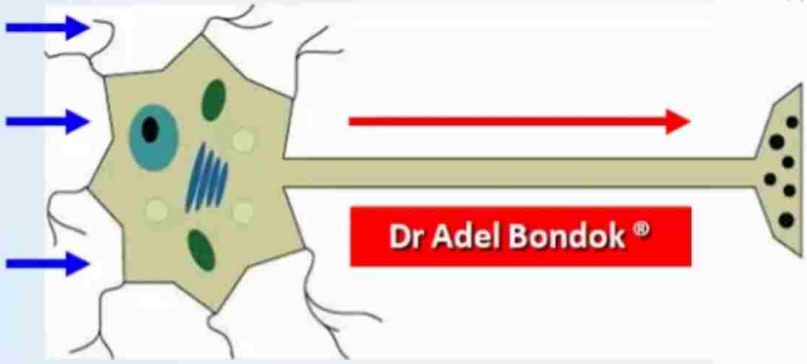
PROCESSES

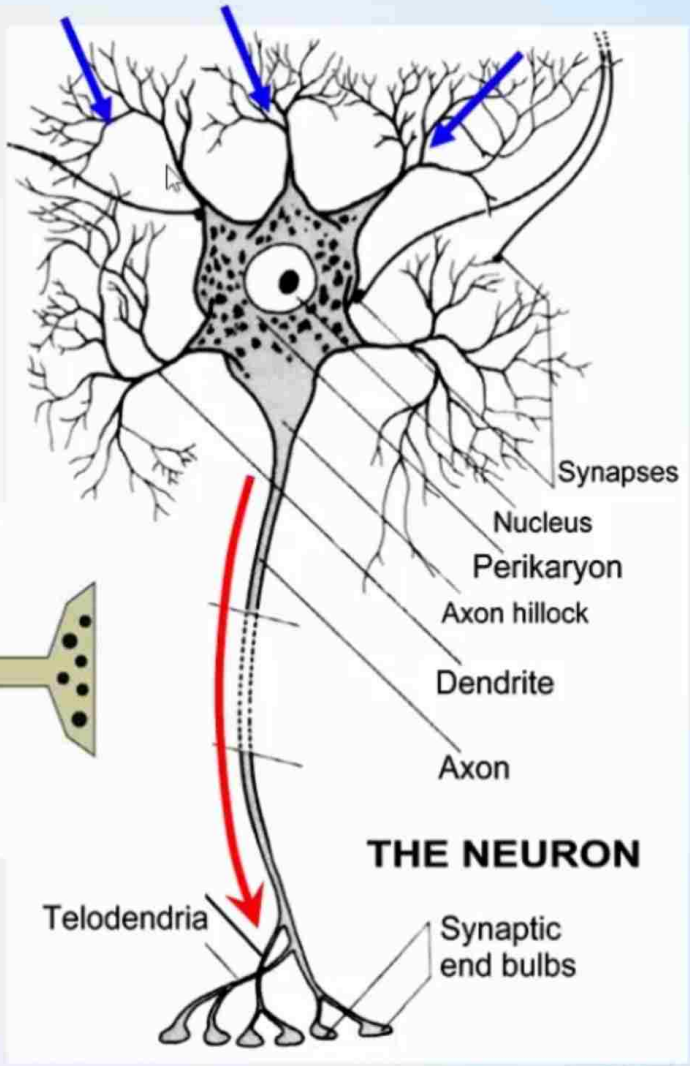
ONE AXON

Transmits information to other nerve cells



DENDRITES

Receive information

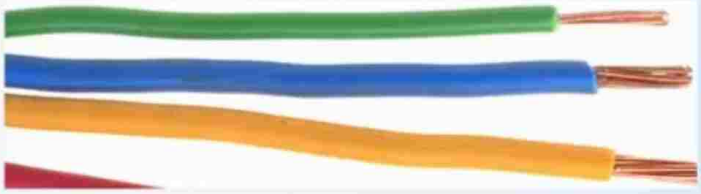


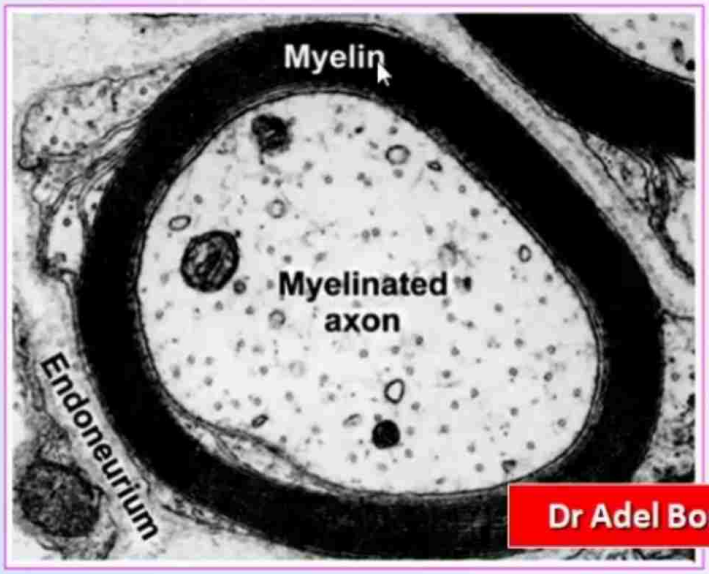
AXONS are like electric wires. Either

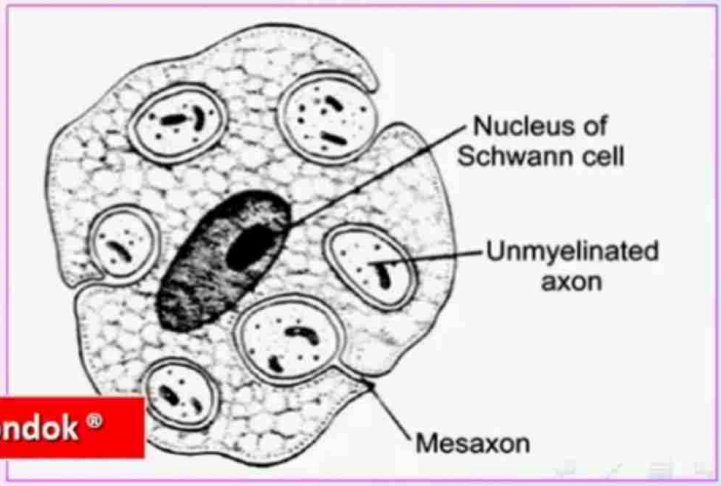
Myelinated | **Unmyelinated**

Myelin: Insulation + impulse conduction

The thicker the faster the conduction







Types of Nerve Cells

ACCORDING TO:

Size, Function & # of Processes

A. SIZE:

1. **Golgi type I:** large
2. **Golgi type II:** small

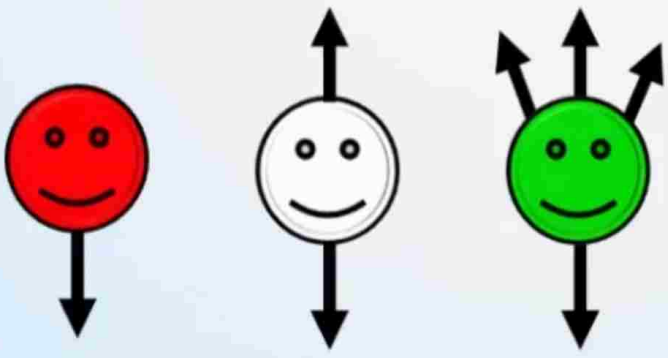
B. FUNCTION:

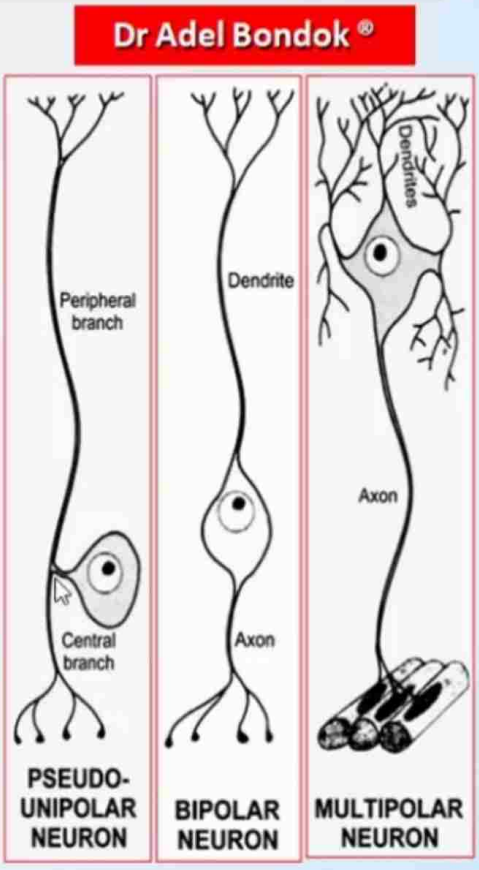
1. **Motor:** movement
2. **Sensory:** perception of sensations
3. **Interneurons:** connect nerve cells together

Classification: Types

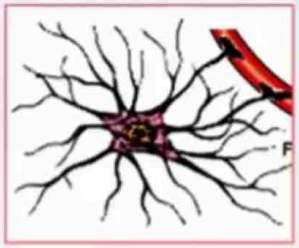
C. # OF PROCESSES:

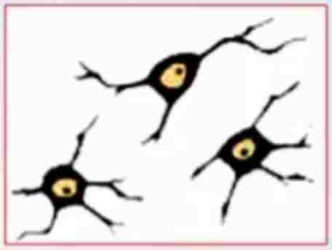
1. **Unipolar:** 1 process
   a. True: amacrine cells of the retina.
   b. Pseudounipolar: dorsal root ganglia
2. **Bipolar:** 2 processes, sense organs
3. **Multipolar:** more than 2





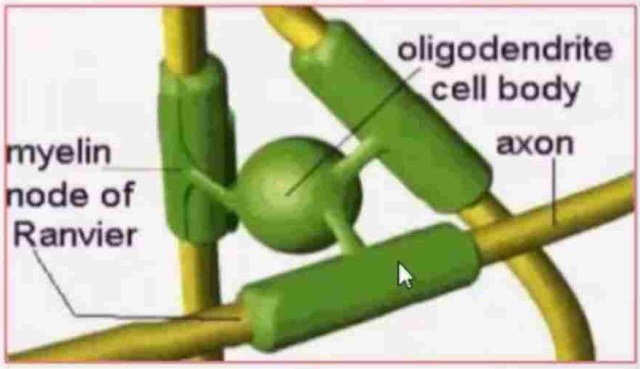
NEUROGLIA

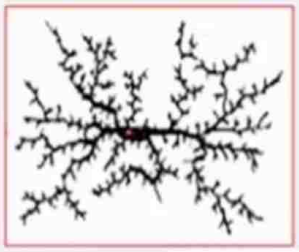


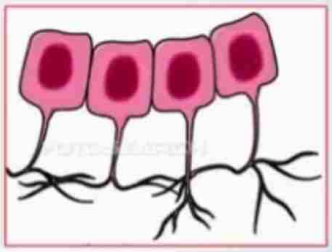


CENTRAL: 4

1. **Astrocytes:** protection
2. **Oligodendrocytes:** myelin
3. **Microglia:** inflammation
4. **Ependyma:** line ventricles, protection & circulation of CSF

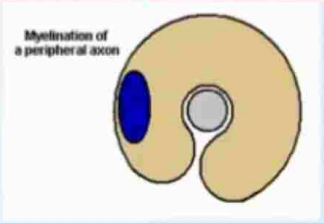






PERIPHERAL: 2

1. **Schwann cells:** myelin
2. **Satellite cells:** around nerve cells



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SYNAPSES

1. Definition:

contact point between 2 nerve cells

2. TYPES:

a. Chemical Synapse:

transmission by chemical substance

b. Electrical Synapse:

transmission without chemical substance

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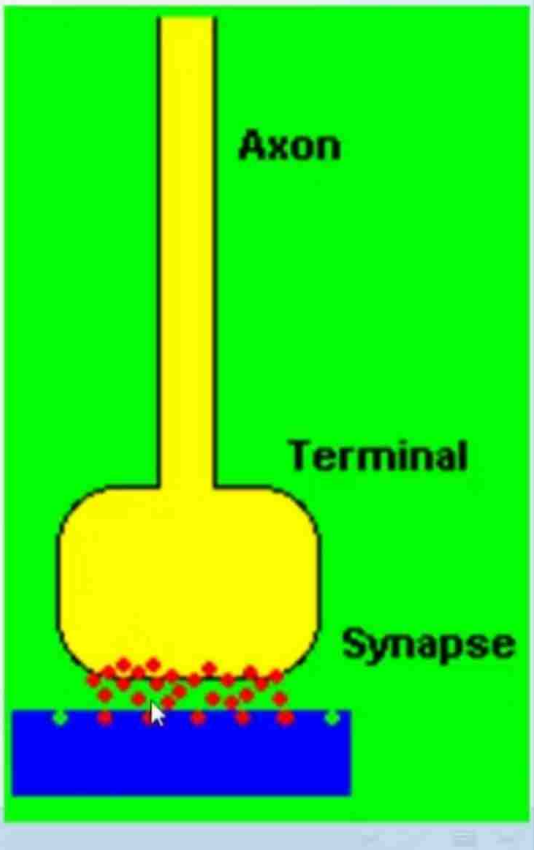

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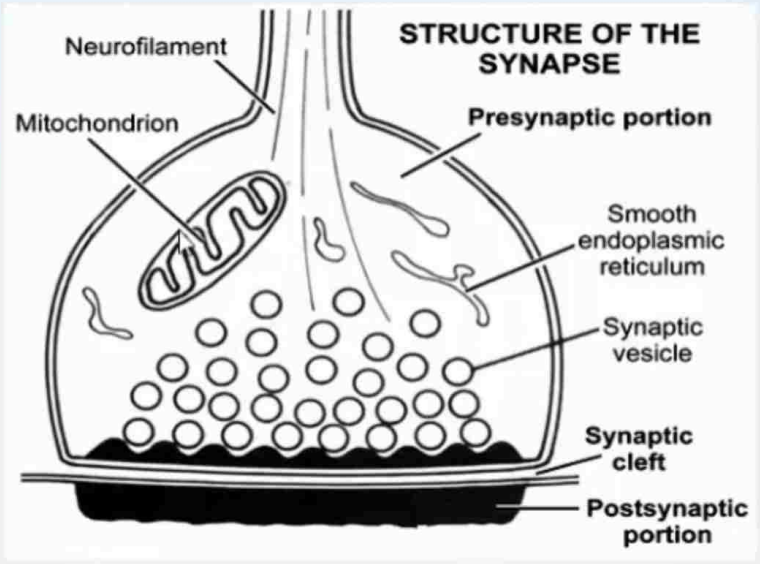

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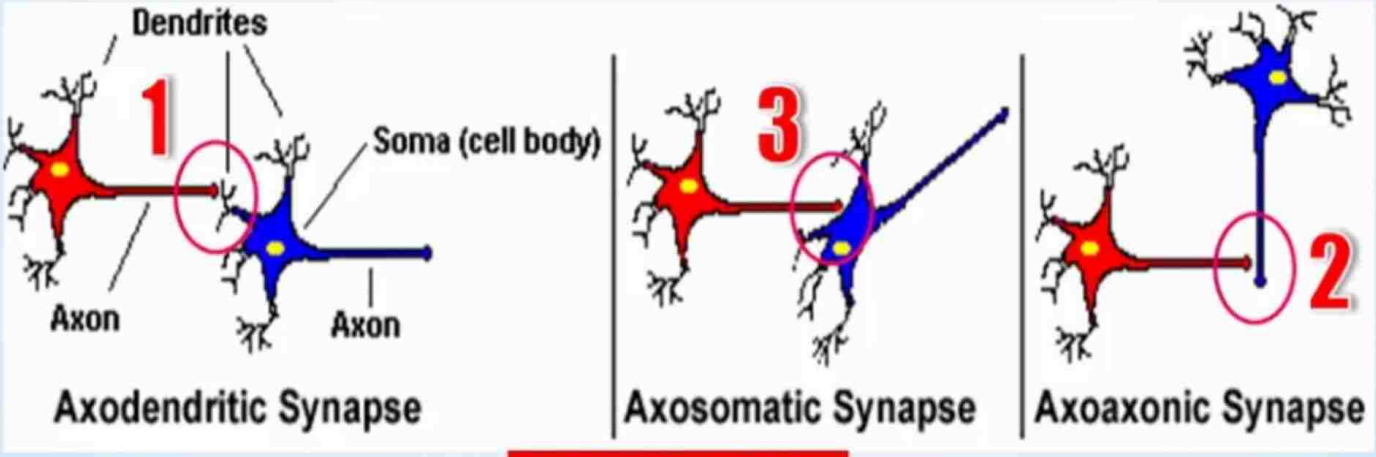
Structure of the chemical synapse: 3 Parts

1. **Presynaptic element:** axon
   contains synaptic vesicles filled with neurotransmitters and mitochondria
2. **Synaptic cleft**
3. **Postsynaptic element:**
   may be dendrite, axon, cell body or muscle

TYPES OF SYNAPSES

1. **Axodendritic:** axon + dendrite
2. **Axoaxonic:** axon + axon
3. **Axosomatic:** axon + cell body
4. **Neuromuscular:** axon + muscle



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DIVISIONS OF THE NERVOUS SYSTEM

1. Central Nervous System:

Brain.

b. Spinal cord.

2. Peripheral Nervous System:

A. Somatic Nervous System:

a. Spinal nerves: 31 pairs.

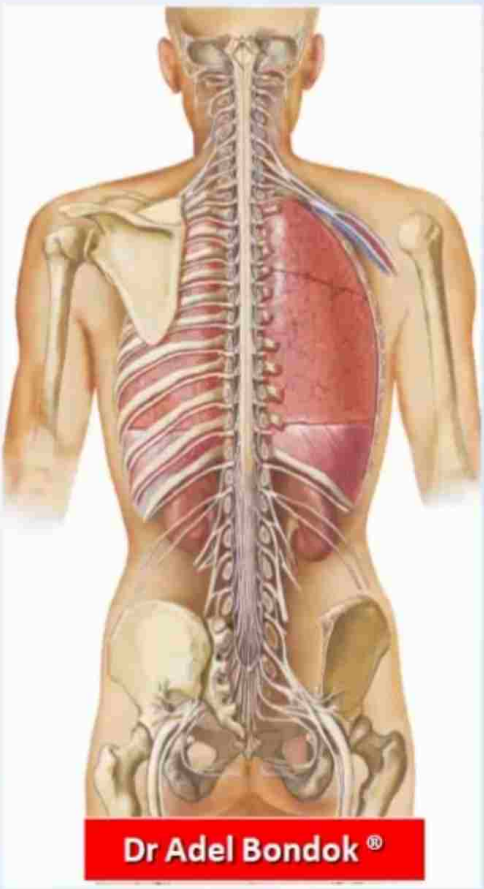
b. Cranial nerves: 12 pairs.

c. Associated ganglia.

B. Autonomic Nervous System:

a. Sympathetic: thoracolumbar

b. Parasympathetic: craniosacral



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BRAIN

1. FOREBRAIN:

a. 2 Cerebral hemispheres

b. Diencephalon: thalamus & hypothalamus

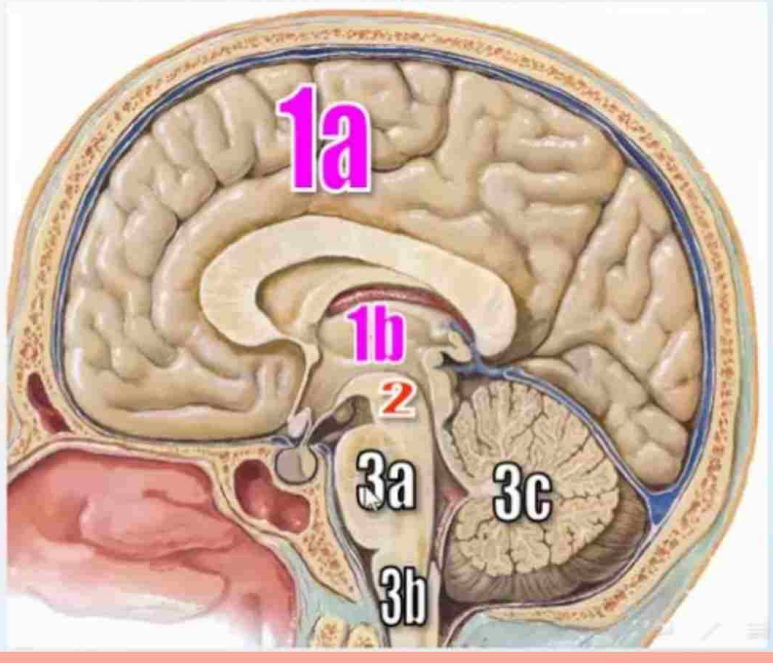
2. MIDBRAIN

3. HINDBRAIN:

a. Pons

b. Medulla

c. Cerebellum



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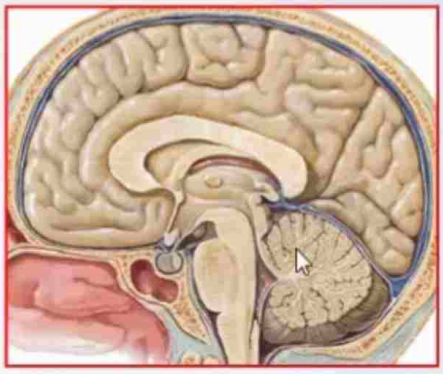
ANOTHER BRAIN DIVISIONS



1. **CEREBRUM:**
   a. **2 Cerebral hemispheres:**
   b. **Diencephalon:** formed mainly of:
      thalamus & hypothalamus
2. **CEREBELLUM:** Coordination & balance
3. **BRAINSTEM:** formed of the
   a. Midbrain
   b. Pons
   c. Medulla

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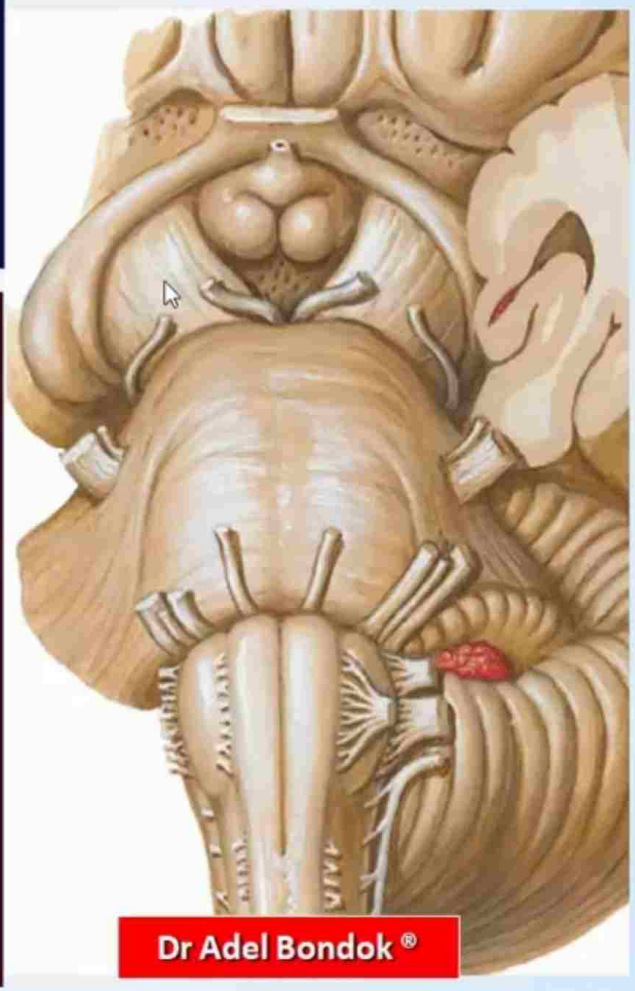
BRAINSTEM

1. **MIDBRAIN**
2. **PONS**
3. **MEDULLA**



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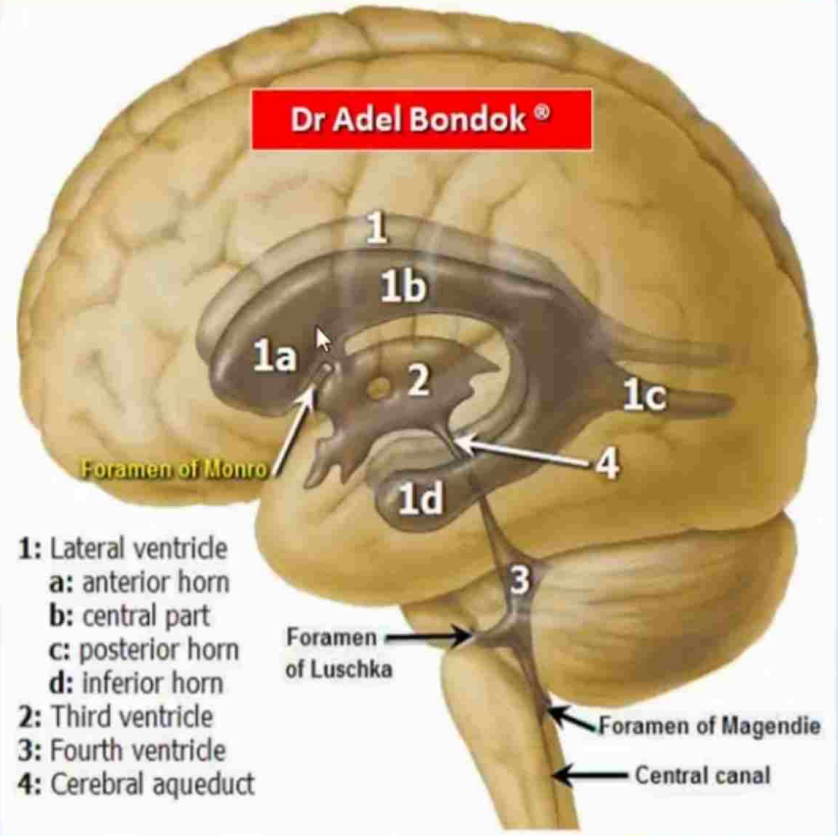
Ventricular System

1. Lateral ventricle:
in the cerebral hemisphere

2. Third ventricle:
in the diencephalon

3. Fourth ventricle:
In the hindbrain



SUMMARY

- The functional unit is the neuron.
- Nerve cells are divided according to size, function and number of processes.
- Nerve cells communicate by synapses.
- Neuroglia are 4 central and 2 peripheral.
- Nervous system is divided into central and peripheral NS
- The brain is divided into cerebrum, cerebellum and brainstem.
- Cavities in the brain are called ventricles.

Semetsr1- Level 1- Module 1 A

Reference:

PERIPHERAL SOMATIC NERVOUS SYSTEM

1. Spinal Nerves: 31 pairs
2. Cranial Nerves: 12 pairs
3. Spinal & Cranial Ganglia

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31 PAIRS OF SPINAL NERVES

Distribution:

- 8 Cervical
- 12 Thoracic
- 5 Lumbar
- 5 Sacral
- 1 Coccygeal

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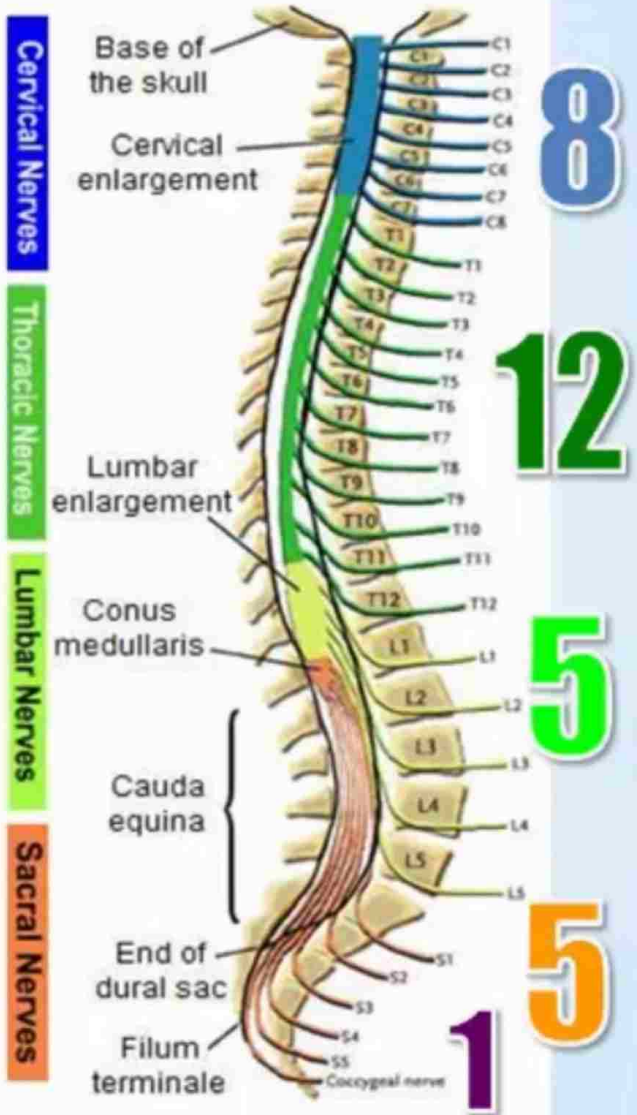
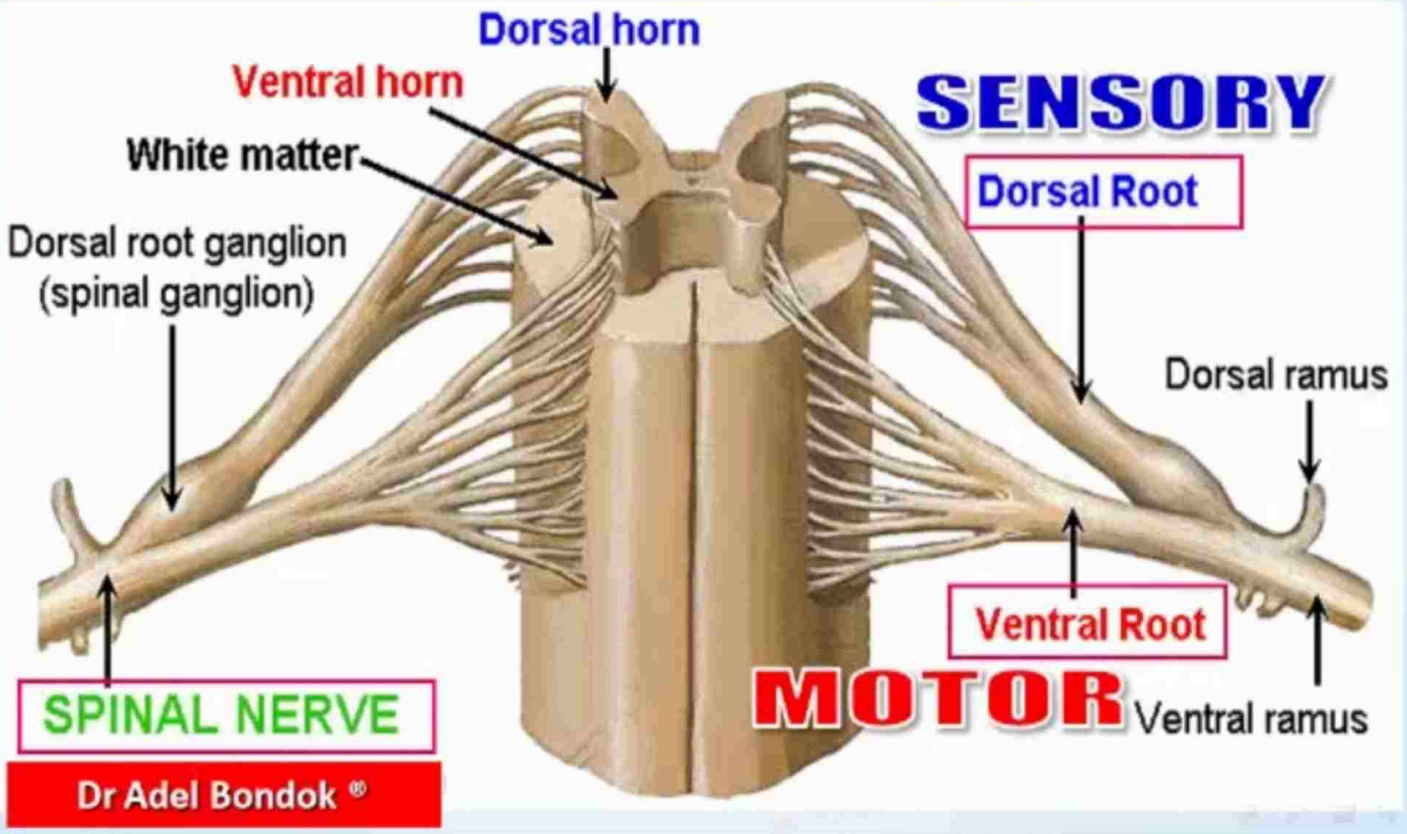
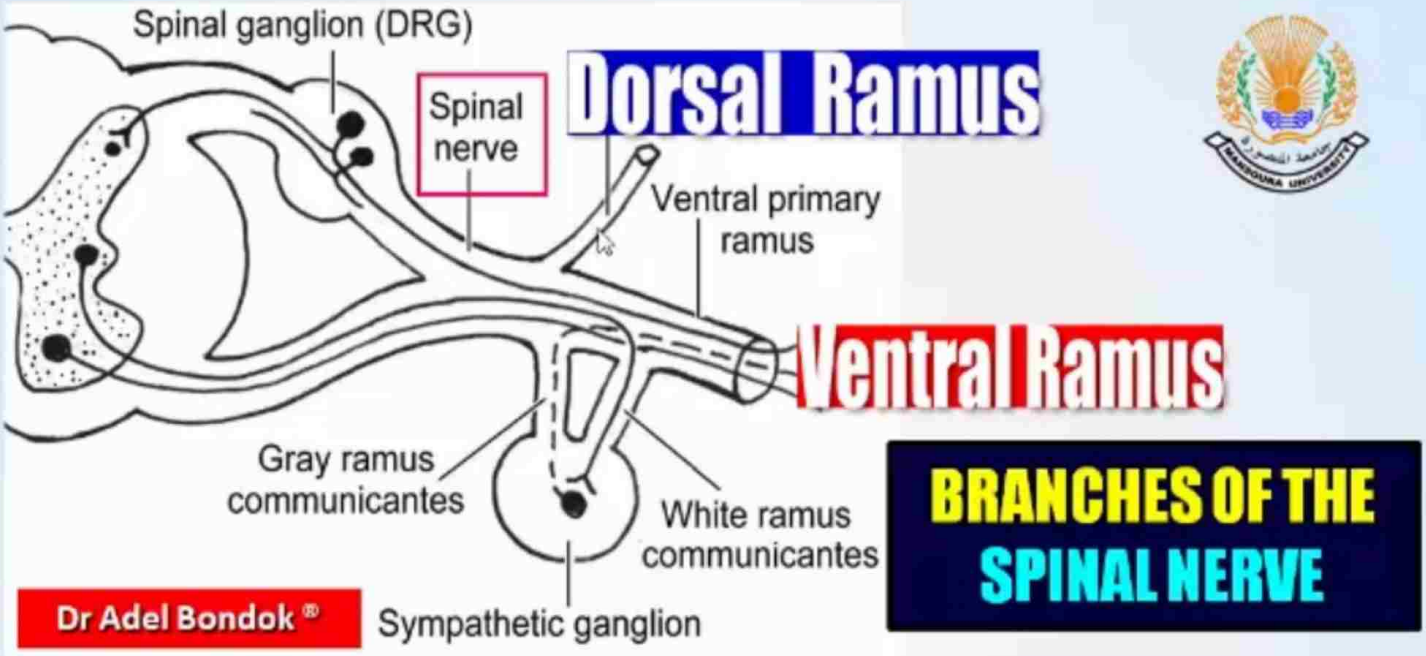


FORMATION OF THE SPINAL NERVE



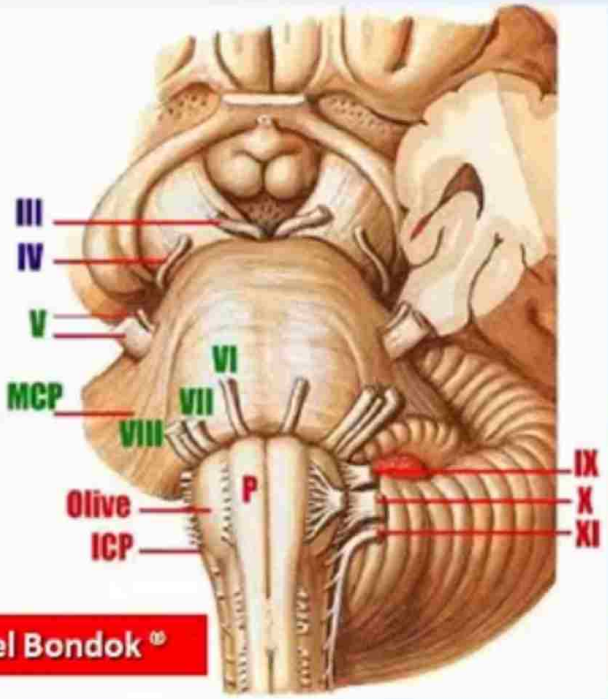


BRANCHES OF THE SPINAL NERVE

VENTRAL RAMUS	DORSAL RAMUS
❑ Large in size	❑ Small in size
❑ Runs anteriorly	❑ Runs backward to back muscles
❑ Joins others & form plexuses	❑ Does not form plexuses
❑ Attached to symp ganglion	❑ Not attached to symp ganglia

ORIGIN OF THE CRANIAL NERVES

1. **Olfactory N:** from nose
2. **Optic Nerve:** from retina
3. **III & IV:** from midbrain
4. **Middle 4:** from pons
5. **Last 4:** from medulla



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Function of Cranial Nerves

1. Olfactory nerve (I): olfaction (smell)
2. Optic nerve (II): vision
3. Oculomotor nerve (III): movement of the eyeball
4. Trochlear nerve (IV): movement of the eyeball
5. Trigeminal nerve (V): sensation from face & move the jaw
6. Abducent nerve (VI): movement of the eyeball
7. Facial nerve (VII): muscles of facial expression.
8. Vestibulocochlear nerve (VIII): hearing and balance
9. Glossopharyngeal nerve (IX): tongue & pharynx.
10. Vagus nerve (X): abdominal & thoracic viscera
11. Accessory nerve (XI): to the larynx with the vagus
12. Hypoglossal nerve (XII): muscles of the tongue.

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AUTONOMIC NERVOUS SYSTEM

1. **Sympathetic:** called thoraco-lumbar. From spinal cord segments T1–L2
2. **Parasympathetic:** called cranio-sacral
   a. **Cranial:** with cranial nerves
   b. **Sacral:** S2, 3 & 4

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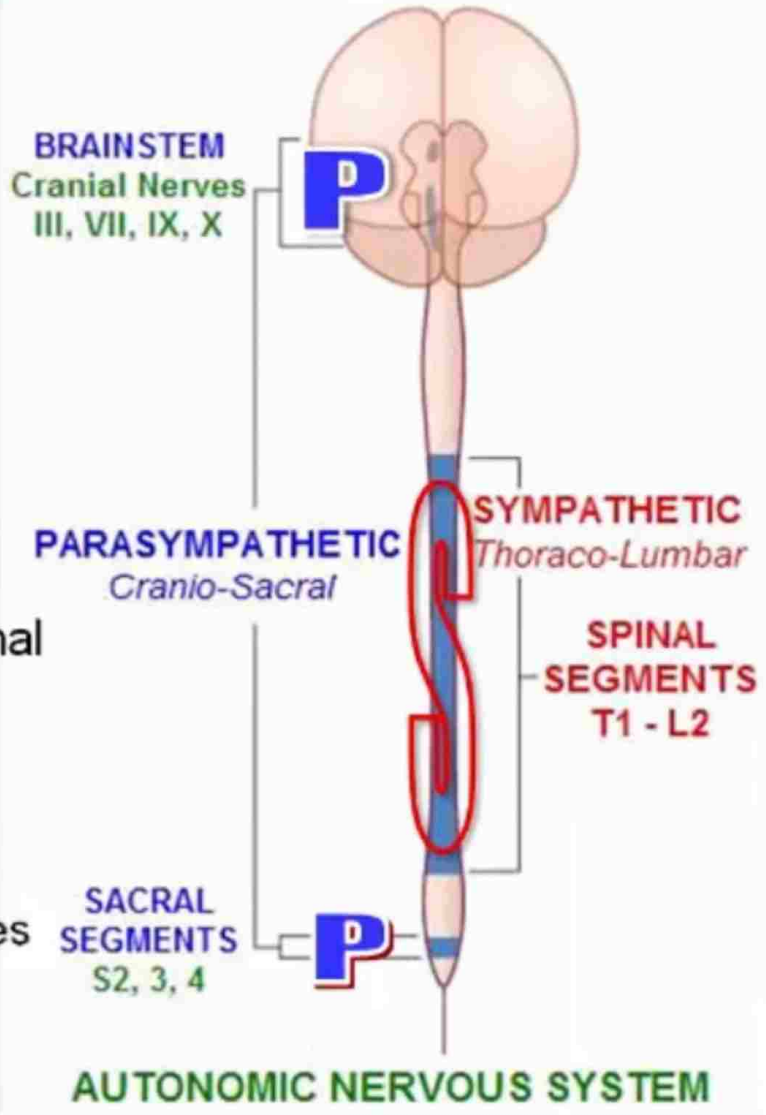
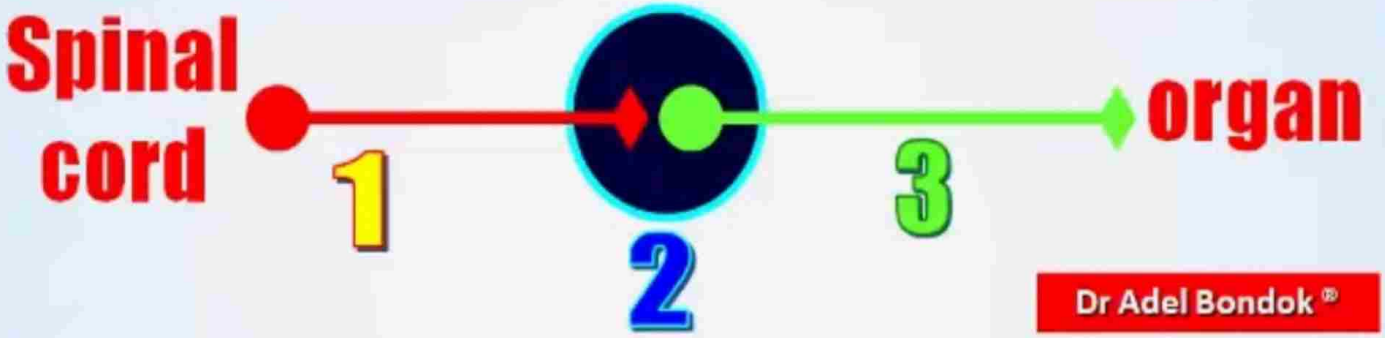


SYMPATHETIC PART



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1. **Preganglionic fibers:** from spinal cord lateral horn cells T1—L2
2. **Ganglion:** sympathetic ganglia
3. **Postganglionic fibers:** from ganglia

FUNCTION OF SYMP.

FUNCTION OF THE SYMPATHETIC SYSTEM

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PARASYMPATHETIC PART

1. CRANIAL OUTFLOW:

with cranial nerves:

III, VII, IX & X

2. SACRAL OUTFLOW:

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from S2, 3, 4 segments

CRANIAL:
III, VII, IX & X

Module 1 A

Semetsr

PARA-SYMPATHETIC

SACRAL:
S2, 3, 4

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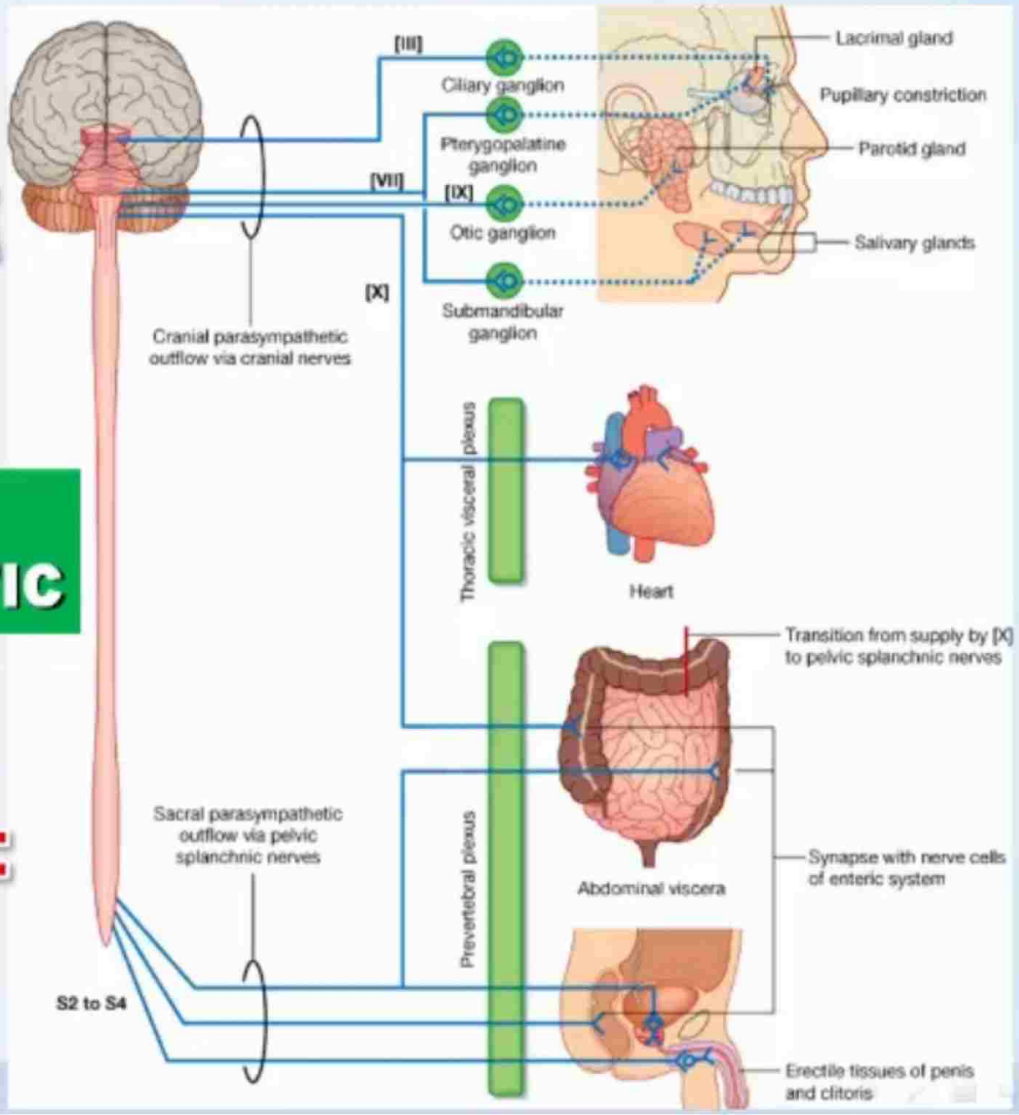
Reference:



FUNCTION OF PARASYMP.

