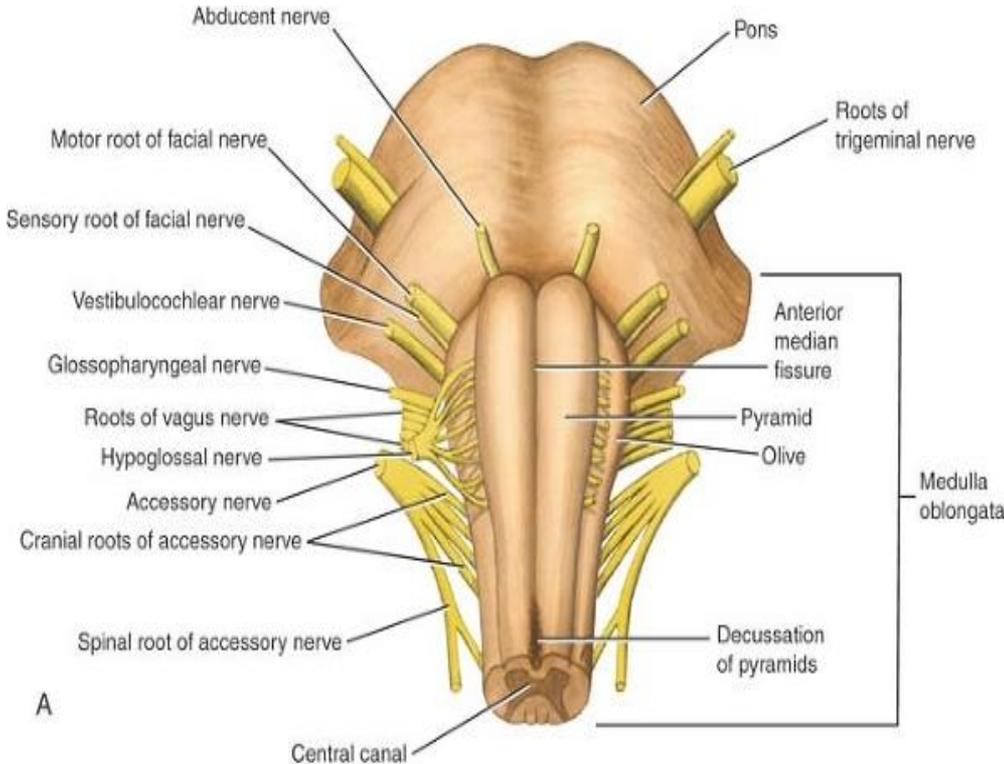


A

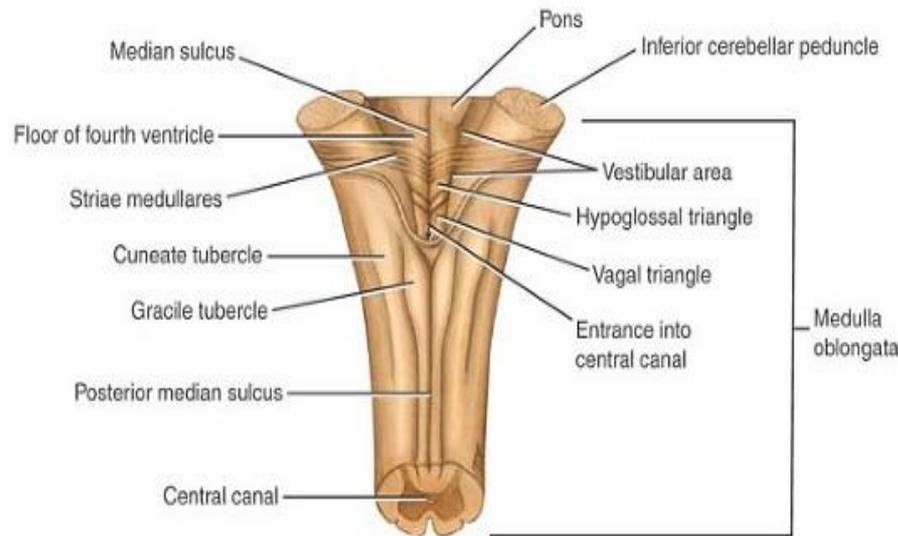


B

- The elevation on each side of the anteromedian fissure is called **pyramid**. It is formed by **the corticospinal fibers**.
- The oval elevation lateral to the pyramid is called **olive** and is formed by the bulging of the **inferior olivary nucleus**.
- The groove between the pyramid and the olive is called **anterolateral sulcus** and it gives exit for the **rootlets of the hypoglossal nerve**.

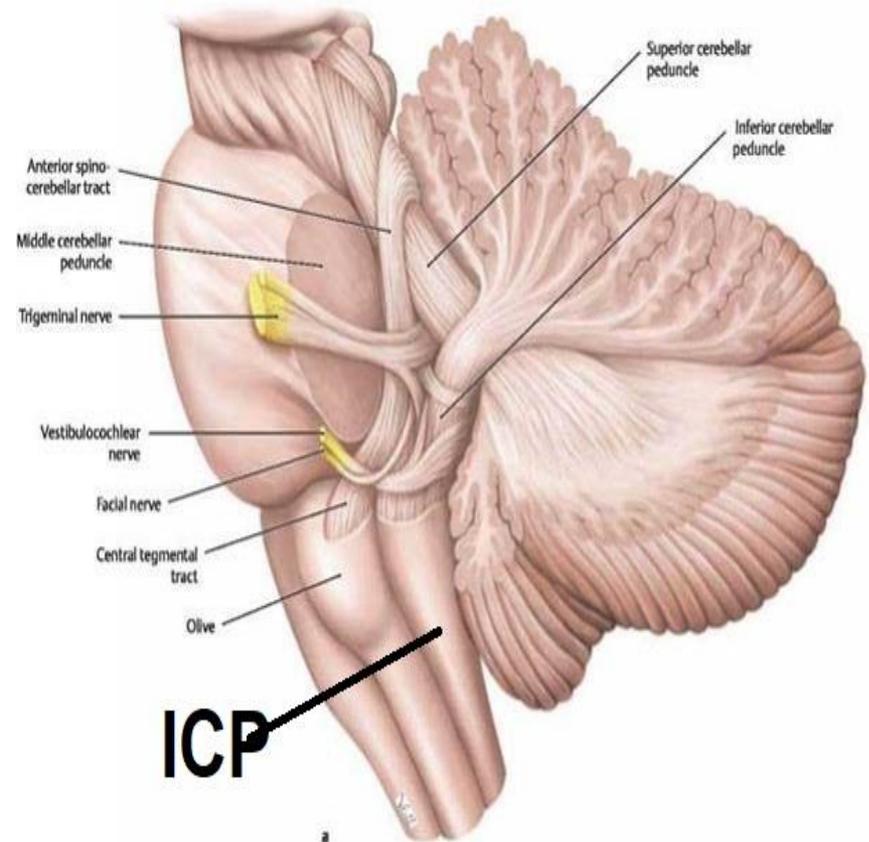


A



B

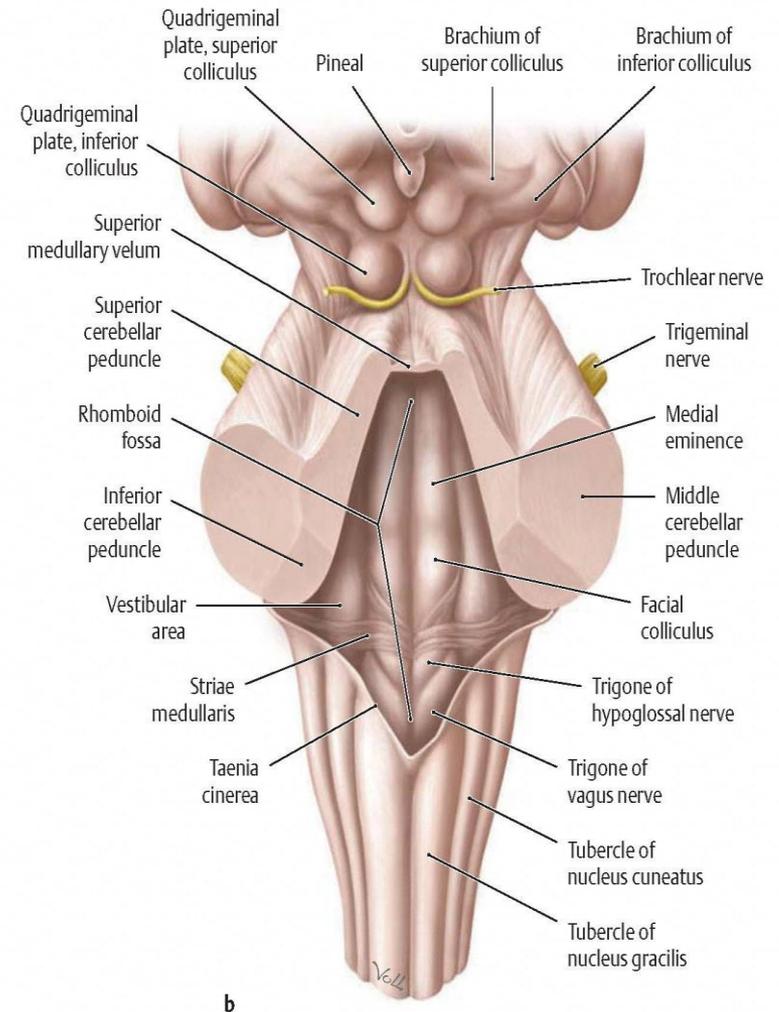
- The groove lateral to the olive is called **posterolateral sulcus**. It gives exit to the rootlets of the glossopharyngeal, vagus and cranial accessory nerves arranged from above downwards.
- **Posterolateral sulcus** separates the olive from the inferior cerebellar peduncle(ICP)



