Structured Notes According to

ANATOMY

Revision friendly **Fully Colored Book/Structured Notes**

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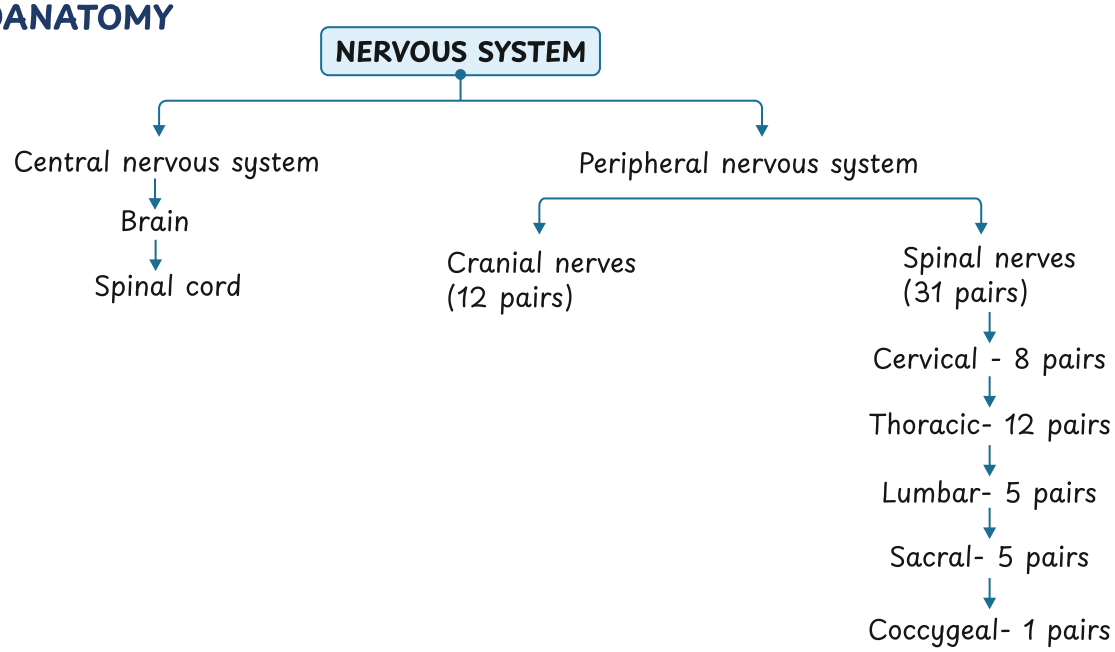
Anatomy

1. INTRODUCTION

NEUROANATOMY



NEUROGLIAL CELLS/ GLIAL CELLS

00:05:45

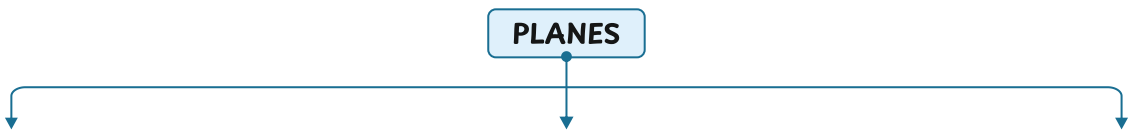
- Supporting cells

CELLS	FEATURE	DERIVED FROM
Astrocytes	Forms Blood-Brain Barrier, Star-shaped	Neuroectoderm
Microglial Cells	Phagocytic cells	Mesoderm
Ependymal Cells	Helps in formation of CSF	Neuroectoderm
Oligodendrocytes	Forms Myelin sheath in CNS	Neuroectoderm

- In PNS, myelin sheath is formed by Schwann cells
  - Schwann cells - derived from