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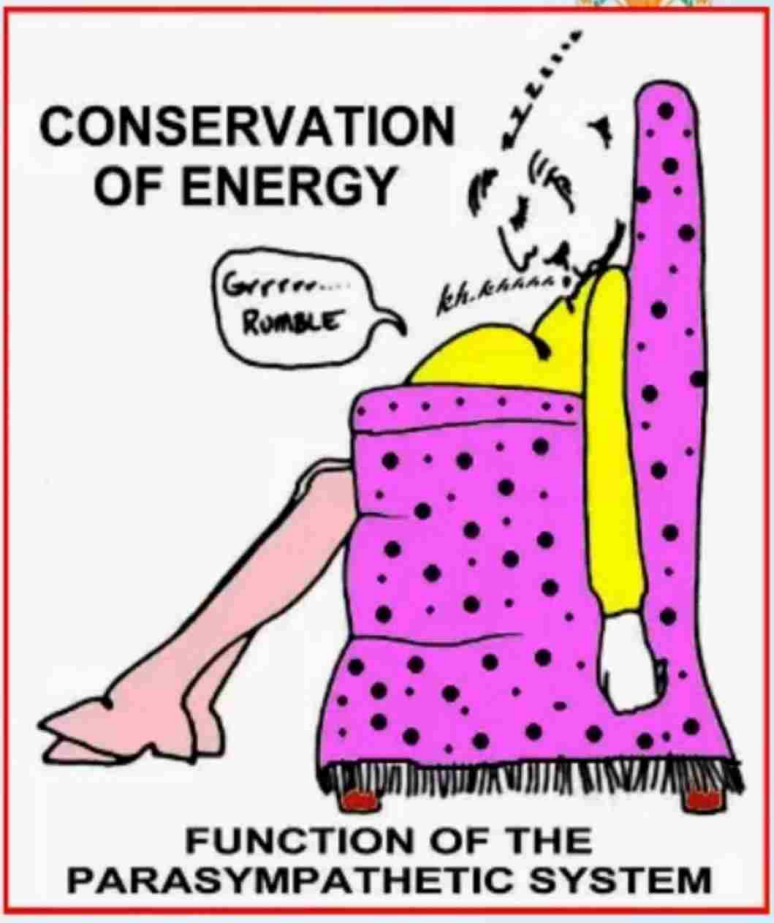


FUNCTIONS OF A.N.S.

SYMPATHETIC	PARASYMPATHETIC
Increases heart rate	Decreases heart rate
Dilates the pupil	Constricts the pupil
Dilates bronchi	Constricts bronchi
Relax wall of GIT	Contract wall of GIT
contracts the sphincter of the GIT	relaxes the sphincter of the GIT

STRUCTURE OF THE NERVOUS SYSTEM

Formed of 2 types of cells:

1. Nerve cells: called neurons

   They communicate by synapses

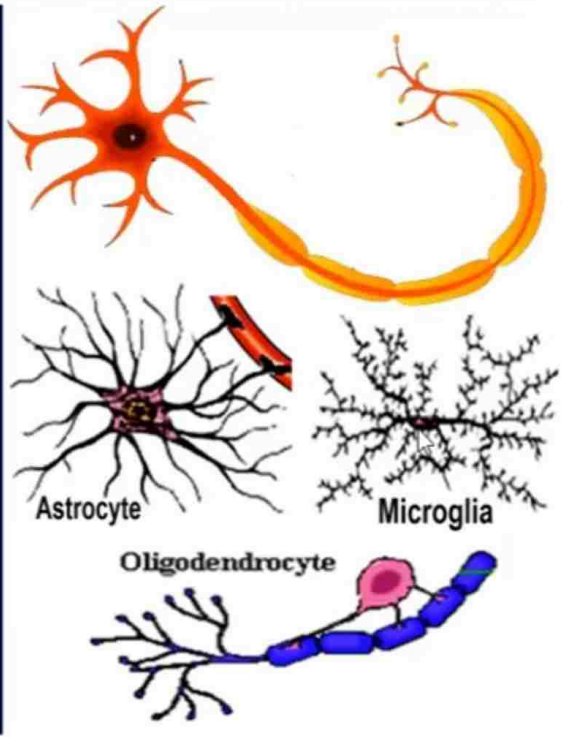
2. Supporting Cells: neuroglia

   a. Astrocytes: Support the nerve cells

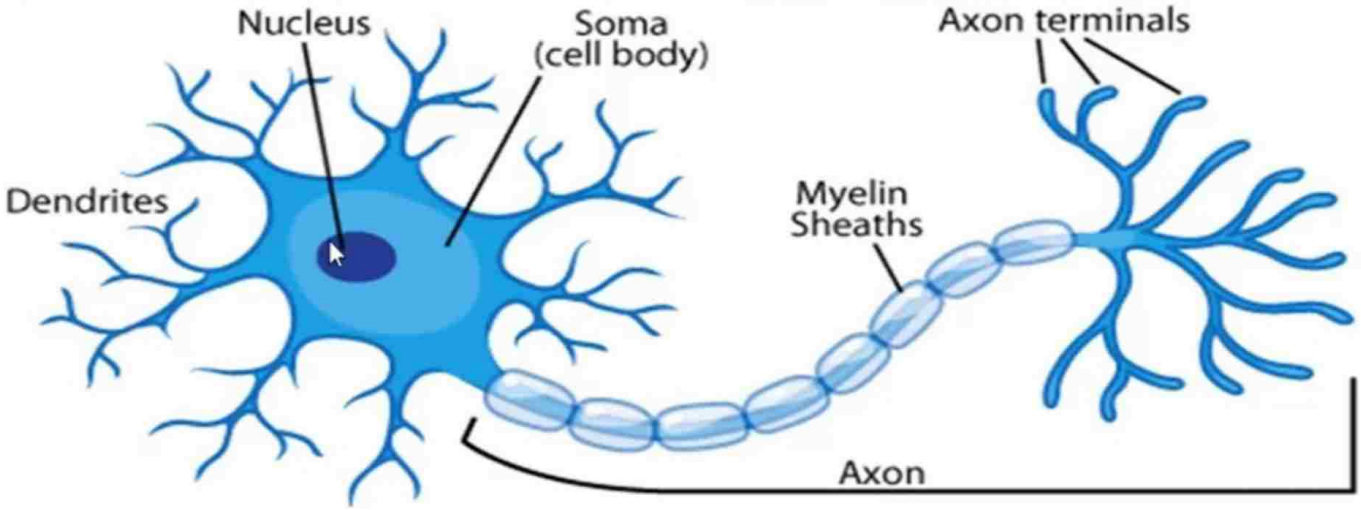
   b. Oligodendrocytes: Form myelin

   c. Microglia: Guard against infection

   d. Ependymal cells: line the ventricles



NERVE CELLS



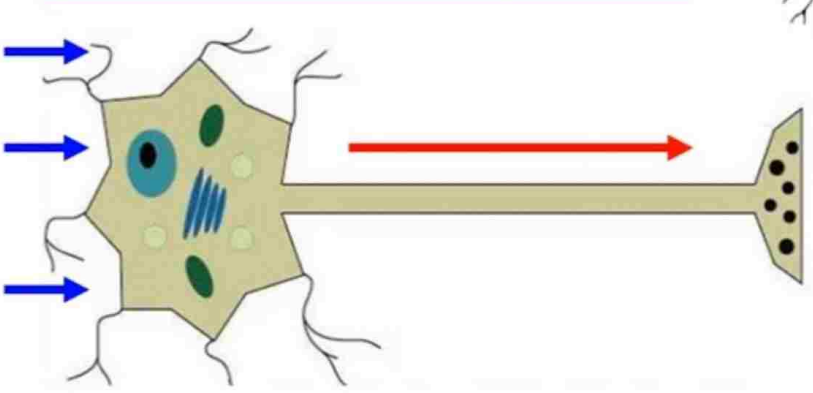
Cytology:

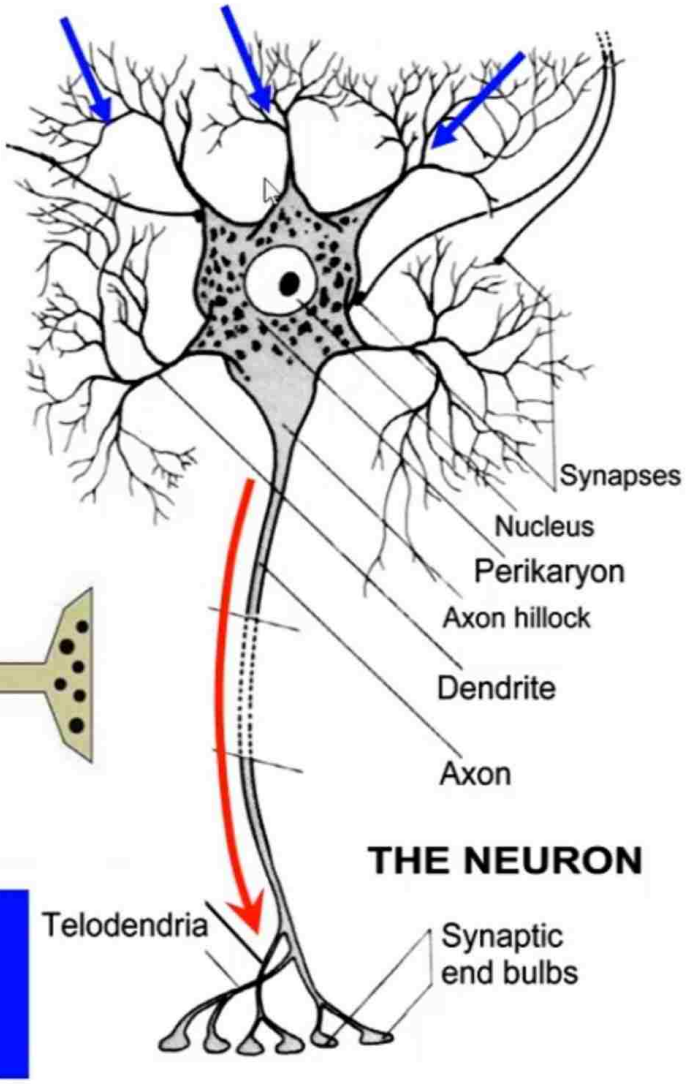
1. **Cell Body:** nucleus & cytoplasm
2. **Processes:** one axon & dendrites

PROCESSES

ONE AXON

Transmits information to other nerve cells





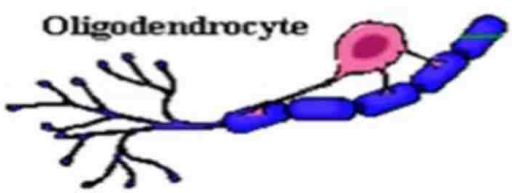
DENDRITES

Receive information

AXONS are like electric wires. Either:

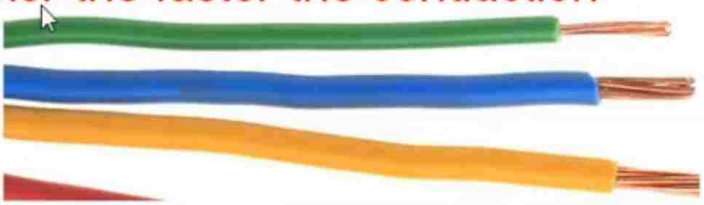
Myelinated

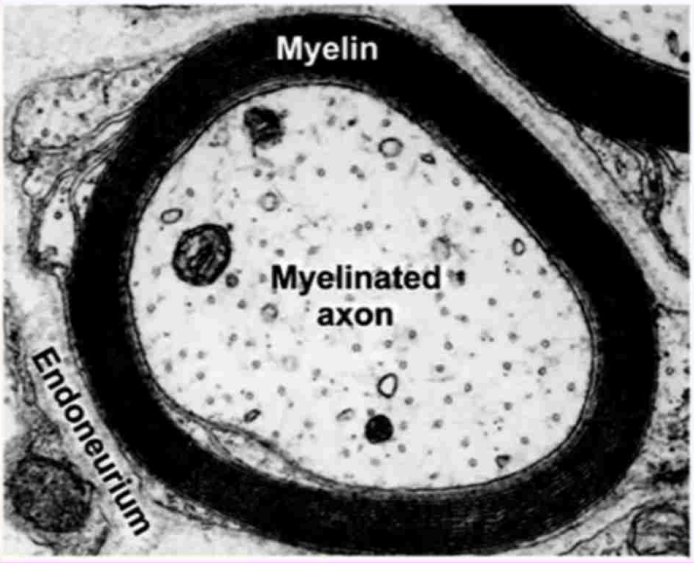
Unmyelinated

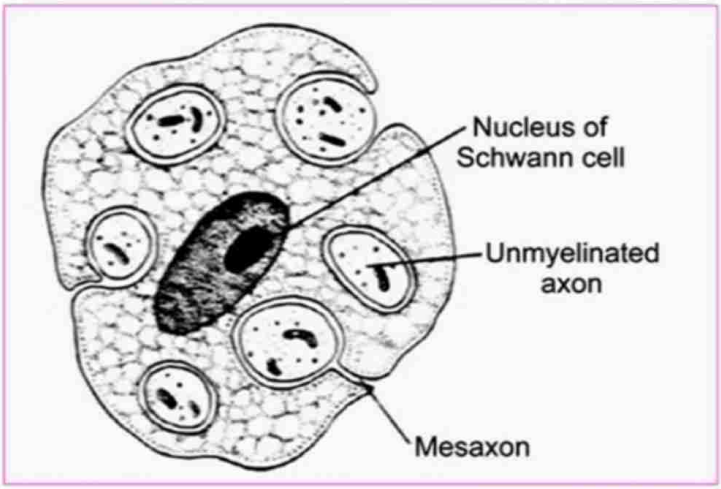


Myelin: Insulation + impulse conduction

The thicker the faster the conduction





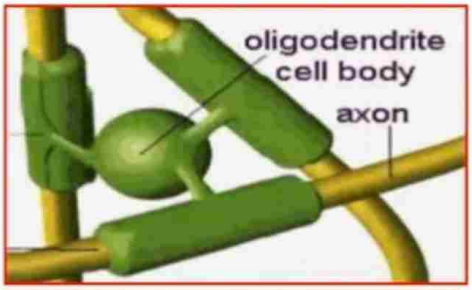


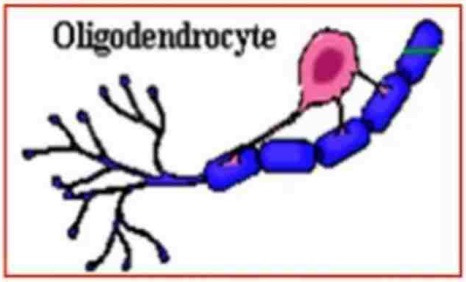
MYELIN PRODUCING CELLS

2

1. In the CNS:

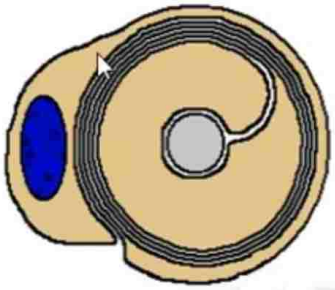
Oligodendrocytes





2. In the PNS:

Schwann cells

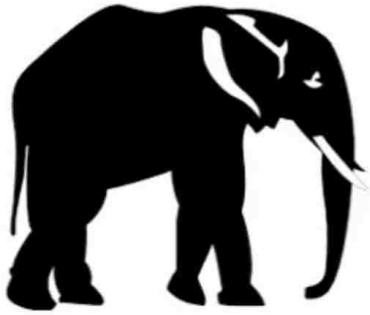


Types of Nerve Cells

ACCORDING TO:

Size, Function & # of Processes

A. SIZE:



1. **Golgi type I:** large
2. **Golgi type II:** small

B. FUNCTION:

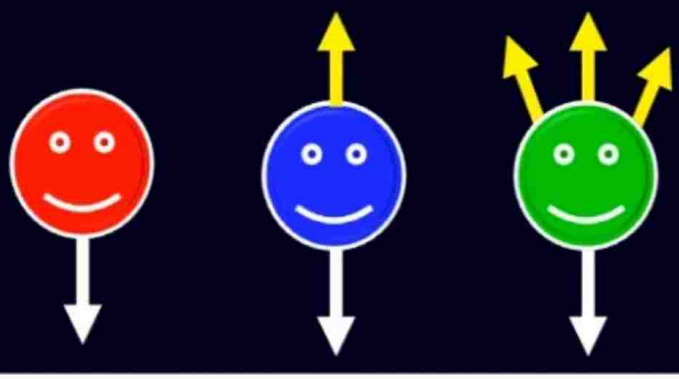
1. **Motor:** movement
2. **Sensory:** perception of sensations

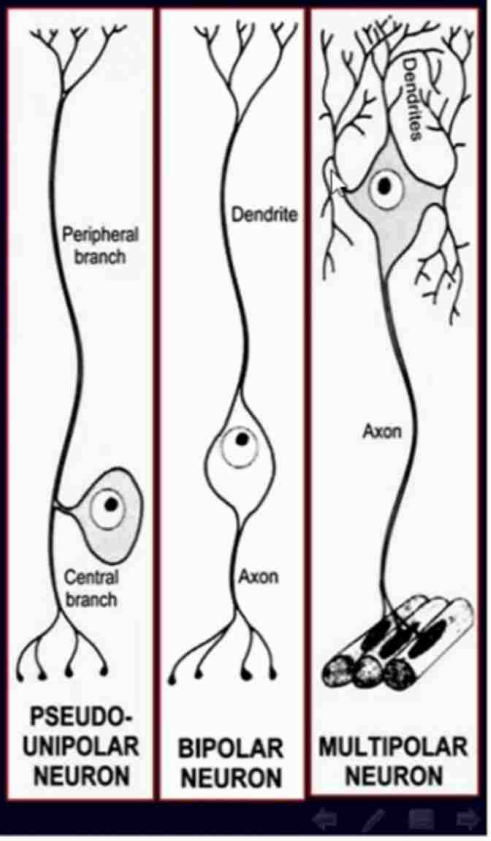
3. **Interneurons:** connect nerve cells together

Classification: Types

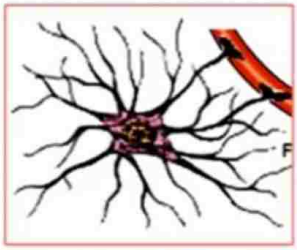
C. # OF PROCESSES:

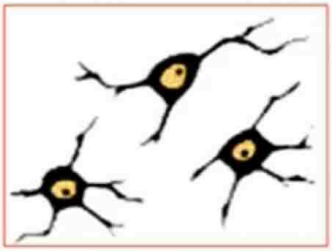
1. **Unipolar:** 1 process
   a. True: amacrine cells of the retina.
   b. Pseudounipolar: in dorsal root ganglia
2. **Bipolar:** 2 processes, sense organs
3. **Multipolar:** more than 2





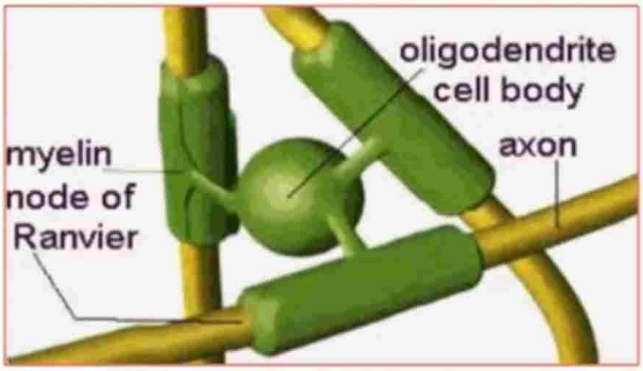
NEUROGLIA

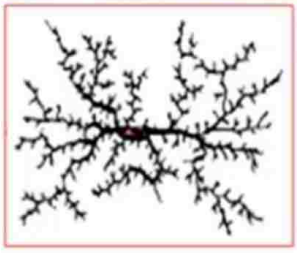


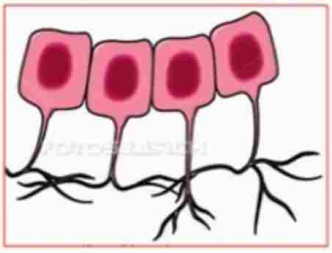


CENTRAL: 4

1. **Astrocytes:** protection
2. **Oligodendrocytes:** myelin
3. **Microglia:** inflammation
4. **Ependyma:** line ventricles, CSF production & circulation

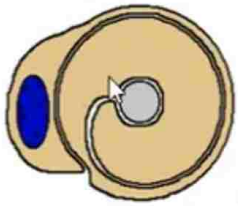






PERIPHERAL: 2

1. **Schwann cells:** myelin
2. **Satellite cells:** around nerve cells



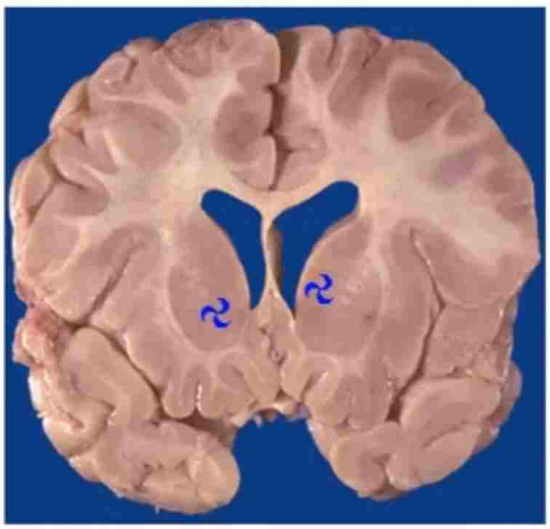
TERMINOLOGY

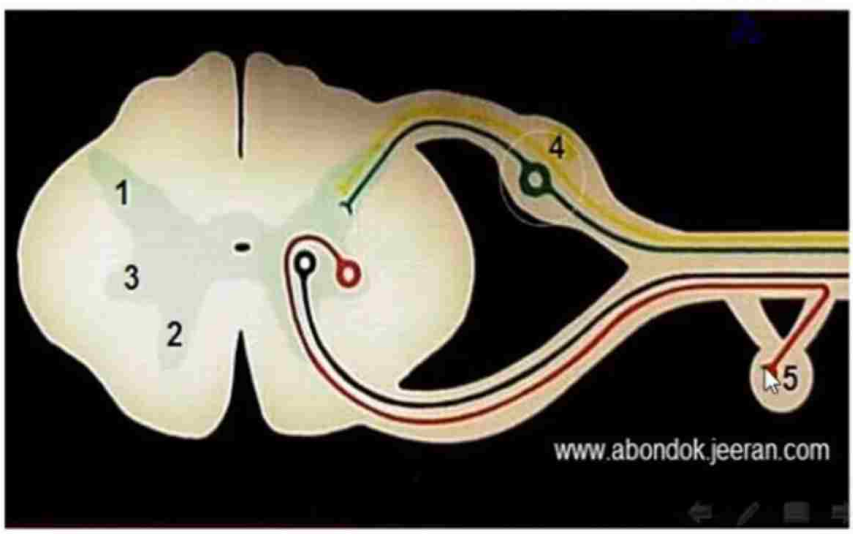
NUCLEUS:

collection of nerve cells inside the CNS

GANGLION:

collection of nerve cells outside the CNS





SYNAPSES

1. Definition:

contact point between 2 nerve cells

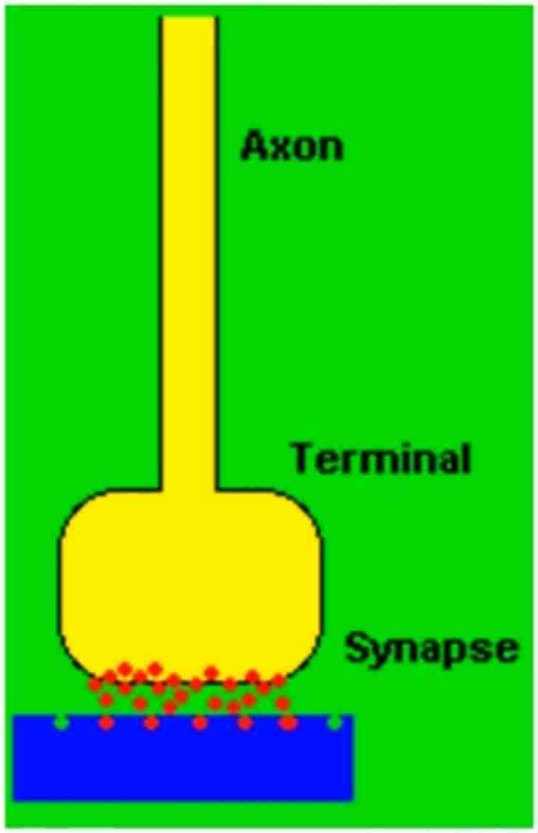
2. TYPES:

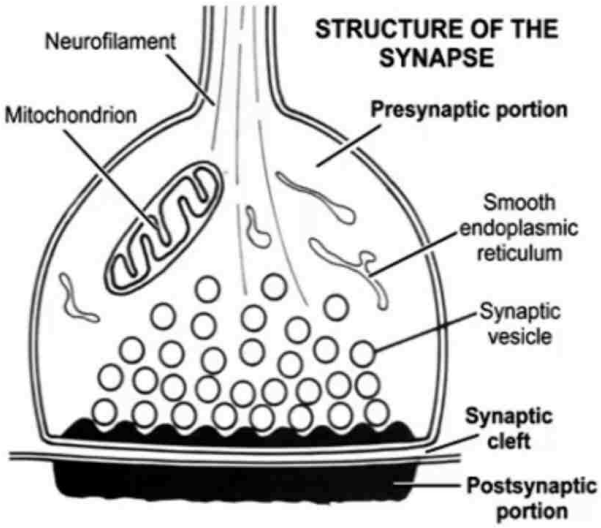
a. Chemical Synapse:

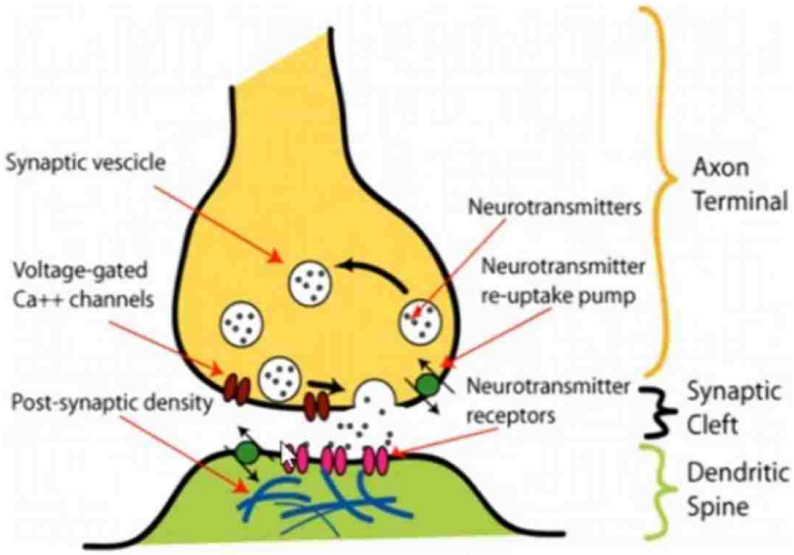
transmission by chemical substance

b. Electrical Synapse:

transmission without chemical substance





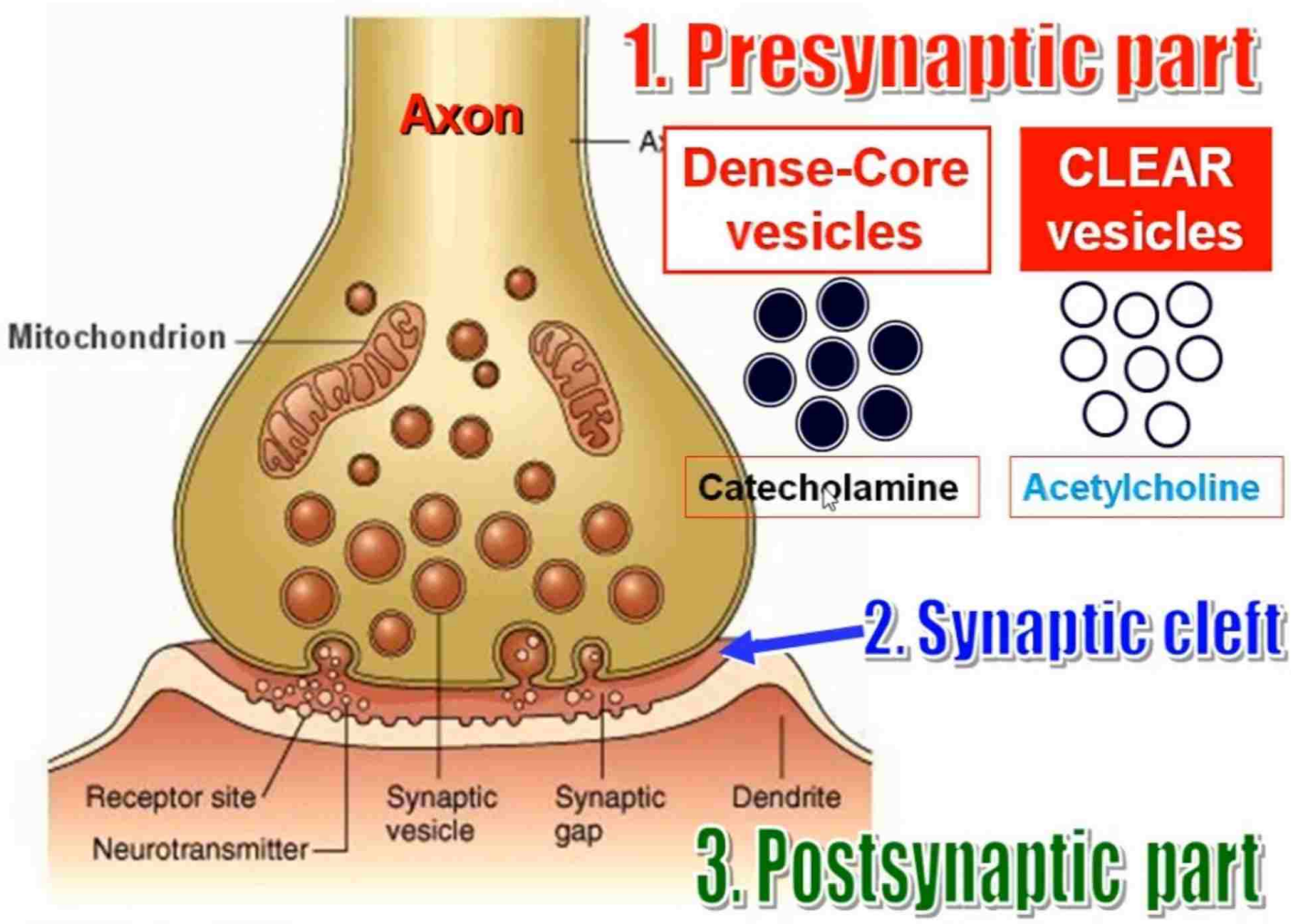


Structure of the chemical synapse

3 elements:

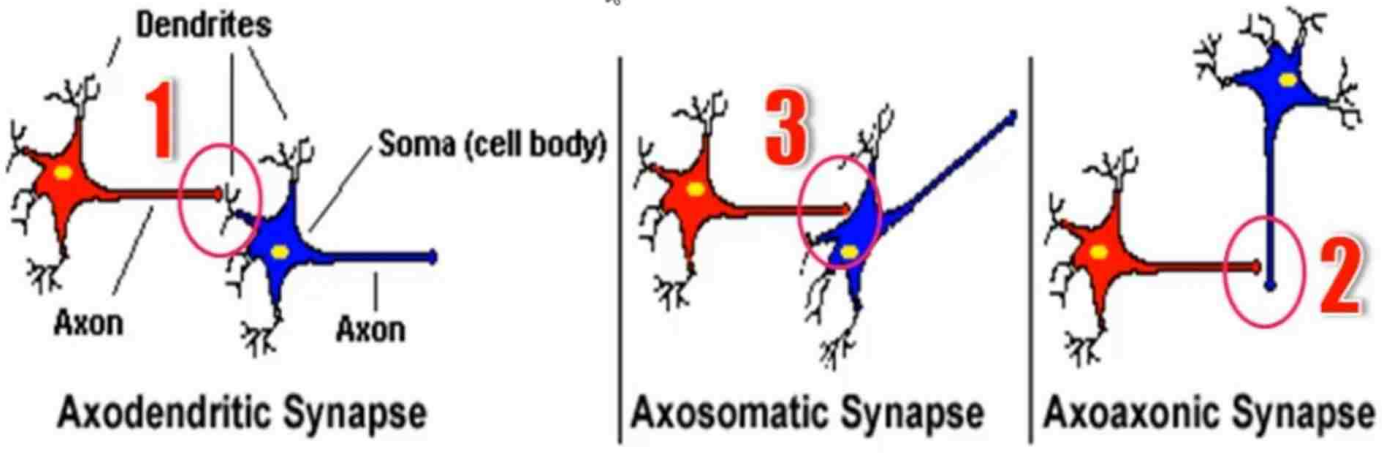
1. **Presynaptic element:** axon
2. **Synaptic cleft**
3. **Postsynaptic element:**

   dendrite, axon, cell body, muscle

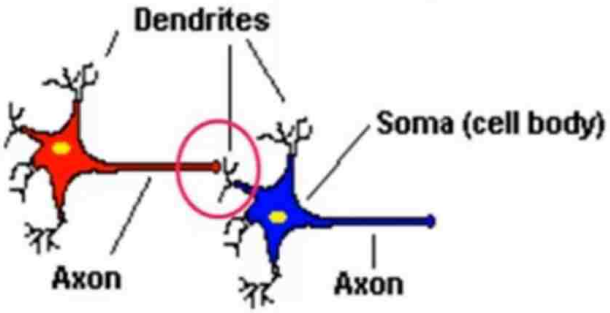


TYPES OF SYNAPSES

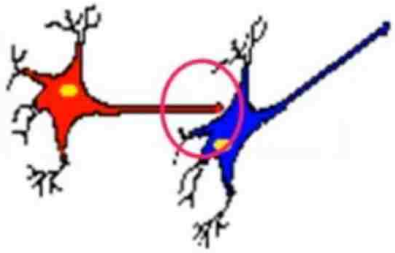
1. **Axodendritic:** axon + dendrite
2. **Axoaxonic:** axon + axon
3. **Axosomatic:** axon + cell body
4. **Neuromuscular:** axon + muscle



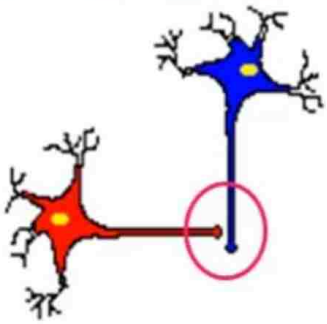
TYPES OF SYNAPSES



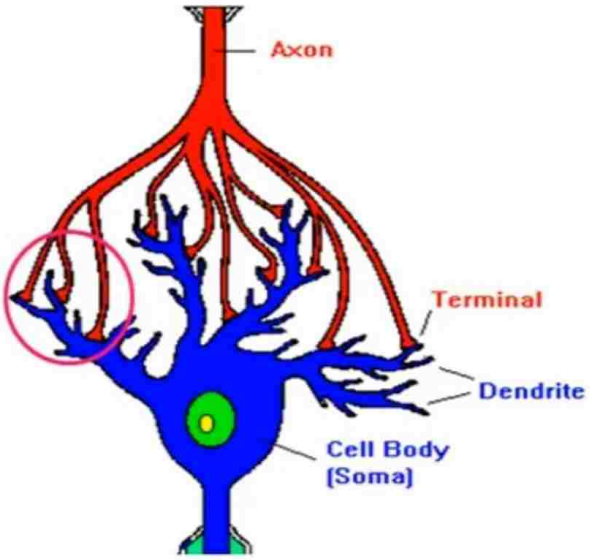
Axodendritic Synapse

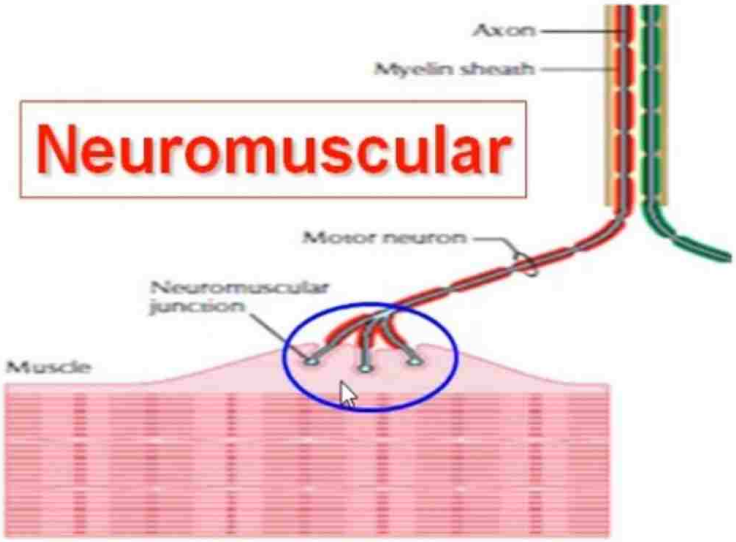


Axosomatic Synapse



Axoaxonic Synapse





DIVISIONS OF THE NERVOUS SYSTEM

1. Central Nervous System:

a. Brain.
b. Spinal cord.

2. Peripheral Nervous System:

A. Somatic Nervous System:

a. Spinal nerves: 31 pairs.
b. Cranial nerves: 12 pairs.
c. Associated ganglia.

B. Autonomic Nervous System:

a. Sympathetic: thoracolumbar
b. Parasympathetic: craniosacral

Divisions of the Nervous System

- **Central**
  - Brain
  - Spinal Cord
- **Peripheral: Somatic**
  - Spinal Nerves: 31
  - Cranial Nerves: 12
  - Ganglia
- **Peripheral: Autonomic**
  - Sympathetic
    - Thoracolumbar
  - Parasympathetic
    - Craniosacral

BRAIN

1. FOREBRAIN:

a. 2 Cerebral hemispheres

b. Diencephalon: thalamus, hypothalamus, epithalamus & subthlamus

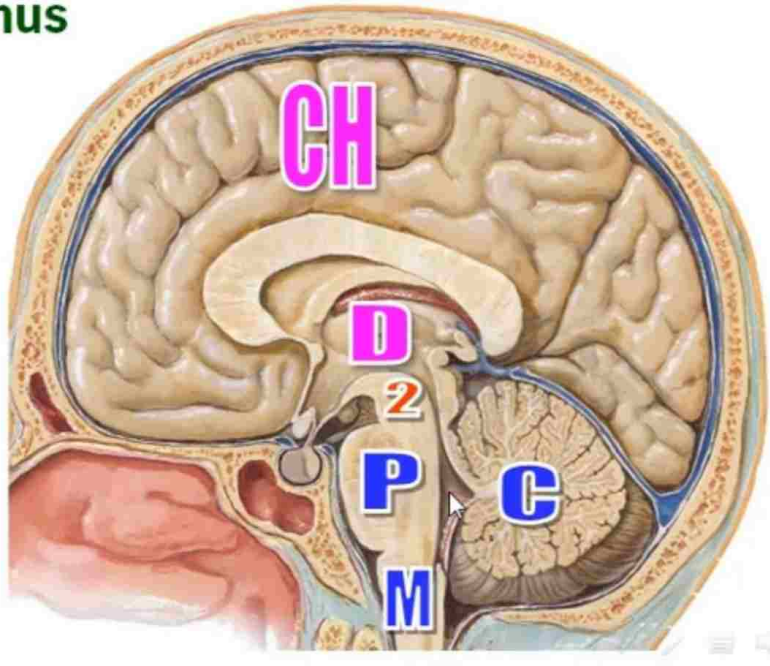
2. MIDBRAIN

3. HINDBRAIN:

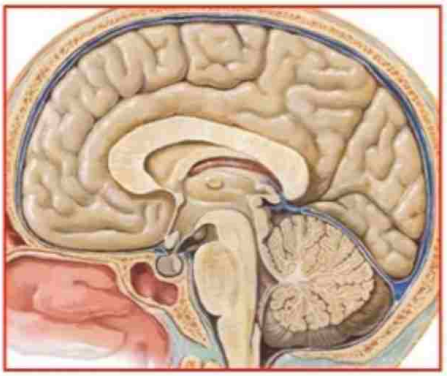
a. Pons

b. Medulla

c. Cerebellum



ANOTHER DIVISIONS



1. CEREBRUM:

a. 2 Cerebral hemispheres:

b. Diencephalon: formed of:

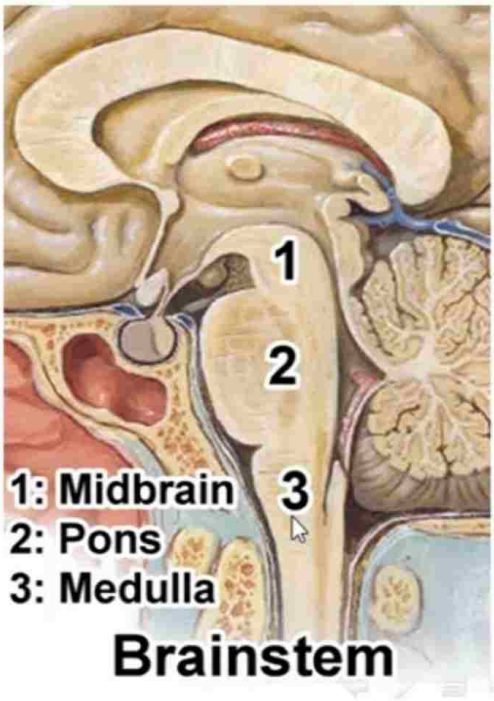
thalamus, hypothalamus, epithalamus & subthlamus

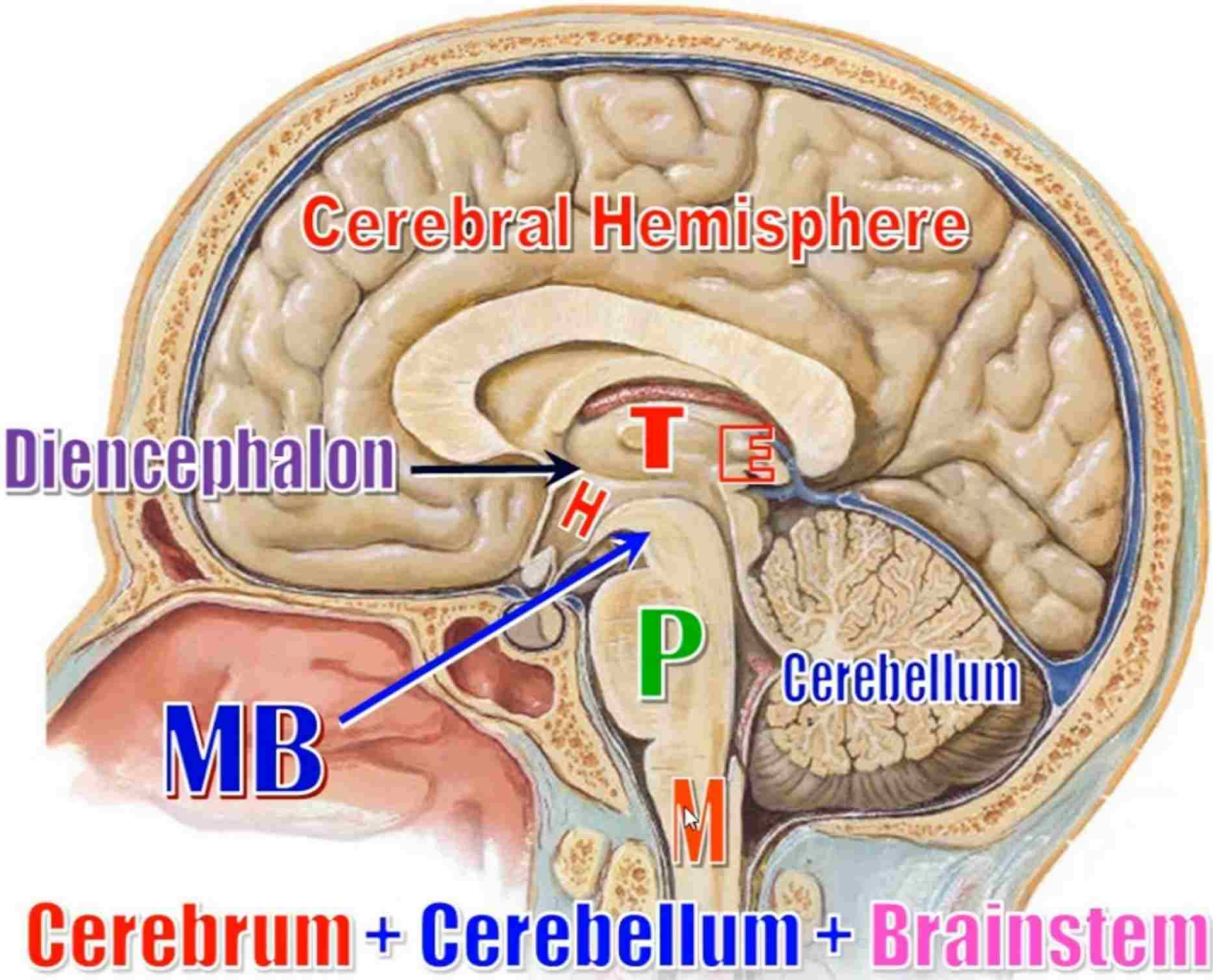
2. CEREBELLUM:

Coordination & balance

3. BRAINSTEM: formed of

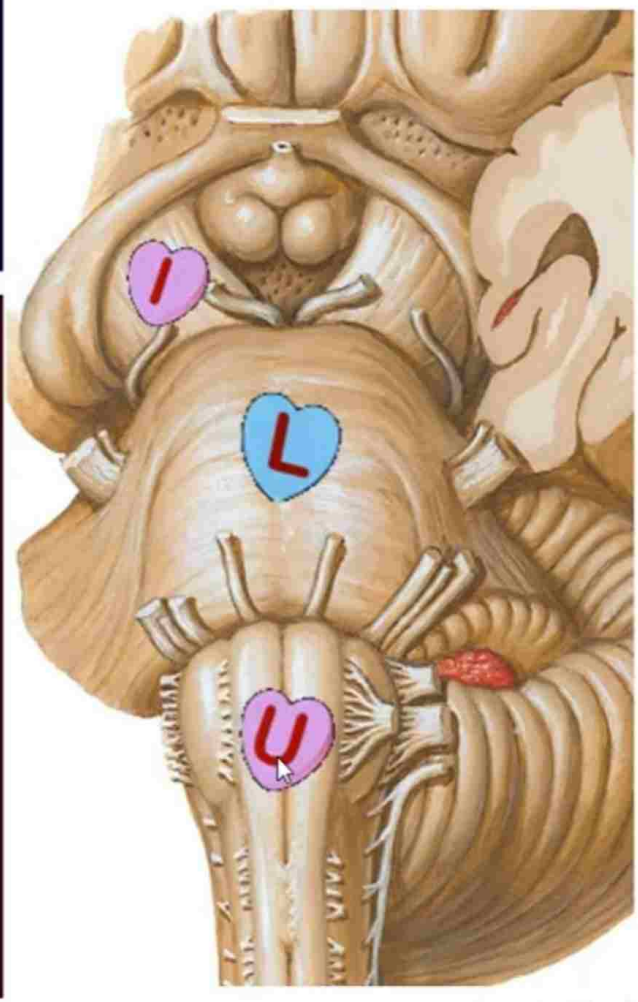
a. midbrain
b. Pons
c. medulla





BRAINSTEM

1. MIDBRAIN
2. PONS
3. MEDULLA



STRUCTURE OF THE SPINAL CORD

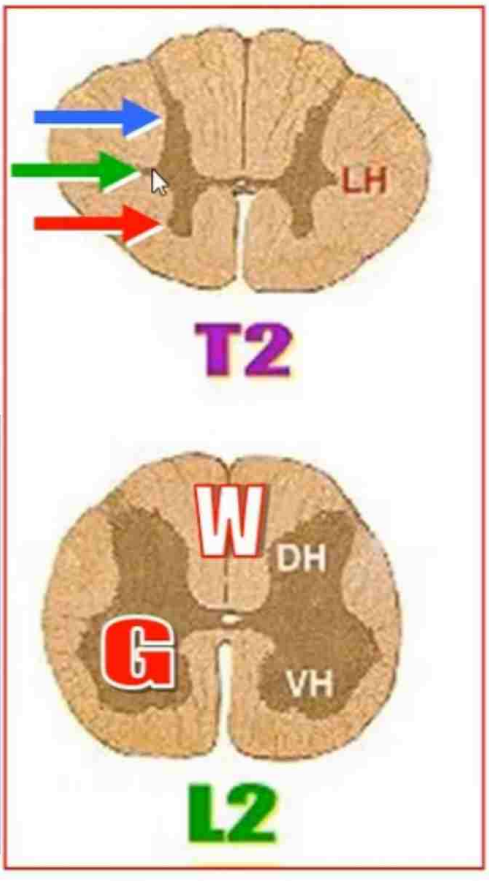
1. White Matter

2. Gray Matter

a. **Dorsal Horn:** sensory

b. **Ventral Horn:** motor

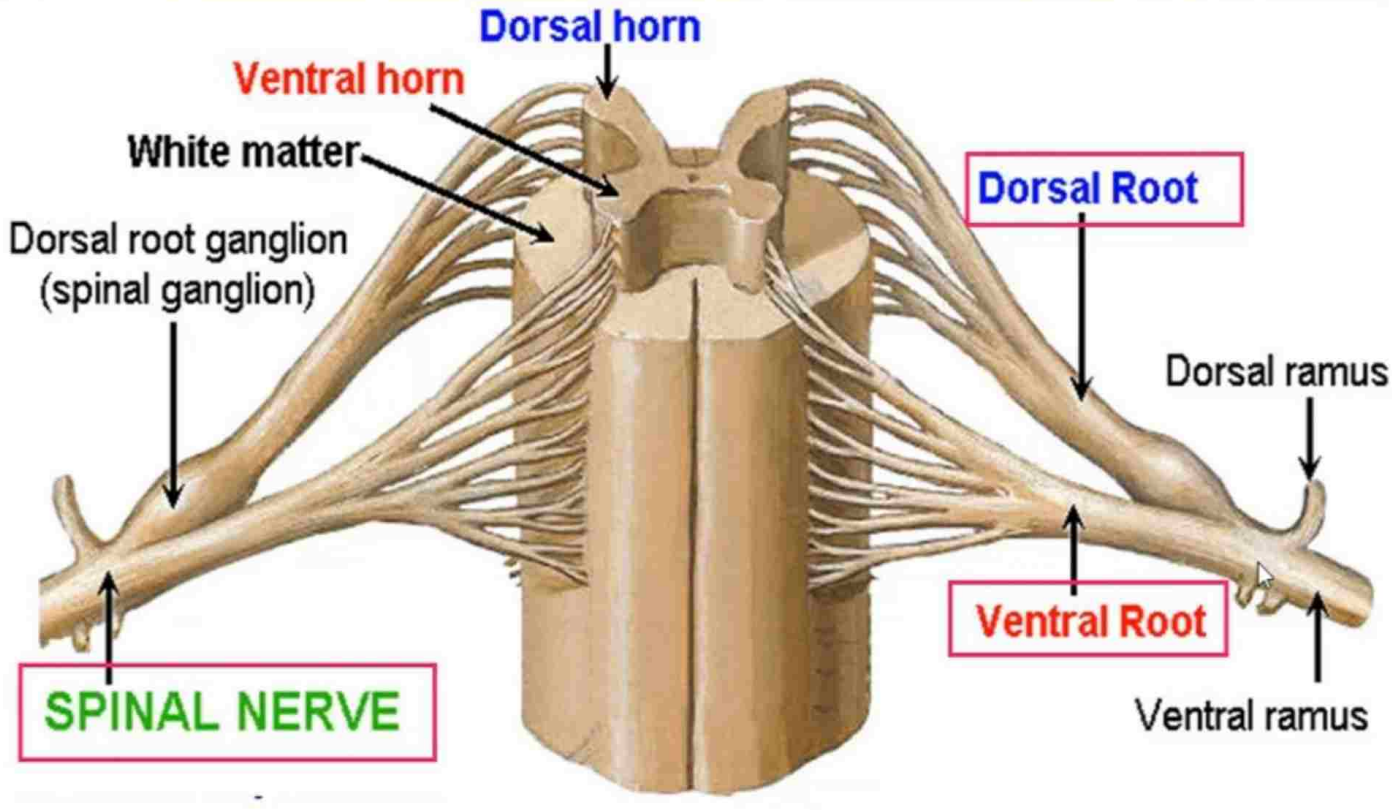
c. **Lateral horn:** autonomic

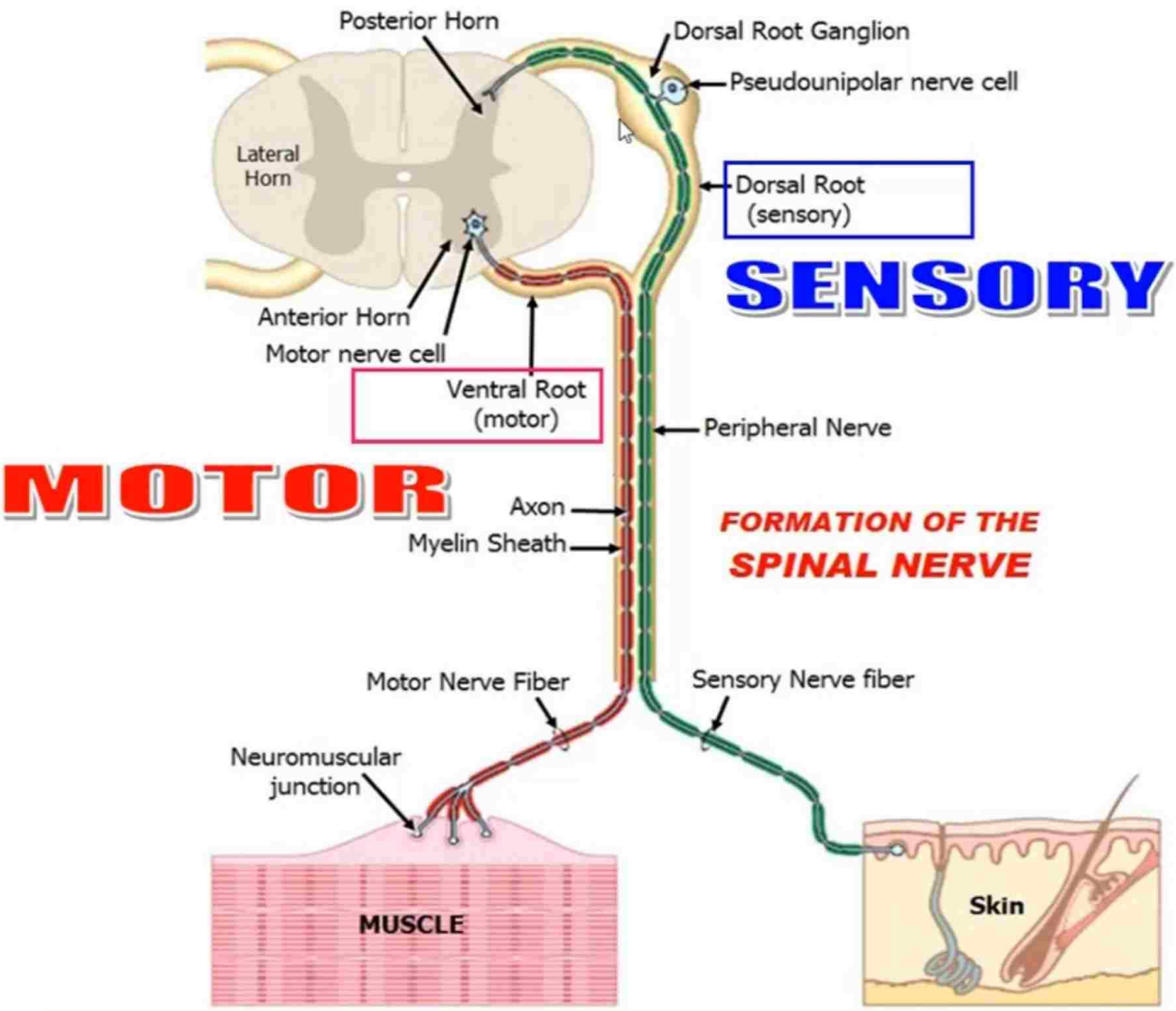


PERIPHERAL NERVOUS SYSTEM

1. Spinal Nerves: 31 pairs
2. Cranial Nerves: 12 pairs
3. Spinal & Cranial Ganglia

FORMATION OF THE SPINAL NERVE





Clinical Note

1. **Lesion in the dorsal root:** loss of sensation
2. **Lesion in the ventral root:** motor paralysis
3. **Lesion in the spinal nerve:** motor paralysis & sensory loss

BRAIN VENTRICLES

Cerebral hemisphere:

lateral ventricle

Diencephalon:

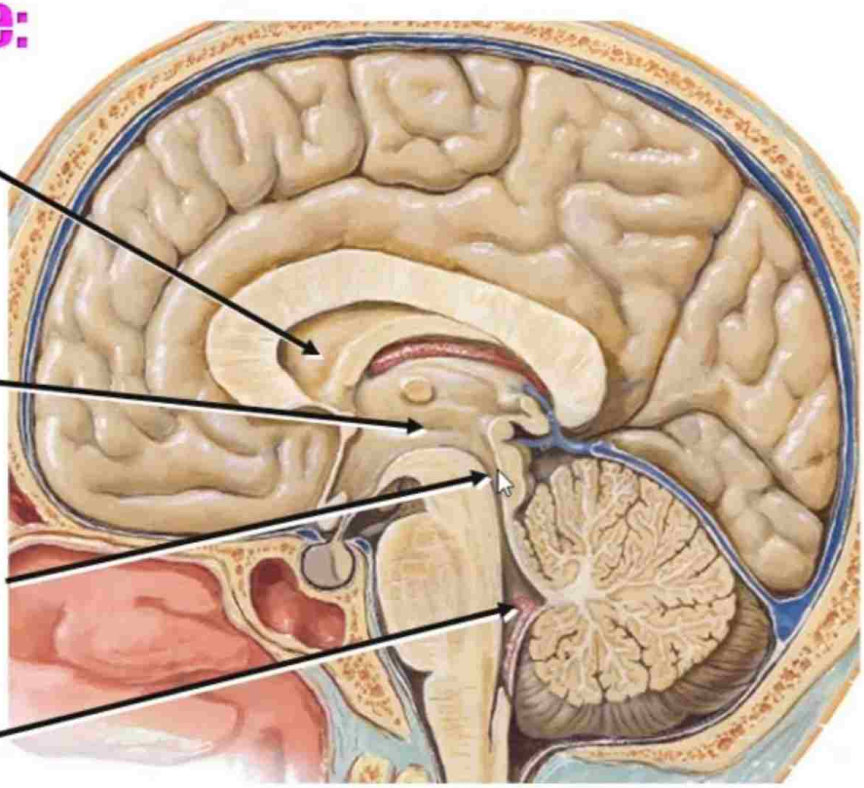
3rd ventricle

MIDBRAIN:

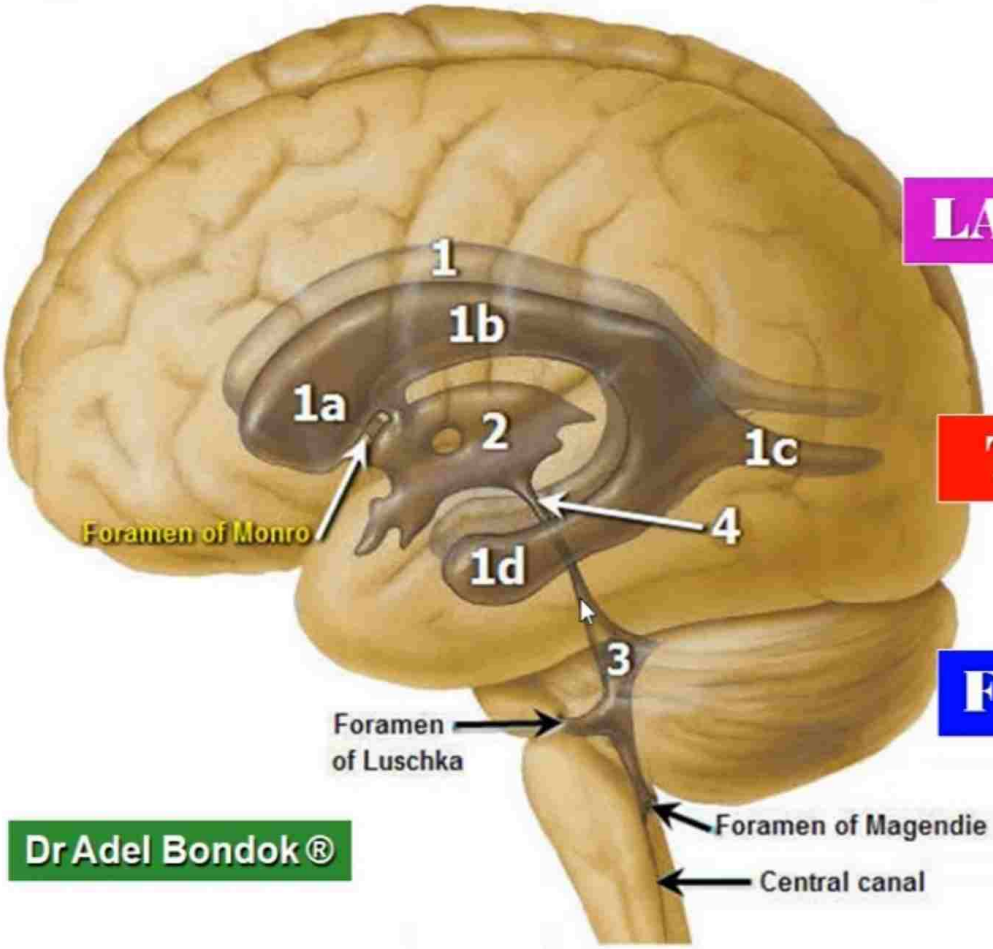
cerebral aqueduct

HINDBRAIN:

4th ventricle



VENTRICULAR SYSTEM



LATERAL V

THIRD V

FOURTH V

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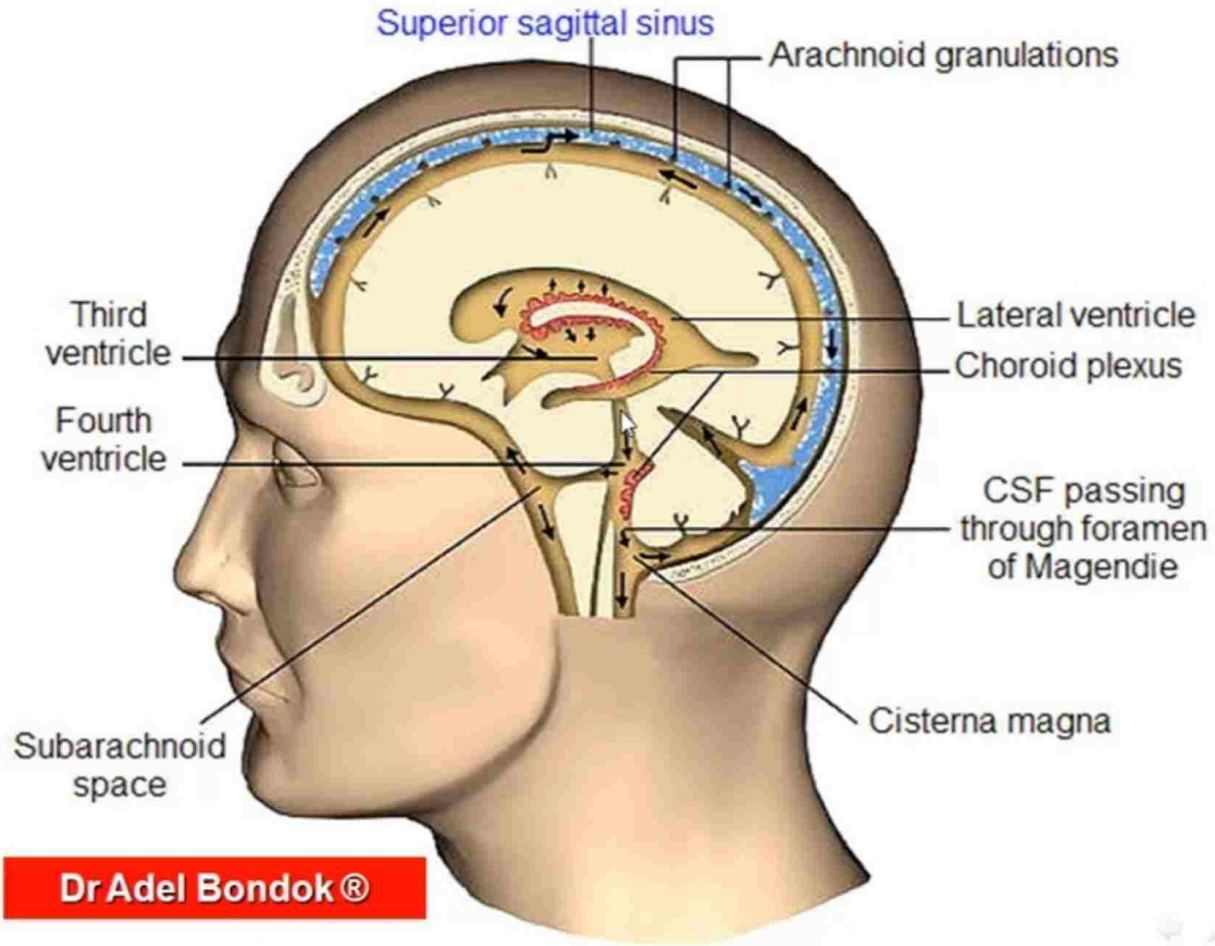
VENTRICULAR SYSTEM



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C.S.F

What and Where?

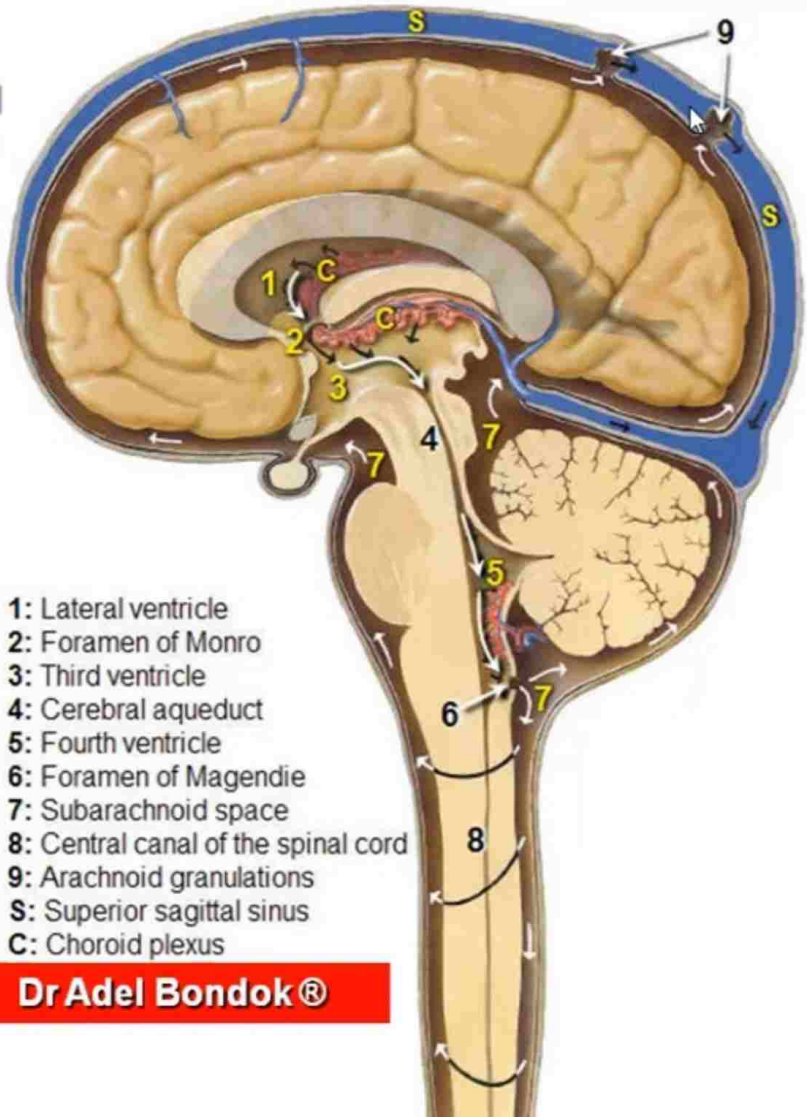
VOLUME

PRODUCTION

CIRCULATION

DRAINAGE

FUNCTION



1: Lateral ventricle
2: Foramen of Monro
3: Third ventricle
4: Cerebral aqueduct
5: Fourth ventricle
6: Foramen of Magendie
7: Subarachnoid space
8: Central canal of the spinal cord
9: Arachnoid granulations
S: Superior sagittal sinus
C: Choroid plexus

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Lateral Ventricle

↓

Foramen of Monro

↓

3rd Ventricle

↓

Aqueduct of Sylvius

↓

4th Ventricle

↓

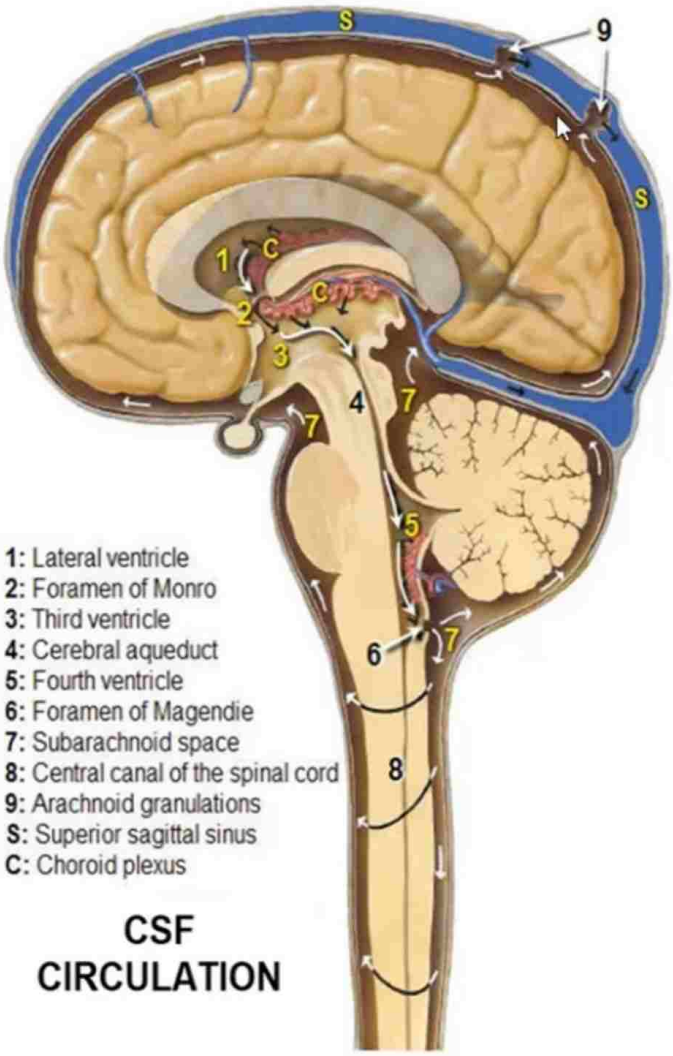
3 Foramina

↓

Subarachnoid space

↓

Arachnoid Villi & Graulations



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9: Arachnoid granulations
S: Superior sagittal sinus
C: Choroid plexus

CSF CIRCULATION

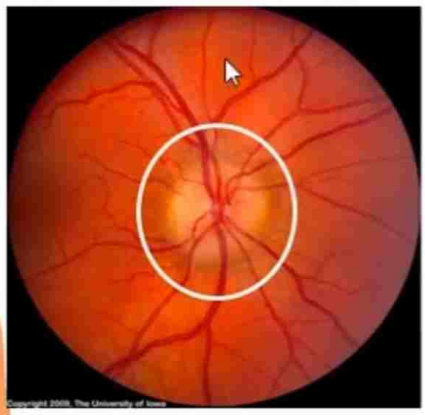
FUNCTIONS OF THE C.S.F

1. ***Reduces*** the brain weight 60 folds (to 25 gm).
2. ***Protects*** the brain and the spinal cord.
3. ***Substitutes*** the lymphatic system in the CNS and transfers waste products from the CSF to the blood.
4. ***Maintains*** the chemical environment through communication with the brain extracellular space.
5. ***Regulation*** of the intracranial pressure

Clinical Notes

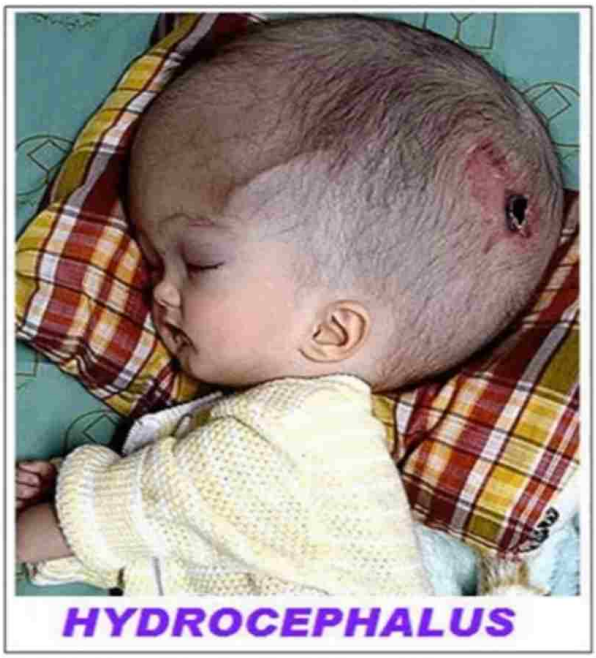
Hydrocephalus

Lumbar Puncture



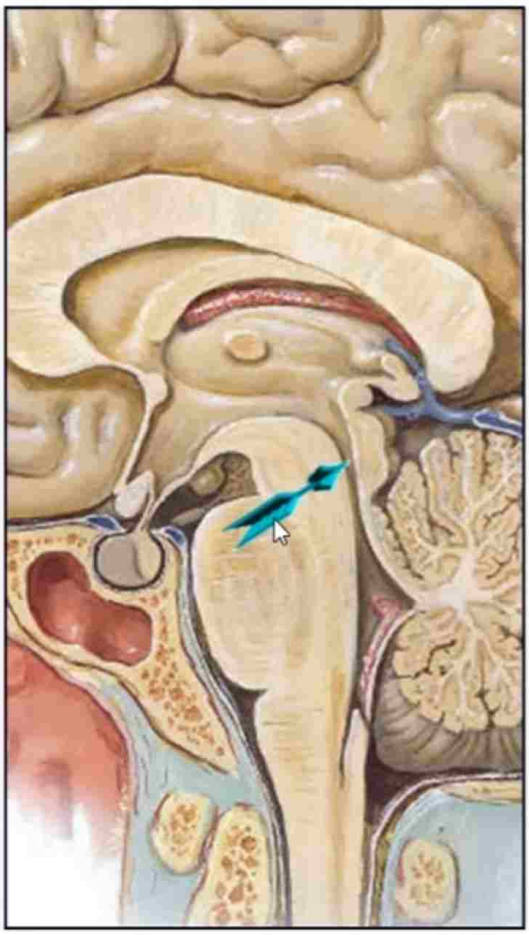
Papilledema

3 Causes of Hydrocephalus

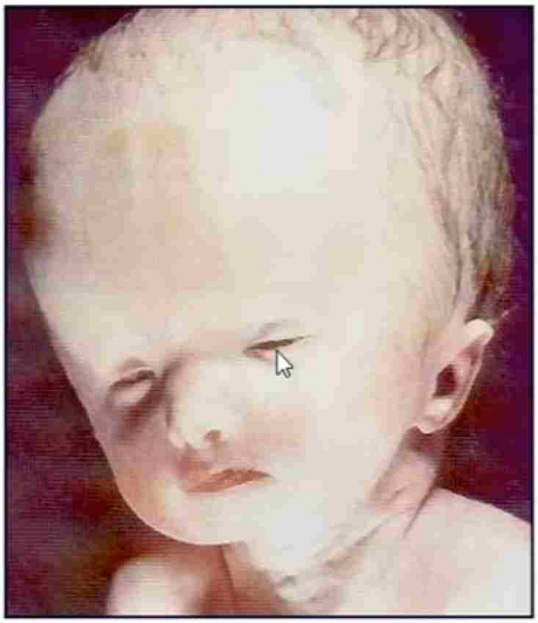


HYDROCEPHALUS

1. Increased production
2. Obstruction to circulation
3. Defective drainage



CASES OF HYDROCEPHALUS



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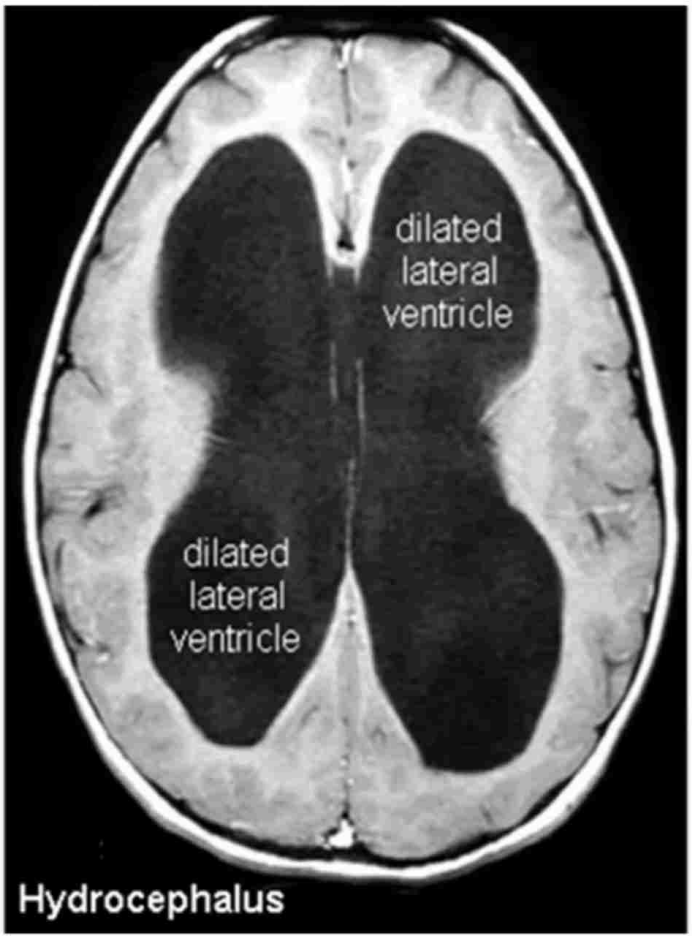
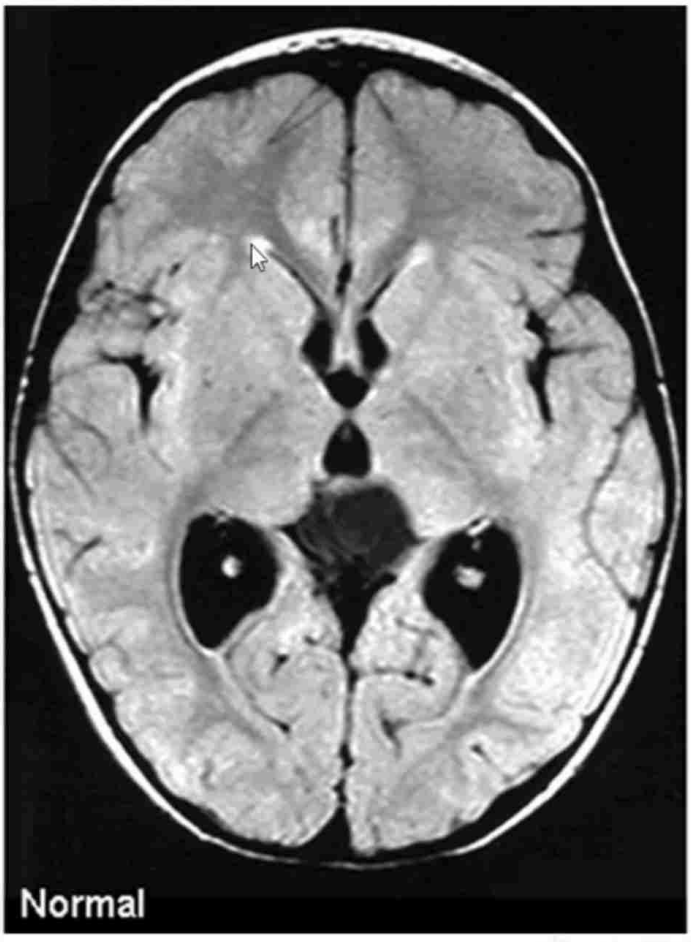
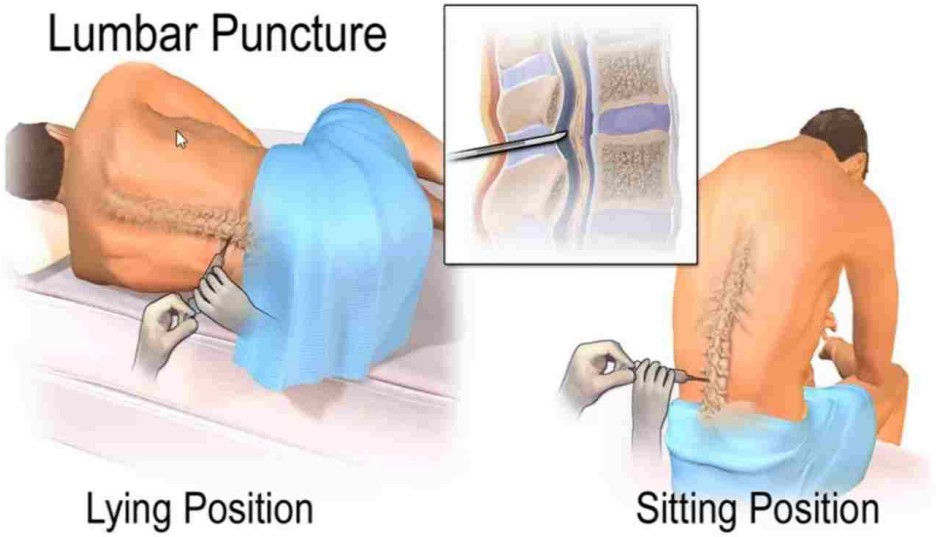
MRI of HYDROCEPHALUS





LUMBAR PUNCTURE

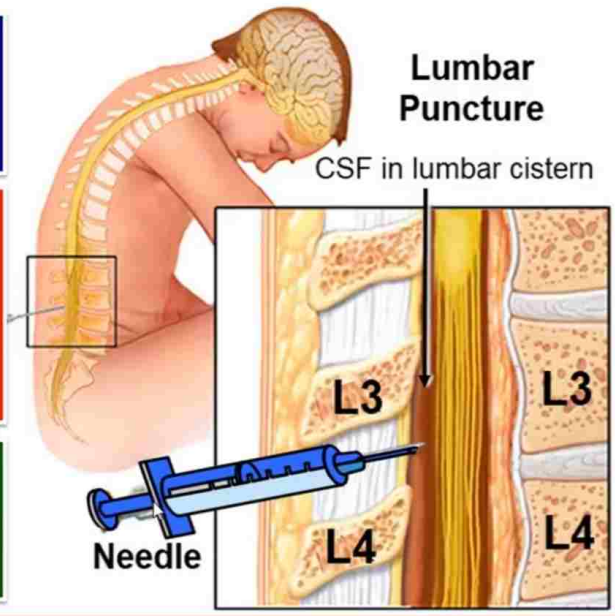


LUMBAR PUNCTURE

Take sample of CSF for analysis

Inject drugs like anesthetics and antibiotics

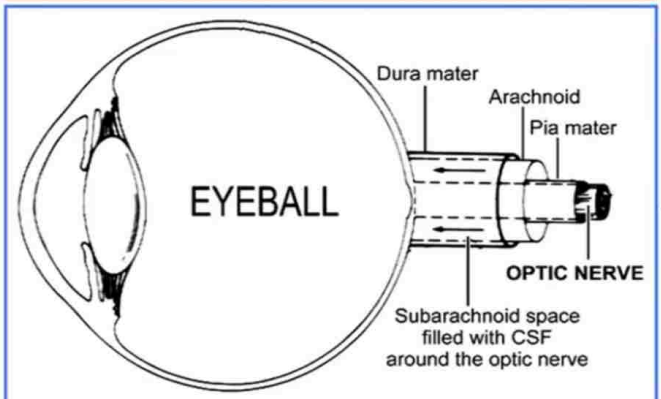
Measure CSF pressure



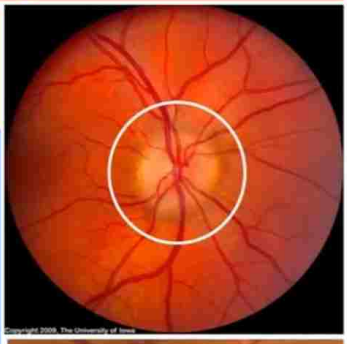
PAPILLEDEMA

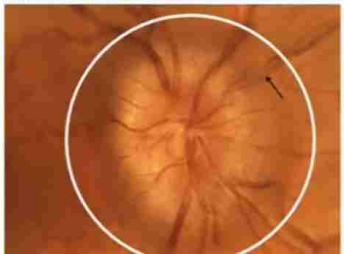
Edema around the optic disc

Due to increased intracranial pressure around the optic nerve



EXTENSION OF THE SUBARACHNOID SPACE AROUND THE OPTIC NERVE





VERTEBRAL COLUMN

33

7

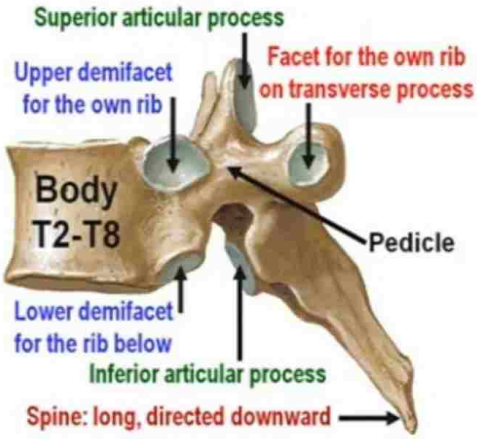
12

5

5

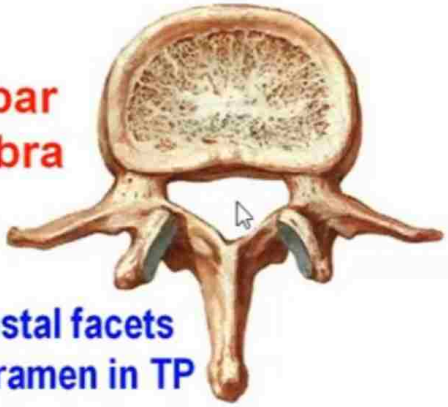
4

Cervical Vertebra



TYPICAL THORACIC VERTEBRA

Lumbar Vertebra



1. No costal facets
2. No foramen in TP

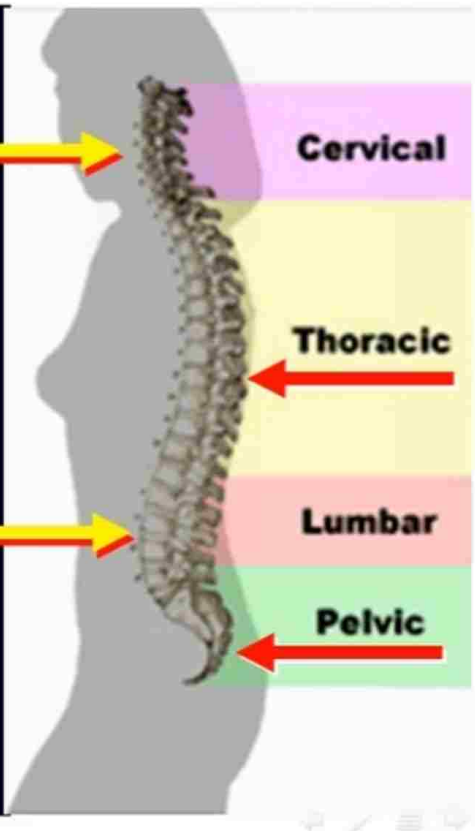
CURVES OF THE VERTEBRAL COLUMN

1. PRIMARY CURVES

- Present at birth
- Are convex posteriorly
- Present as thoracic & pelvic curves

2. SECONDARY CURVES

- Develop after birth
- Are convex anteriorly
- Present as cervical & lumbar curves



1. CERVICAL CURVE

- Secondary, appears at the 3rd month when the child raises his head
- Convex anteriorly

2. THORACIC CURVE

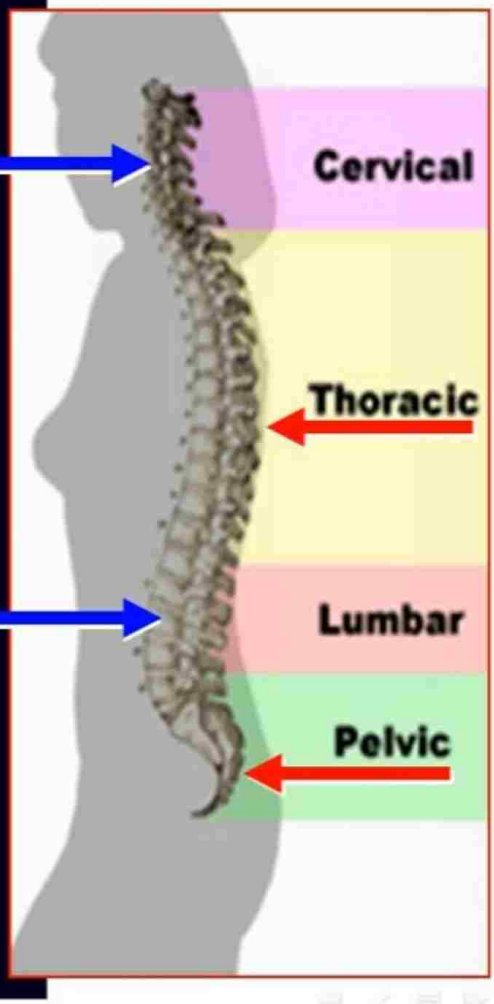
- Primary, appears at birth
- Convex posteriorly

3. LUMBAR CURVE

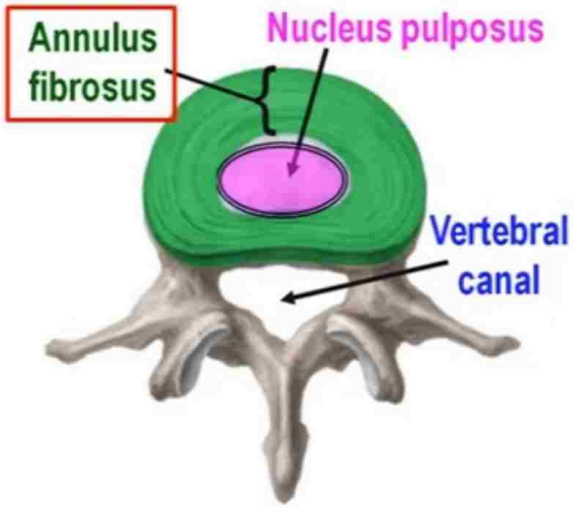
- Secondary, appears at the 9th – 18th month when the child sits and begins to walk
- Convex anteriorly