## B. Dorsal surface:

### 1- closed medulla

- A **posteromedian sulcus** which is an upward continuation of the posteromedian sulcus of the spinal cord. It extends up to the lower angle of the fourth ventricle.
- The longitudinal elevation lateral to the posteromedian sulcus is called **gracile fasciculus** as it overlies the gracile tract. Its upper end expands to form the **gracile tubercle** which overlies the gracile nucleus.
- The longitudinal elevation lateral to the gracile fasciculus is called **cuneate fasciculus** as it overlies the cuneate tract. Its upper end expands to form the **cuneate tubercle** which overlies the cuneate nucleus.
- The ridge lateral to the cuneate tubercle is the **inferior cerebellar peduncle**



### E Brainstem

#### b Posterior view.

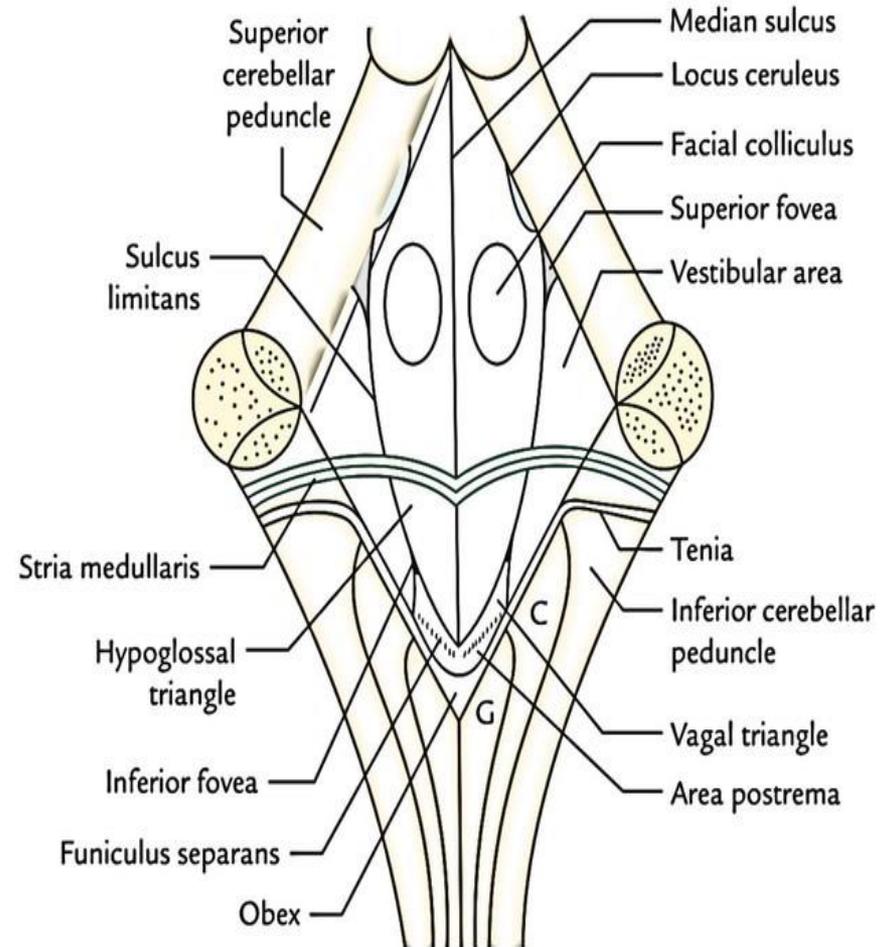
Illustrator: Markus Voll

pp. 226-227

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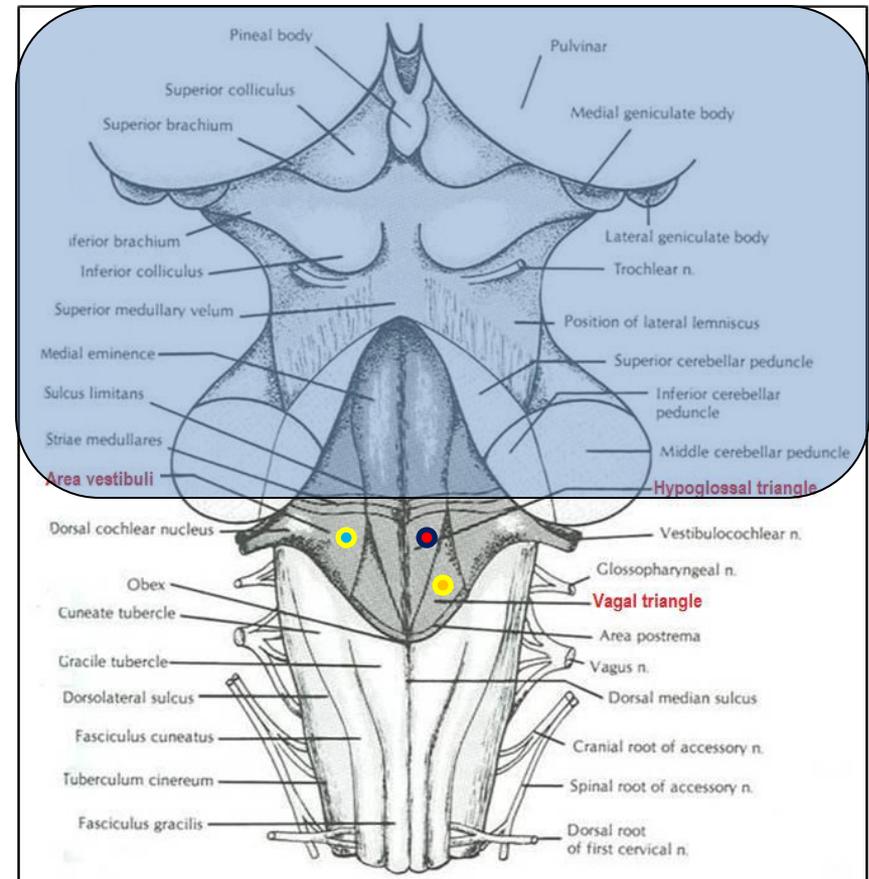
# 2-OPEN MEDULLA

- The area between the two inferior cerebellar peduncles forms the lower part of the **floor of the fourth ventricle**. This area is triangular in shape and is bounded above by the **stria medullaris**. This area presents an inverted V-shaped depression called inferior fovea which divides it into three trigones from medial to lateral:



# OPEN MEDULLA

- 1. Hypoglossal triangle:** overlies hypoglossal nucleus.
- 2. Vagal triangle:** overlies dorsal vagal nucleus.
- 3. Vestibular area: IT** overlies the inferior vestibular nucleus and part of the medial vestibular nuclei.