CENTRAL NERVOUS SYSTEM

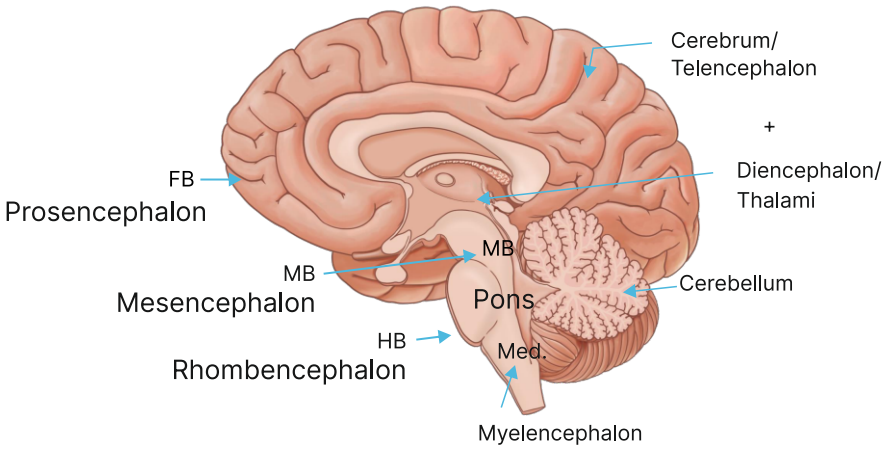
00:08:32



- Sagittal plane
  - Body divided into right and left half
- Coronal plane / frontal plane
  - Body divided into anterior and posterior half
- Transverse plane
  - Body divided into upper and lower half

SAGITTAL SECTION

00:09:32



- Brain/Encephalon

BRAIN

- Forebrain/Prosencephalon
  - Cerebrum/Telencephalon
  - Diencephalon/Thalami
- Midbrain/Mesencephalon
- Hindbrain/Rhombencephalon
  - Metencephalon: pons , cerebellum
  - Myelencephalon: Medulla oblongata
    → Continues as spinal cord

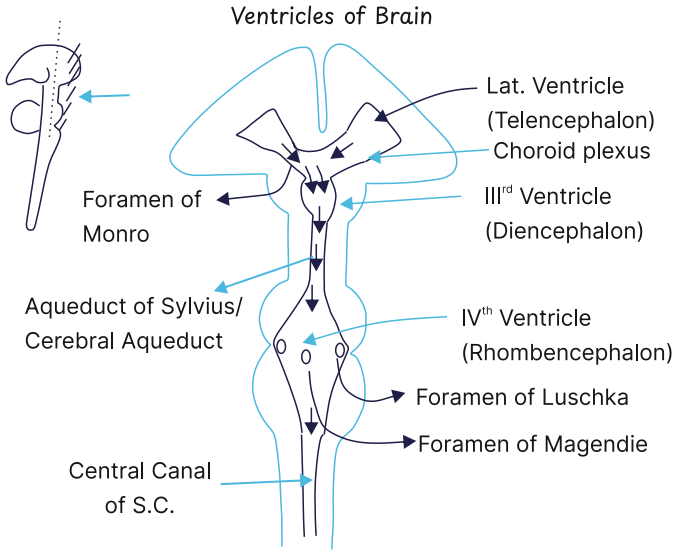
CORONAL SECTION

00:17:20

- 2 cerebral hemispheres → Diencephalon → Midbrain → Pons →
- Cerebellum is present behind pons and medulla oblongata
  - Hence, not appreciated in coronal section

VENTRICLES OF BRAIN

00:20:29



- Filled with Cerebrospinal fluid → produced majorly from the choroid plexus of lateral ventricles

STRUCTURE	LOCATION
Lateral ventricles (2 in number)	Telencephalon
IIIrd ventricle	Diencephalon
IVth ventricle	Rhombencephalon

- Lateral ventricles connected to IIIrd ventricle through Foramen of Monro
- IIIrd ventricle connected to IVth ventricle through Aqueduct of Sylvius/ Cerebral Aqueduct
- IVth ventricle continues down to central canal of spinal cord

CEREBROSPINAL FLUID

00:24:30

- Formed from Choroid plexus
  - Network of capillaries
  - Present in all ventricles
- Most of CSF - formed from choroid plexus in lateral ventricles
- Course of CSF -

Choroid plexus in lateral ventricle
↓
Foramen of Monro
↓
IIIrd ventricle
↓
Aqueduct of Sylvius
↓
IVth ventricle