4. PELVIC CURVE

- Primary, appears at birth
- Convex posteriorly

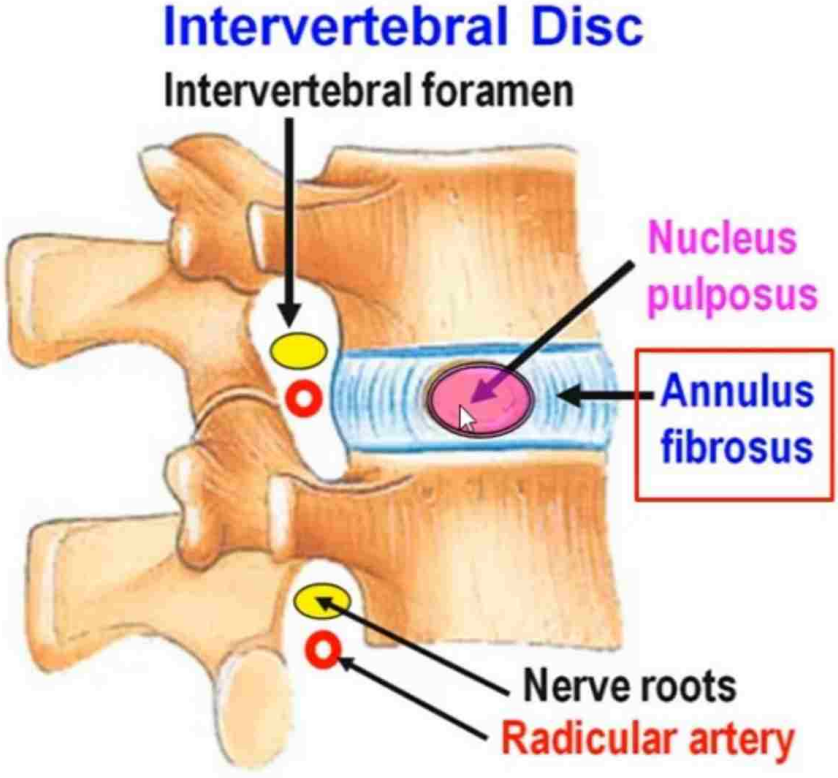


INTERVERTEBRAL DISC

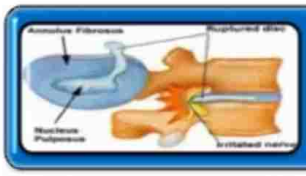


Formed of 2 parts

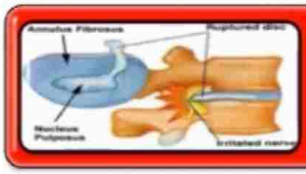
Absorb shocks



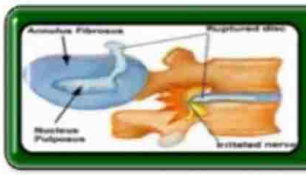
Age Changes In The Intervertebral Disc



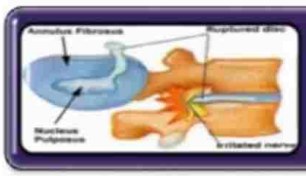
Decrease Water content



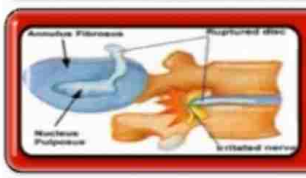
Disc loses elasticity



Disc becomes thin

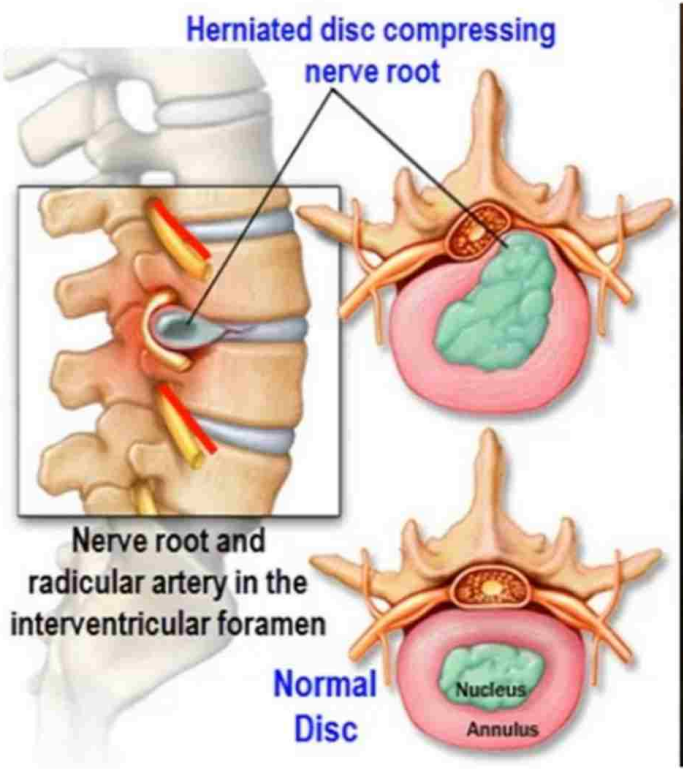


Bone-on-bone friction

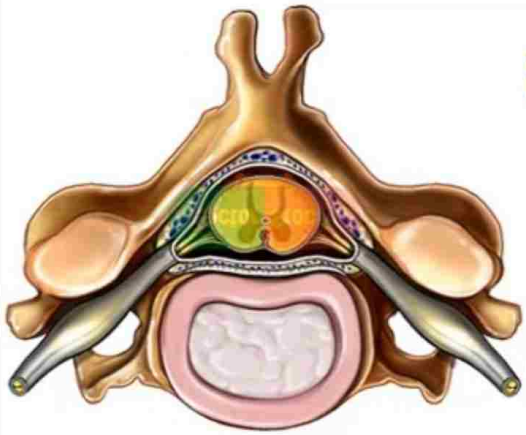


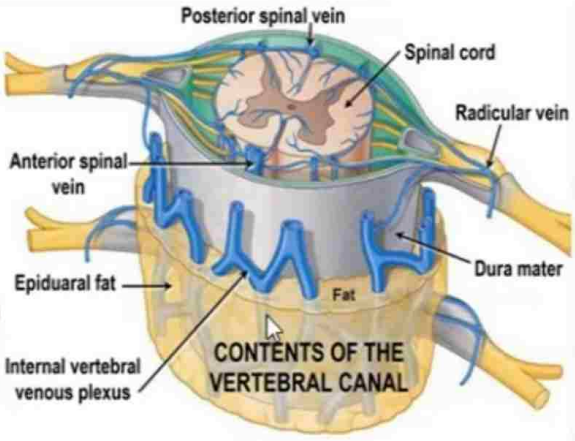
Osteophyte formation

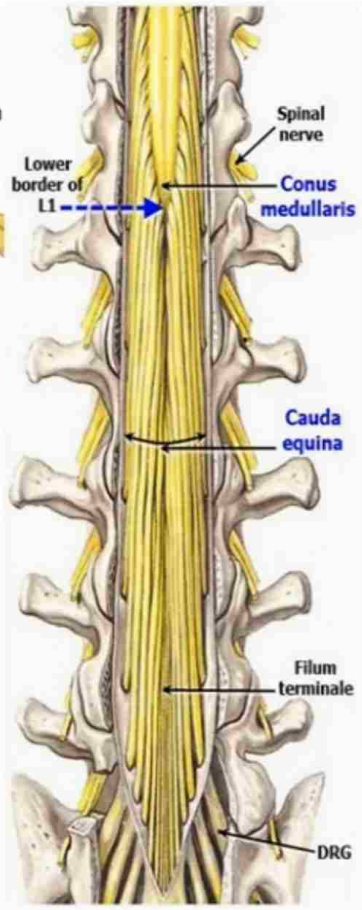
Degenerated Intervertebral Disc and Disc Prolapse



Contents of the Vertebral Canal







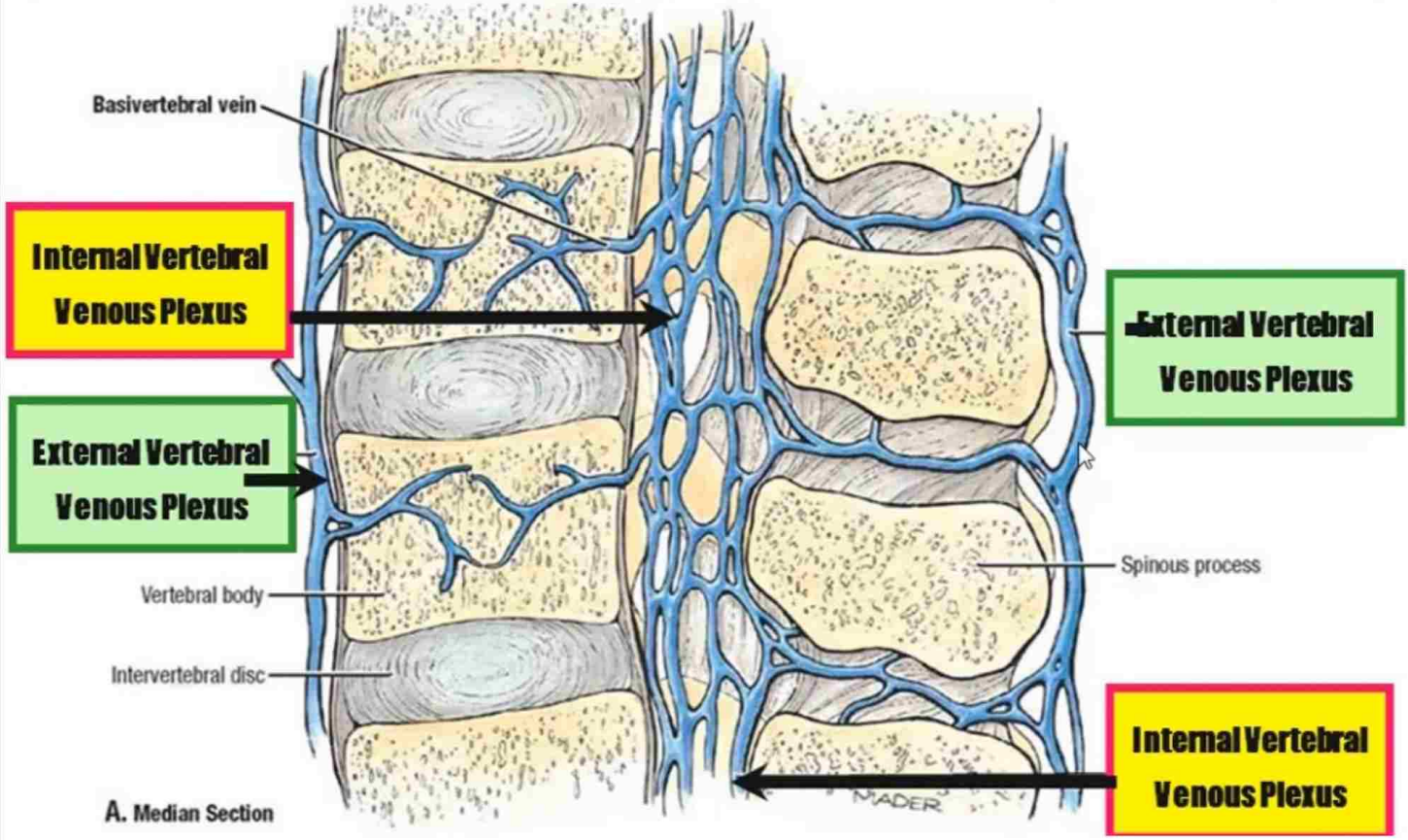
- Spinal cord till L1/L2.
- Cauda equina below L1/L2
- Meninges and epidural space
- Internal vertebral venous plexus
- Epidural fat

BLOOD SUPPLY
of the Spinal Cord and Vertebrae

1. **Anterior spinal artery: Vertebral**
2. **2 Posterior spinal arteries: PICA / Vertebral**
3. **Radicular arteries: from**
   - a. **Neck:** Vertebral & Ascending Cervical
   - b. **Thorax:** Posterior intercostal arteries
   - c. **Abdomen:** Lumbar arteries
   - d. **Pelvis:** Lateral & Median sacral arteries

VENOUS DRAINAGE

Internal & External Vertebral Venous plexuses



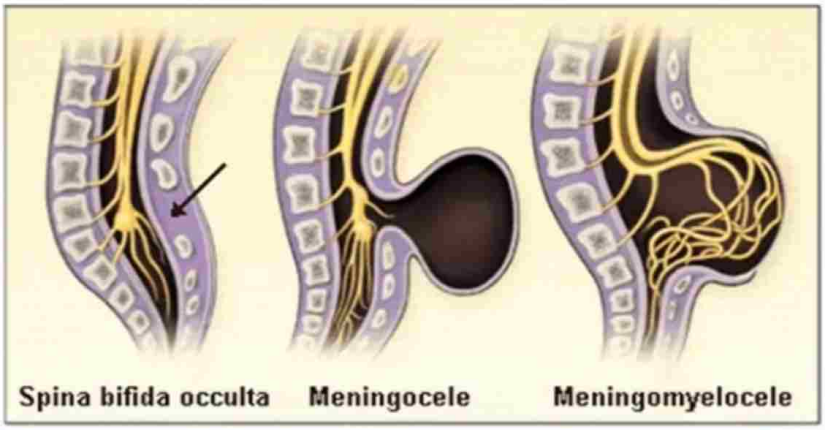
ABNORMALITIES OF THE VERTEBRAL CANAL

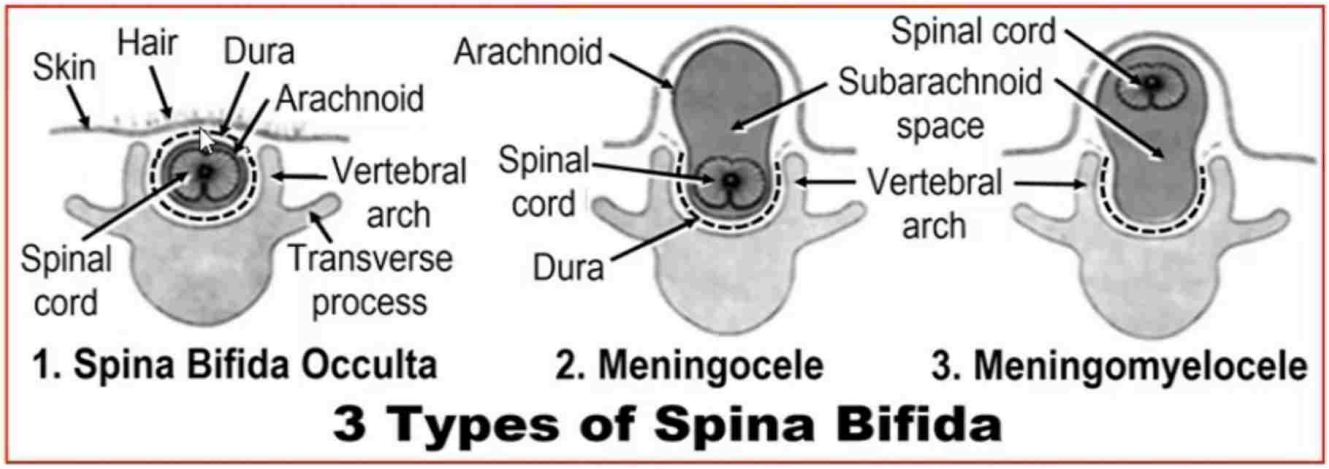
1. SPINA BIFIDA

2. VERTEBRAL CANAL STENOSIS

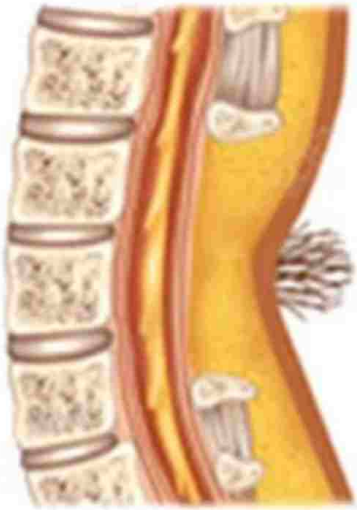
3. ABNORMAL CURVATURES

SPINA BIFIDA



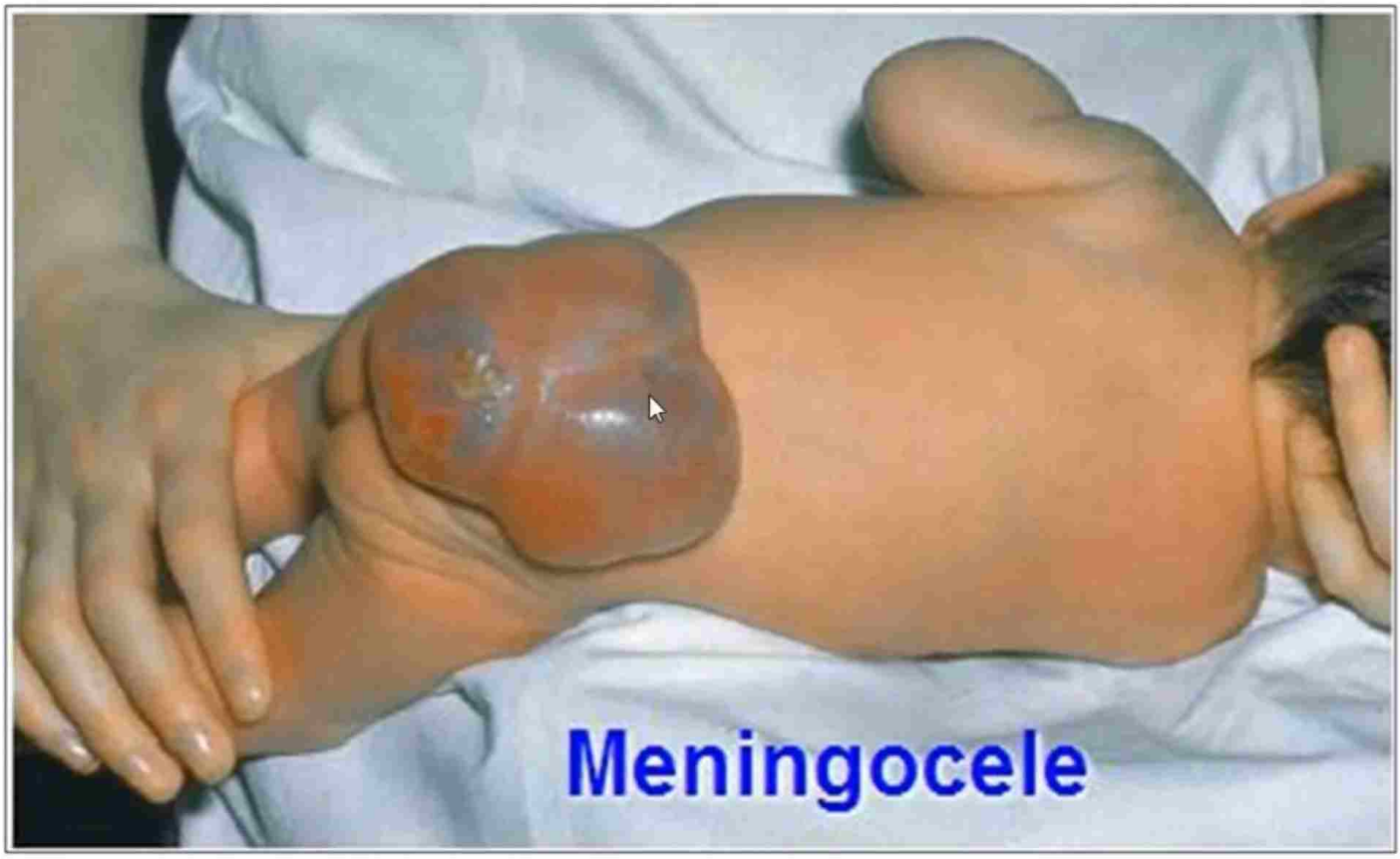


3 TYPES OF SPINA BIFIDA

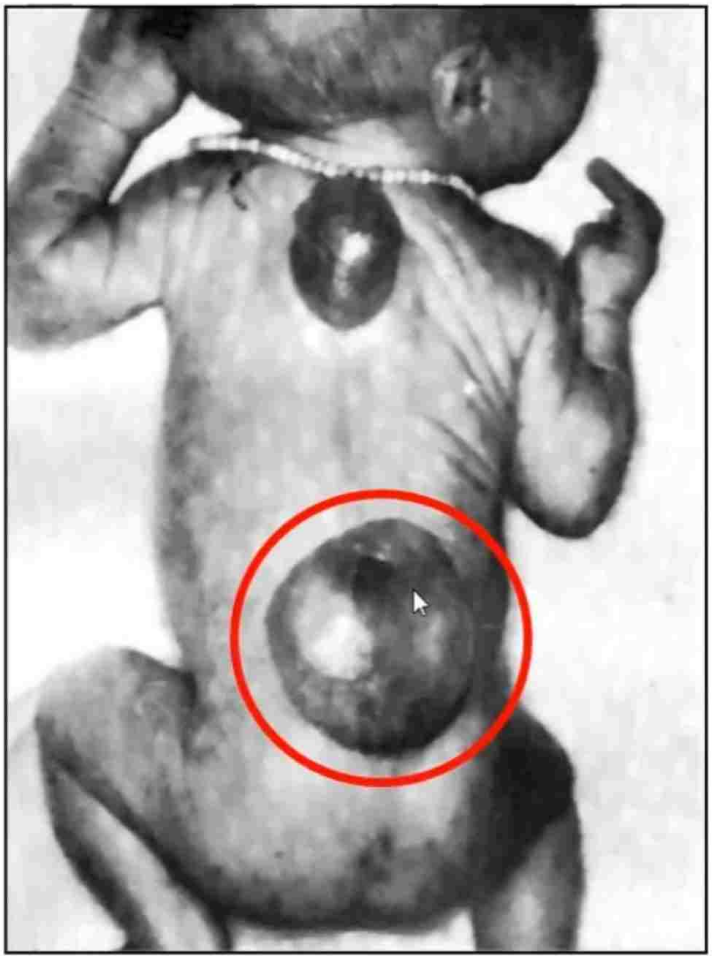


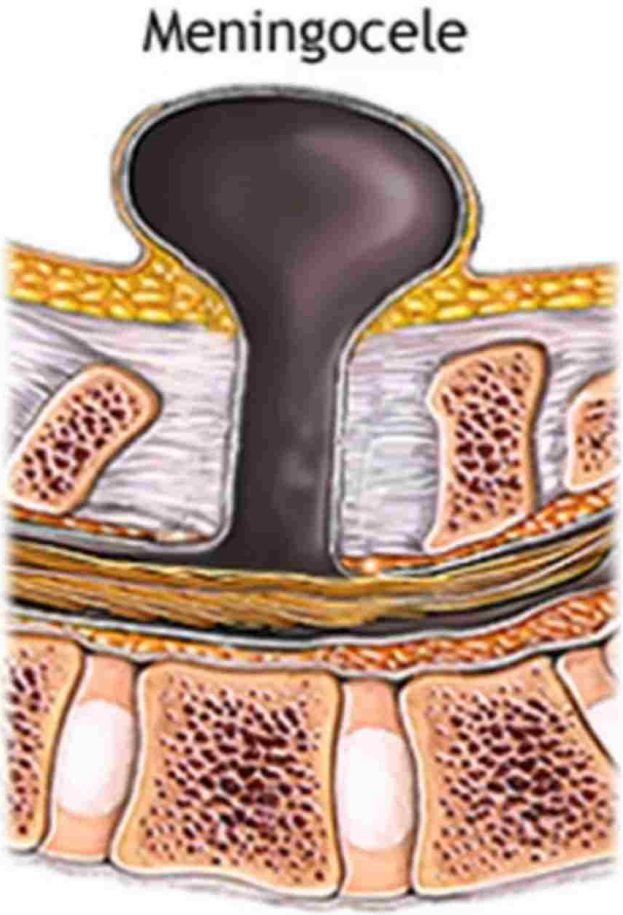
Spina Bifida Occulta

1. It is a defect in the vertebral arch
2. The defect is covered by skin and a tuft of hair
3. The spinal cord and meninges are in place
4. **Most patients don't know they** have it (no manifestations)
5. **The commonest site is the lumbosacral region**



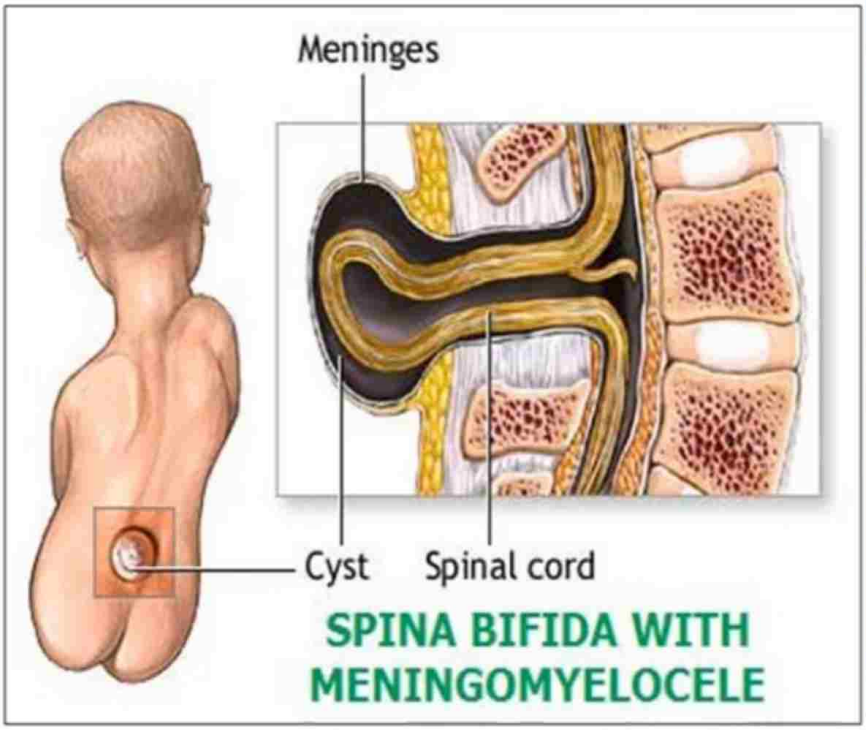
Spina Bifida With Meningocele





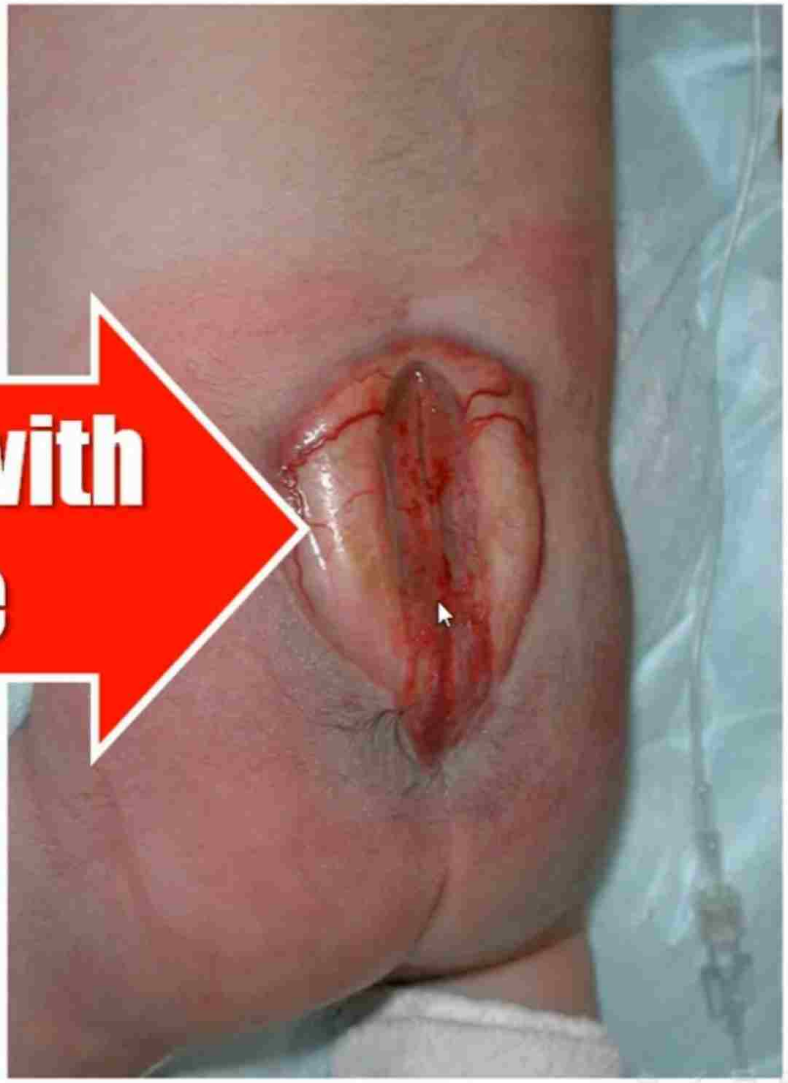
MENINGOCELE

Spina Bifida With Meningomyelocele



4th Type

Spina bifida with myelocele



ABNORMAL CURVES

1. KYPHOSIS

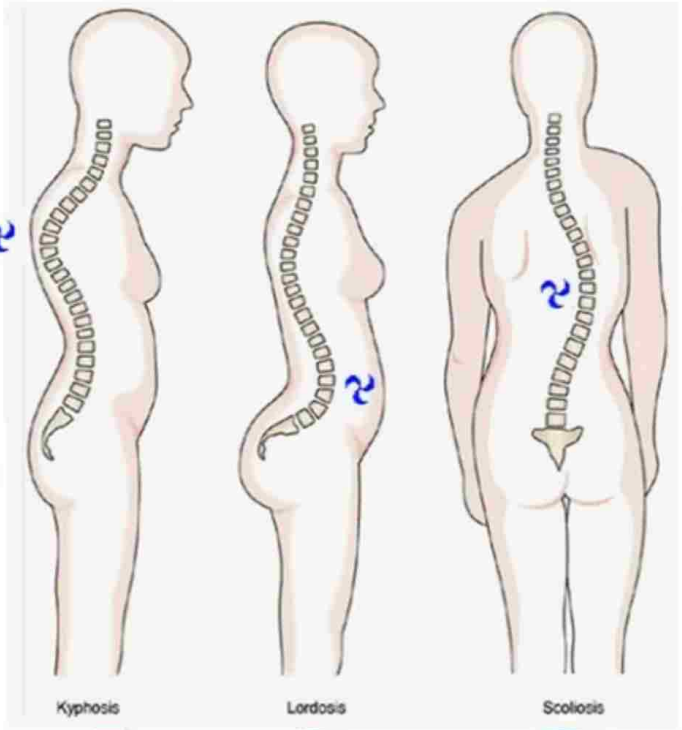
Backward Curve

2. LORDOSIS

Forward Curve

3. SCOLIOSIS

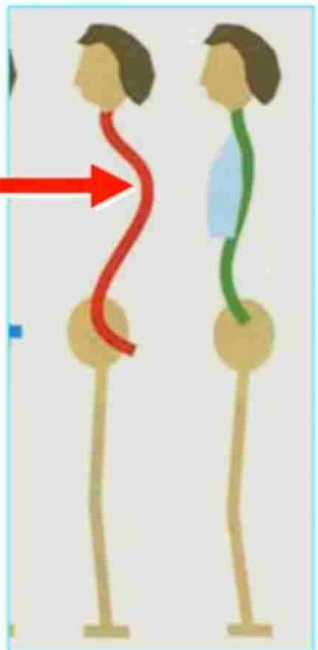
Lateral Curve



KYPHOSIS

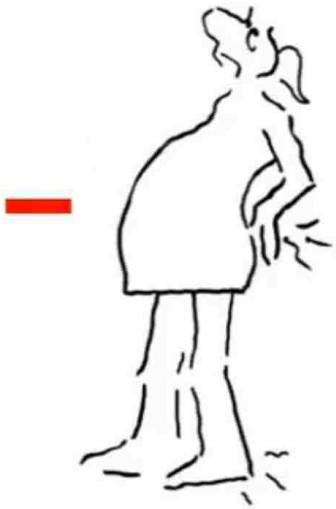
- Is exaggerated thoracic curve (posterior curve in the thoracic region)
- It is commonly seen in osteoporosis

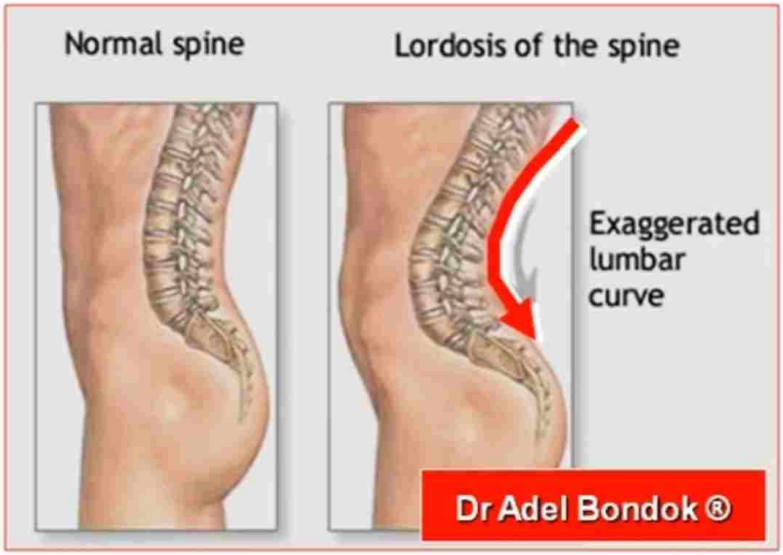
Dr Adel Bondok ®



LORDOSIS

- Is exaggerated lumbar curve (anterior curve of the lumbar region)
- Is common in pregnant women

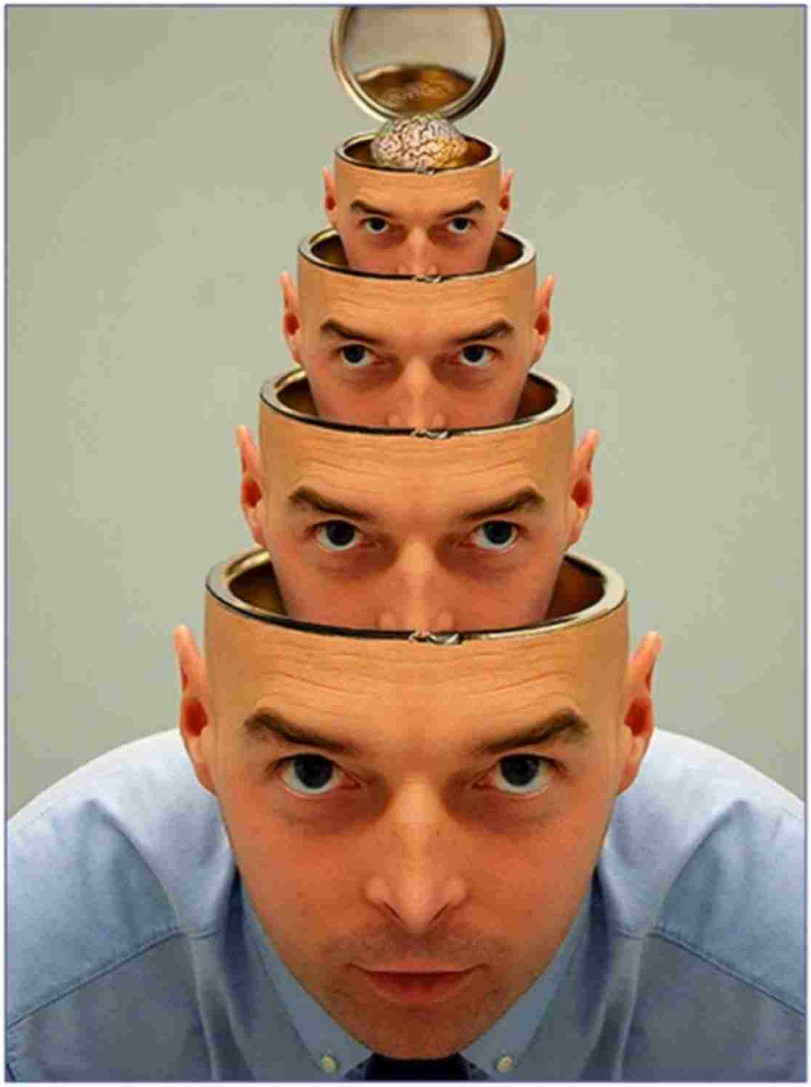




SCOLIOSIS

- Is lateral curve of the vertebral column
- Is the most common abnormal curvature
- It is more common among females
- Is due to unequal growth of the two sides of the vertebrae: one side grows faster than the other

CRANIAL MENINGES



1. Dura
2. Arachnoid
3. Pia

MENINGES

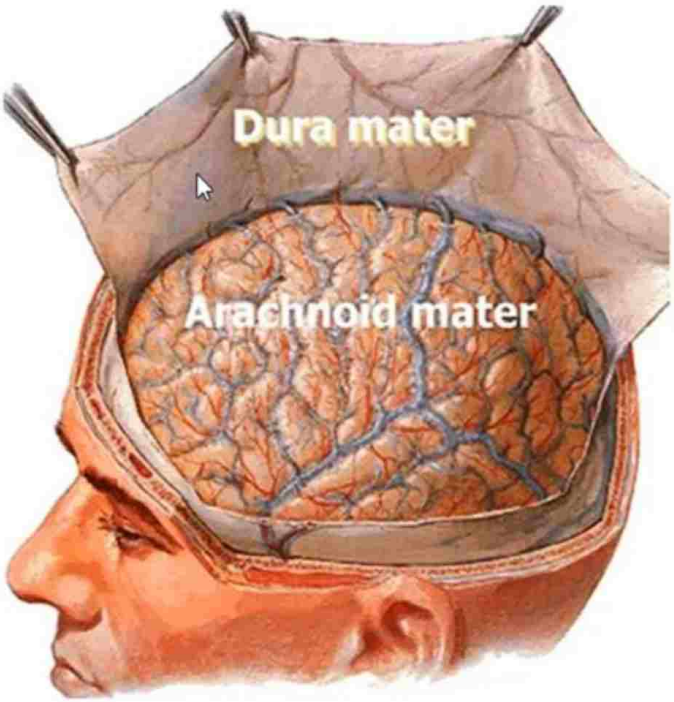
1. DURA MATER: outer
2. ARACHNOID : middle
3. PIA MATER: inner