Shown after removing cerebellum

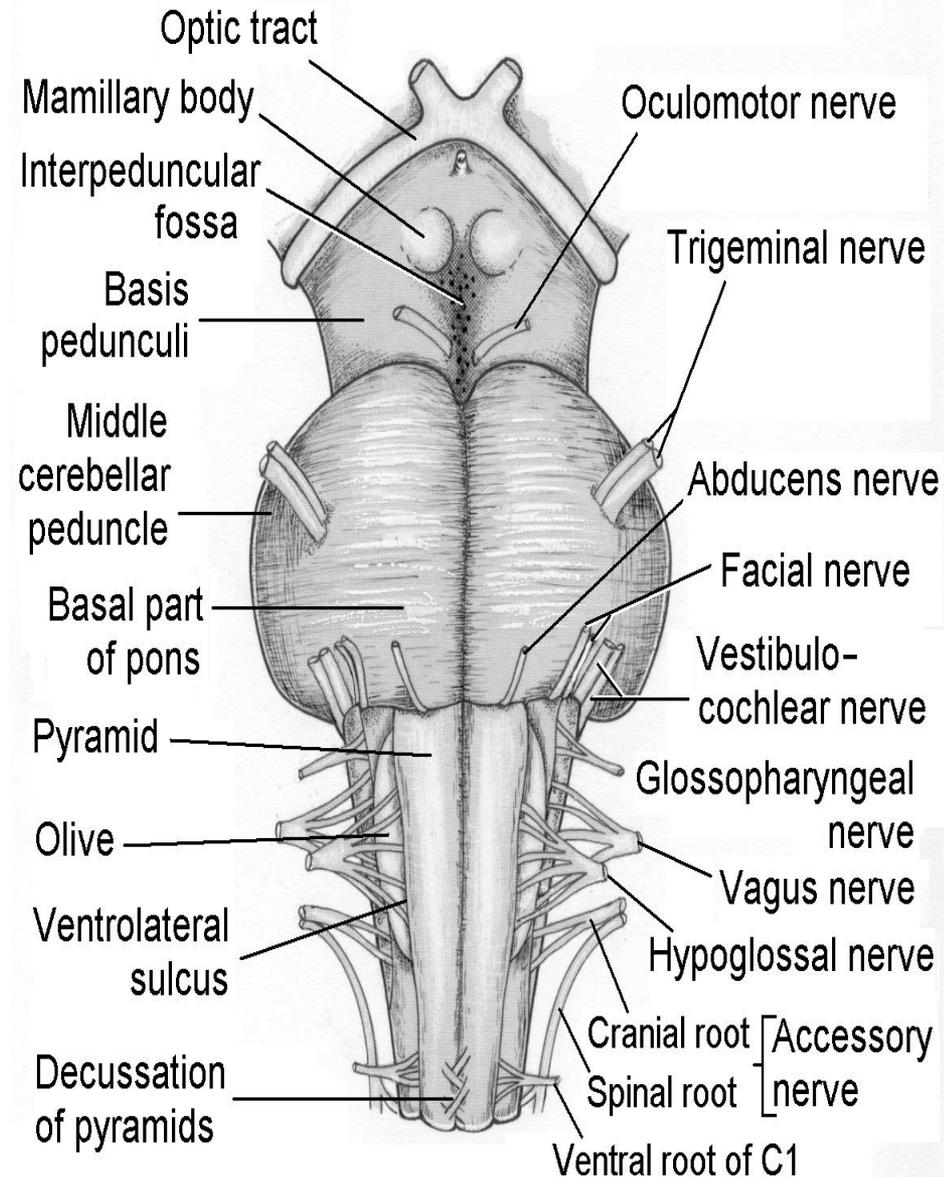
# External features of the pons

## A. The ventral surface :

- It is convex from side to side; laterally it is continuous with the middle cerebellar peduncle on each side.

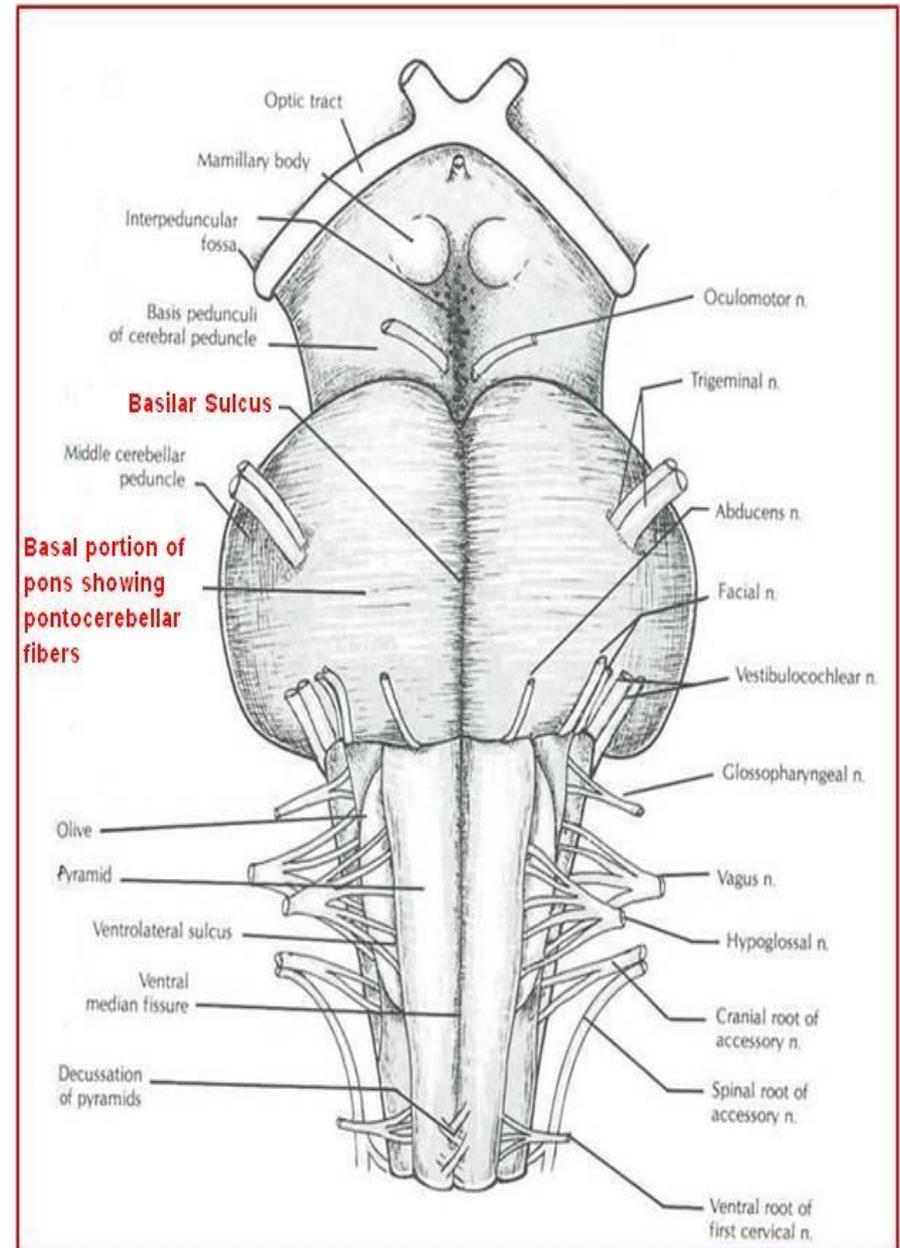
- It presents a median groove called **basilar groove** as it lodges the basilar artery.

- **The trigeminal nerve** emerges from the middle part of the pons at its junction with the middle cerebellar peduncle. The **abducent nerve** emerges at the lower border of the pons, between it and the pyramid. The **facial and vestibulo-cochlear nerves** also emerge at the lower border of the pons, between it and the olive (The facial nerve is medial to the vestibulo-cochlear).



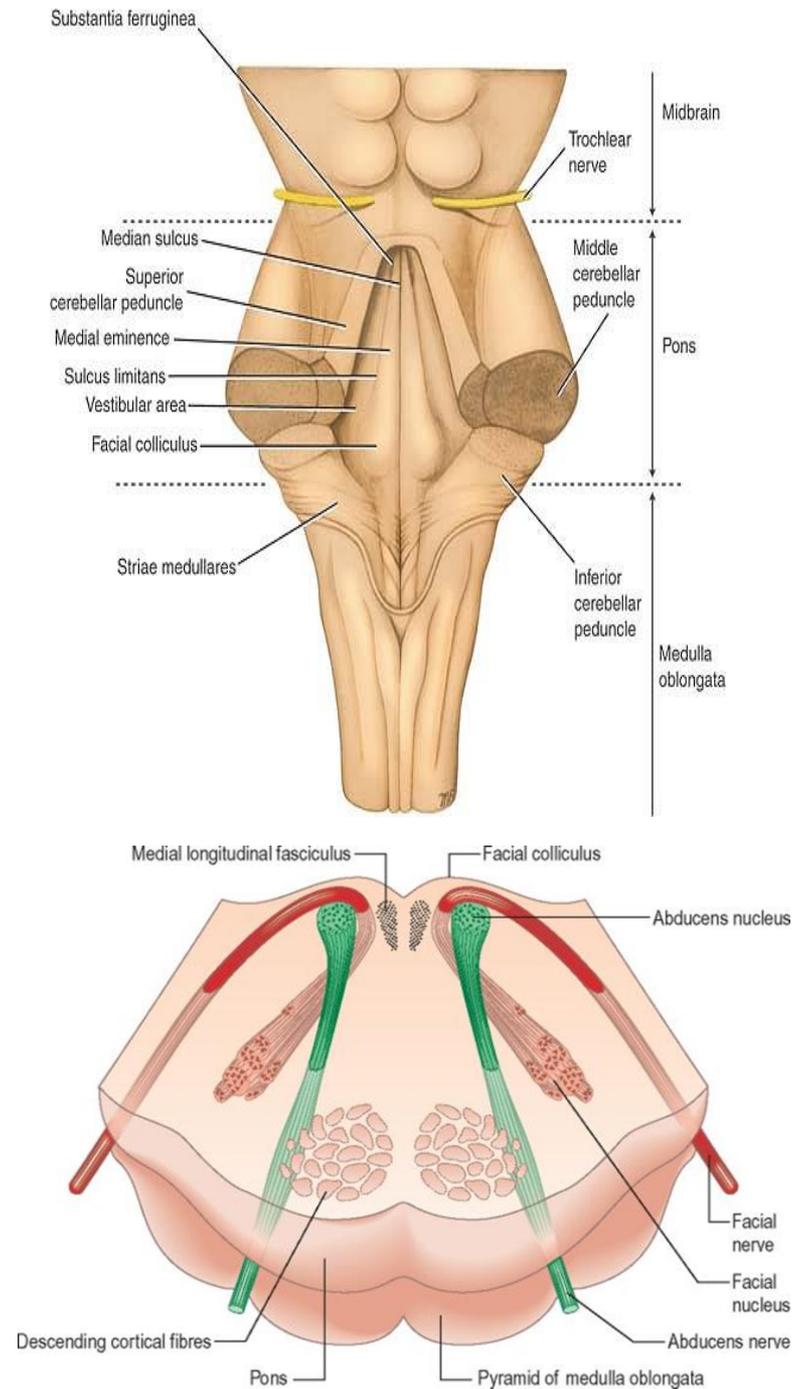
## - Transverse pontine (pontocerebellar) fibers:

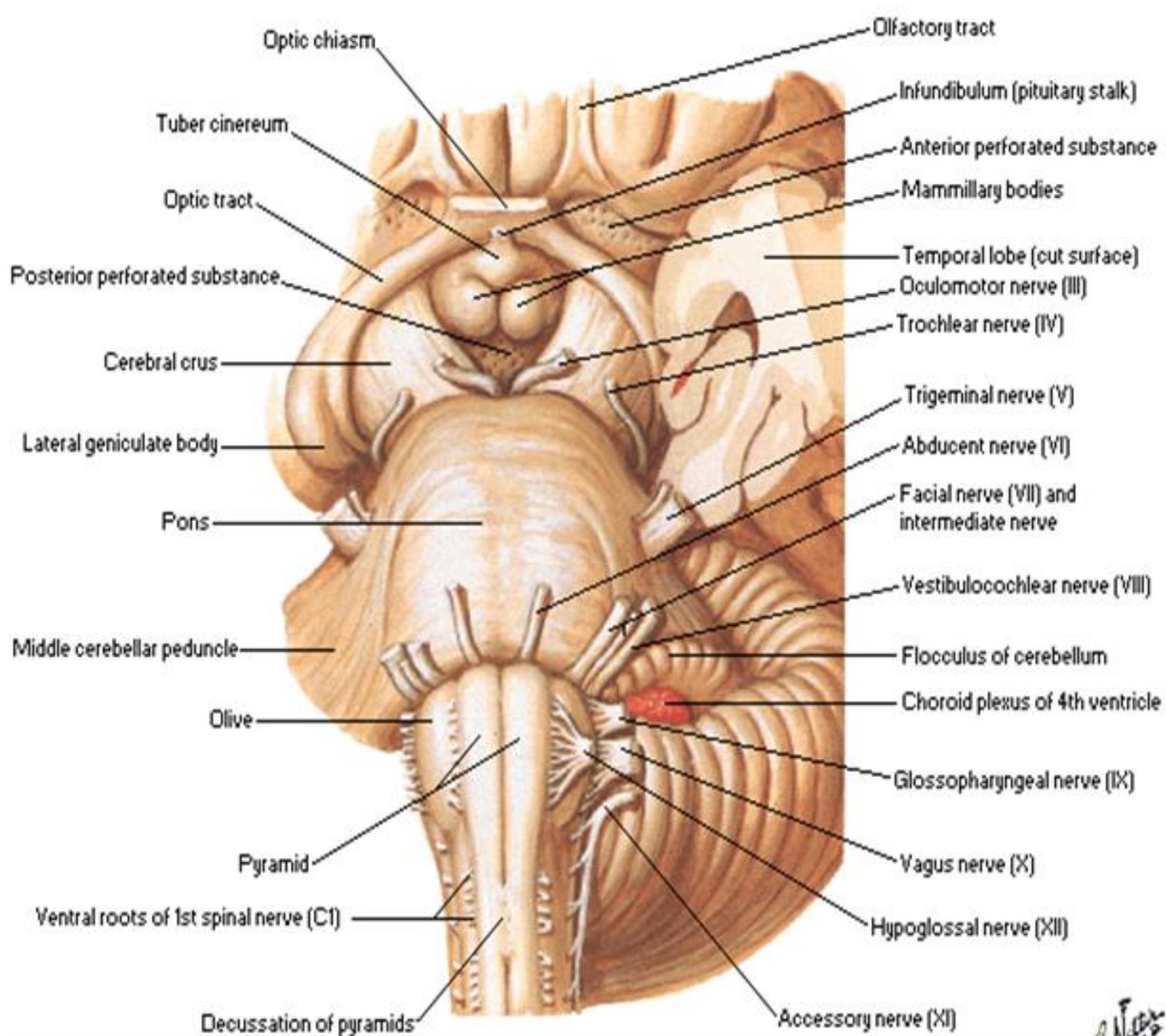
- Originate from pontine nuclei, cross the midline & pass through the contralateral middle cerebellar peduncle to enter the opposite cerebellar hemisphere.



## B. The dorsal surface:

- It forms the upper part of the floor of the fourth ventricle. It presents a depression called **superior fovea** that separates the **medial eminence** from the **upper vestibular area**.
- The lower part of the medial eminence presents a prominent elevation called **facial colliculus**. This **colliculus** is produced by the **abducent nucleus** surrounded by the **facial nerve fibers**. The **upper vestibular area** is produced by the **lateral and superior vestibular nuclei**.





# External features of the midbrain

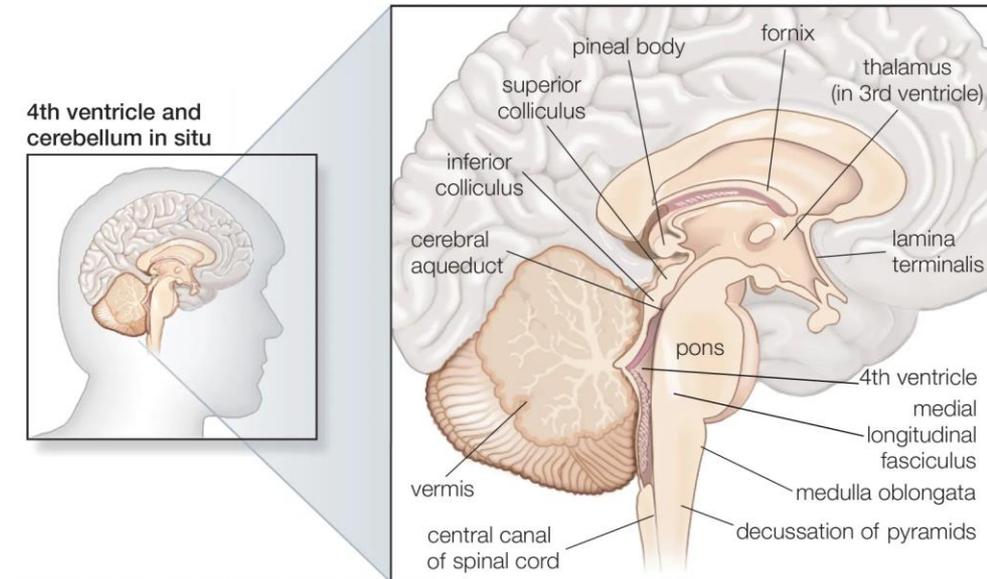
➤ The midbrain presents a narrow lumen called cerebral aqueduct (aqueduct of sylvius). A coronal plane passing through the cerebral aqueduct divides the midbrain into two divisions:

A. Ventral part: Called **cerebral peduncle**.

B. Dorsal part: Called **tectum**.

**A. Cerebral peduncle:** The two peduncles form the posterolateral boundaries of a depression on the base of the brain called interpeduncular fossa. The cerebral peduncle is differentiated into 3 parts:

- 1 . **Crus cerebri (Basis pedunculi).**
- 2 . **Substantia nigra.**
- 3 . **Tegmentum.**