- Some CSF flows down into the central canal of spinal cord from IVth ventricle
- In the IVth ventricle -
  - 2 foramens on lateral side – [redacted]
    → Mnemonic - L for Lateral and Luschka
  - 1 foramen in midline - [redacted]
    → Mnemonic - M for Midline and Magendie
    → Foramen of Magendie pierces inferior medullary velum
- CSF comes out of brain from these foramens present in IVth ventricle
- Brain and spinal cord covered by 3 layers of meninges from outer to inner
  - Dura mater, Arachnoid mater, Pia mater

SPACE	FEATURE
Subdural Space	Space between Dura mater and Arachnoid mater
Subarachnoid Space	Space between Arachnoid mater and Pia mater

- No space between Pia mater and brain
- CSF comes out from IVth ventricle into Subarachnoid space
  - CSF will then be drained off by arachnoid villi into dural venous sinuses
    → Space between 2 layers of dura mater
    → 23 dural venous sinuses (DVS) present
    → Majority of CSF drains into superior sagittal sinuses
  - From dural venous sinuses, CSF drains into venous blood

CLINICAL ANATOMY

00:31:35

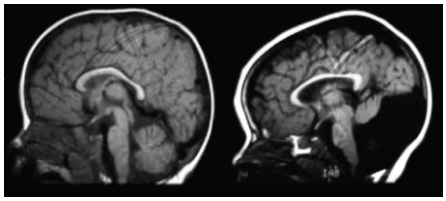
HYDROCEPHALUS

- Abnormal accumulation of CSF → enlargement of ventricles
- Aqueductal stenosis
  - M/c cause of congenital hydrocephalus
  - Block in Aqueduct of Sylvius/ Cerebral aqueduct → Dilatation of IIIrd ventricle

Narrowing of Aqueduct of Sylvius
↓
Accumulation of CSF in IIIrd ventricle
↓
Enlargement of IIIrd ventricle

DANDY-WALKER SYNDROME

Atresia of Foramen of Luschka and Foramen of Magendie
↓
Accumulation of CSF in IVth ventricle
↓
Enlargement of IVth ventricle

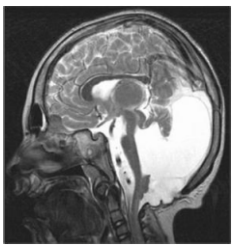


Normal fourth ventricle Dilated fourth ventricle

MCQ's

Q. During examination of a child with complaints of delayed gait development and a large head revealed cystic obstruction of the median outlet of the fourth ventricle, causing ballooning of the inferior medullary velum into the cisterna magna. Imperforation of which of the following structures leads to the given condition?

a. Foramen of Luschka
b. Foramen of Monro
c. Foramen of Magendie
d. Aqueduct of Sylvius



Ans. (c)

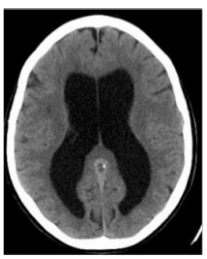
Q. The T2 weighted MRI of a child is given below. Which of the following is true about the ventricle primarily involved in this condition?

a. Foramina of Luschka are lateral openings
b. Choroid plexus is formed from folds of arachnoid called tela choroidea
c. Foramen of Magendie is a central aperture that pierces inferior medullary velum
d. Inferior medullary velum is a sheet of white matter

Ans. (a)

Q. A patient walked into our patient department and diagnosed with congenital toxoplasmosis. CT scan shows hydrocephalus, which is shown below. Which of the following cells form the lining of the involved structure?

a. Astrocytes
b. Oligodendrocytes
c. Ependymocytes
d. Podocytes



Ans (c)