Cranial Dura: 2 layers

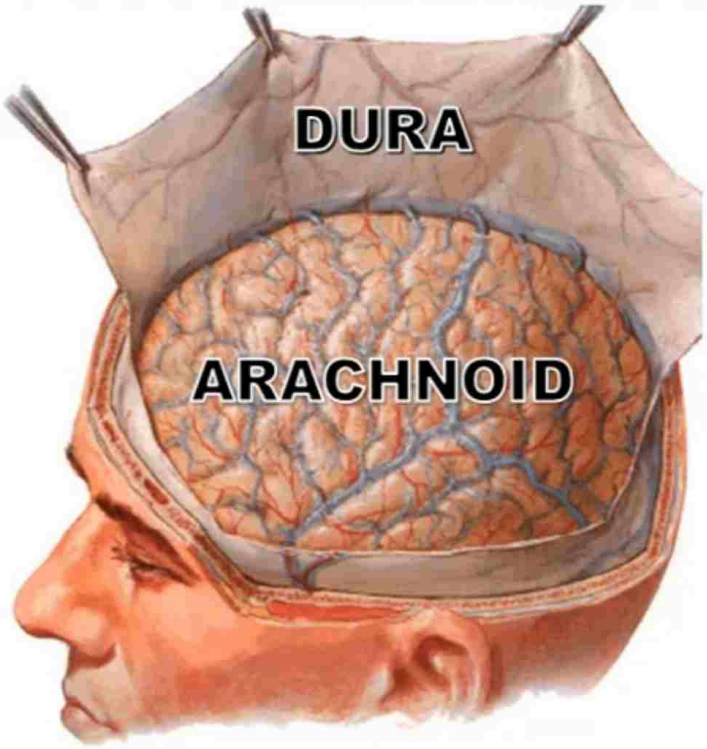
a. Outer endosteal

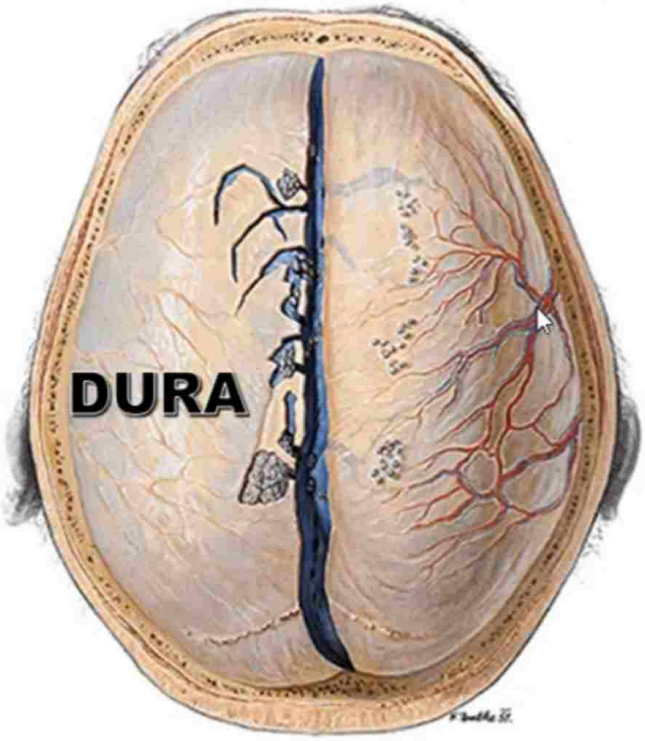
b. Inner meningeal

Spinal Dura: one layer



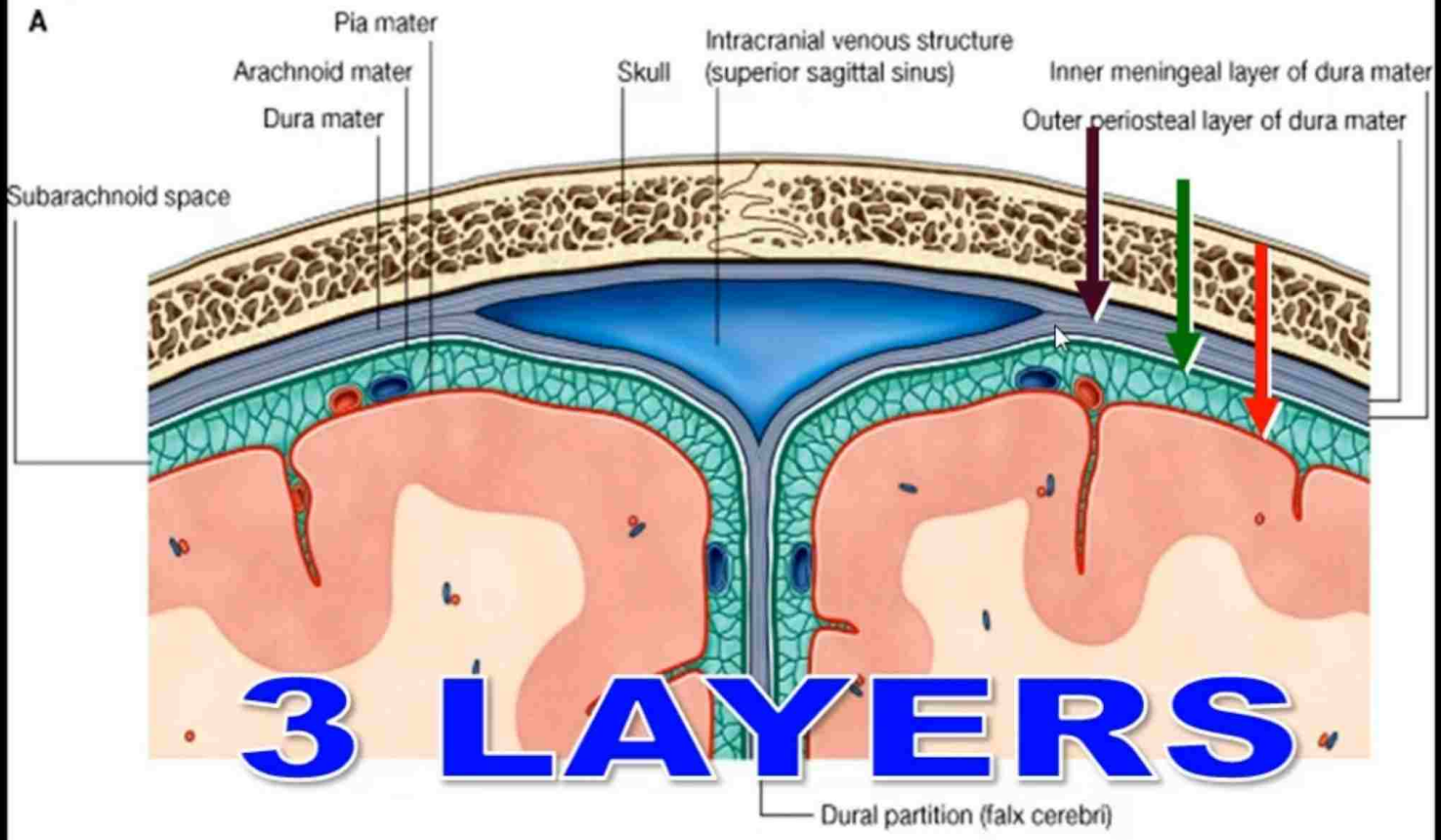
MENINGES





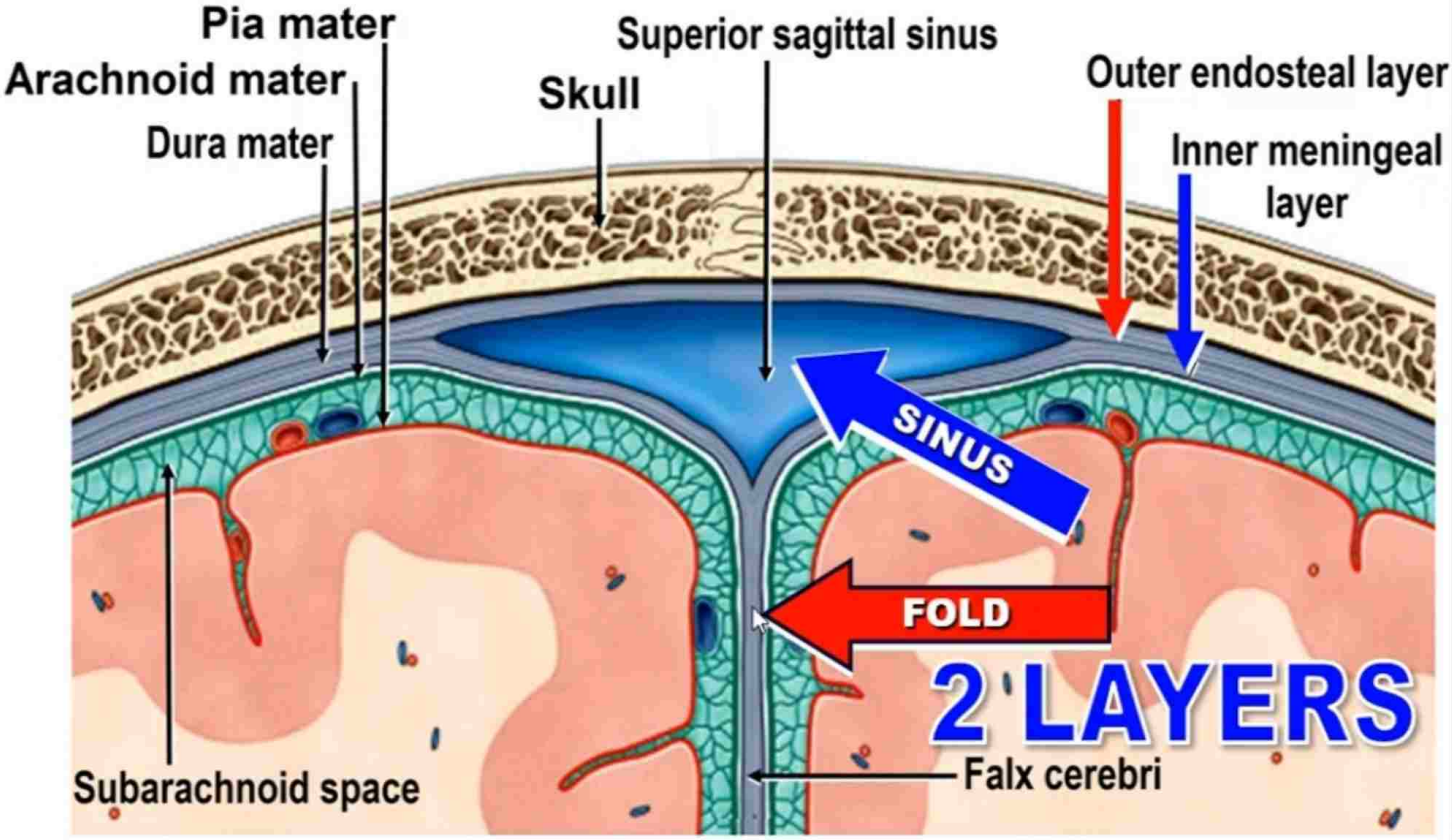
3 LAYERS

MENINGEAL LAYERS

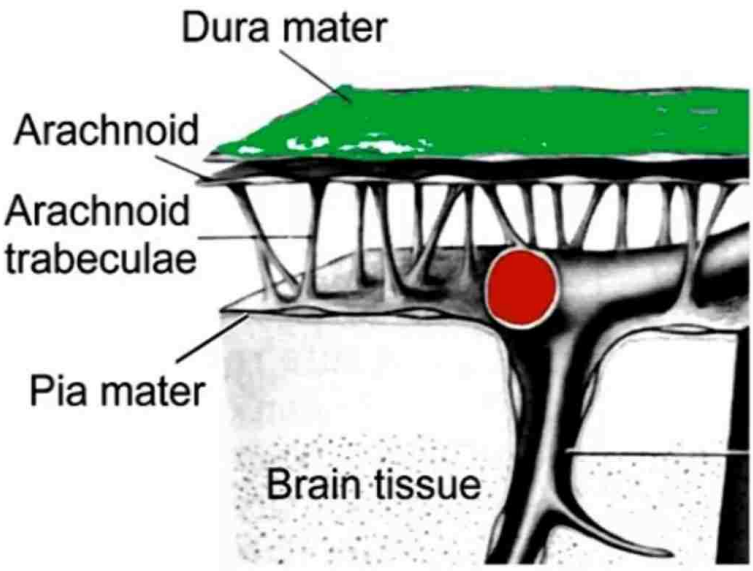


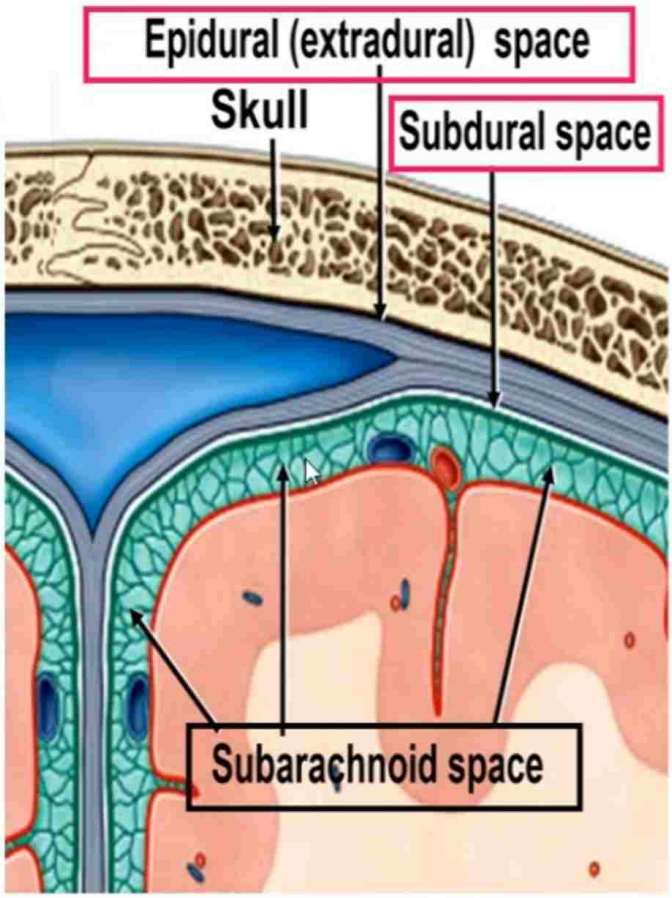
3 LAYERS

DURA MATER

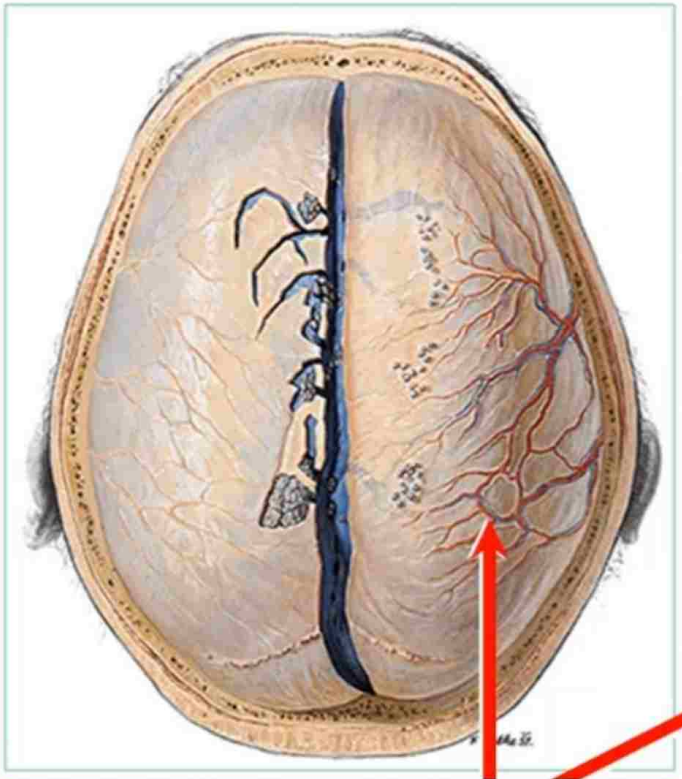


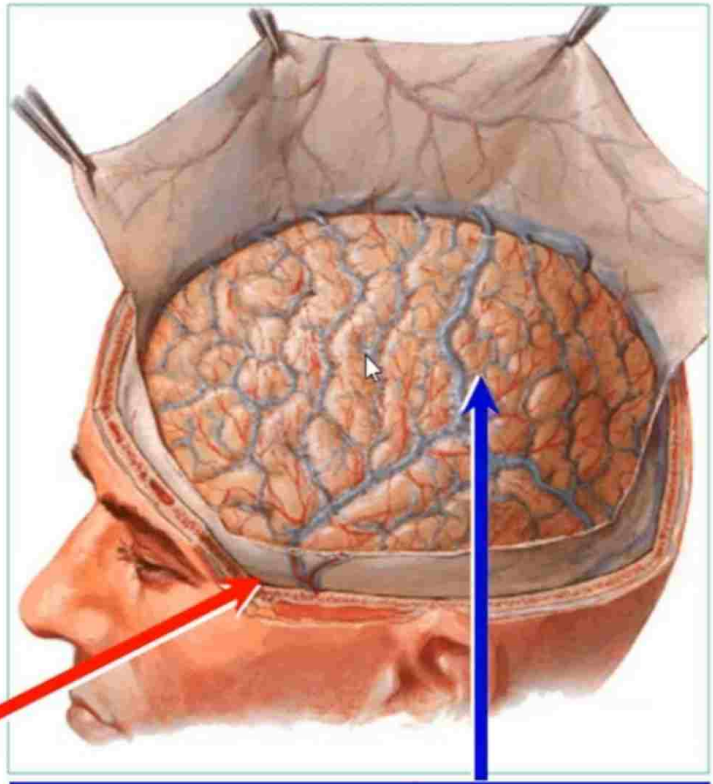
MENINGEAL SPACES





1. Extradural or Epidural
2. Subdural
3. Subarachnoid

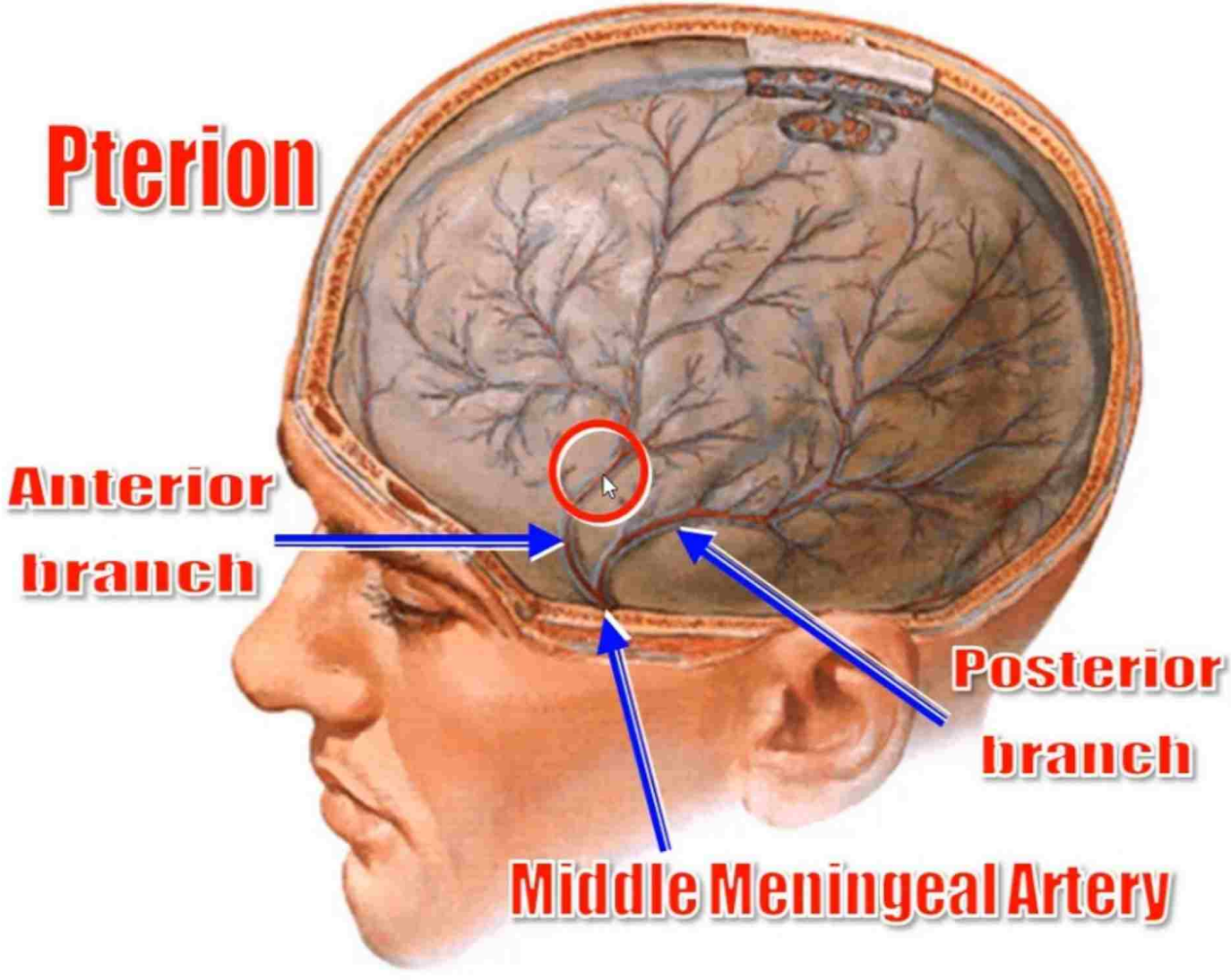


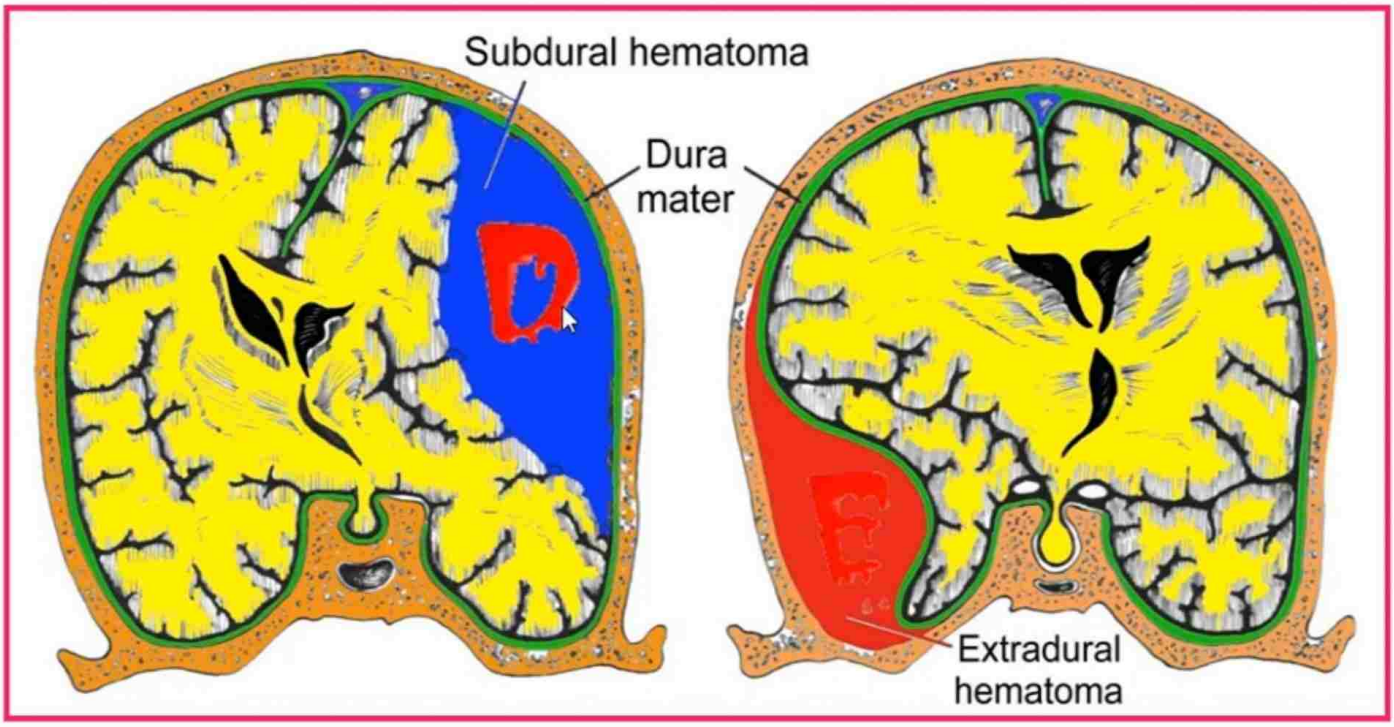


Extradual (Epidural) Space

Subdual Space

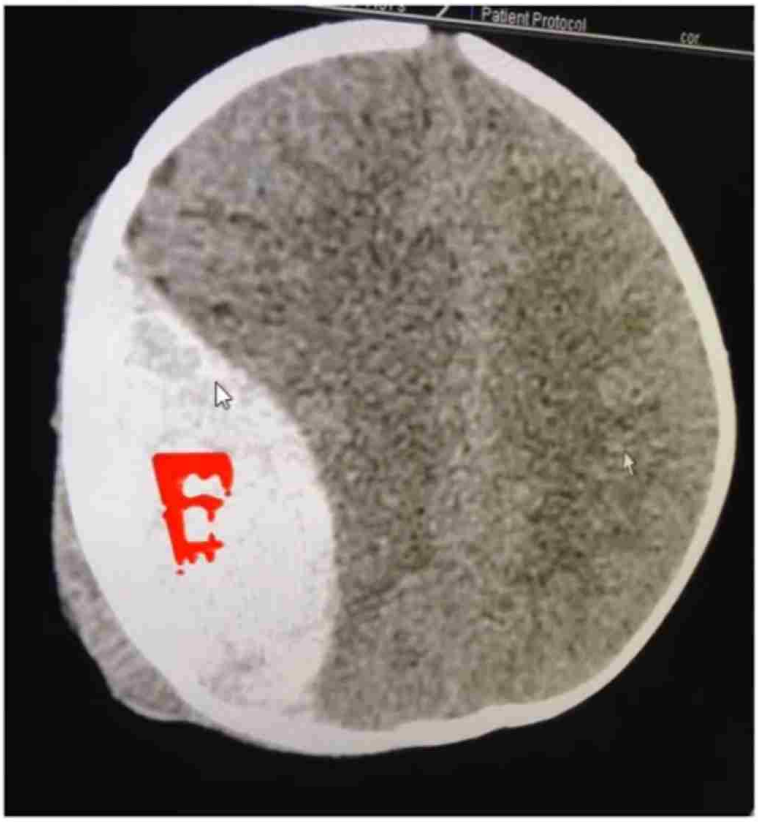
SITE	CONTENT	CLINICAL IMP

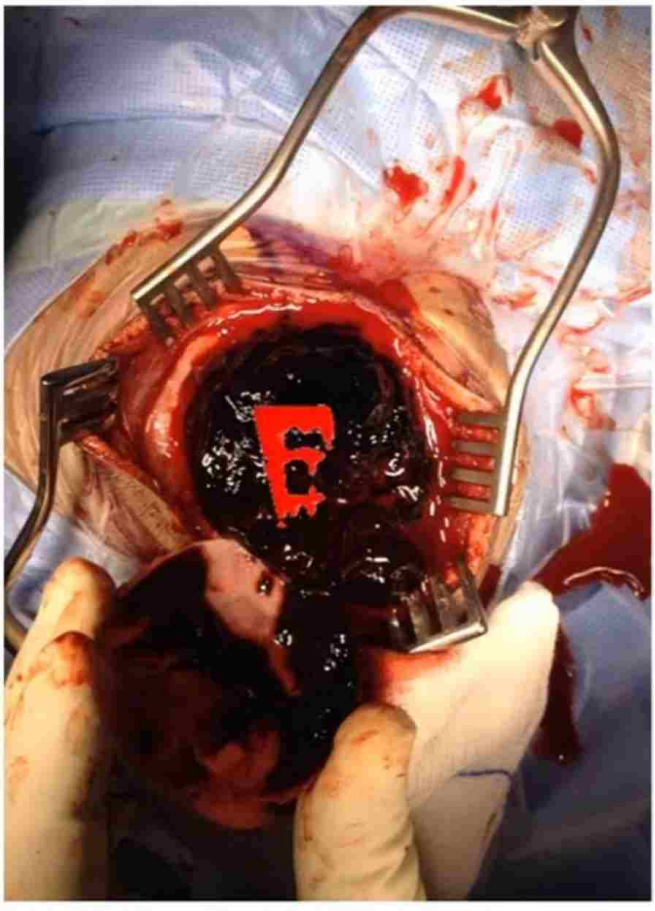




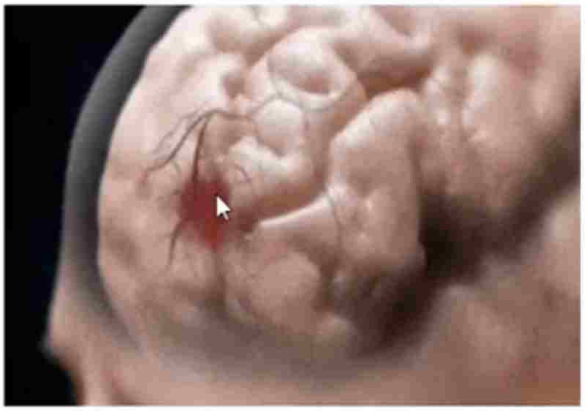
SUBDURAL HEMORRHAGE

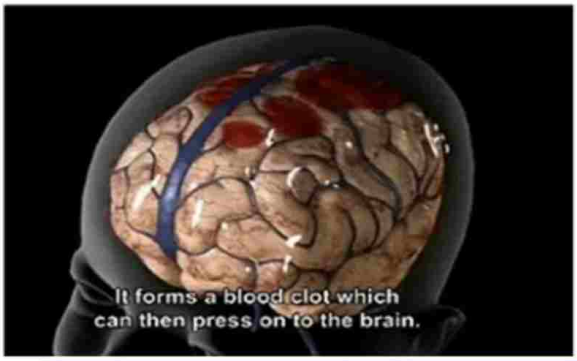
EXTRADURAL HEMORRHAGE





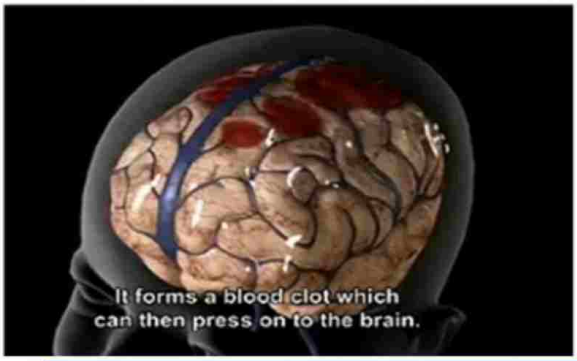
EPIDURAL HEMORRHAGE





SUBDURAL HEMORRHAGE

Shaken Baby Syndrome
Never Ever Shake a Baby



SUBDURAL HEMORRHAGE

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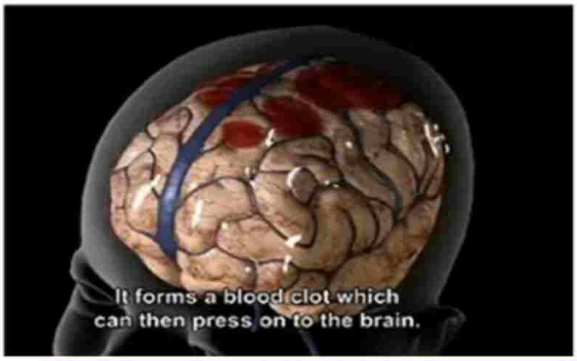
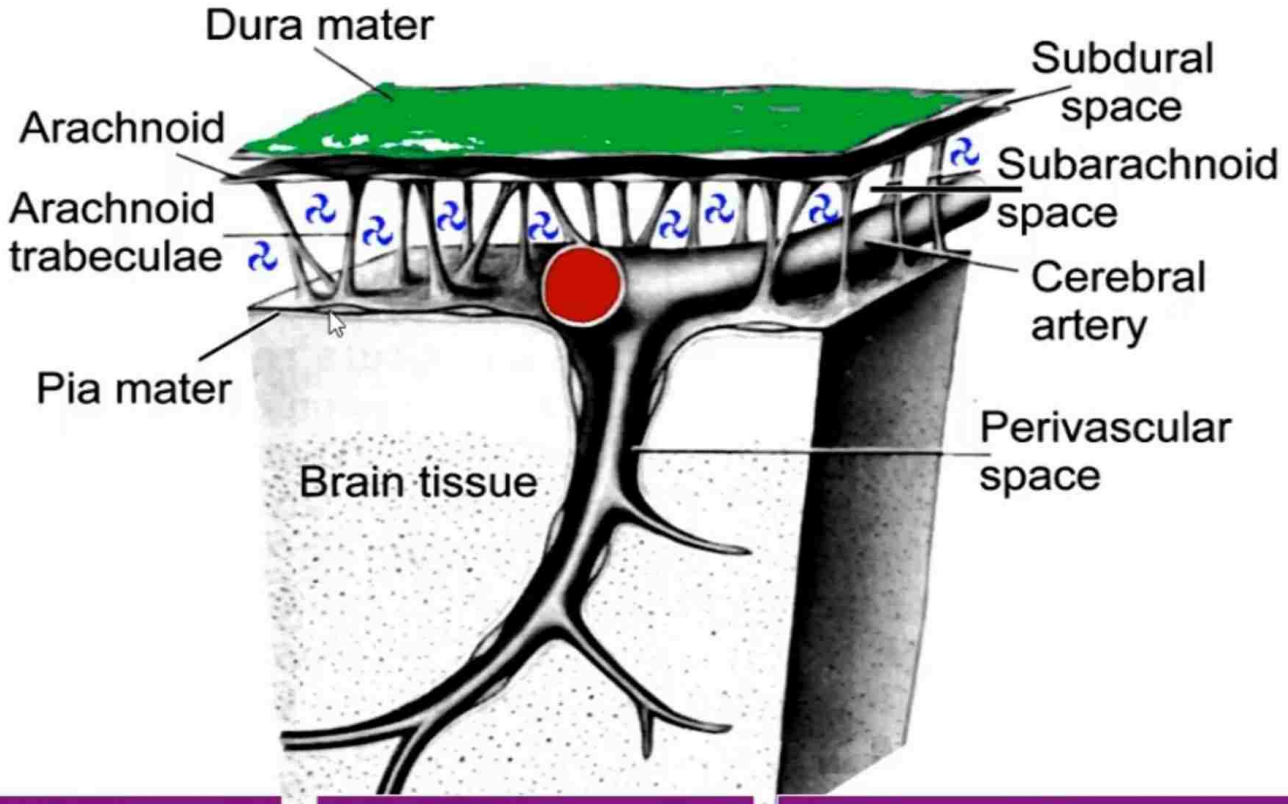
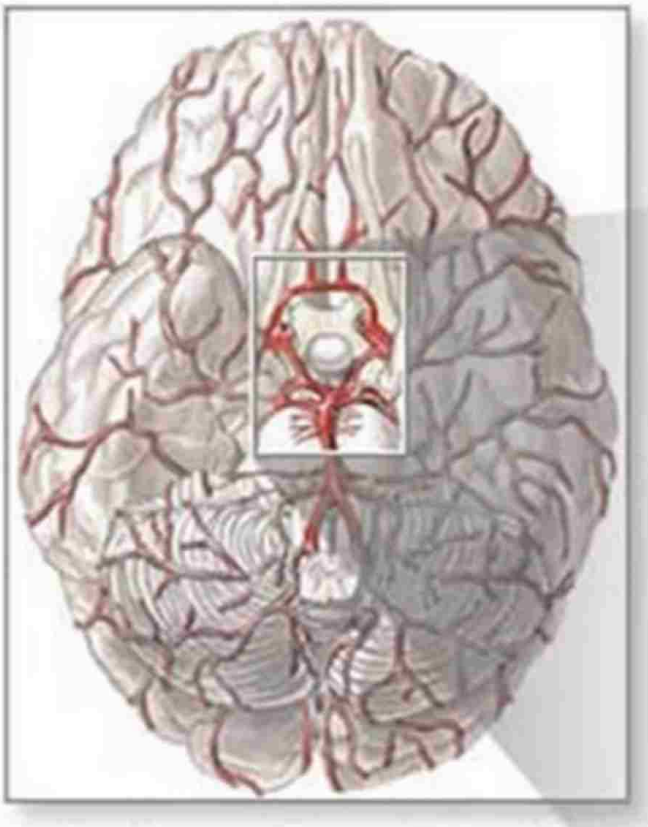


SUBDURAL HEMORRHAGE

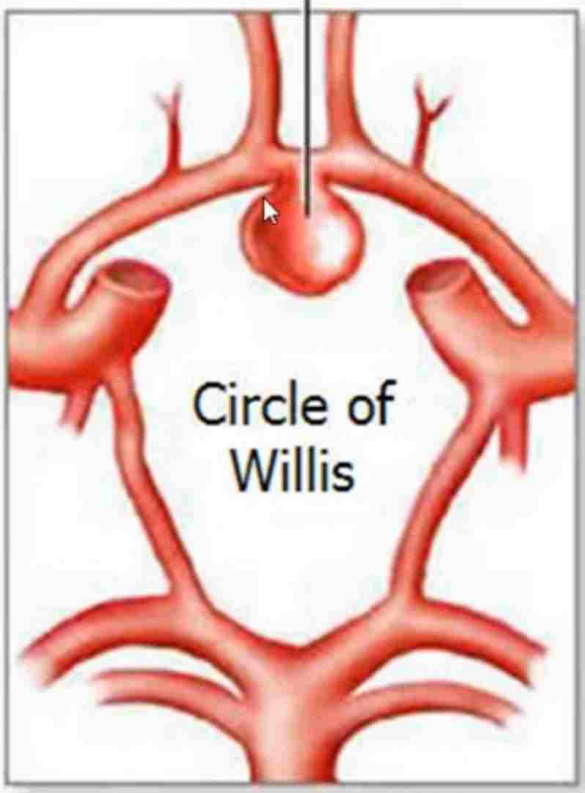
SUBARACHNOID SPACE



SITE | **CONTENT** | **CLINICAL IMP**



Aneurysm of the anterior communicating artery

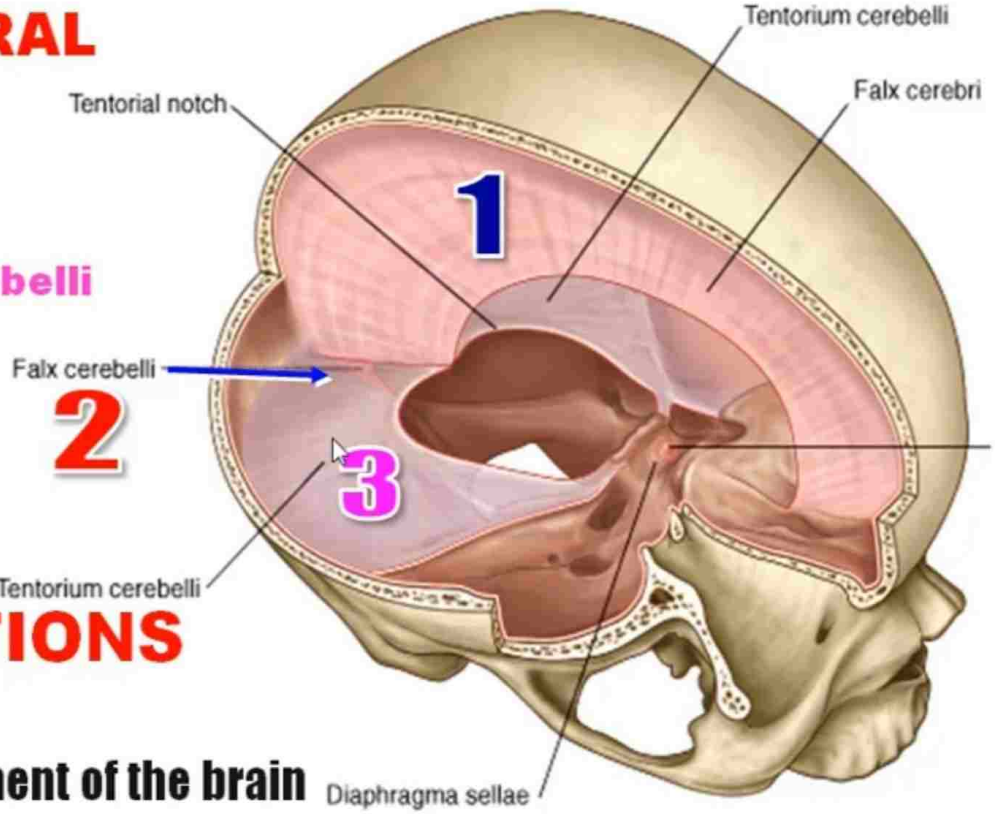


BASE OF THE BRAIN
CIRCLE OF WILLIS

DURAL FOLDS

3 Main DURAL FOLDS

1. Falx Cerebri
2. Falx Cerebelli
3. Tentorium Cerebelli



FUNCTIONS

1. Protect the brain
2. Prevent displacement of the brain
3. Minimize the effect of vibrations

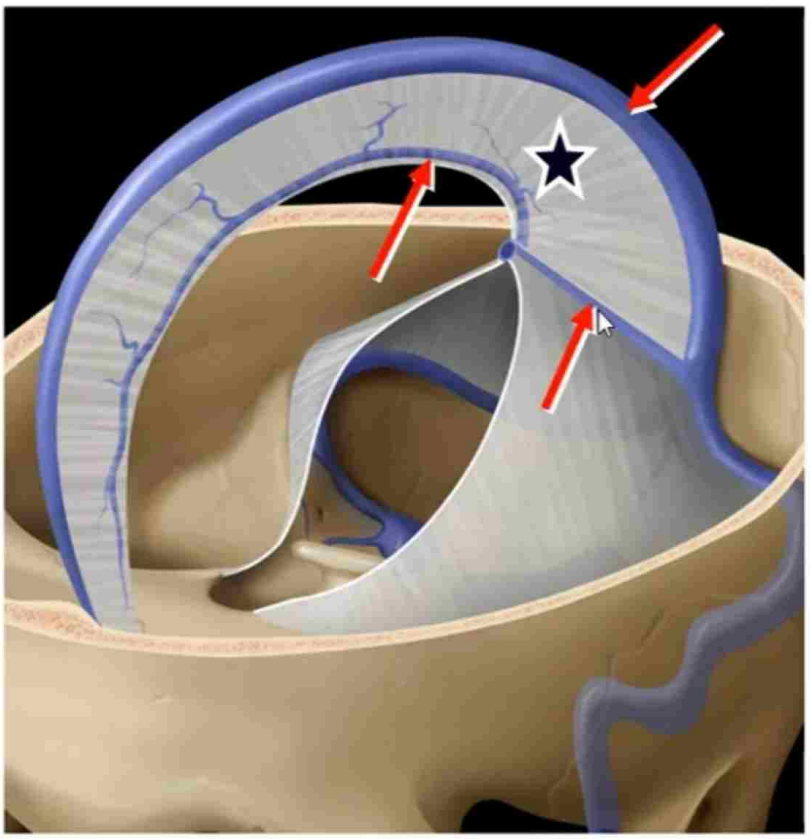
FALX CEREBRI

SITE:

SHAPE:

RELATED SINUSES:

1. Superior sagittal sinus: upper border
2. Inferior sagittal sinus: lower border
3. Straight sinus: base



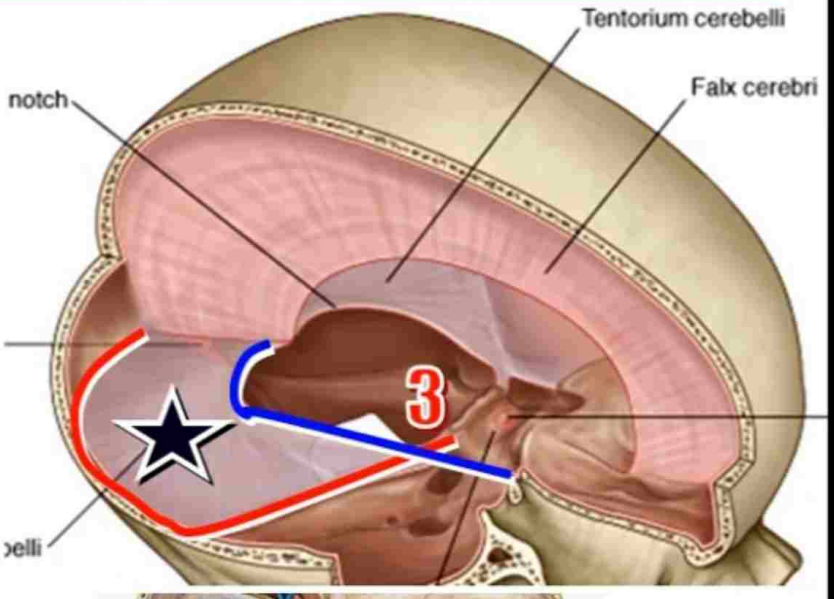
TENTORIUM CEREBELLI

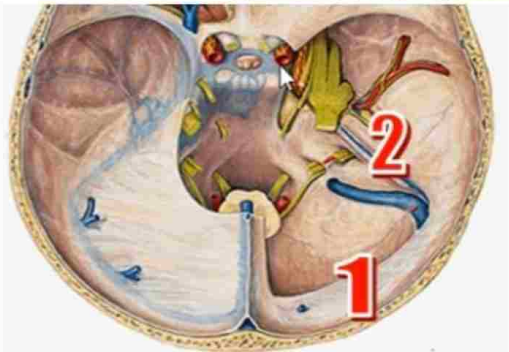
SITE:

SHAPE: tent-like

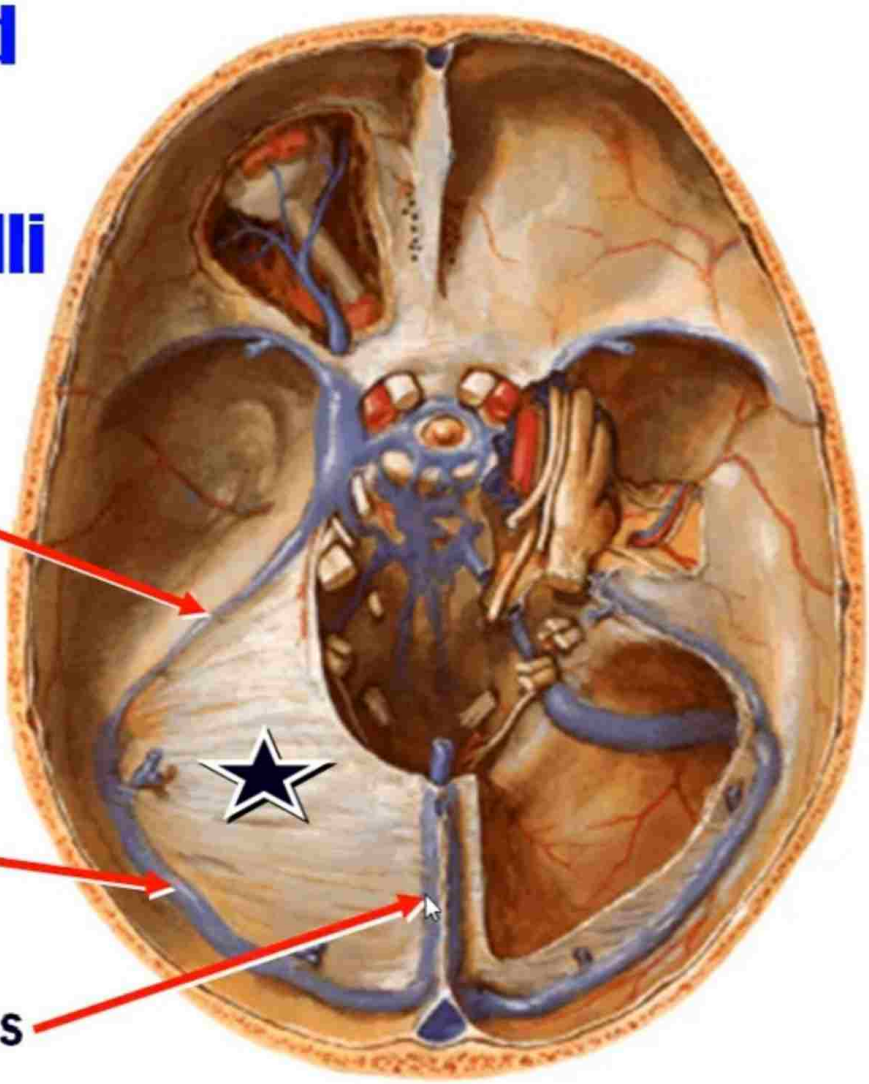
BORDERS:

- Free border
- Attached border





3 Sinuses Related to the Tentorium Cerebelli



1. Superior petrosal sinus
2. Transverse sinus
3. Straight sinus

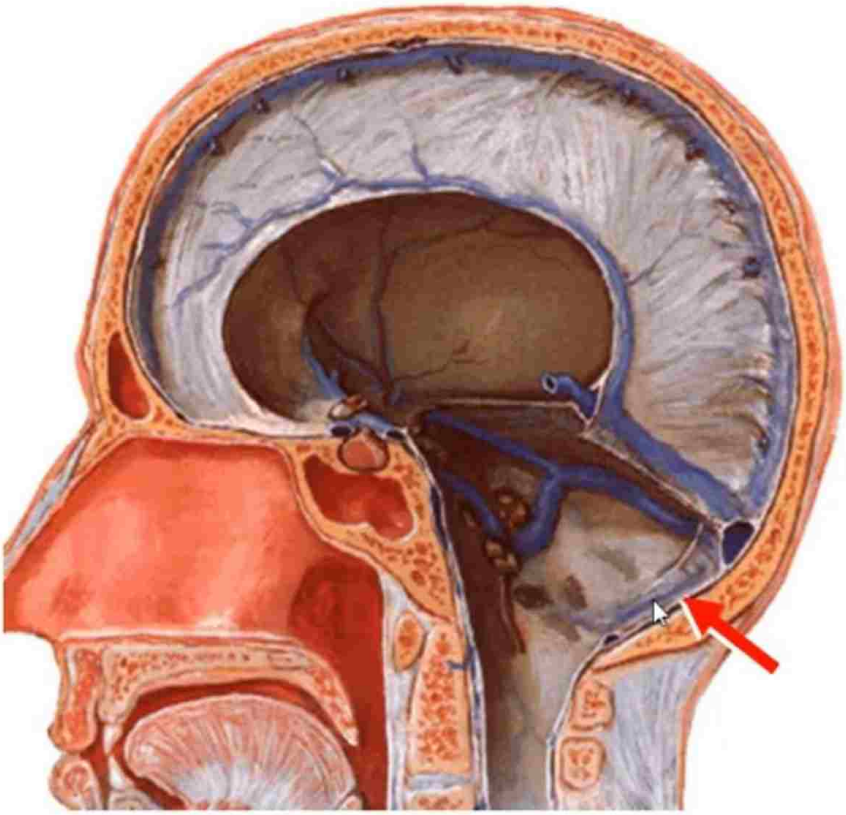
FALX CEREBELLI

SITE:

SHAPE:

RELATED SINUS:

Occipital sinus



ARTERIAL SUPPLY

1. **ANTERIOR meningeal arteries:**
   from the anterior and posterior ethmoidal branches of the ophthalmic artery
2. **MIDDLE meningeal artery:**
   from the 1st part of the maxillary artery
3. **ACCESSORY meningeal artery:**
   from the 1st part of the maxillary artery
4. **POSTERIOR meningeal arteries: from**
   a. Vertebral artery
   b. Occipital artery
   c. Ascending pharyngeal artery

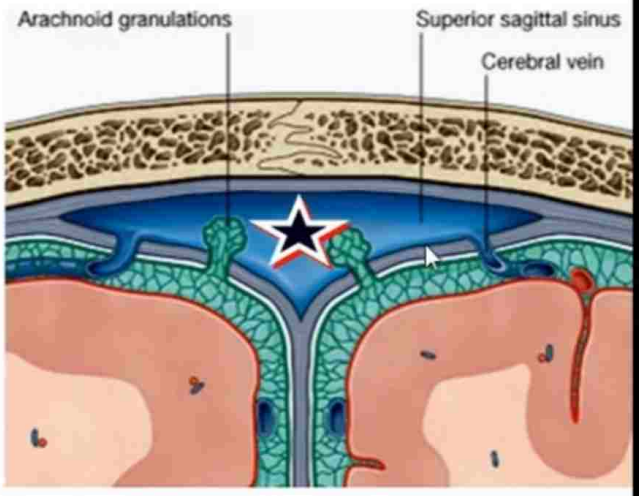
4

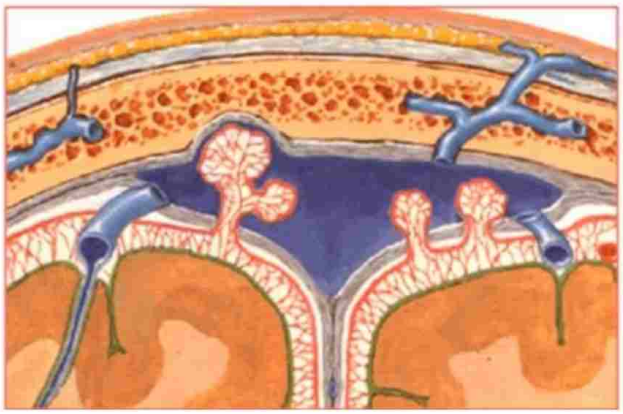
NERVE SUPPLY

1. **ANTERIOR CRANIAL FOSSA:**
   from the anterior and posterior ethmoidal branches of the ophthalmic nerve
2. **MIDDLE CRANIAL FOSSA:**
   from the maxillary and mandibular nerves
3. **POSTERIOR CRANIAL FOSSA:**
   from the cervical nerves through the 9th, 10th & 12th cranial nerves