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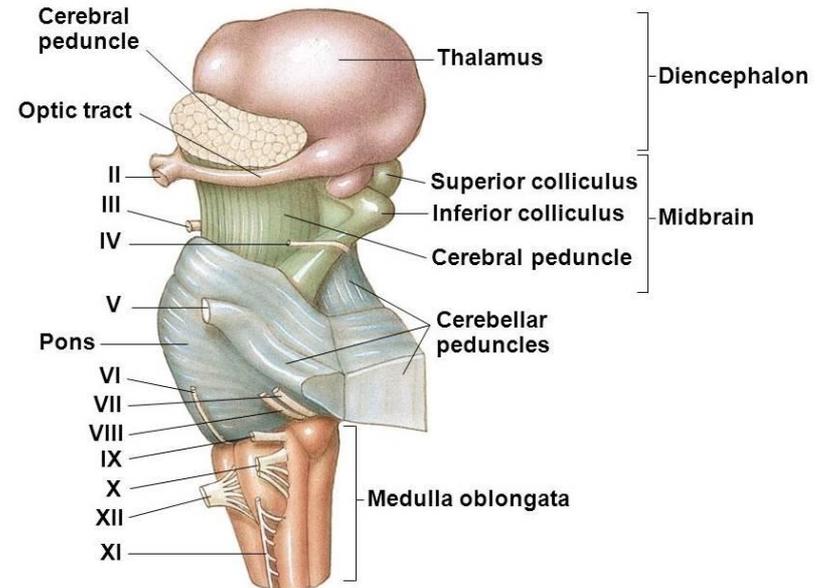
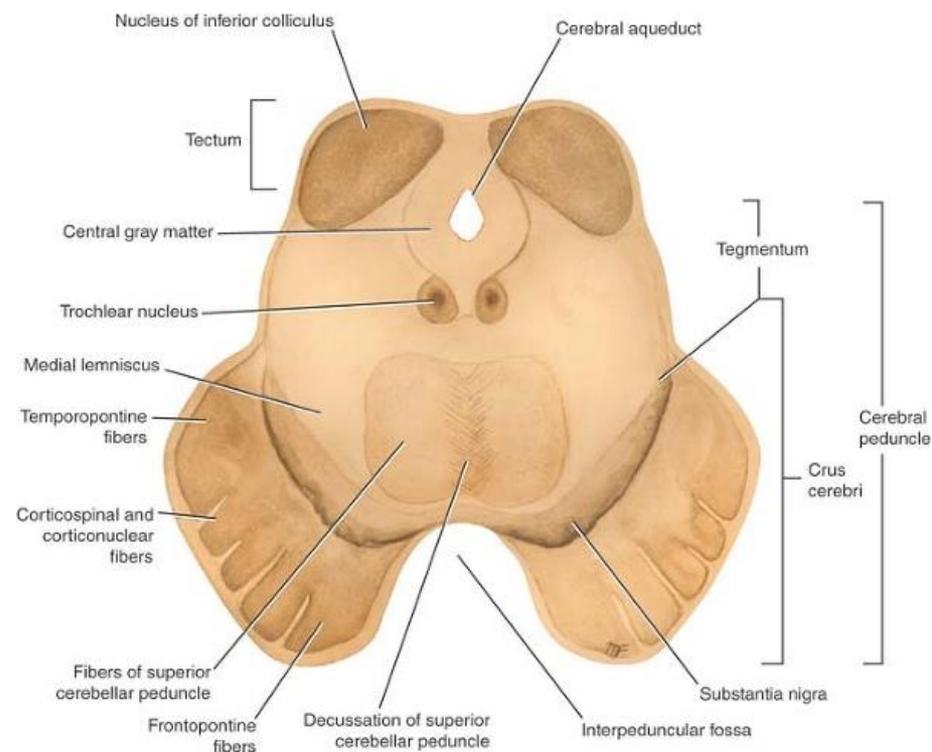
**1 . Crus cerebri** This is formed of bundles of nerve fibers descending from the cerebral cortex to lower levels of the brain stem and spinal cord. These fibers constitute the corticopontine, corticonuclear and corticospinal fibers (will be given later).

The crus cerebri is crossed by:

- a. Basal vein.
- b. Superior cerebellar artery.
- c. Posterior cerebral artery.
- d. Trochlear nerve.
- e. Optic tract.

**2 . Substantia nigra:** It is a lamina of pigmented grey matter containing melanin pigment.

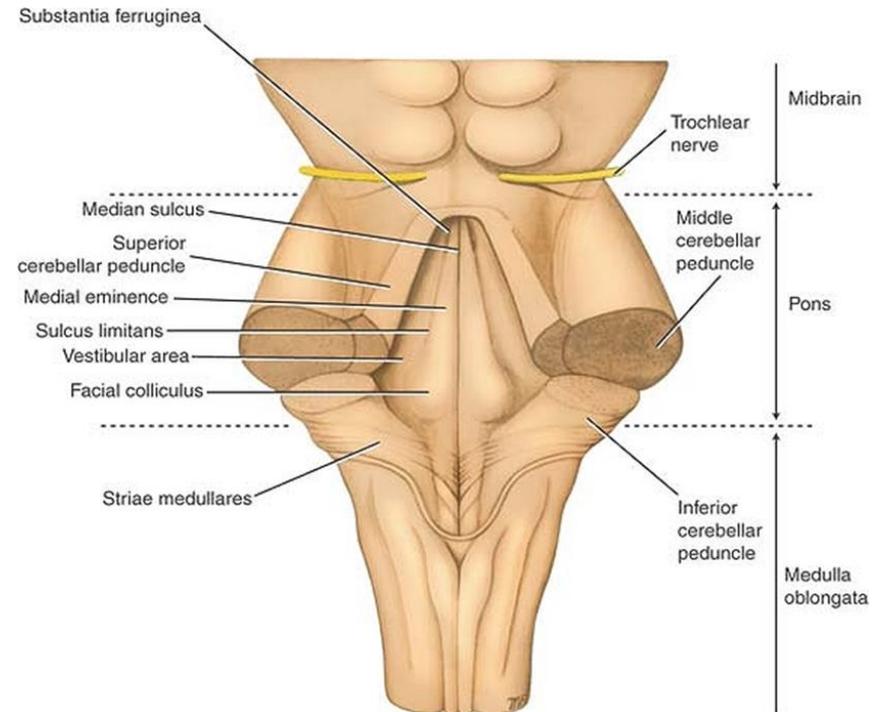
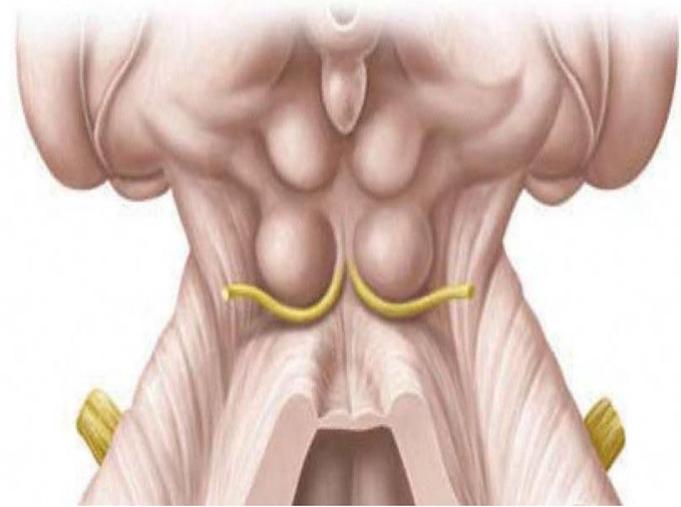
**3. Tegmentum:** This is the posterior part of the cerebral peduncle and is continuous inferiorly with the tegmentum of the pons.