2. SPINAL CORD

SPINAL CORD

EXTERNAL FEATURES

00:01:05

EXTENT

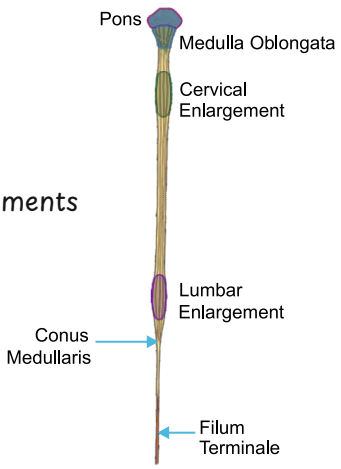
- Adults: C1 – lower border L1 vertebrae
  - Spinal cord does not begin from foramen magnum as medulla oblongata crosses foramen magnum
- Neonates: C1 – upper border of L3 vertebra
- Update
  - In adults, the spinal cord typically terminates at the middle third of the body of the 1st lumbar vertebra
- Length: Males – 45 cm, Females – 42 cm
- Shape - Cylindrical - Not uniform

ENLARGEMENTS

00:05:25

ENLARGEMENT

Cervical enlargement	Lumbar enlargement
Extends from C3 to T2 spinal segments	Extends from L1 to S3 spinal segments



- Spinal cord ends in cone-shaped structure - Conus Medullaris
  - Located at the lower border of L1
- From Conus Medullaris, a fine thread-like structure extends upto level of coccyx - Filum Terminale

FILUM TERMINALE

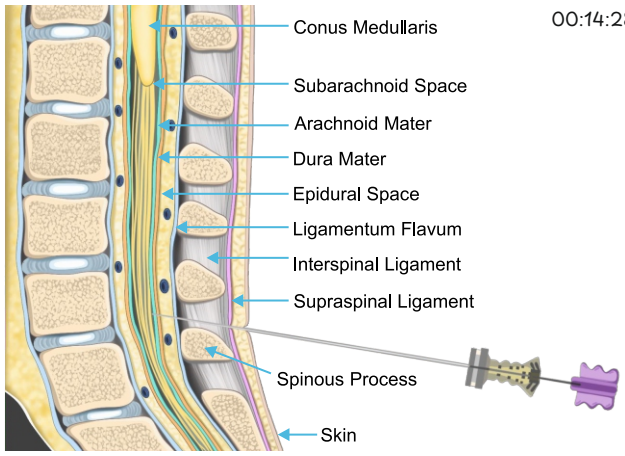
- Pia mater is closely attached to spinal cord
- Continuation of pia mater after tip of conus medullaris - Filum Terminale
  - Modification of pia mater
- Arachnoid and dura mater descend and merge with pia mater
  - At level of lower border of S2
- Spinal cord ends at level of L1
- Subarachnoid space ends at level of lower border S2
  - CSF present in this space
  - Site of lumbar puncture → L1 - S2
    → No risk of spinal cord damage

LUMBAR PUNCTURE

- Location - between L3 and L4> L4 and L5
- Structures pierced by needle

Skin
↓
Supraspinal ligament
↓
Interspinal ligament Ligamentum flavum
↓
Epidural space
↓
Dura mater Arachnoid mater
↓
Subarachnoid space CSF

00:14:28



Sagittal section of spinal cord

LIGAMENTS

- Supraspinal ligament covers all spinous processes
- Interspinal ligament present between spinous processes
- Ligamentum flavum the inside of the vertebral column

CAUDA EQUINA

00:18:15

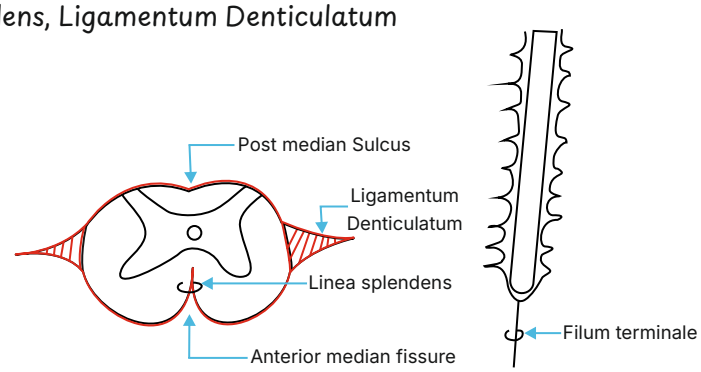
- At end of spinal cord, a bundle of nerves resembling a horse's tail- Cauda Equina
- Spinal cord extends upto lower border of L1
- Nerves begin from respective spinal segments at Conus Medullaris
  - These nerves descend down and come out as:
    → 5 pairs of Lumbar nerves, 5 pairs of sacral nerves
    → 1 pair of coccygeal nerves