DURAL SINUSES

- **Are channels** between outer and inner layers of dura
- **They drain the:**
  1. Brain
  2. Meninges
  3. Skull bones
  4. CSF





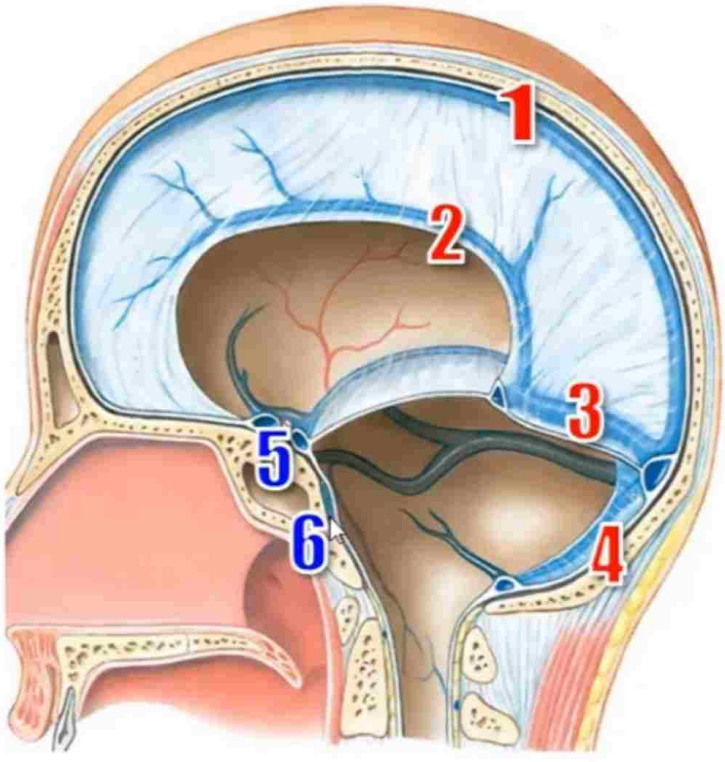
CLASSIFICATION OF SINUSES

6 SINGLE SINUSES & 6 PAIRED SINUSES

6 SINGLE SINUSES

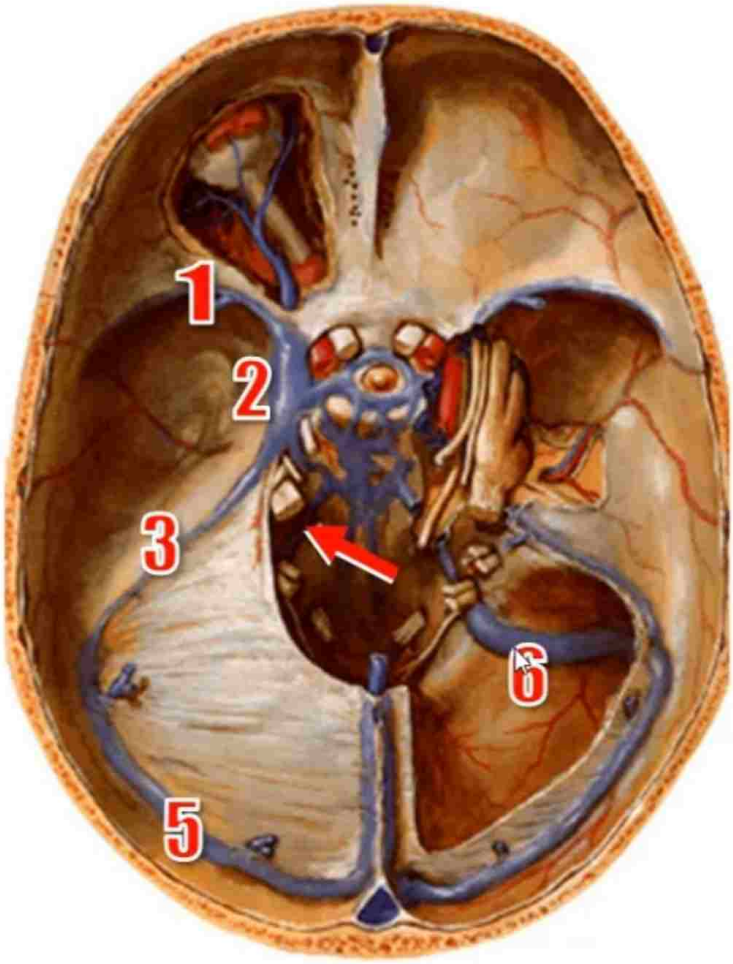
(midline sinuses)

1. Superior Sagittal sinus
2. Inferior Sagittal Sinus
3. Straight Sinus
4. Occipital Sinus
5. Intercavernous Sinuses
6. Basilar Plexus

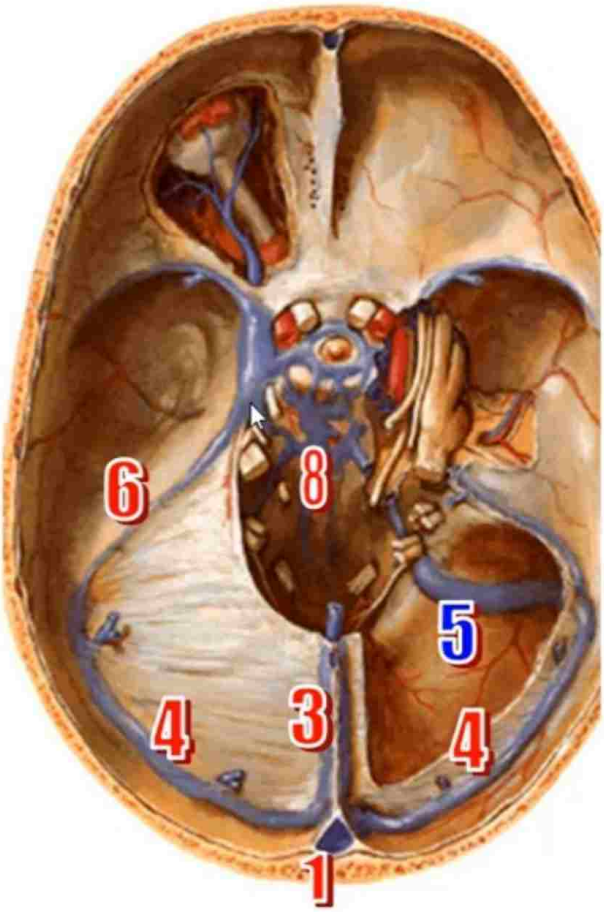


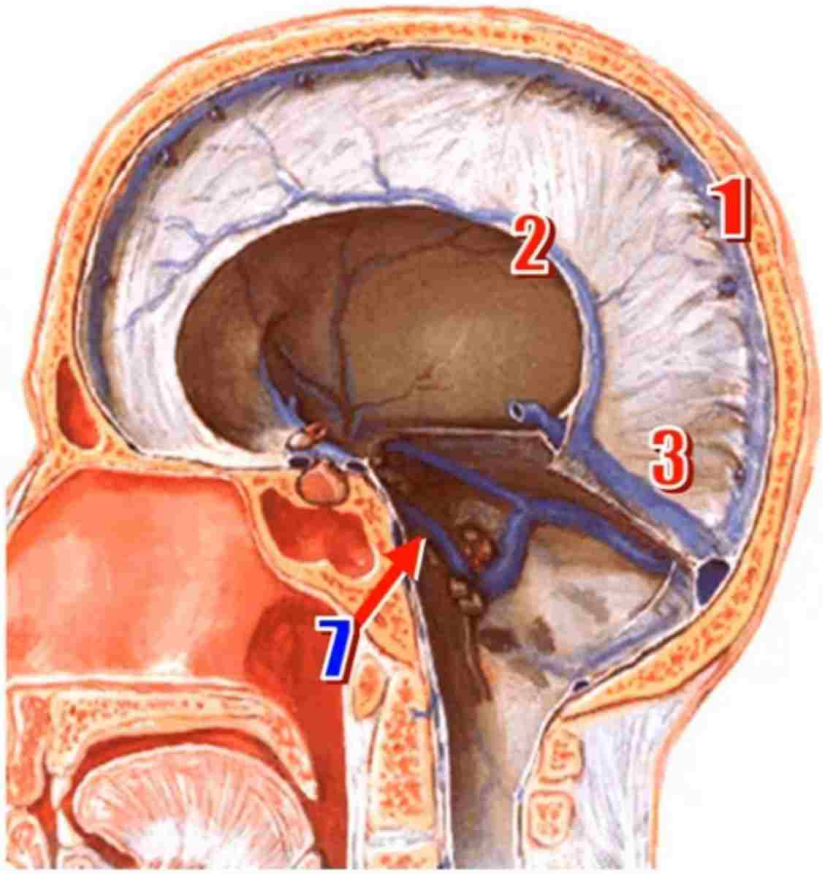
6 PAIRED SINUSES

1. Sphenoparietal sinus
2. CAVERNOUS SINUS
3. Superior Petrosal Sinus
4. Inferior Petrosal Sinus
5. Transverse Sinus
6. Sigmoid Sinus



ORIGIN & TERMINATION OF EACH SINUS





CAVERNOUS SINUS

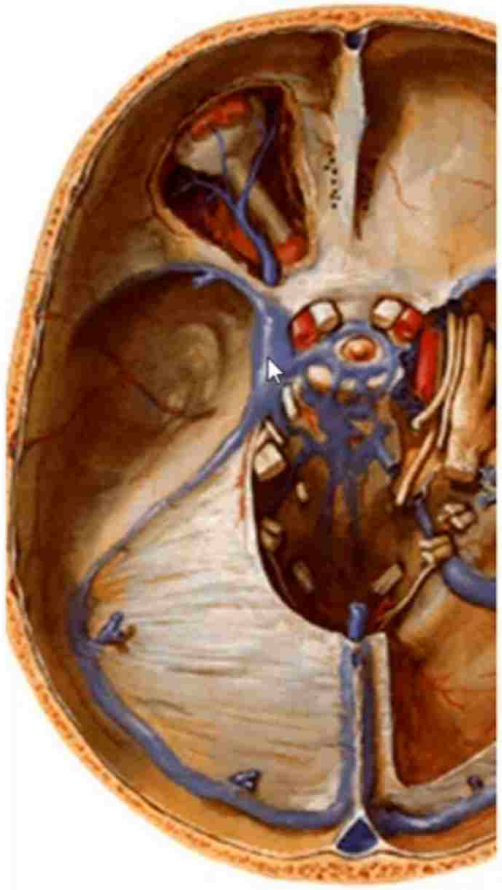
SITE:

TRIBUTARIES:

1. ANTERIOR END: ophthalmic veins, central vein of the retina & sphenoparietal sinus
2. MEDIALLY: 3 intercavernous sinuses
3. SUPERIORLY: middle & inferior cerebral veins
4. INFERIORLY: emissary veins connecting it with:
   a pterygoid plexus: foramen ovale & lacerum
   b. pharyngeal plexus: carotid canal

DRAINAGE: posteriorly to

1. Superior petrosal sinus: to the transverse sinus
2. Inferior petrosal sinus: to the internal jugular V



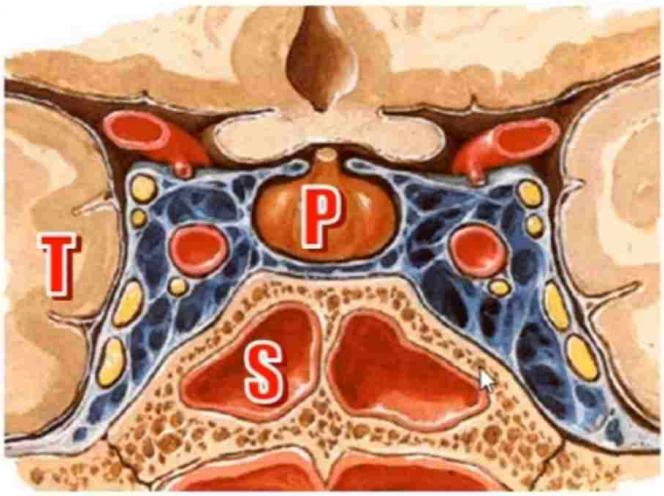
RELATIONS OF THE CAVERNOUS SINUS

MEDIALLY:
1. Piuitary gland
2. Sphenoidal air sinus

LATERALLY:
Temporal lobe of the brain

SUPERIORLY:
1. Internal carotid artery
2. Optic chiasma

INFERIORLY: sphenoidal air sinus

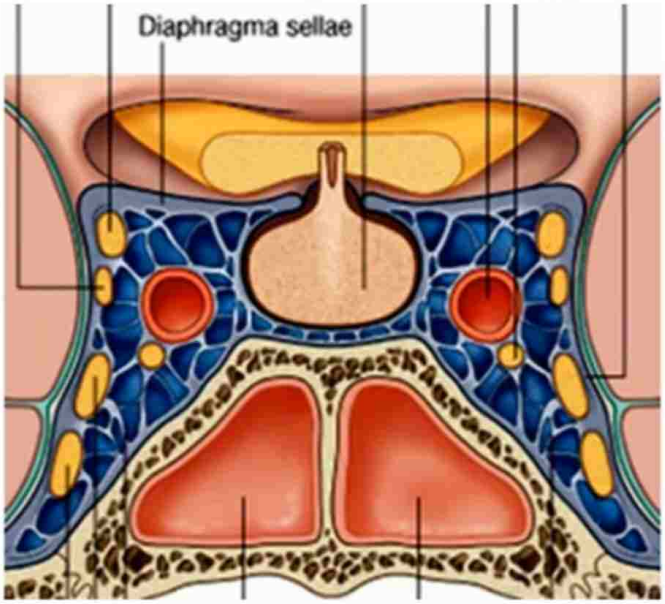


STRUCTURES IN THE LATERAL WALL:

1. Oculomotor nerve
2. Trochlear nerve
3. Ophthalmic nerve
4. Maxillary nerve

3 - 4 - 5

OTOM

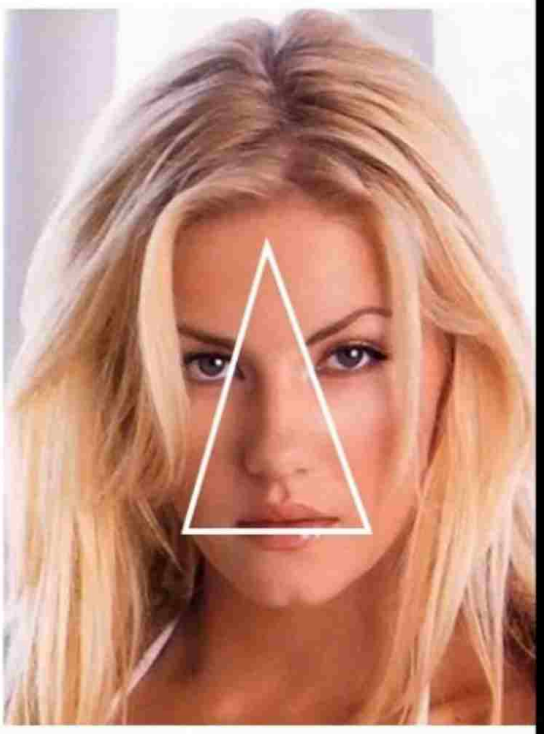


STRUCTURES INSIDE THE SINUS:

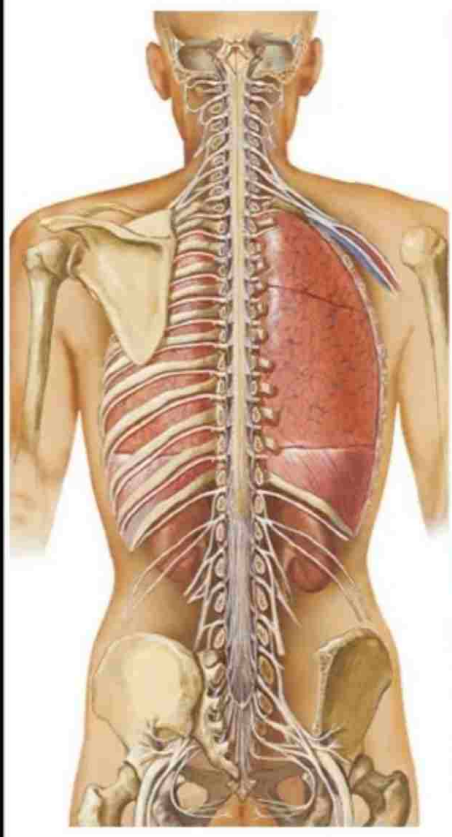
1. Internal carotid artery
2. Abducent nerve

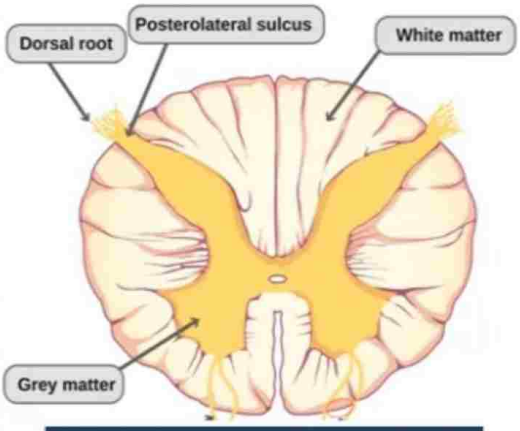
CLINICAL IMPORTANCE

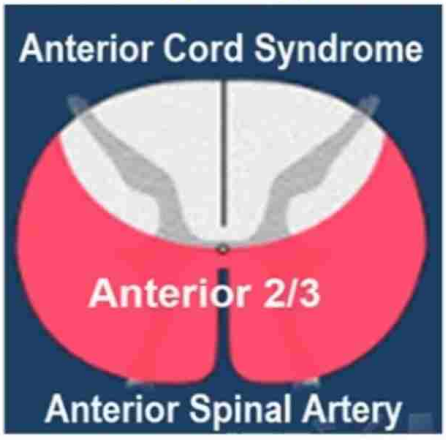
1. Spread of infection from the dangerous area of the face to the cavernous sinus
2. Infection and thrombosis of the cavernous sinus may cause:
   a. Blindness due to interference with the venous drainage of the retina
   b. Paralysis of the oculomotor, trochlear, ophthalmic and abducent nerves



External Features
SPINAL CORD

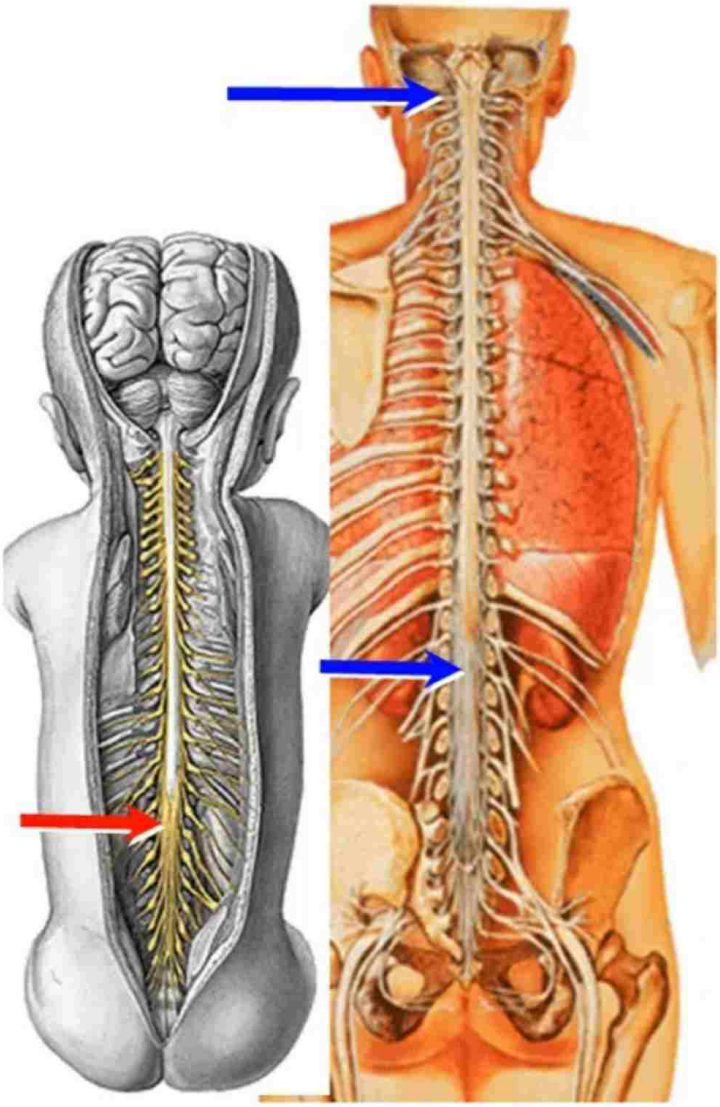




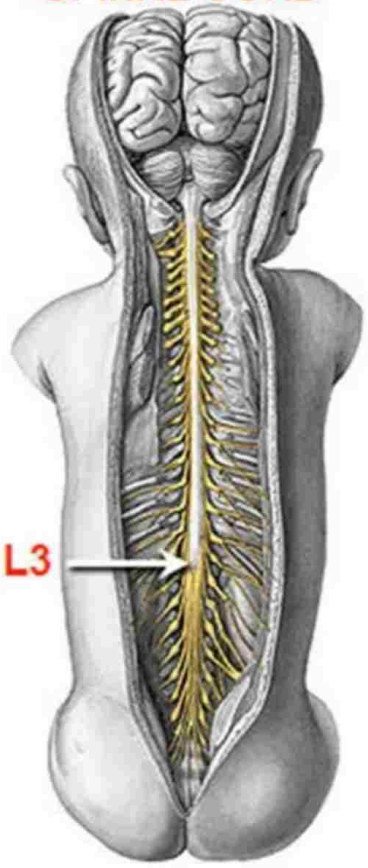


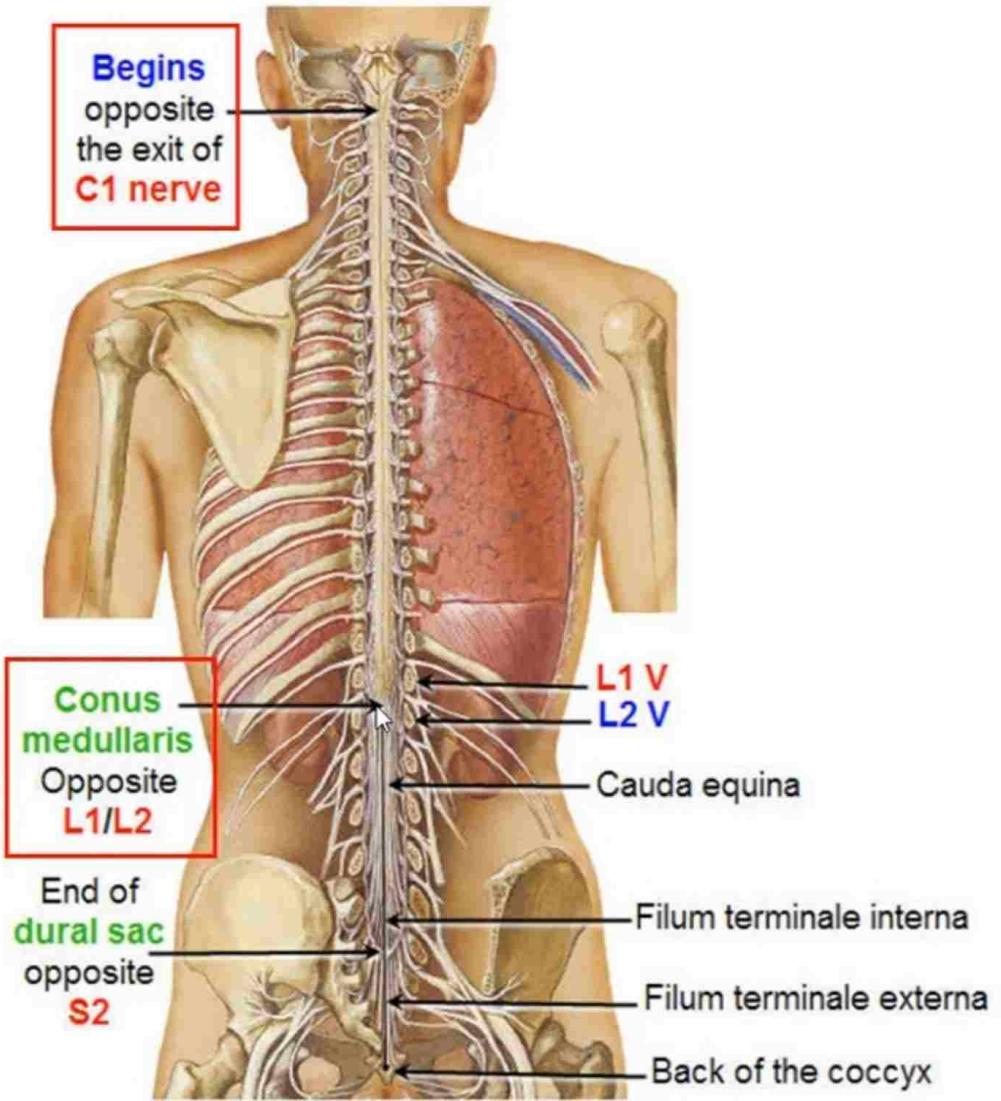
SPINAL CORD

- Length
- Extent
- Enlargements
- Meninges
- Lumbar cistern
- Blood supply



NEWBORN SPINAL CORD



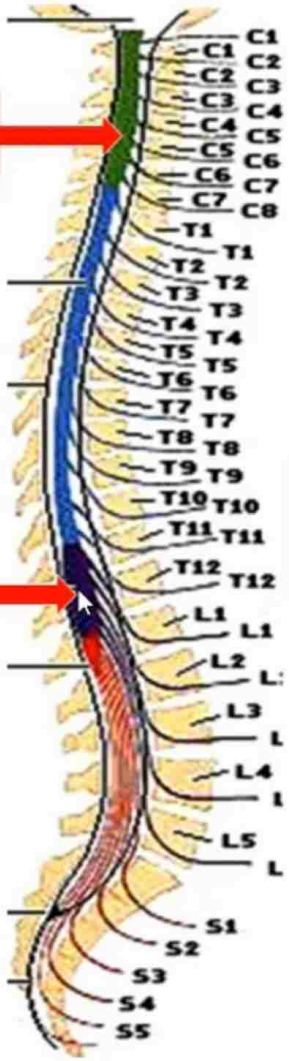


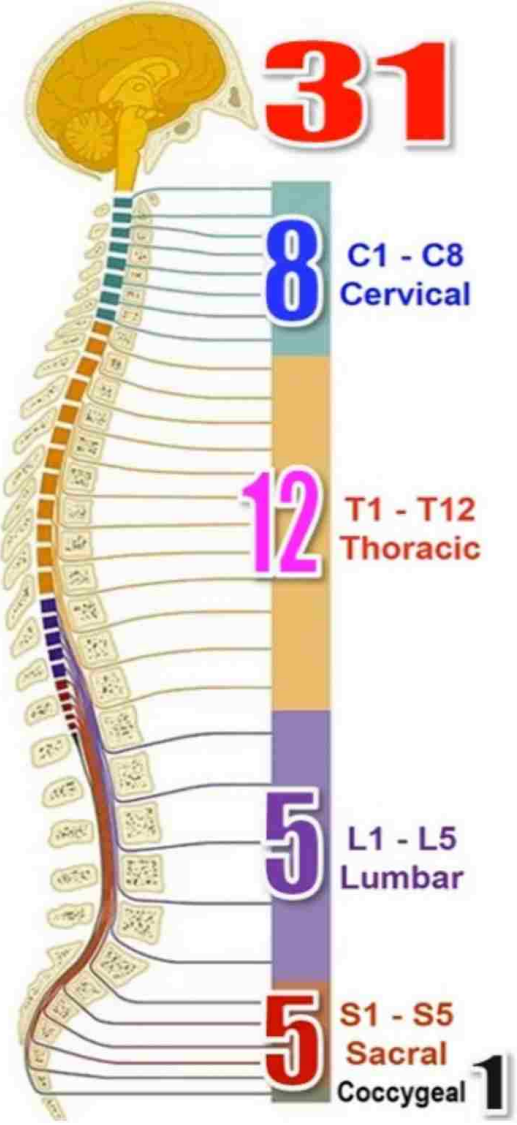
Cervical: C5 – T1

ENLARGEMENTS

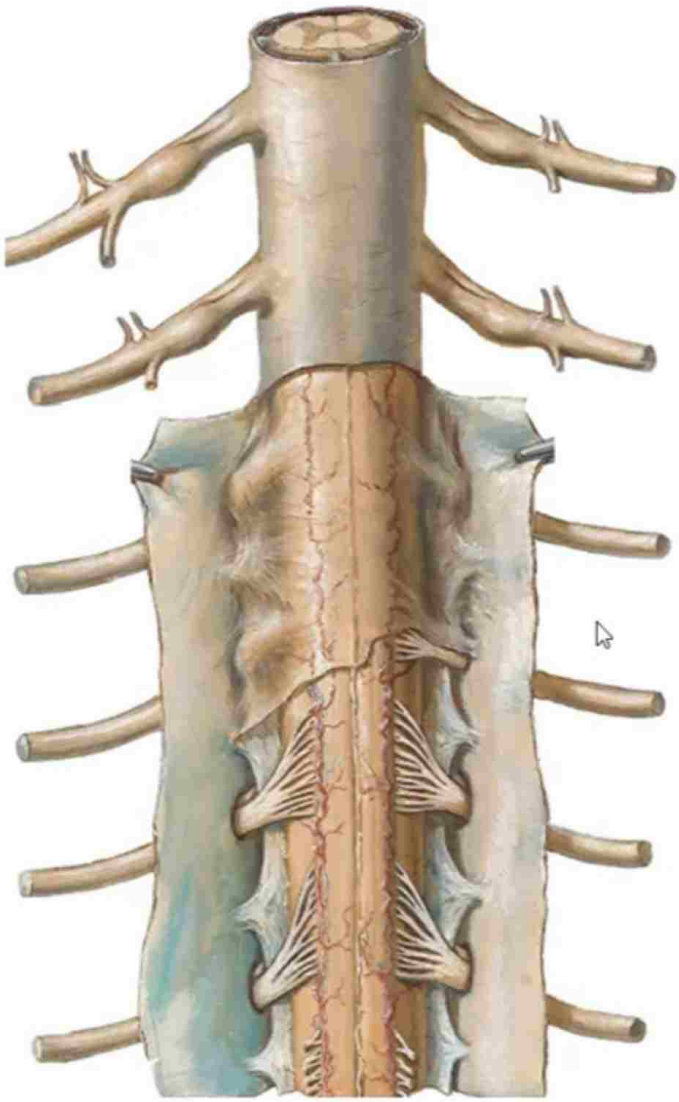
Lumbar: L1 – S2

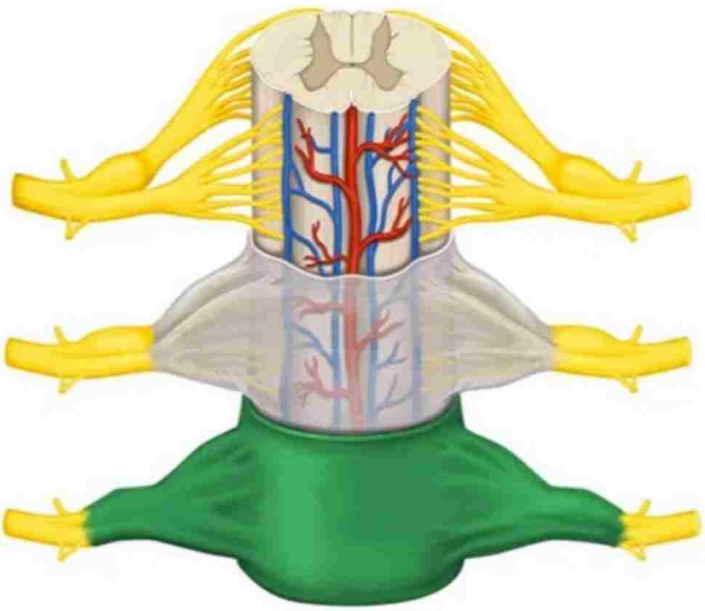
SEGMENTS



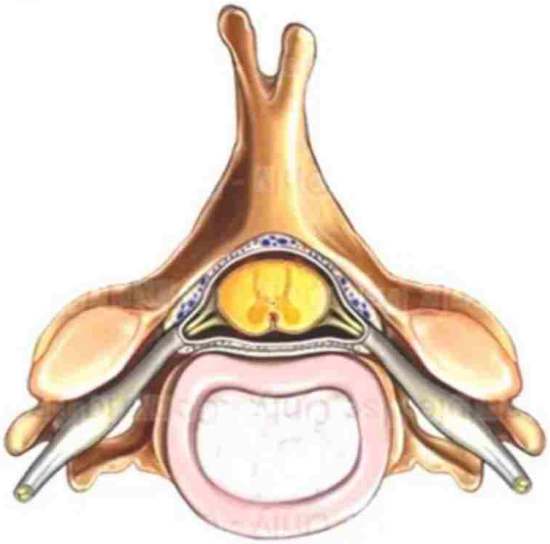


SPINAL MENINGES





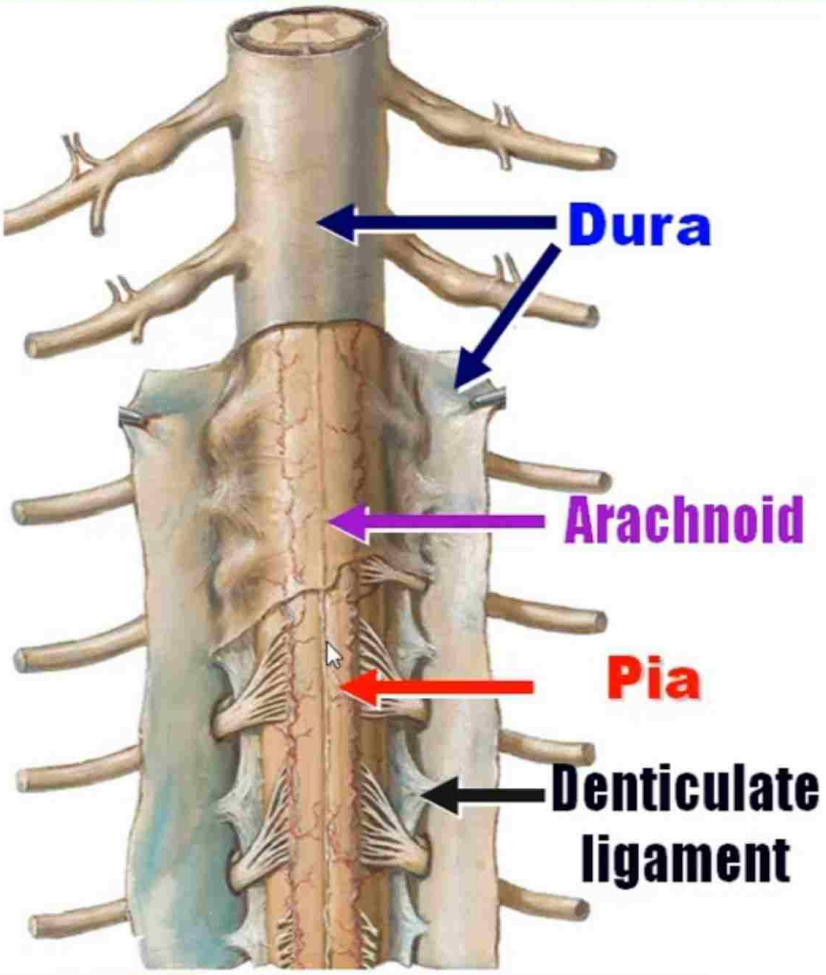
SPINAL MENINGES & MENINGEAL SPACES

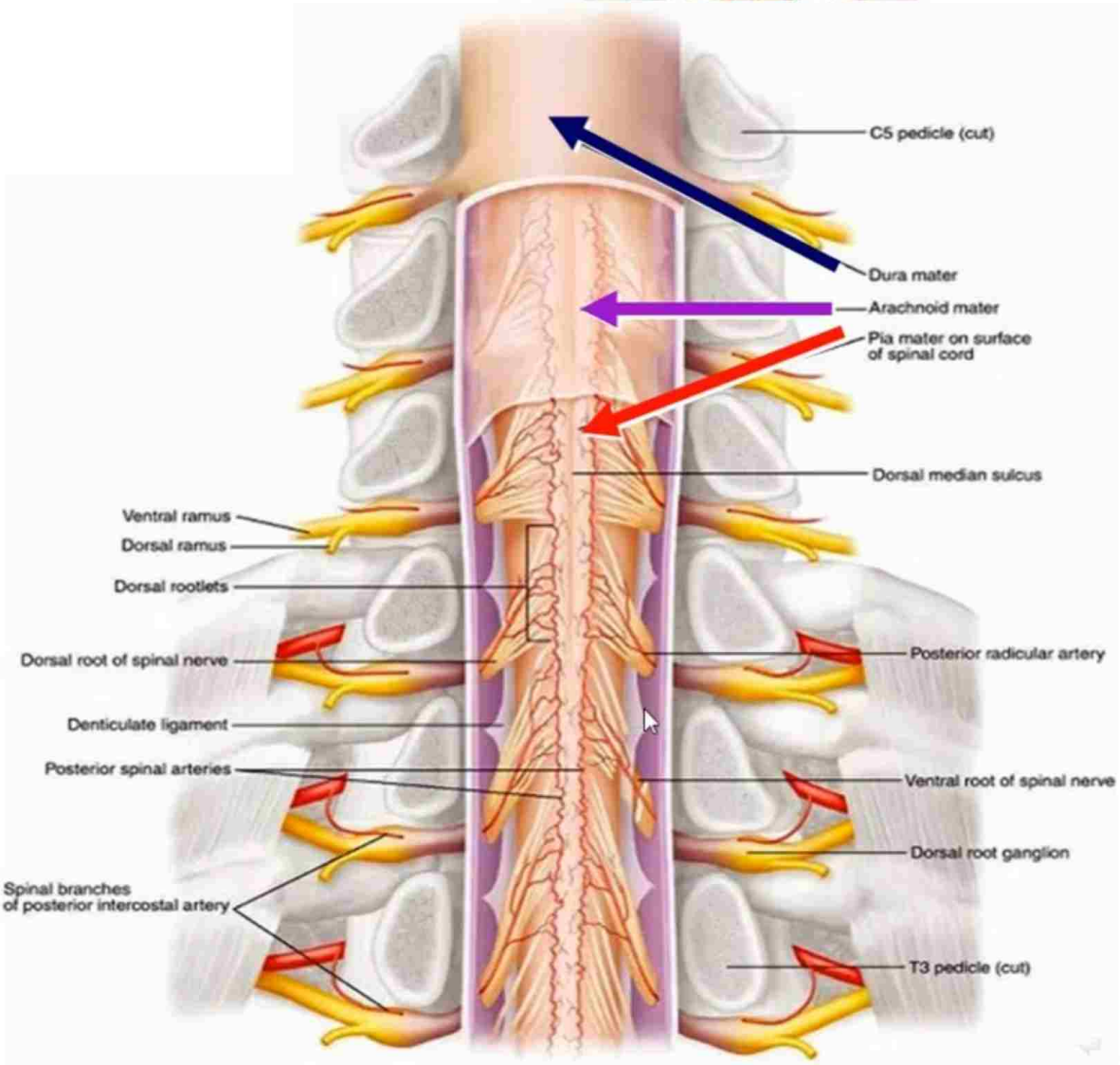


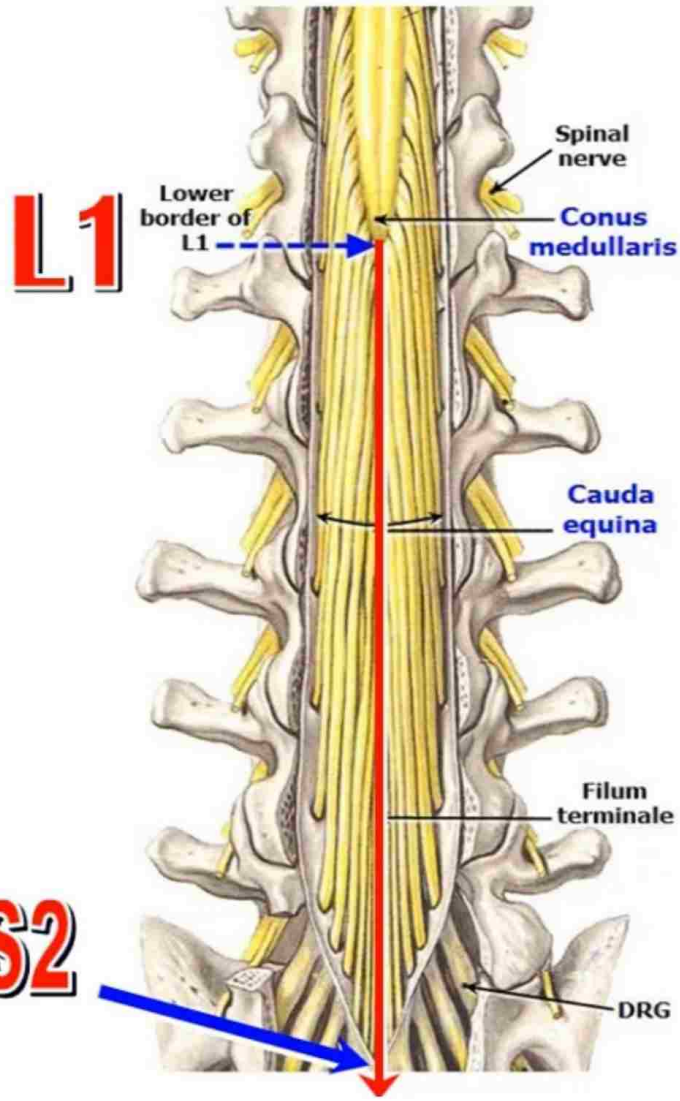
Epidural Space

Subdural Space

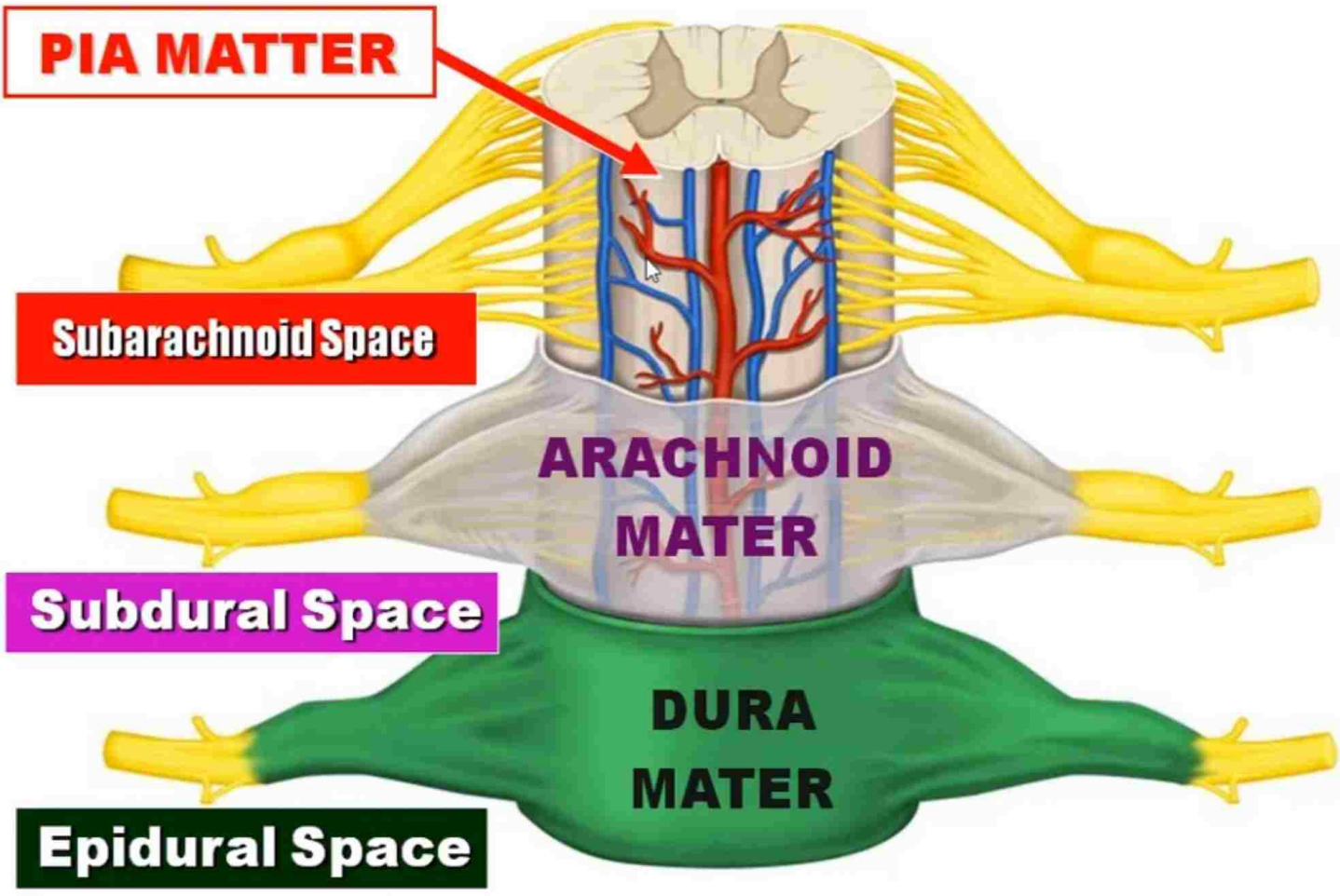
Subarachnoid Space







SPINAL MENINGES



Sagittal Section through the Spinal Cord

1: Intervertebral disc
2: Vertebral body
3: Dura mater
4: Epidural (extradural) space
5: Spinal cord
6: Subarachnoid space