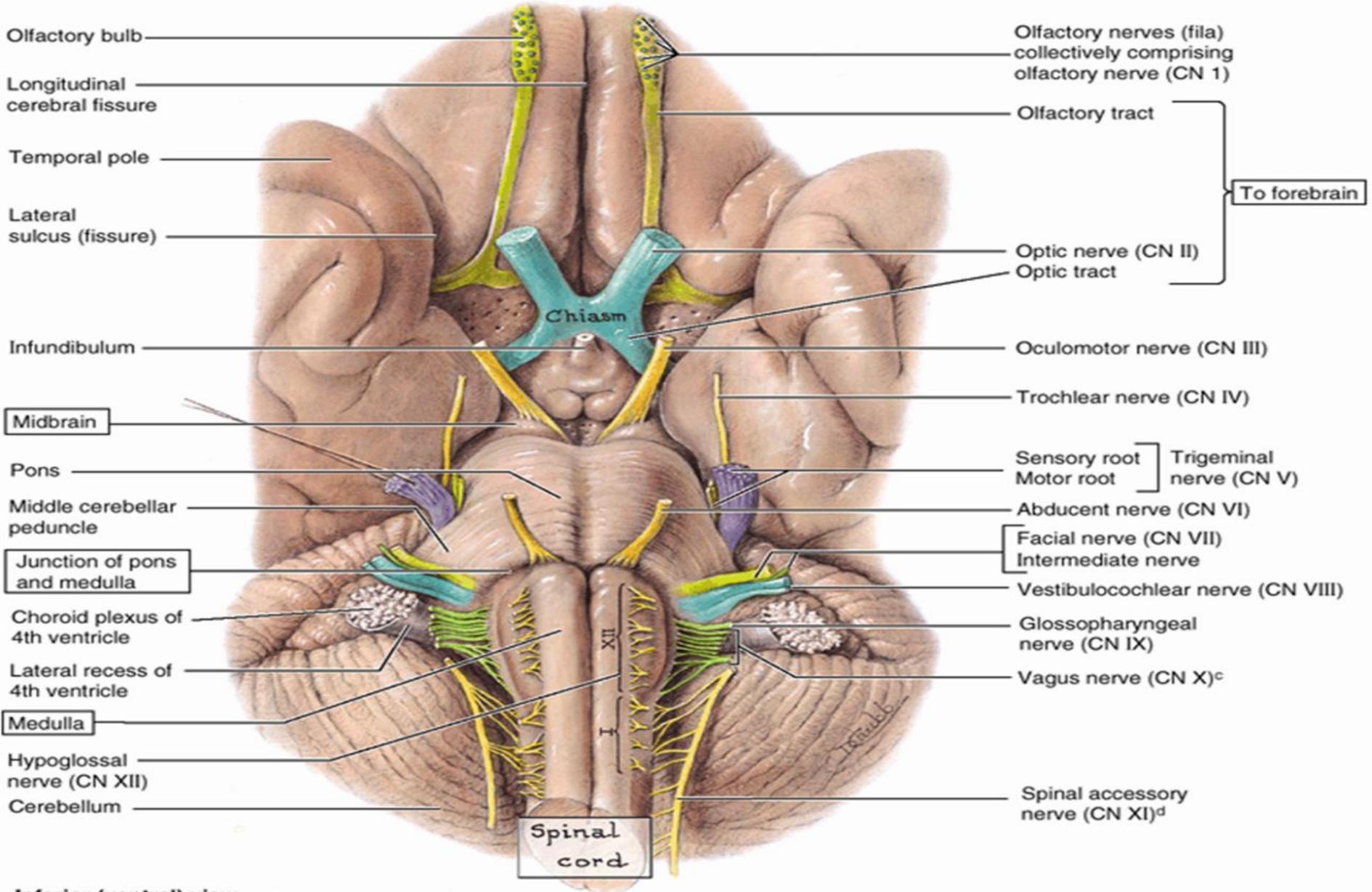
(a) Lateral view

**B. Tectum** : This is the smaller dorsal part of the midbrain. The tectum is formed of four Knob-like elevation called **colliculi**. They are arranged as two superior and two inferior colliculi.

- Each colliculus gives rise to a **brachium** from its lateral side. The superior brachium connects the superior colliculus with the lateral geniculate body. The inferior brachium connects the inferior colliculus with the medial geniculate body.

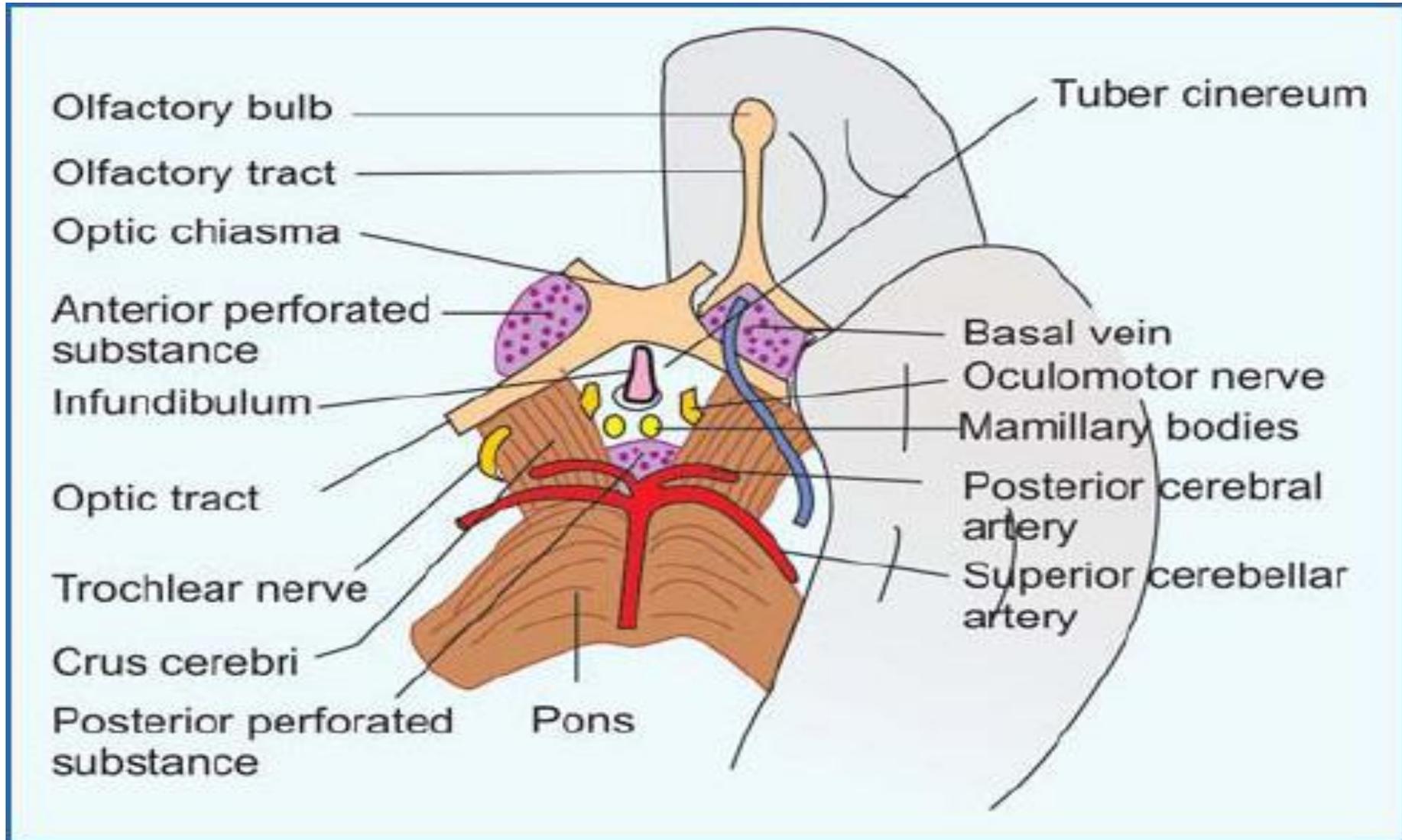


# EXIT OF CRANIAL NERVES FROM



Inferior (ventral) view

# Interpeduncular Fossa



## **Interpeduncular Fossa**

\* **Shape and site:** this is a diamond shaped depression at the base of the brain between the two cerebral peduncles.

\* **Boundaries:**

1- Anteriorly, Optic chiasma.

2- Posteriorly, Upper border of the pons.

3- Anterolaterally, Optic tracts.

4- Posterolaterally, crus cerebri.

• **Contents:**

1-Tuber cinereum

2- Infundibulum.

3- Mammillary bodies.

4- Posterior perforated substances

5- The oculomotor (3<sup>rd</sup>) cranial nerve exits through the medial sides of the cerebral peduncles.

6- Interpeduncular cistern contains: C.S.F

**Anterior perforating substance :** area in front of optic tract, it is pierced by branches of anterior choroidal artery from ICA, anterior & middle cerebral arteries to internal capsule & basal nuclei.

**Posterior perforating substance** is the area in the interpeduncular fossa, it is pierced by branches of posterior cerebral artery to the thalamus.