Cauda Equina

MODIFICATION OF PIA MATER

00:20:30

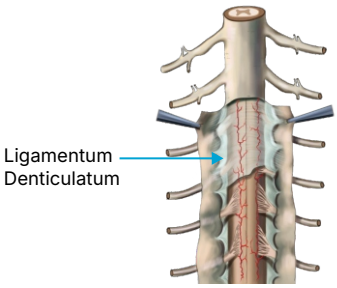
- Filum terminale, Linea splendens, Ligamentum Denticulatum



LINEA SPLENDENS

- In transverse section of spinal cord
  - Slight depression posteriorly → Posterior median sulcus
  - Deep depression anteriorly → Anterior median fissure
- Extension of pia mater into Anterior median fissure - Linea splendens
  - Ventral and dorsal aspects of spinal cord differentiated

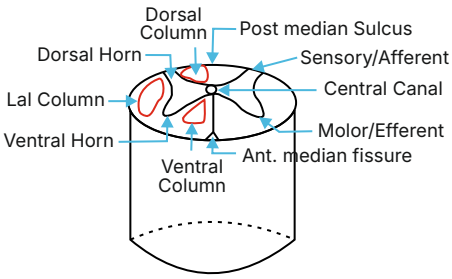
LIGAMENTUM DENTICULATUM



- Pia mater also extends on lateral aspect - Ligamentum Denticulatum
  - Tooth-like projections of spinal cord (seen in longitudinal section)
- Only 2 Ligamenta Denticulata present
  - 1 on left, 1 on right side
  - With 21 projections on each side

00:28:50

TRANSVERSE SECTION OF SPINAL CORD



- Cylindrical in shape
- Posterior median sulcus - present posteriorly
- Anterior median fissure - present anteriorly
- Grey matter (H-shaped/ Butterfly-shaped) - present in center
- Central canal - present in middle
  - CSF passes through this canal
- Grey matter has 2 horns - Dorsal horn, Ventral horn

HORNS

- All sensory information entering spinal cord will enter from dorsal horn
  - Dorsal horn - purely sensory / afferent
- All motor information exits spinal cord through ventral horn
  - Ventral horn- purely motor/ efferent

- White matter present in periphery:
  - Divided into 3 columns because of horns of grey matter
    → Dorsal, Lateral, Ventral column/ Funiculus

MCQ's

Q. Which statement is not true for Ligamentum Denticulatum?

a. It serves as a neurosurgical landmark for hemi-sectioning of the spinal cord.
b. It has a serrated appearance
c. It is a modification of arachnoid mater
d. There is one on each side with 21 triangular processes

Ans: (c)

Q. The needle is inserted into a particular space to withdraw CSF in an adult. At which level does this space terminate?

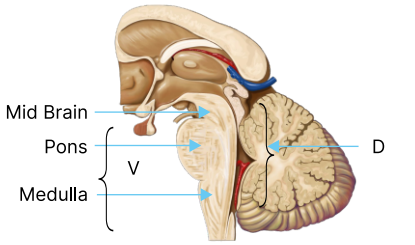
a. S2
b. S1
c. L2
d. L4

Ans: (a)

3. BRAINSTEM

BRAINSTEM

- Brainstem made of:
  - Midbrain
  - Pons (bridge-like structure)
  - Medulla oblongata