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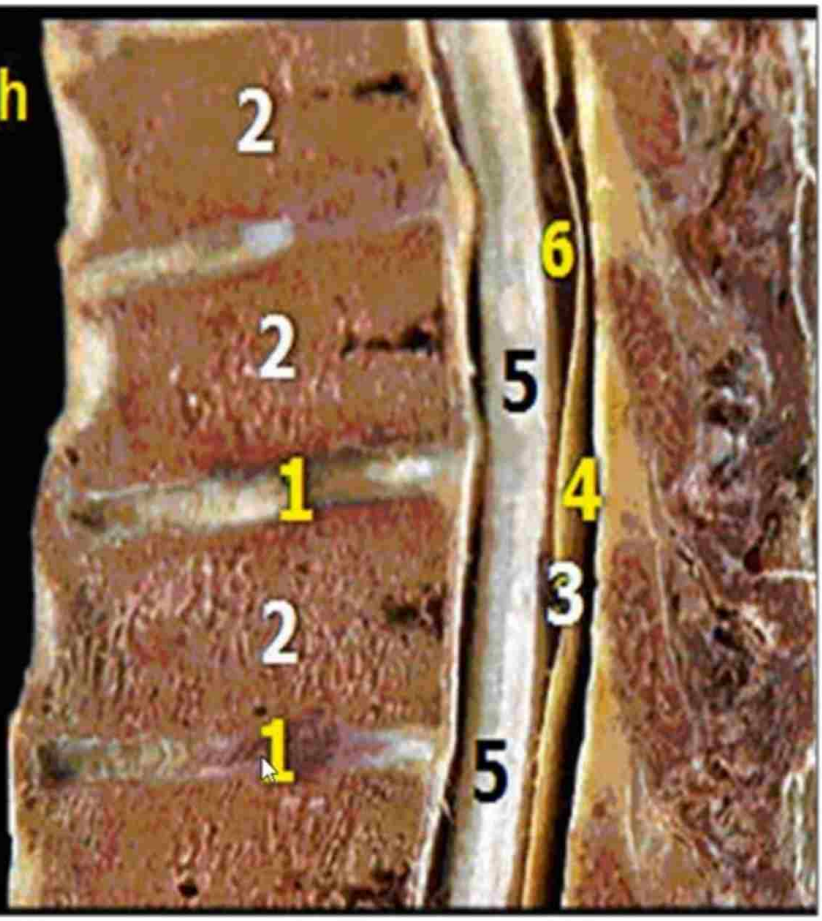
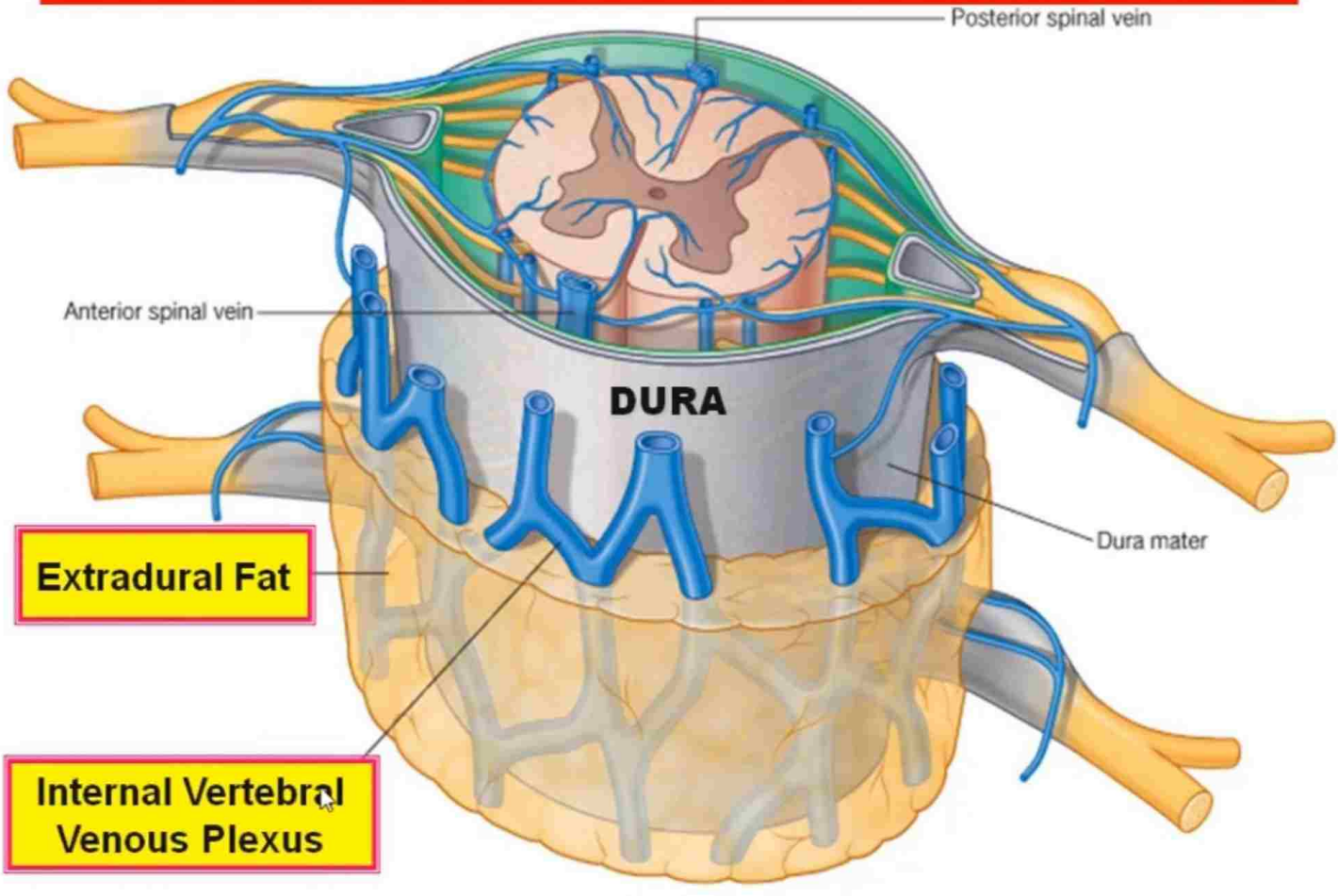
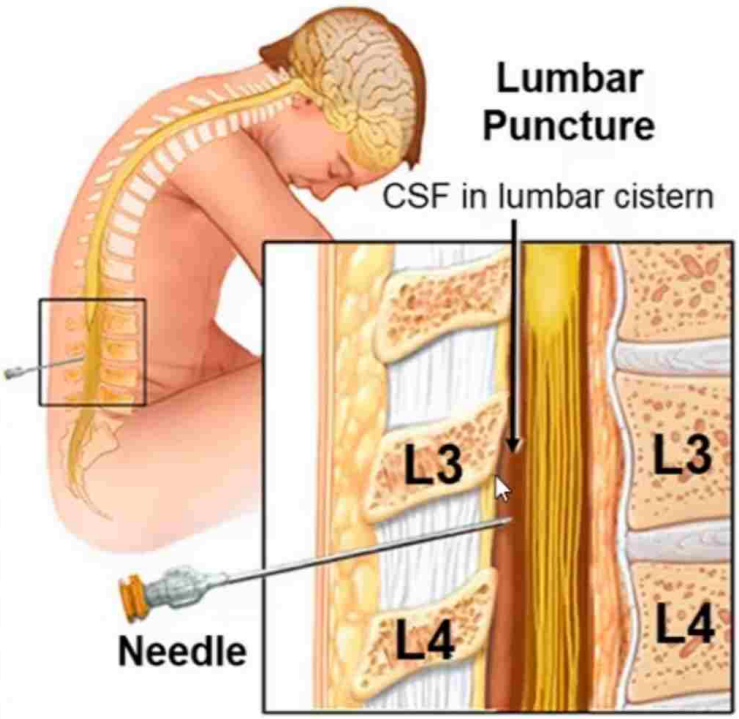


SPINAL EPIDURAL SPACE

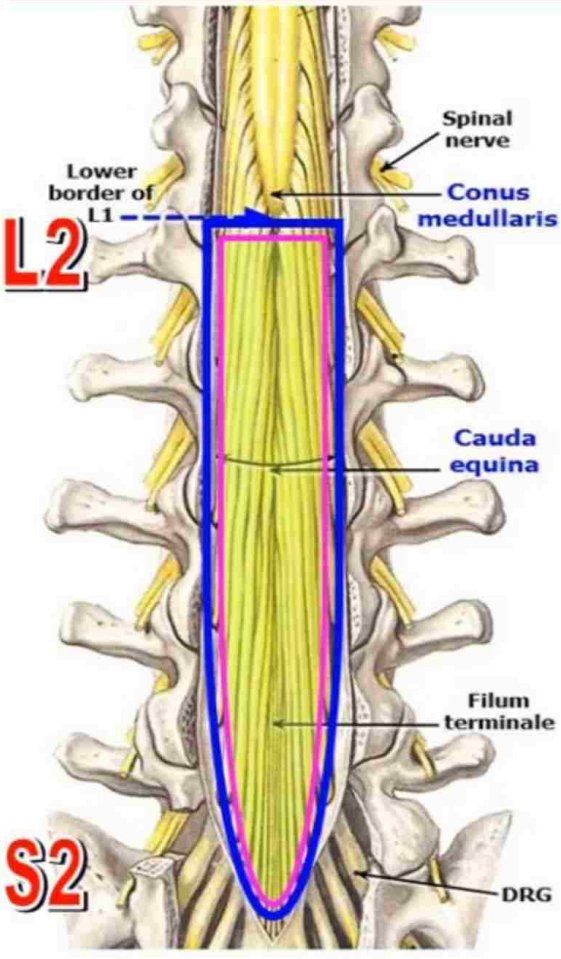


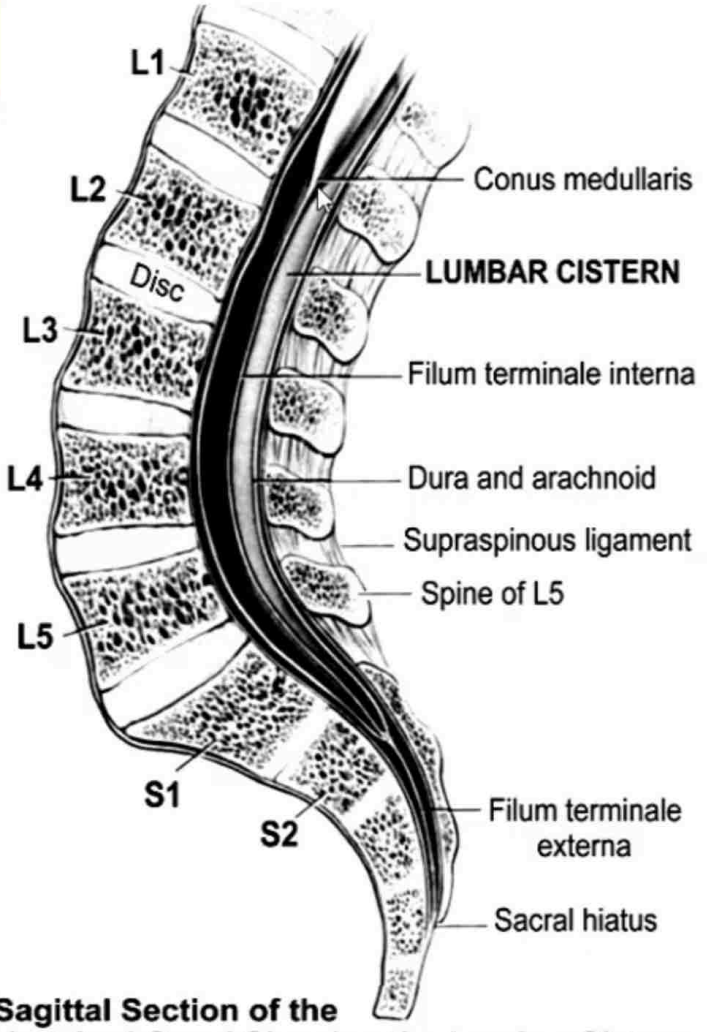
LUMBAR CISTERN

- Definition:
- Extent:
- Contents:
- Importance:



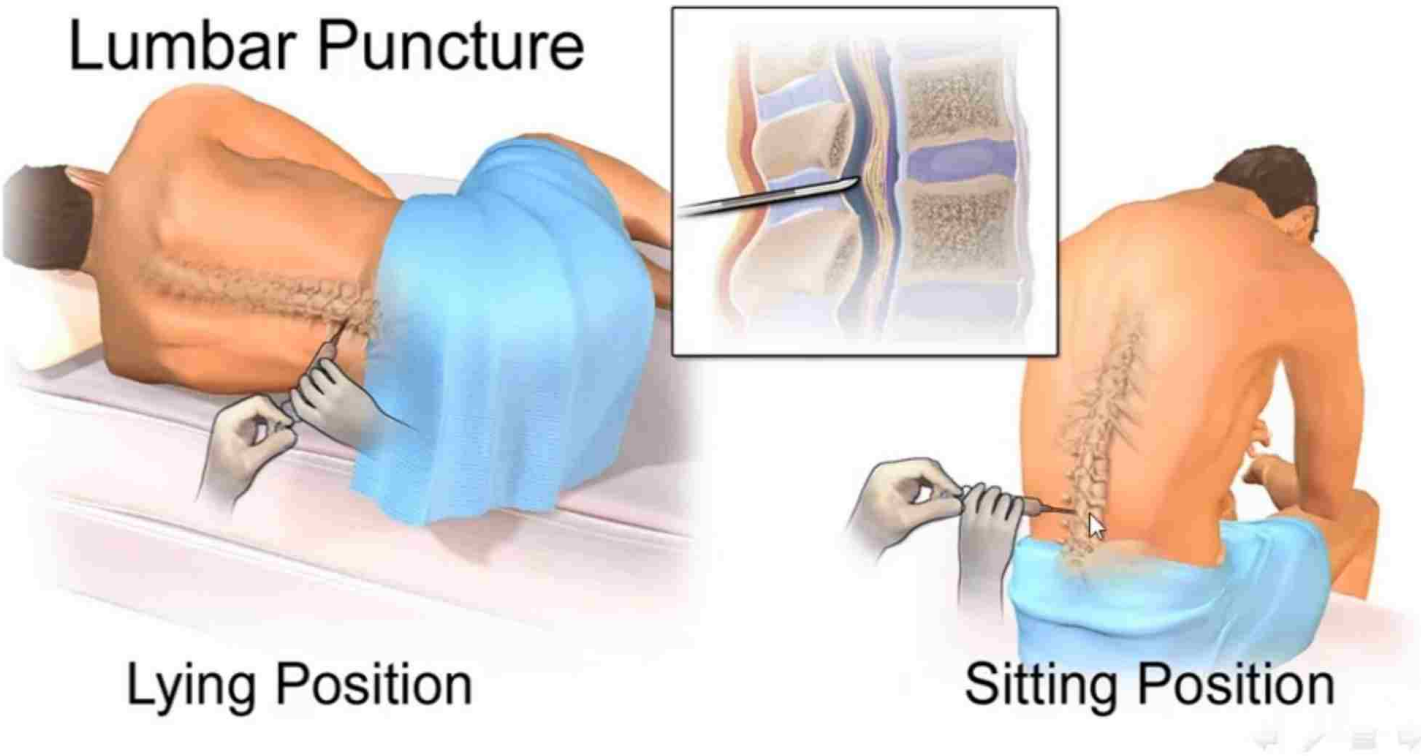
LUMBAR CISTERN





Sagittal Section of the Vertebral Canal Showing the Lumbar Cistern

CLINICAL IMPORTANCE
"LUMBAR PUNCTURE"

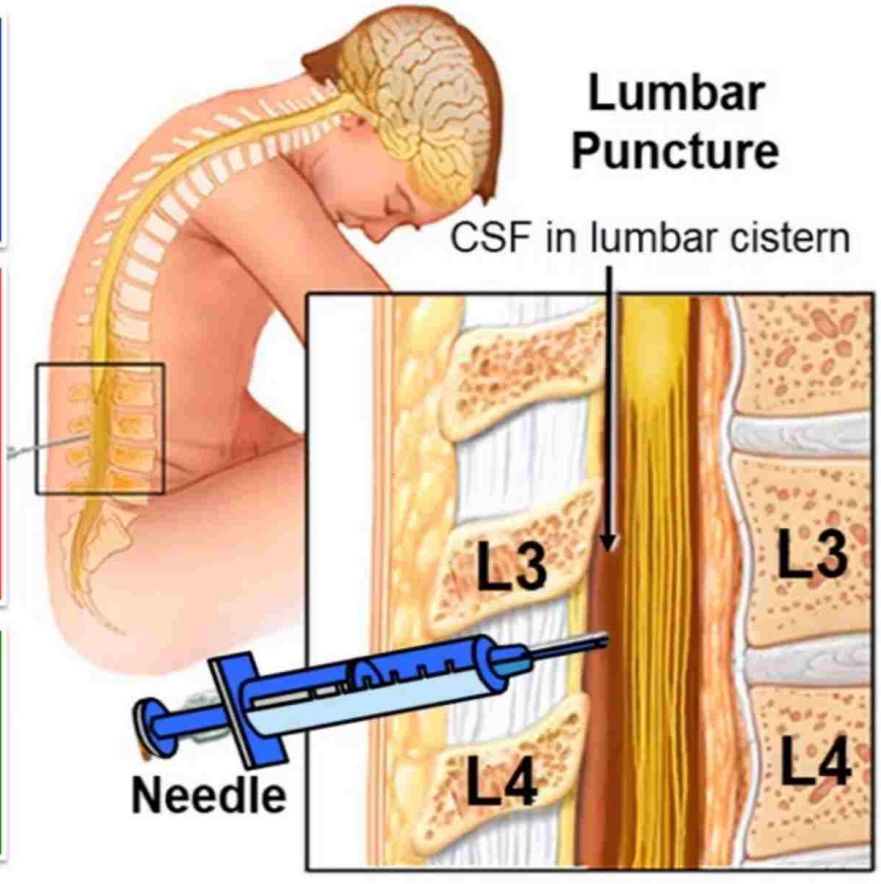


LUMBAR PUNCTURE

Take sample of CSF for analysis

Inject drugs like anesthetics and antibiotics

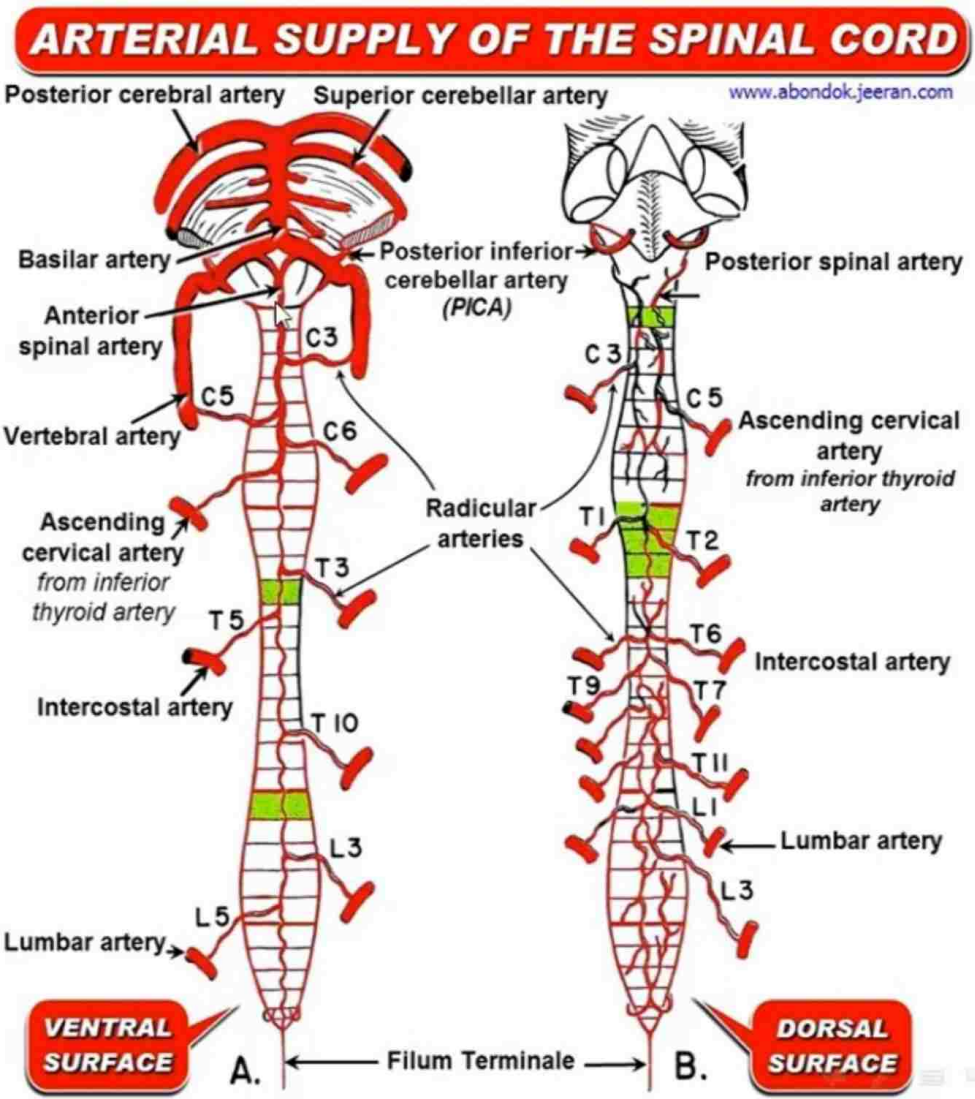
Measure CSF pressure

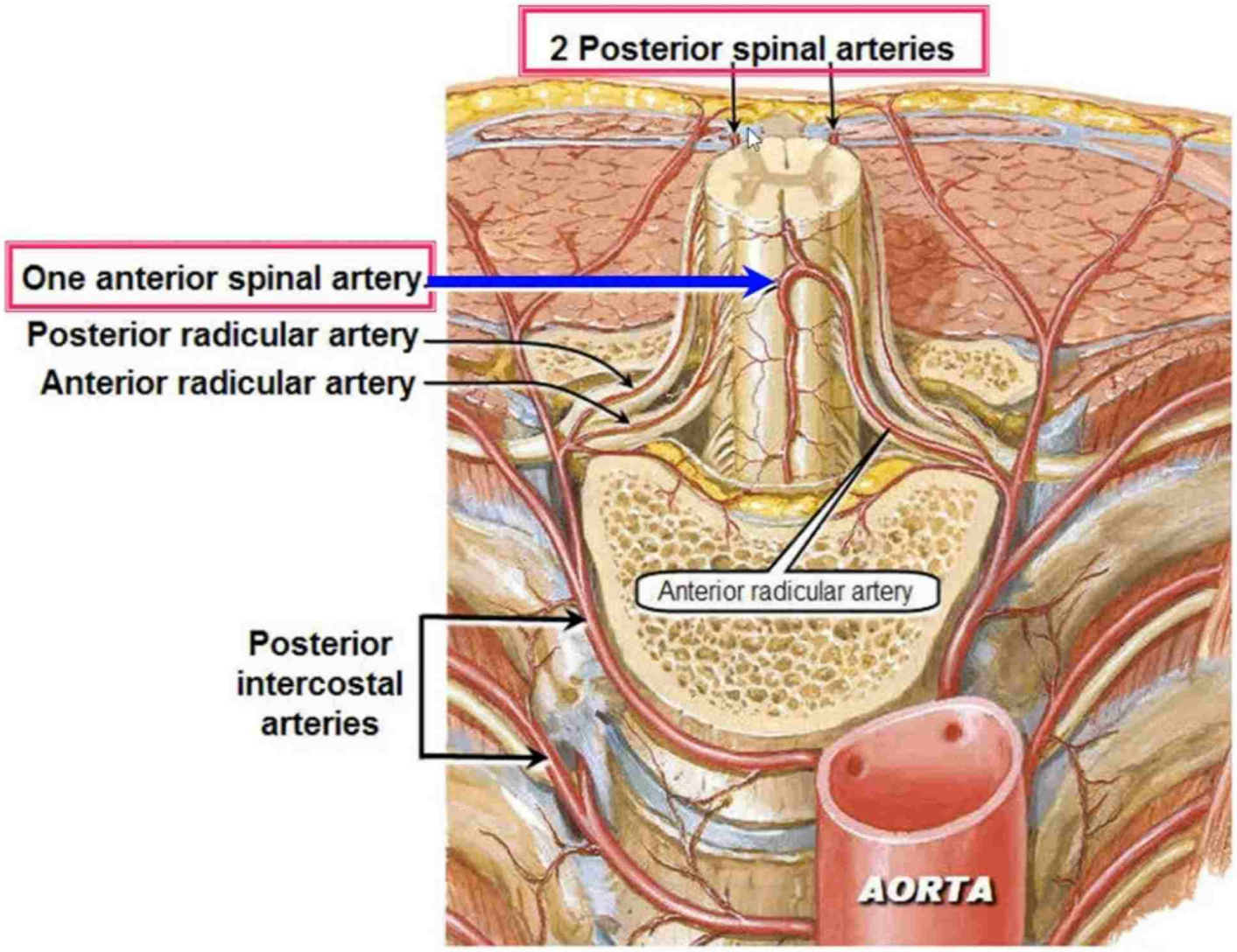


Blood Supply OF THE SPINAL CORD 3

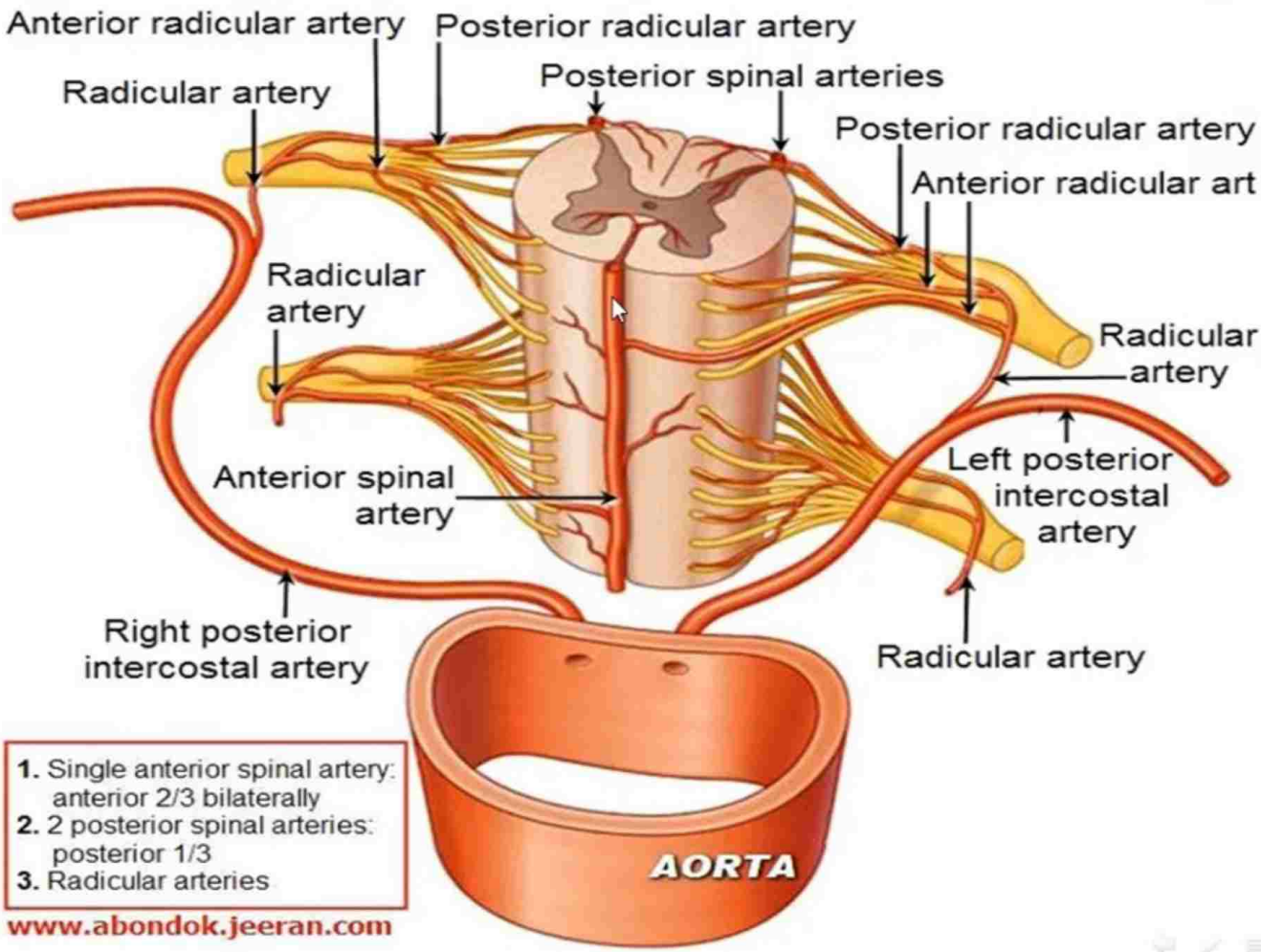
1. 1 Anterior Spinal Artery
2. 2 Posterior Spinal Arteries
3. Radicular Arteries

ARTERIAL SUPPLY OF THE SPINAL CORD





ARTERIAL SUPPLY OF THE SPINAL CORD



1. Single anterior spinal artery: anterior 2/3 bilaterally
2. 2 posterior spinal arteries: posterior 1/3
3. Radicular arteries

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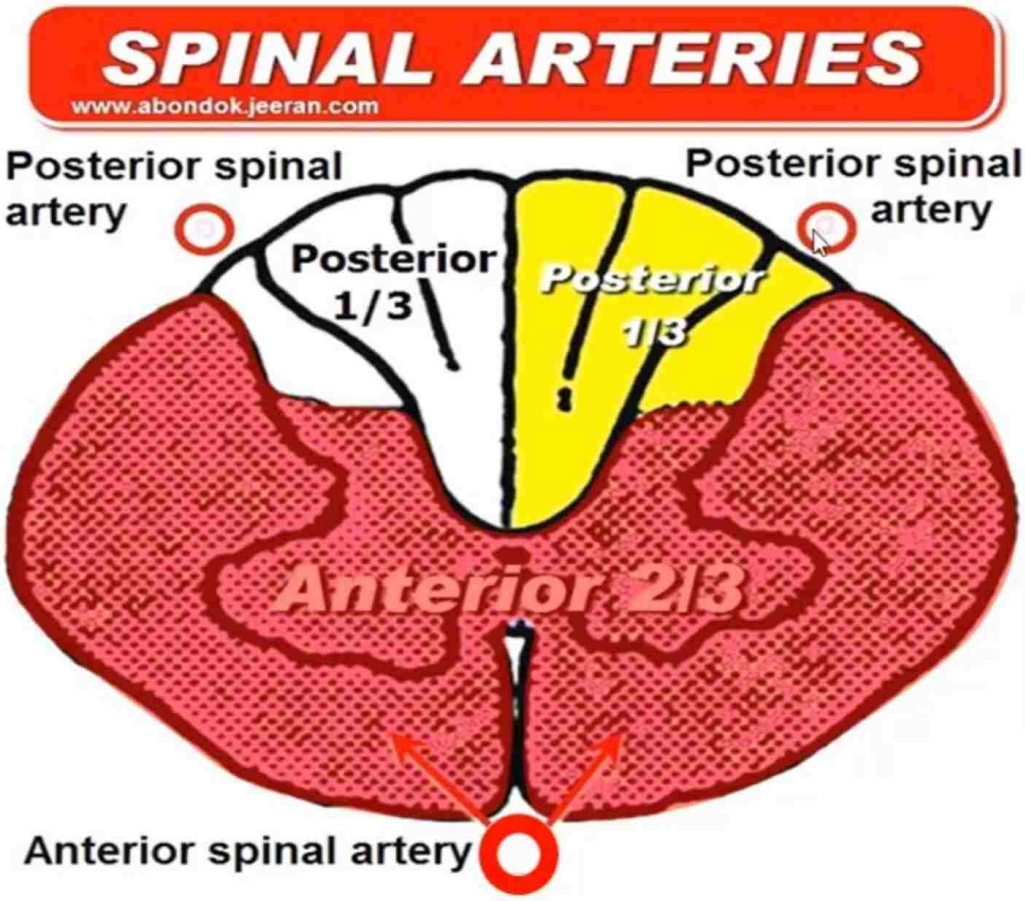
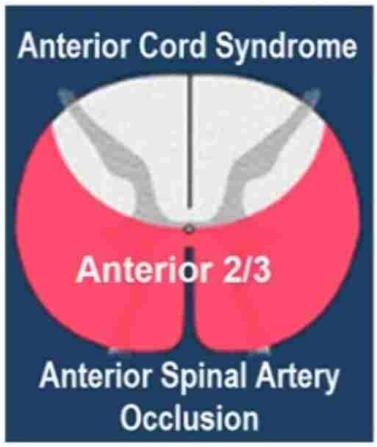
DISTRIBUTION OF THE SPINAL ARTERIES





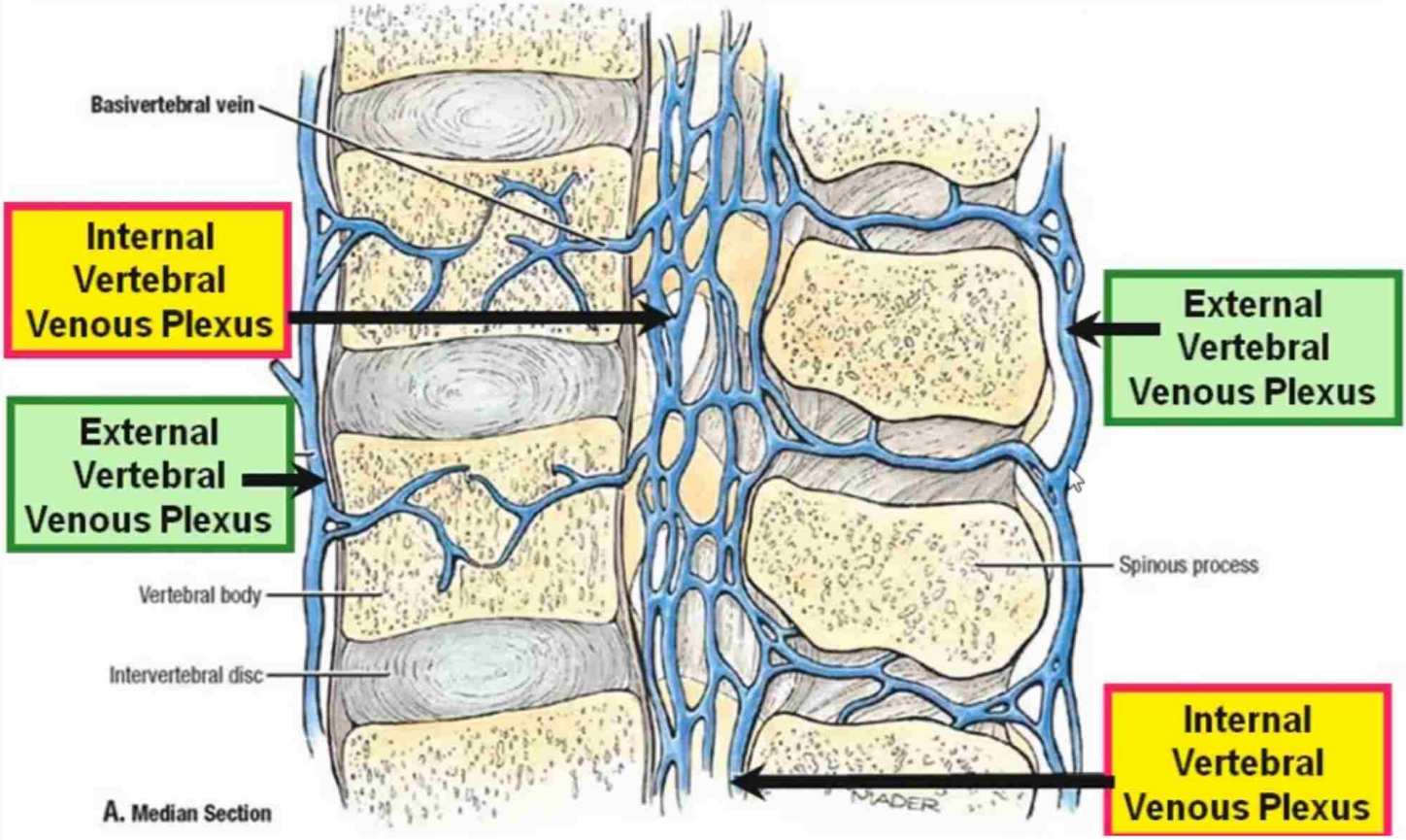
BLOOD SUPPLY

of the Spinal Cord and Vertebrae (SUMMARY)

1. **Anterior spinal artery:** Vertebral
2. 2 Posterior spinal arteries: PICA / Vertebral
3. **Radicular arteries:** from
   - a. **Neck:** Vertebral & Ascending Cervical
   - b. **Thorax:** Posterior intercostal arteries
   - c. **Abdomen:** Lumbar arteries
   - d. **Pelvis:** Lateral & Median sacral arteries

VENOUS DRAINAGE

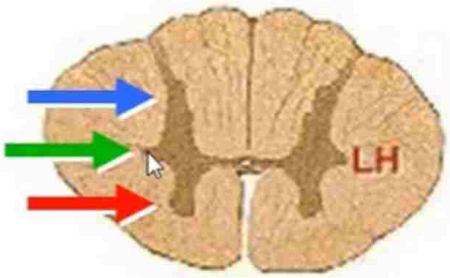
Internal & External Vertebral Venous plexuses



STRUCTURE OF THE SPINAL CORD

1. White Matter

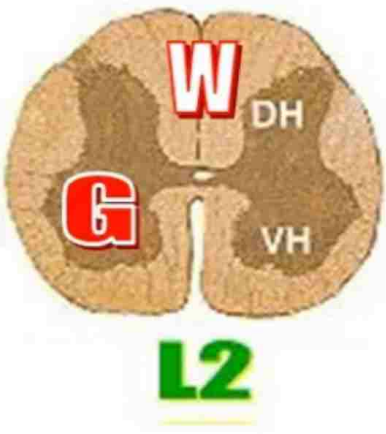
2. Gray Matter



a. Dorsal Horn

b. Ventral Horn

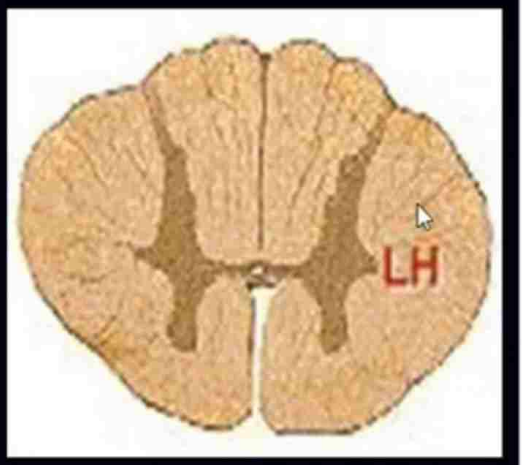
c. Lateral horn



SPINAL CORD INTERNAL STRUCTURE

WHITE MATTER:

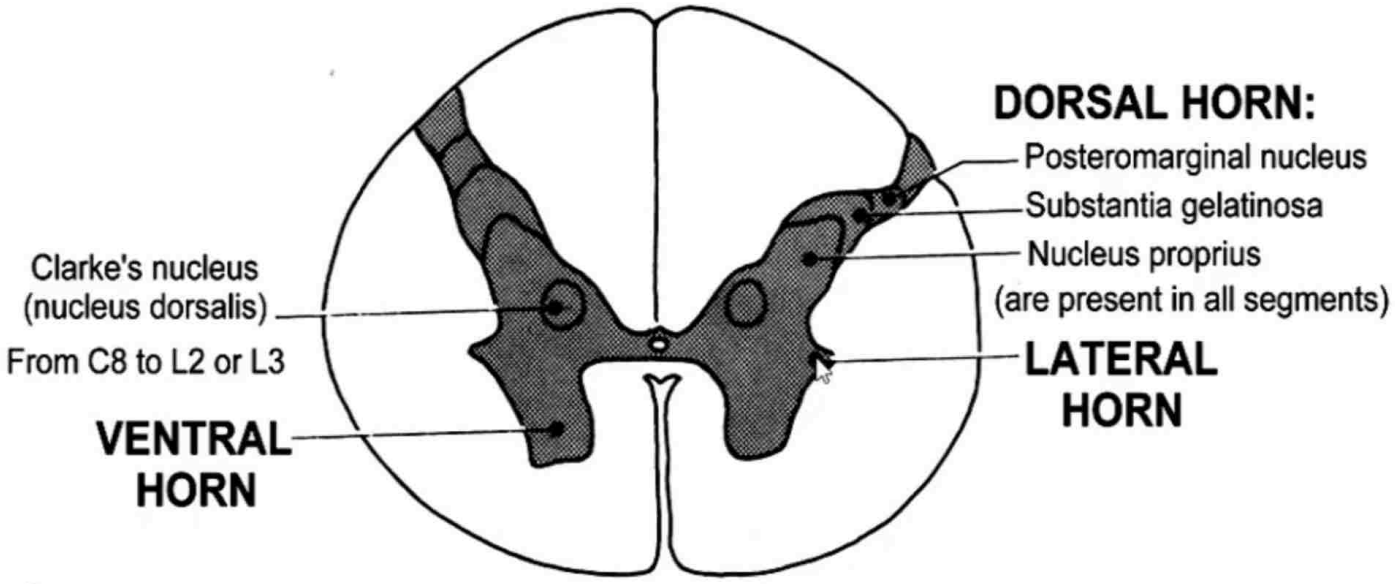
- **Anterior Funiculus** (Column)
- **Posterior Funiculus** (Column)
- **Lateral Funiculus** (Column)



GRAY MATTER:

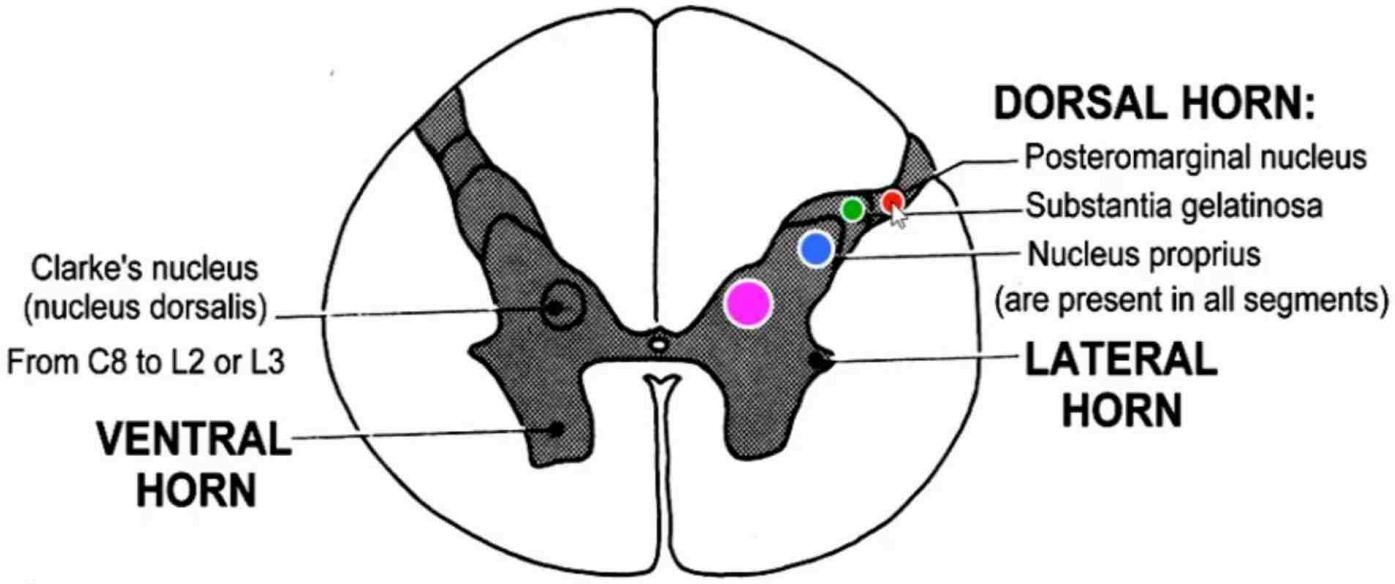
- **Anterior Horn:** motor
- **Posterior Horn:** sensory
- **Lateral Horn:** autonomic (sympathetic)