# Blood supply of the brainstem

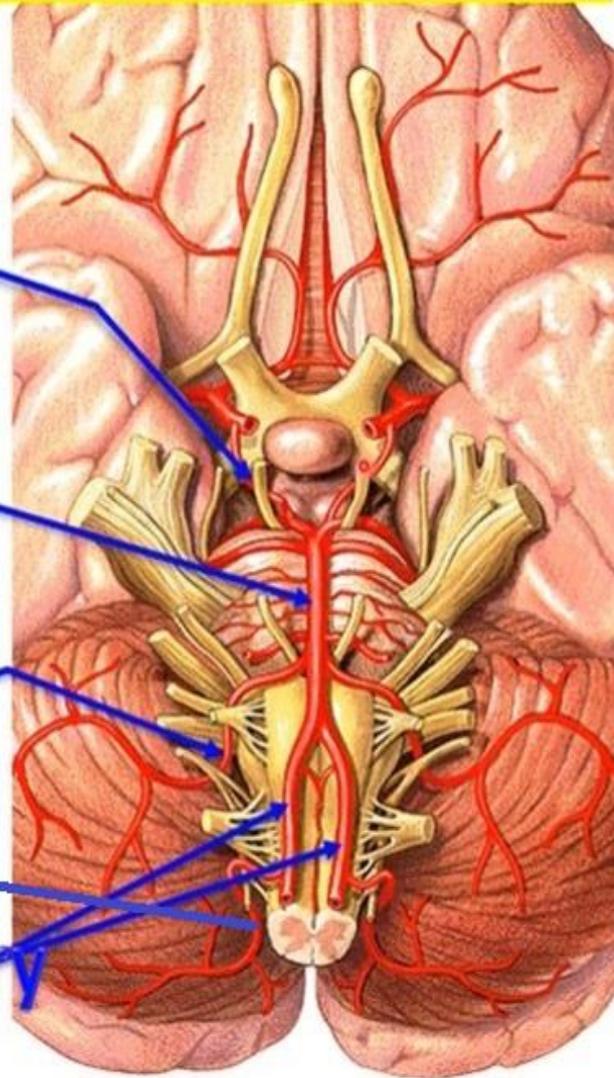
Circle of Willis

Basilar artery

anterior inferior cerebellar artery

PICA

Vertebral artery



- **Medulla oblongata;**

1- Medullary branch from the 4<sup>th</sup> part of vertebral artery.

2- Medullary branch from posterior inferior cerebellar artery (from vertebral artery).

- **Venous drainage** into vertebral venous plexus.

- **Pons**

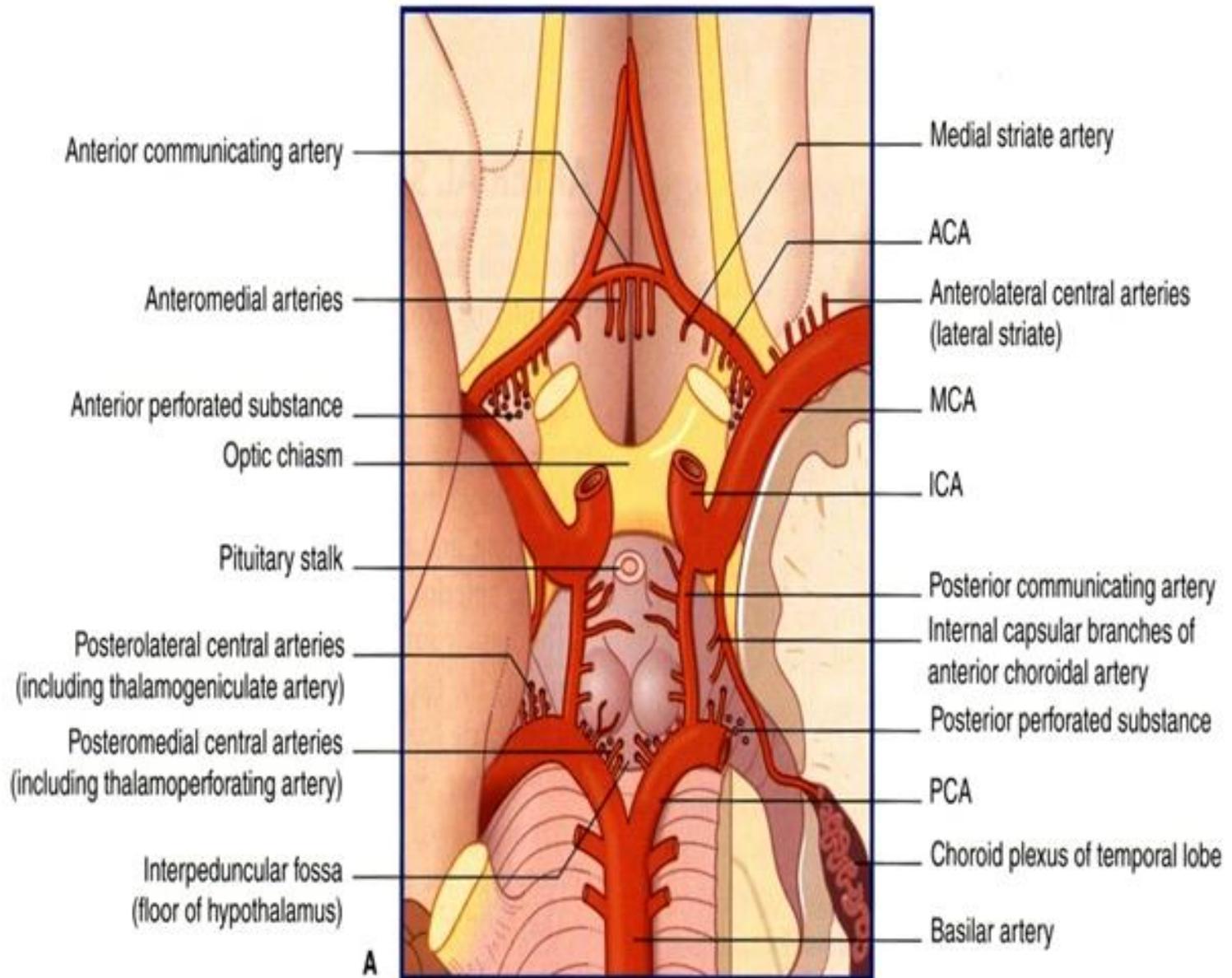
- Pontine branches from basilar artery.

- **Venous drainage** to dural venous sinuses.

- **Midbrain**

- Arterial from circle of Willis.

- **Venous drainage** to great cerebral vein or basal vein.



# Fourth ventricle

It is a tent- like cavity of the hindbrain. It lies between the pons & medulla anteriorly and the cerebellum posteriorly.

## Boundaries of the 4<sup>th</sup> ventricle

### Roof:

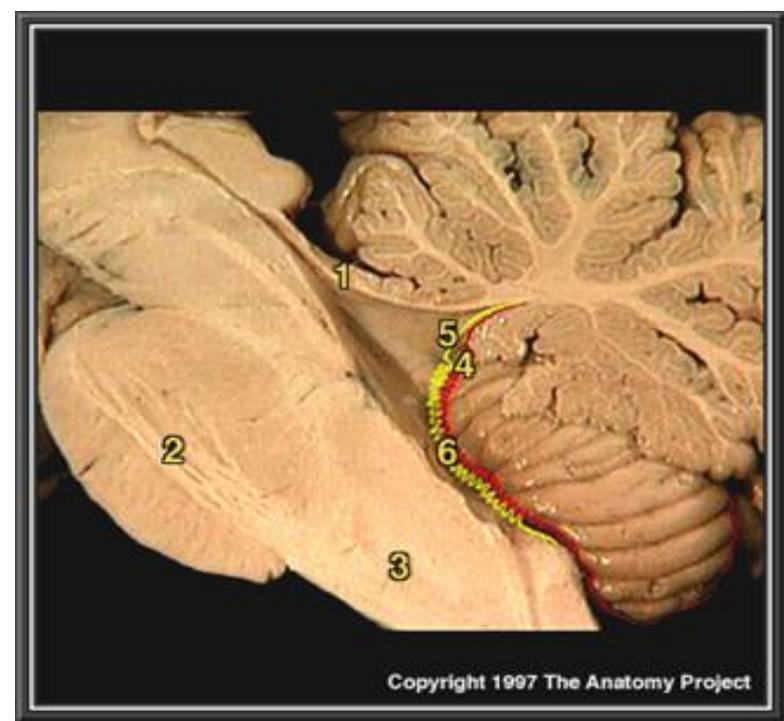
**Upper part:** the superior medullary velum stretching inbetween the superior cerebellar peduncles.

Middler part : cerebellum

**Lower part:** Inferior medullary velum stretching in between the two inferior cerebellar peduncles.

### Lateral wall :

- **Upper part:** superior cerebellar peduncles.
- **Lower part:** inferior cerebellar peduncles and gracile & cuneate tubercles.



- 1- Superior medullary vellum.
- 2- Pons.
- 3- Medulla oblongata.
- 4- Pia matter.
- 5- Ependyma.
- 6- Choroid plexuses.

- **Floor (Rhomboidal fossa)**

- **Median sulcus** divides floor into right and left halves, extends from superior to inferior angle.
- **Stria medullaris** divides the floor into upper part (**pontine**) and lower part (**medullary**).

**A- The medullary (lower) part** presents on each side of the median sulcus,

- An inverted V shaped groove called **inferior fovea**.