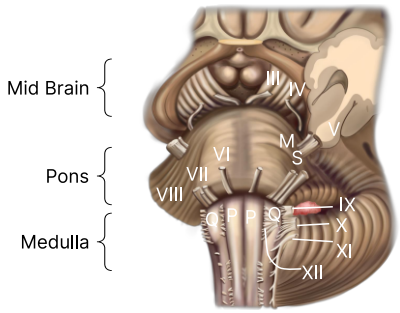
Sagittal section of brainstem

CEREBELLAR PEDUNCLE

- Superior cerebellar peduncle (connects midbrain with cerebellum)
- Middle cerebellar peduncle (connects pons with cerebellum)
- Inferior cerebellar peduncle (connects medulla with cerebellum)

VENTRAL ASPECT OF BRAINSTEM

- All cranial nerves except Olfactory (CN I) and Optic (CN II) nerves originate from brainstem
- All cranial nerves originate ventrally, except for the trochlear nerve (CN IV), which originates dorsally



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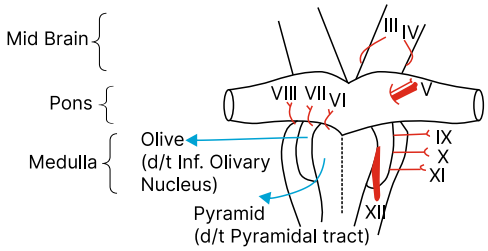
CRANIAL NERVES	EXIT FROM
Oculomotor nerve (CN III)	Midbrain- ventral origin
Trochlear nerve (CN IV)	Midbrain – dorsal origin

Trigeminal nerve (CN V) - mixed nerve	• Junction of pons and Middle cerebellar peduncle
	  ○ Sensory root – thick
	  ○ Motor root - thin

Abducens nerve (CN VI) Facial nerve (CN VII) Vestibulocochlear nerve (CN VIII)	Pontomedullary junction
Glossopharyngeal nerve (CN IX) Vagus nerve (CN X) Accessory nerve (CN XI)	Lateral to olive
Hypoglossal nerve (CN XII)	Between pyramid and olive

- In medulla, sulcus is present in middle
  - On either side, elevation is present - pyramid
    → Due to pyramidal tract (descending tract)
  - Olive - elevation present lateral to pyramid
    → Due to inferior olivary nucleus below olive
    → Shape of inferior olivary nucleus – crumpled paper bag shaped



Important Information
- Crumpled paper bag shape seen in -
  - Inferior olivary nucleus
  - Dentate nucleus – in deep nuclei of cerebellum

TROCHLEAR NERVE (CN IV)

00:24:00

- Smallest cranial nerve
- Thinnest/slenderest cranial nerve
- Dorsal origin →
- Has internal decussation (crossing inside midbrain)

TRIGEMINAL NERVE (CN V)

00:26:50

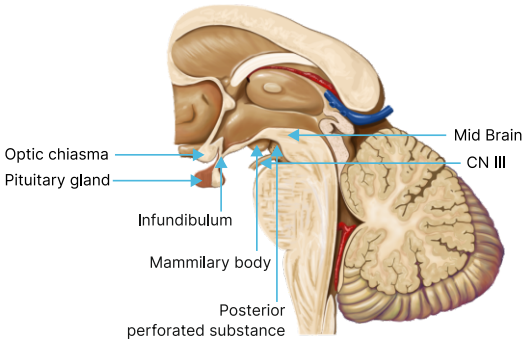
- Largest, thickest cranial nerve
- Exits between pons and middle cerebellar peduncle

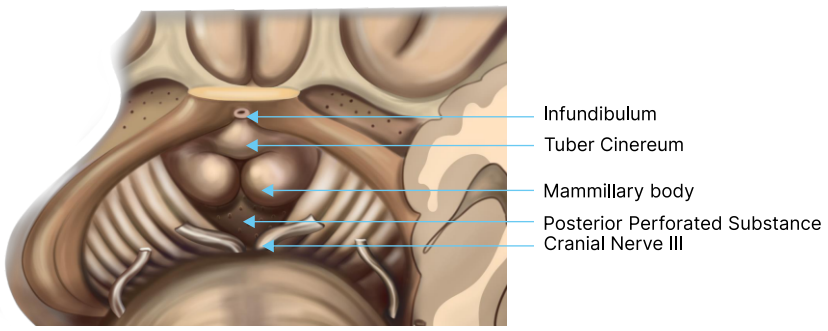
PONTOMEDULLARY JUNCTION

- Abducens nerve (CN VI)
  - Longest intradural course
  - M/c involved in ↑intracranial pressure
  - Exits from Ponto-pyramidal junction
- Facial nerve (CN VII)
  -
  - Exits from Ponto-olivary junction
- Vestibulocochlear nerve (CN VIII)

INTERPEDUNCULAR FOSSA

00:31:27





- Interpeduncular fossa - depression present between cerebral peduncles

CONTENTS

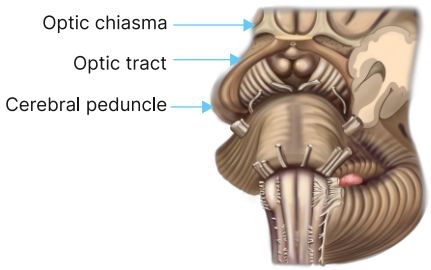
Infundibulum and Tuber Cinereum

Mamillary body on both sides - Part of limbic system

- Posterior perforated substance – Grey matter
  - Perforated by branches of posterior cerebral artery (PCA)

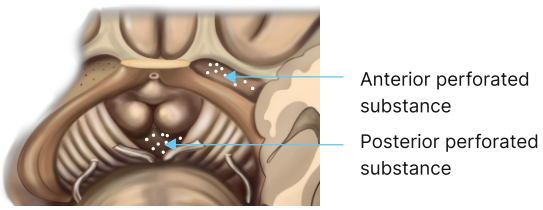
Oculomotor nerve (CN III)

- Boundaries - Optic chiasma, Optic tract, Cerebral peduncle



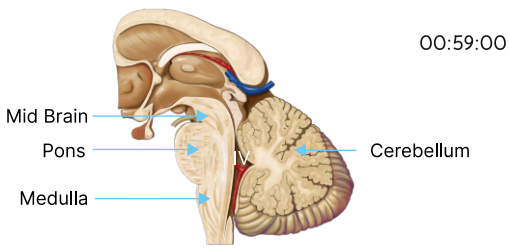
ANTERIOR PERFORATED SUBSTANCE

- Grey matter perforated by branches of anterior and middle cerebral artery (ACA & MCA)
- Boundaries:
  - Medially - Optic chiasma
  - Posteriorly - Optic tract
  - Laterally - Limen insulae > Uncus

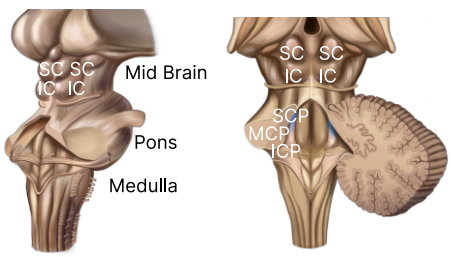


DORSAL ASPECT OF BRAINSTEM

- Interpeduncular fossa - present in front of midbrain
- Corpora quadrigemina - present behind midbrain
  - Corpus – bodies, Quadri - four
  - Group of four colliculi
    → 2 superior colliculi (SC) → Visual pathway
    → 2 inferior colliculi (IC) → Auditory pathway
- Floor of fourth ventricle - present behind pons and medulla
- Roof of fourth ventricle (Tent-like structure) extends into cerebellum



Sagittal section of brainstem



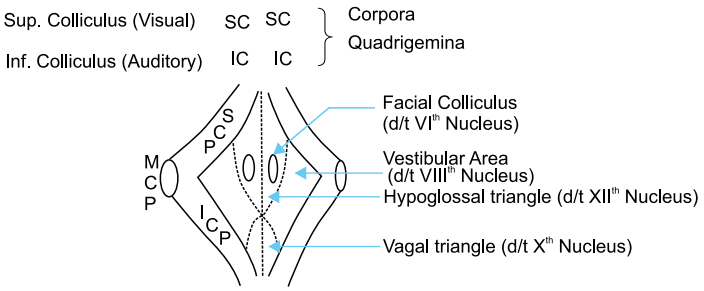
Dorsal aspect of brainstem after removing cerebellum and roof of IVth ventricle