**a- Hypoglossal area (trigone)** medial to inferior fovea.

**b- Vagal area (trigone)** between 2 limbs of inferior fovea.

**c- Vestibular area (trigone)** lateral to inferior fovea.

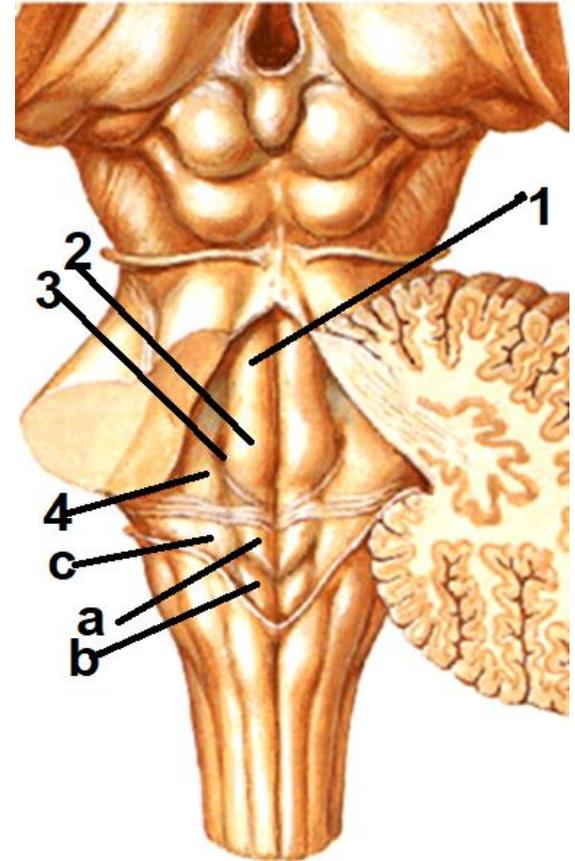
**B- The pontine (Upper) part** presents on each side of the median sulcus,

**1- Medial eminence:** a longitudinal elevation on each side of the median sulcus,

**2- Facial colliculus;** a round swelling on the lower part of the medial eminence.

**3- Superior fovea,** a groove lateral to the facial colliculus.

**4- Vestibular area,** lateral to superior fovea. It overlies superior, medial and lateral vestibular nuclei.



- **Connection (openings) of the fourth ventricle**

- 1- Superior angle is continuous with **cerebral aqueduct**.

- 2- Inferior angle is continuous with the central canal of the closed medulla.

- 3- three openings in the lower part of the roof which transmit cerebrospinal fluid to the subarachnoid space.

- a- One Median opening (foramen of Magendie) in the lower part of the roof.

- b- Two Lateral openings (foramen of Luschka) one in each lateral recess.

- **Recesses of the fourth ventricle:**

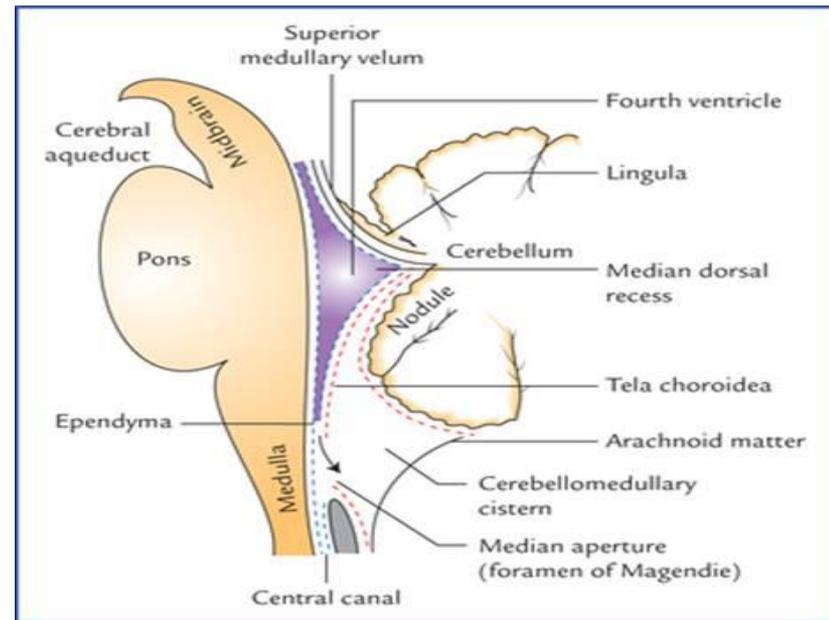
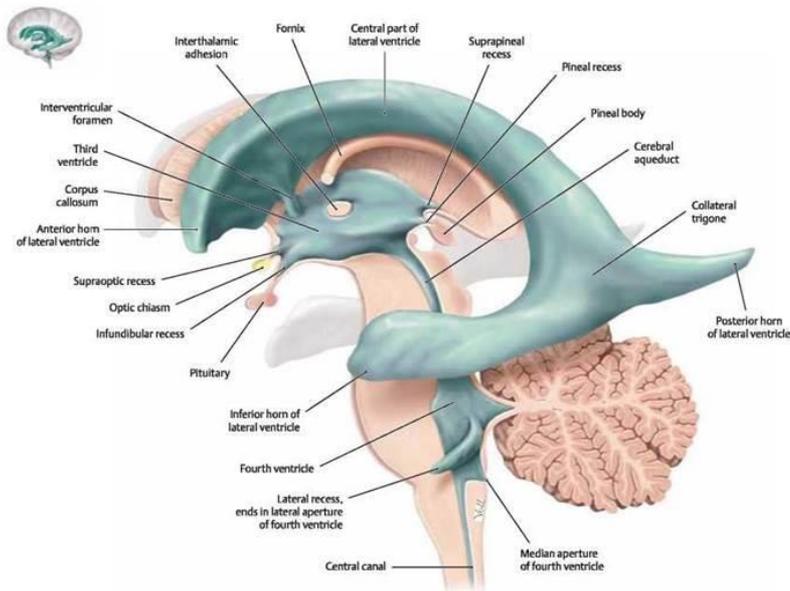
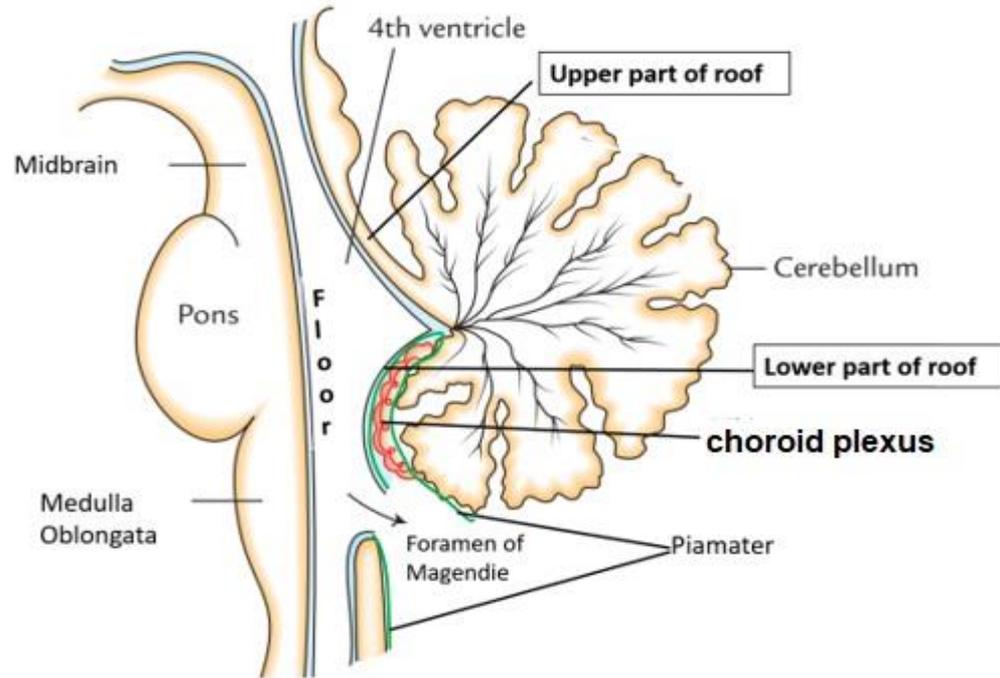
- 1- 2 Lateral recesses; extend behind the inferior cerebellar peduncles.

- 2- Dorsal recess extends in the gap between superior & inferior medullary vela.

- **Tela choroidea and Choroid plexus of the fourth ventricle;**

- Tela choroidea is a **double layer of pia matter** that invaginated by the choroid plexus into the cavity of the ventricle.

- Choroid plexuses, branches from the **posterior inferior cerebellar arteries**, secrete C.S.F. into the cavity of the 4<sup>th</sup> ventricle.



**THANK YOU**

**BEST WISHES**