- Brainstem connected to cerebellum through cerebellar peduncles
  - Superior cerebellar peduncle (SCP) - Comes down and joins cerebellum
  - Inferior cerebellar peduncle (ICP) - Comes up and joins cerebellum
  - Middle cerebellar peduncle (MCP) - Joins pons and cerebellum

FOURTH VENTRICLE

- Middle cerebellar peduncle does not form boundary of fourth ventricle
- Only superior and inferior cerebellar peduncles form the boundary of fourth ventricle
- Floor of fourth ventricle - rhomboid shaped →
- Median sulcus - present in midline of fourth ventricle
- Sulcus limitans - present on lateral side

ELEVATIONS	DUE TO
Facial colliculus	VIth nucleus (abducens nucleus), Present behind pons
Hypoglossal triangle	XIIth nucleus
Vagal triangle	Xth nucleus
Vestibular area	VIIIth nucleus



Floor of IV Ventricle/Rhomboid fossa

FACIAL COLLICULUS

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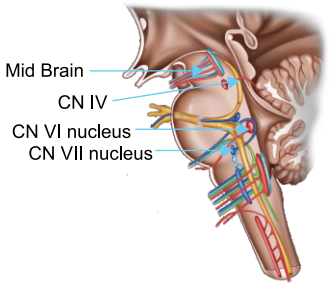
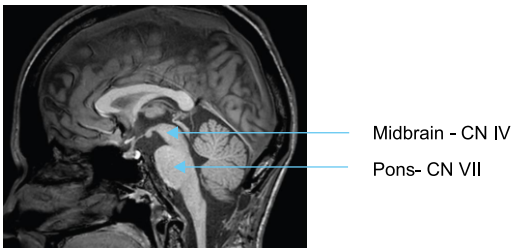
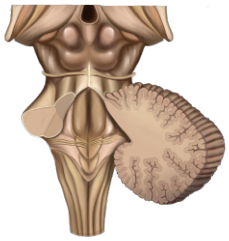


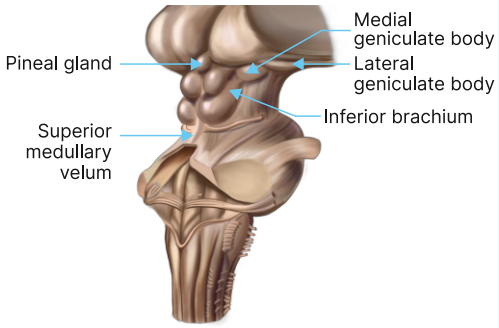


- Cranial nerve located behind the midbrain – Trochlear nerve (CN IV)
- Cranial nerve located behind the pons – Facial nerve (CN VII)
  - 6th cranial nerve nucleus present behind pons
  - 7th cranial nerve nucleus present more anteriorly (ventrally)
    → 7th cranial nerve turns around 6th CN nucleus, exits out through pontomedullary junction

- Injury to facial colliculus
  ↓
  Damage to facial nerve > abducens nuclei
  - Facial muscle (Risorius) > Lateral rectus



DESCRIPTION	IMAGES

• Third ventricle - present between the two thalami
• Pineal gland - present behind third ventricle
• Superior brachium → Connects superior colliculi to Lateral geniculate body (Visual pathway)
• Inferior brachium → Connects inferior colliculi to Medial geniculate body (Auditory pathway)
• Roof of fourth ventricle is tent-like formed by:
  ○ Superior medullary velum
  ○ Inferior medullary velum
	

• Habenular trigone contains habenular nucleus
• Locus coeruleus
  ○ Bluish pigmented area in superior part of floor of fourth ventricle
  ○ Secretes norepinephrine
• Sulcus limitans splits in two areas
  ○ Superior fovea
  ○ Inferior fovea
• Stria medullaris – Fibers going laterally
• Obex - lower part of fourth ventricle