SPINAL CORD GRAY MATTER



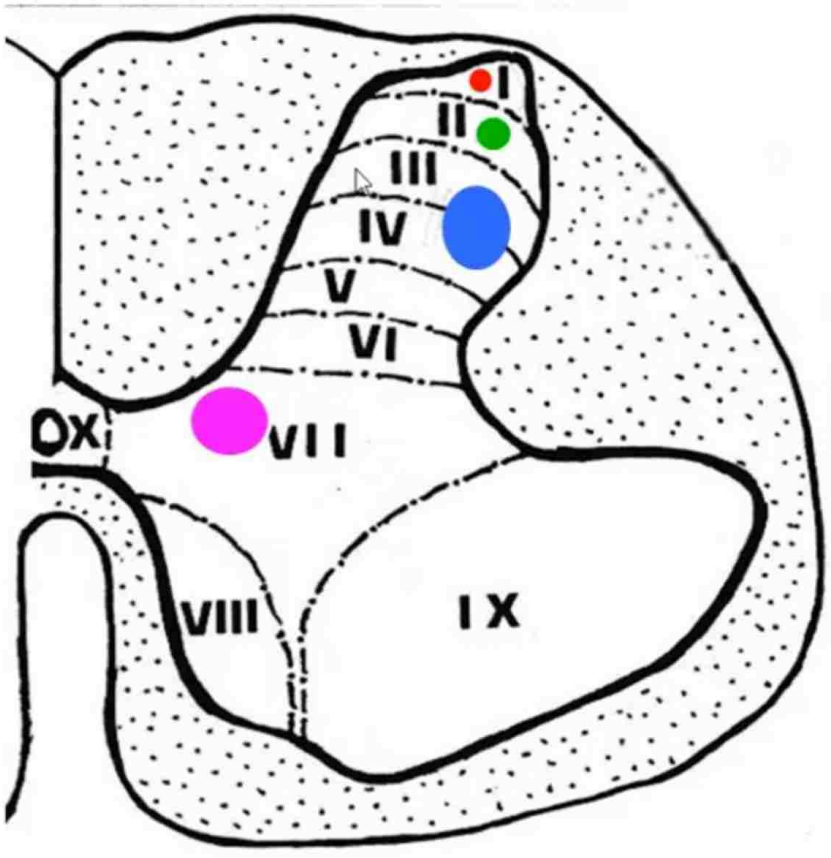
NUCLEAR GROUPS OF THE GRAY MATTER

SPINAL CORD GRAY MATTER



NUCLEAR GROUPS OF THE GRAY MATTER

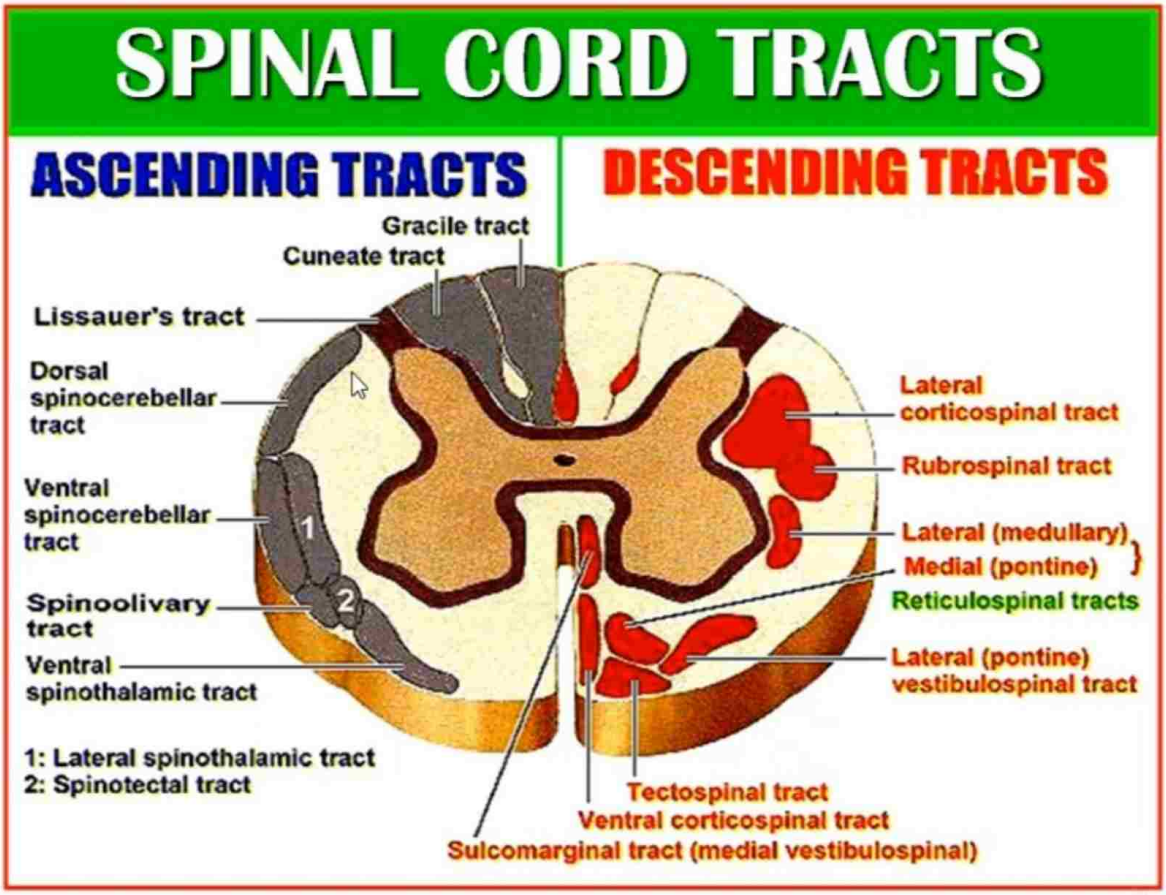
LAMINAE OF REXED



LAMINAE OF REXED

WHITE MATTER

SPINAL CORD TRACTS



4 Types of Sensations

- Superficial From the Skin
- Deep From the Muscles & Joints
- Special From the Sense Organs
- Visceral From the Viscera

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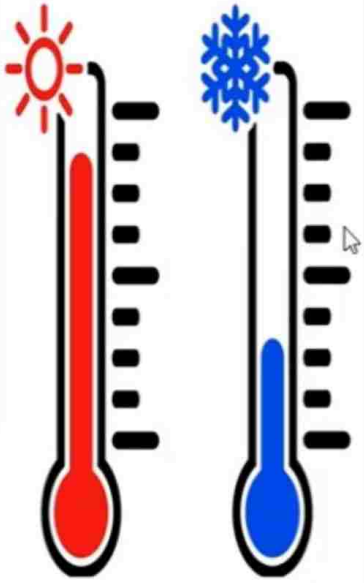
Superficial Sensations
Exteroception

- Pain
- Temp
- Touch



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Deep Sensations
Proprioception

- Sense of movement
- Sense of position
- Vibration sense

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Special Sensations
Special Senses

- Vision

- Hearing

- Taste

- Smell

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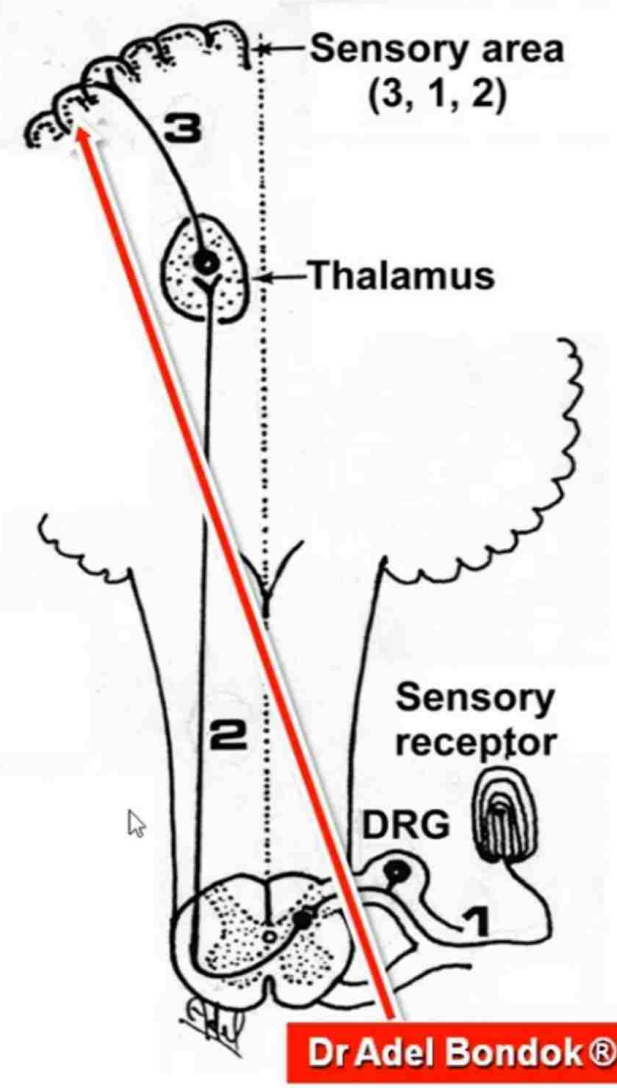
ASCENDING SENSORY PATHWAY

Sensation from one side goes to the opposite cerebral hemisphere

Therefore, crossing must occur

Sensation is carried by 3 neurons: 1st, 2nd & 3rd



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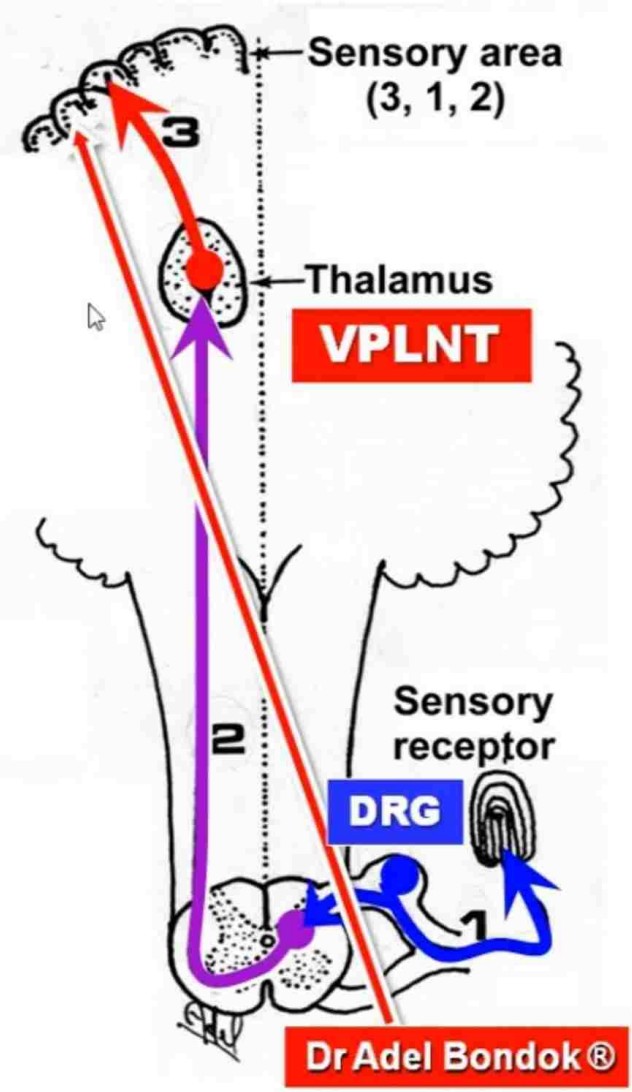

3 ORDER NEURONS

1

2

3

ALWAYS Thalamus VPLN

Spinal Cord or Brainstem ALWAYS CROSS

ALWAYS Dorsal Root Ganglia

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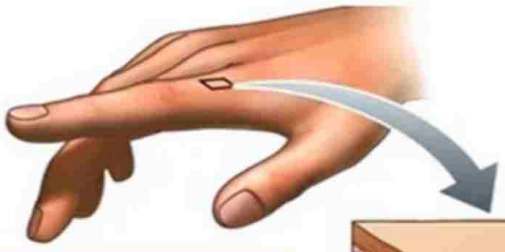
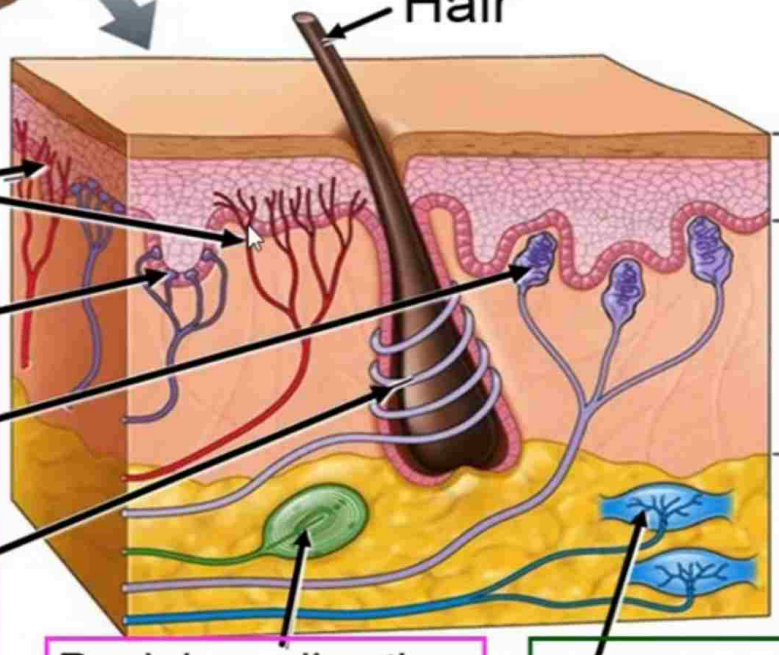
Sensory Receptors



Skin Receptors



Free nerve ending: pain

Merkel's disc: touch

Meissner's: touch

Hair follicle receptor: touch

Pacinian: vibration and pressure

Ruffini: stretch

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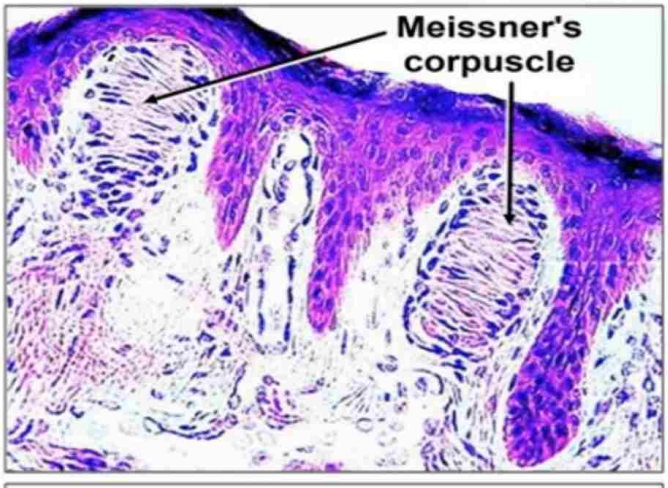
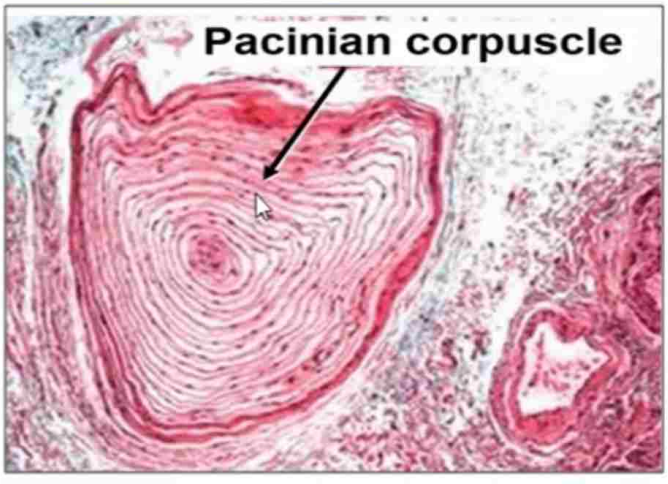
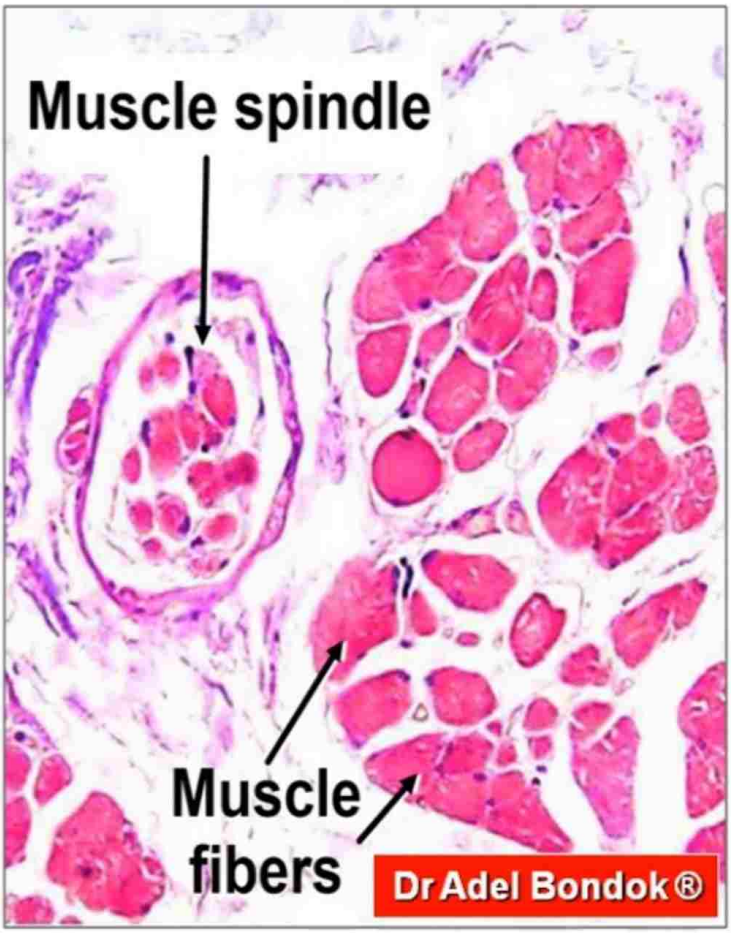
Sensory Receptors







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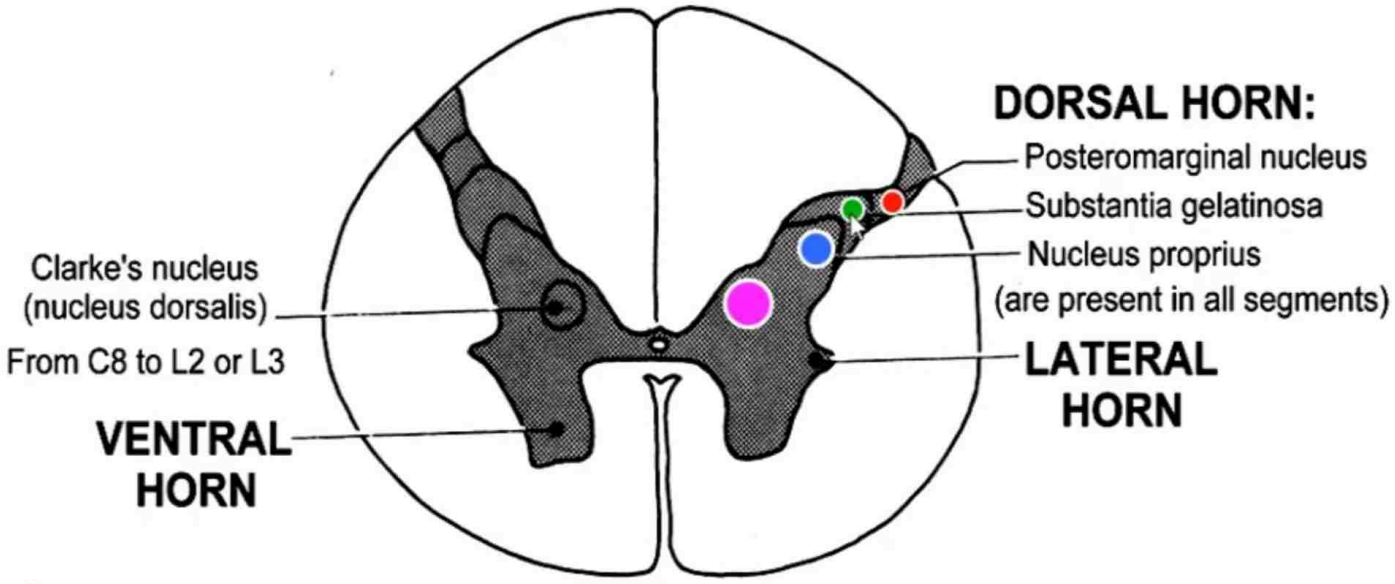
Relay Stations In the Gray Matter



NUCLEAR GROUPS OF THE GRAY MATTER

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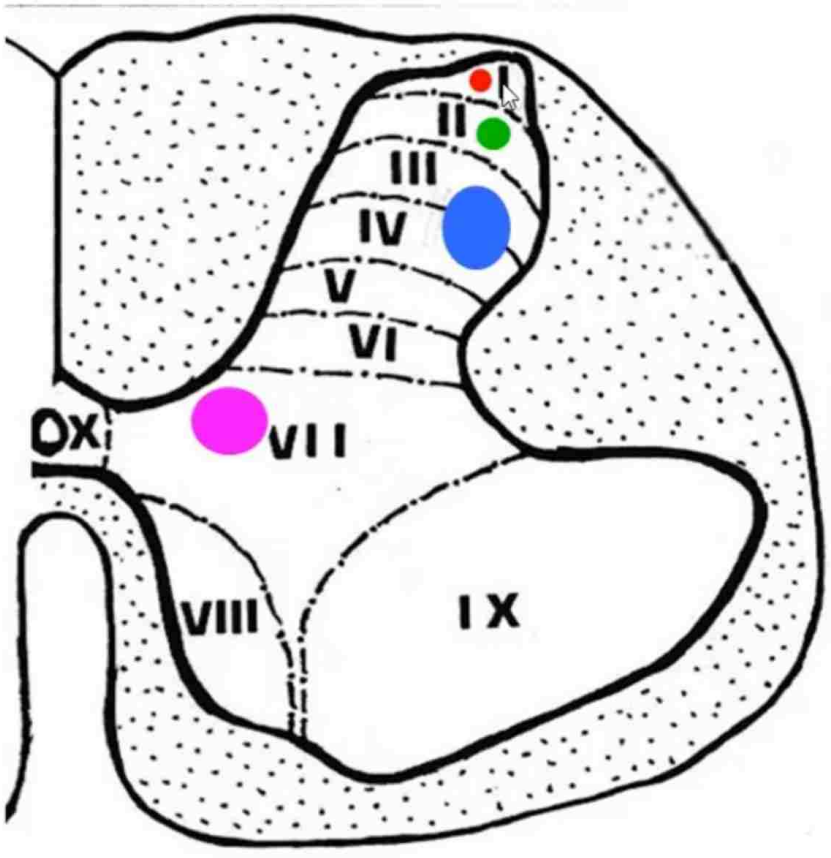
LAMINAE OF REXED



LAMINAE OF REXED

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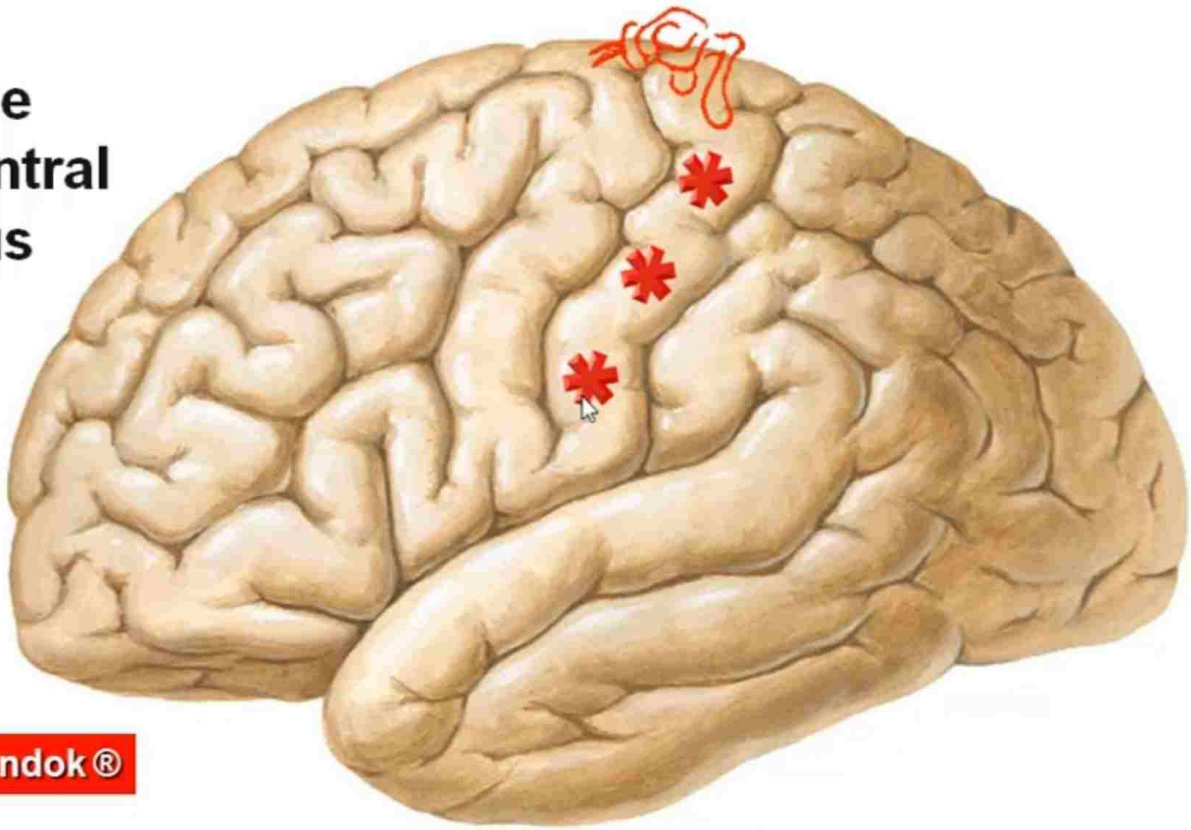
General Sensory Area in the Cerebral Cortex

In the postcentral gyrus



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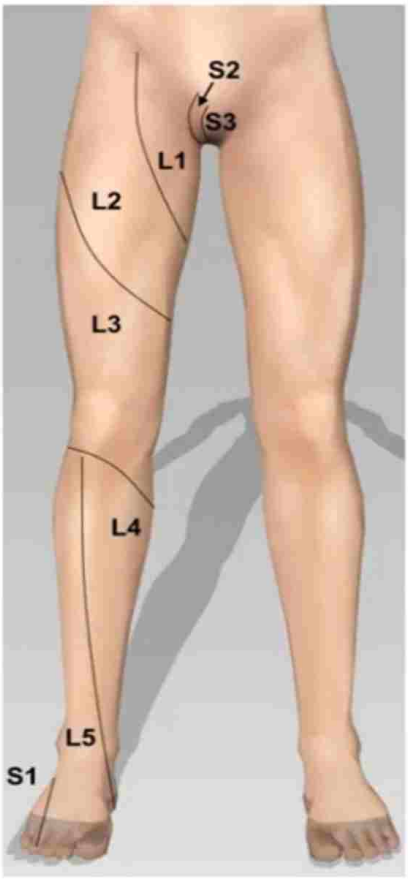
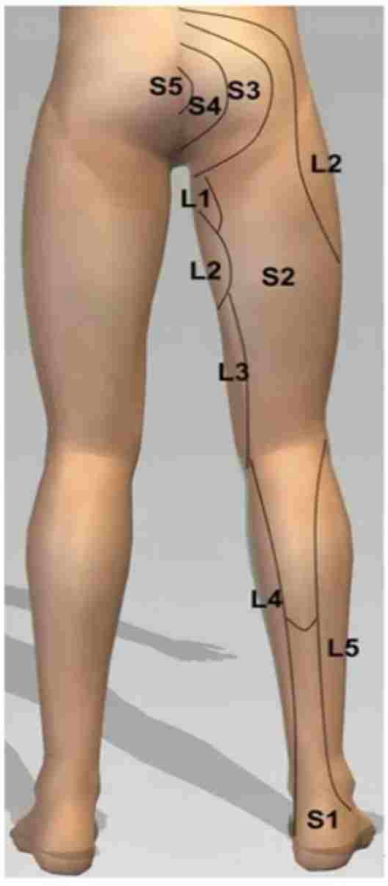
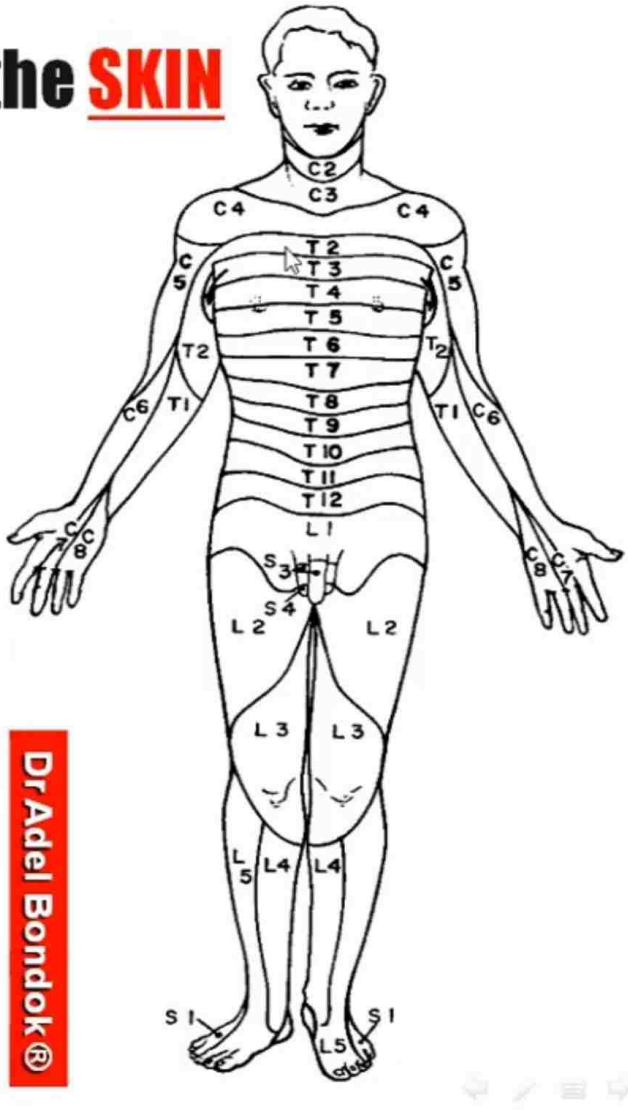
Segmental Innervation of the SKIN

Dermatomes







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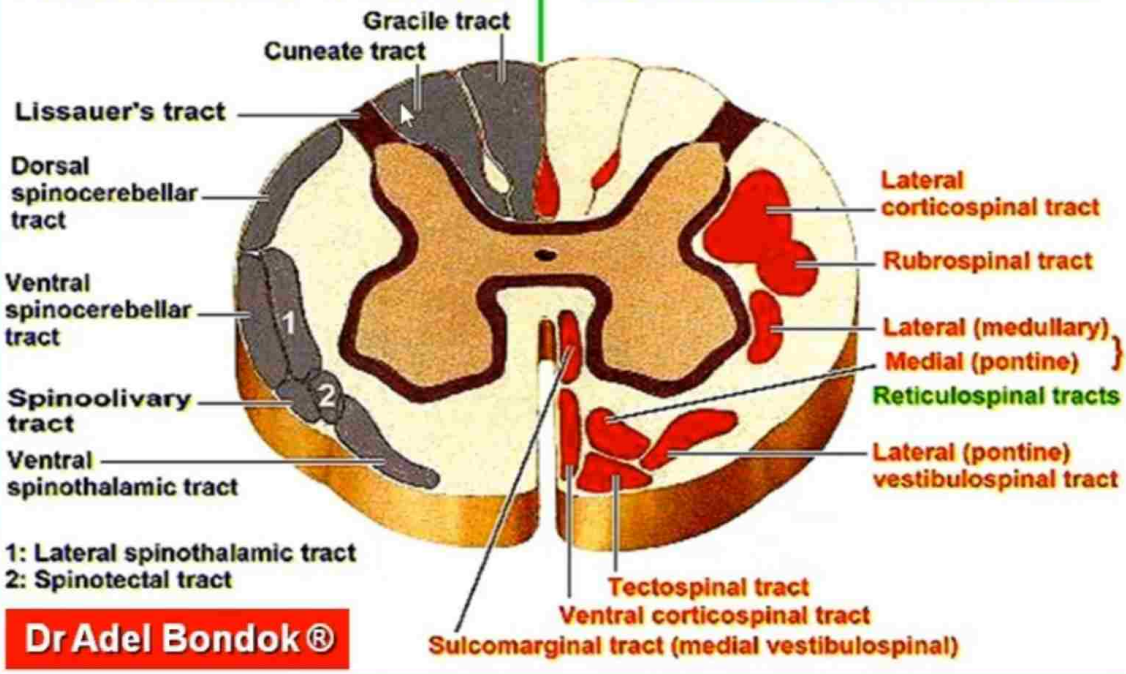
WHITE MATTER

SPINAL CORD TRACTS

ASCENDING TRACTS

DESCENDING TRACTS



1: Lateral spinothalamic tract
2: Spinotectal tract

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LOCATION OF ASCENDING TRACTS

Gracile Tract

Cuneate Tract

Dorsal Spinocerebellar Tr

Ventral Spinocerebellar Tr

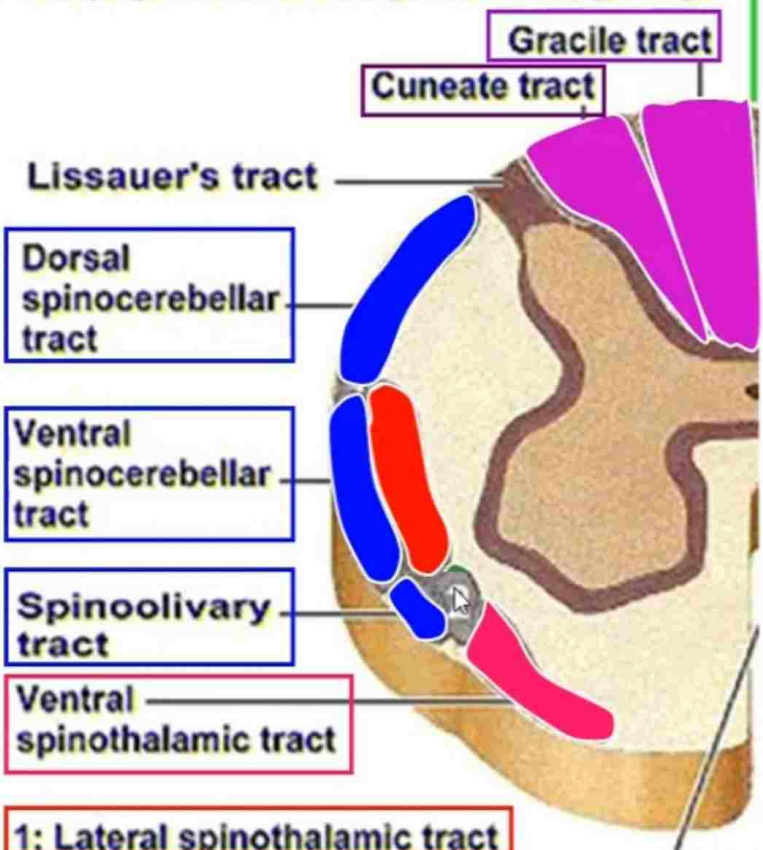
Spinoolivary Tract

Lateral Spinothalamic Tr

Ventral Spinothalamic Tr

Spinotectal Tract

ASCENDING TRACTS



1: Lateral spinothalamic tract
2: Spinotectal tract

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PROPRIOCEPTION

CONSCIOUS

To Cerebral Cortex

Gracile Tract: ↓T6

Cuneate Tract: ↑T6

UNCONSCIOUS

To Cerebellum

DSCT: direct

VSCT: indirct

Spinoolivary Tract

Cuneocerebellar T

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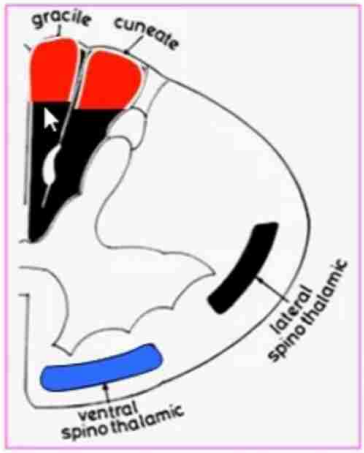
TOUCH

SIMPLE

Light / Crude



Fine

Discriminative

Ventral

Spinothalamic Tract

Gracile Tract

Cuneate Tract

Dr Adel Bondok®

FUNCTIONS OF ASCENDING TRACTS

EXTEROCEPTION

PAIN & TEMP:

Lat spinothalamic tract

TOUCH:

Fine touch: G + C tract

Simple touch: VSTT

SPINOVISUAL REFLEXES:

Spinotectal tract

PROPRIOCEPTION

CONSCIOUS:

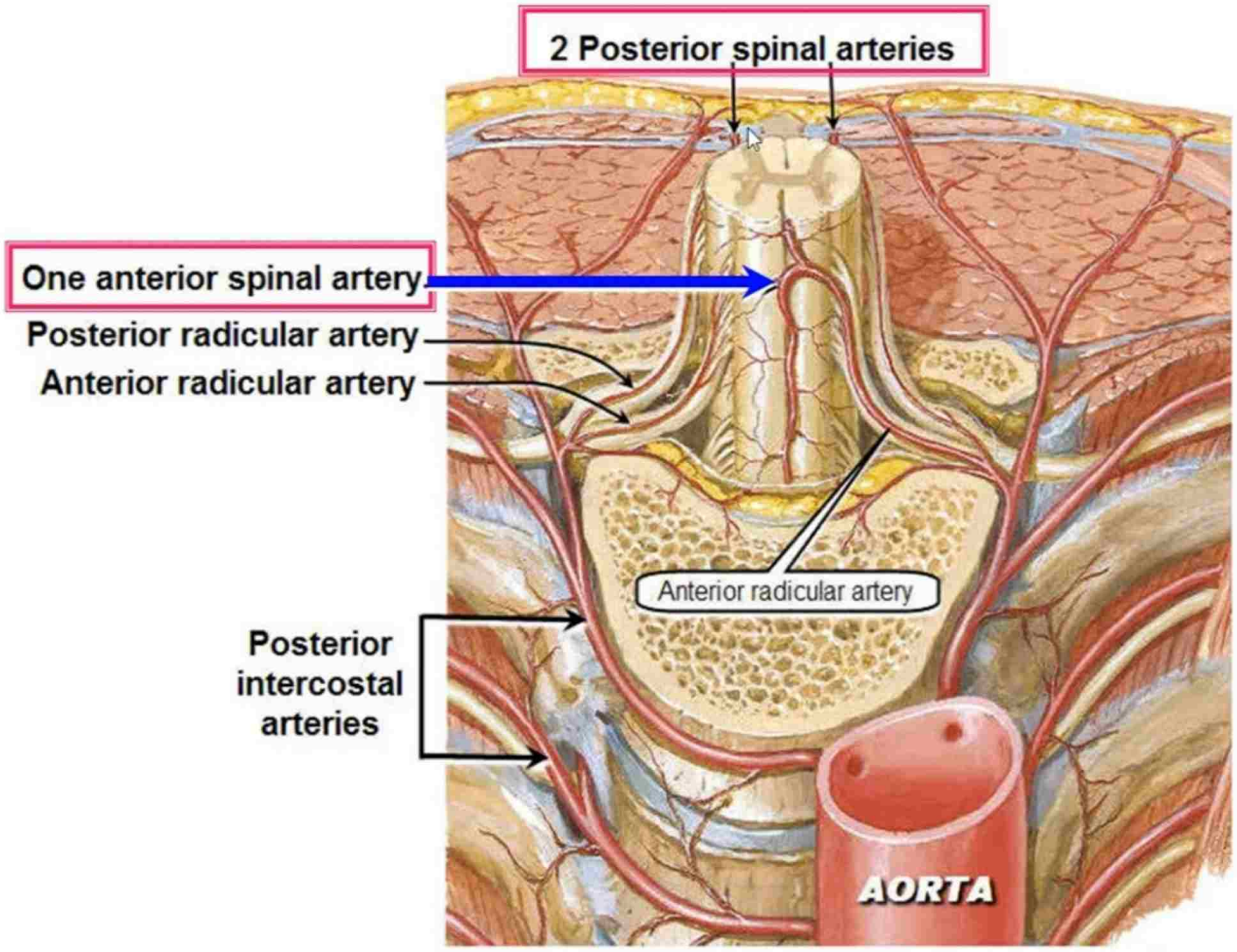
1. Gracile tract
2. Cuneate tract

UNCONSCIOUS:

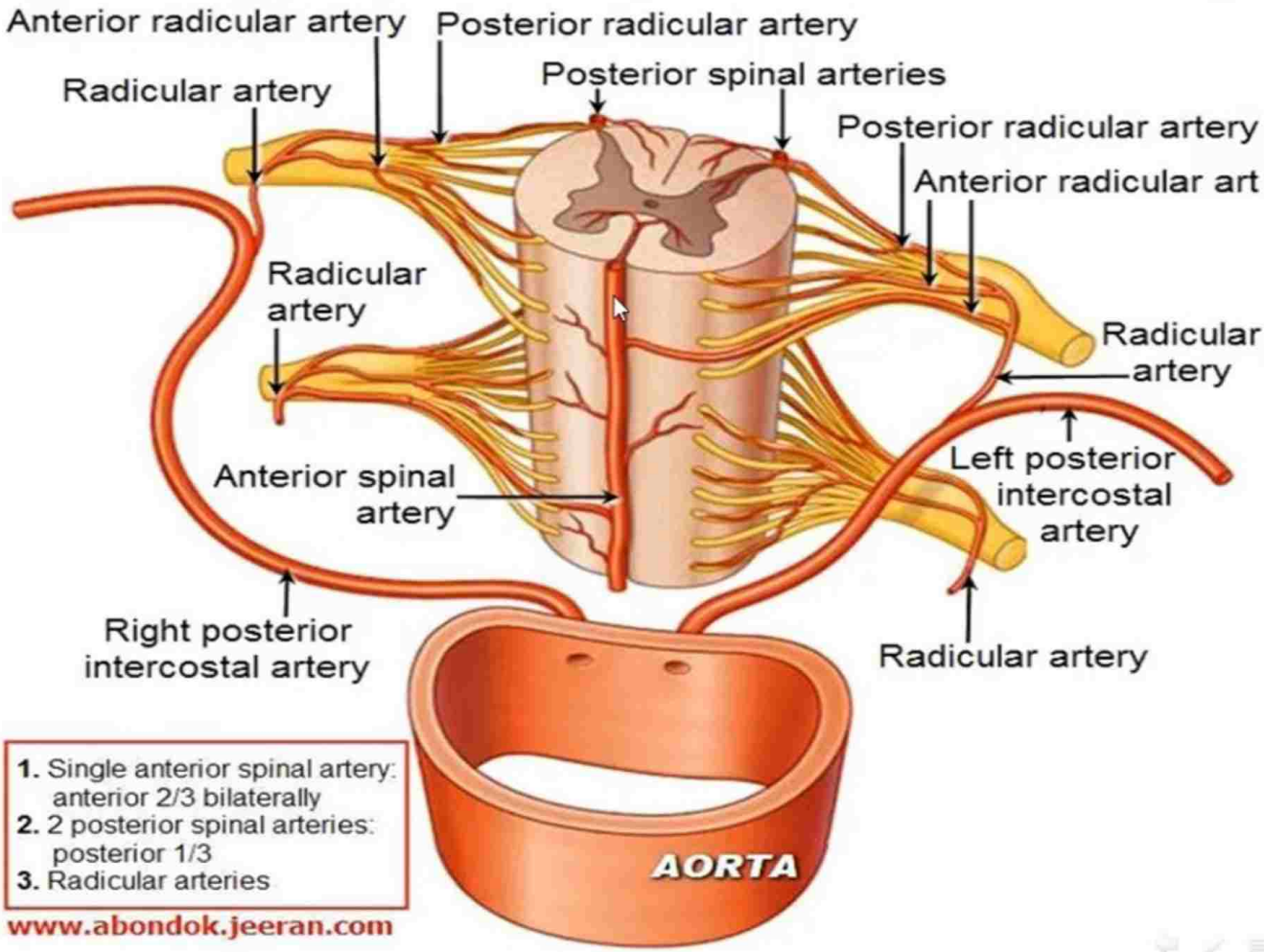
1. Dorsal spinocerebellar
2. Ventral spinocerebellar
3. Spinolivary tract

For Any Pathway: You Must Know

- RECEPTORS
- TRACT
- FIRST-ORDER NEURON
- SECOND-ORDER NEURON
- THIRD-ORDER NEURON
- EFFECT OF A LESION



ARTERIAL SUPPLY OF THE SPINAL CORD



1. Single anterior spinal artery: anterior 2/3 bilaterally
2. 2 posterior spinal arteries: posterior 1/3
3. Radicular arteries

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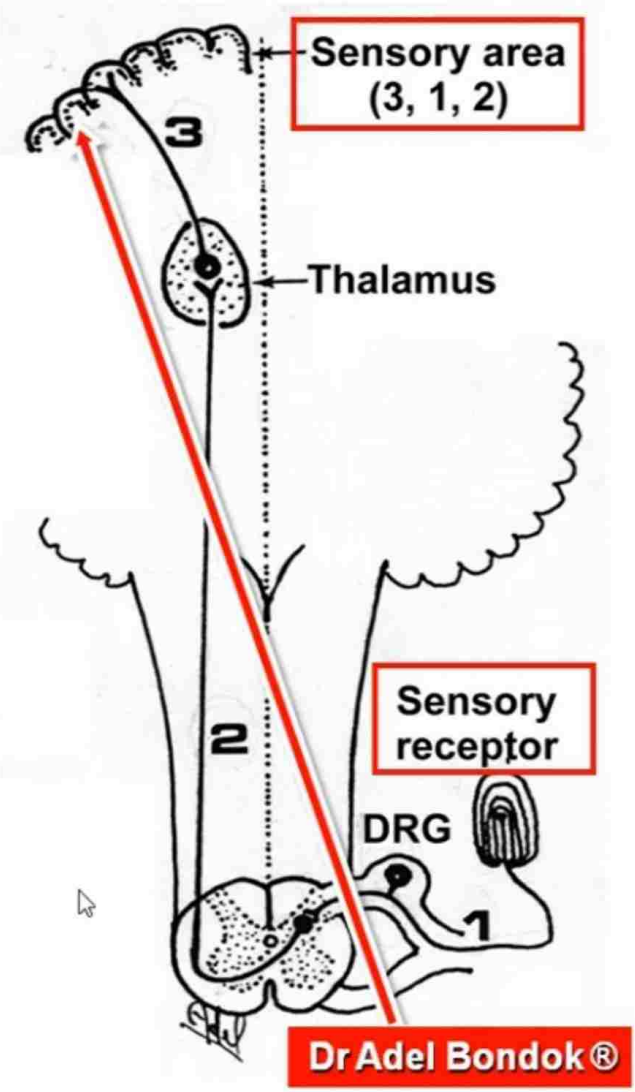
ASCENDING SENSORY PATHWAY

Sensation from one side goes to the opposite cerebral hemisphere

Therefore, crossing must occur

Sensation is carried by 3 neurons: 1st, 2nd & 3rd



3 ORDER NEURONS

1

2

3

ALWAYS Thalamus VPLN

Spinal Cord or Brainstem ALWAYS CROSS

ALWAYS Dorsal Root Ganglia

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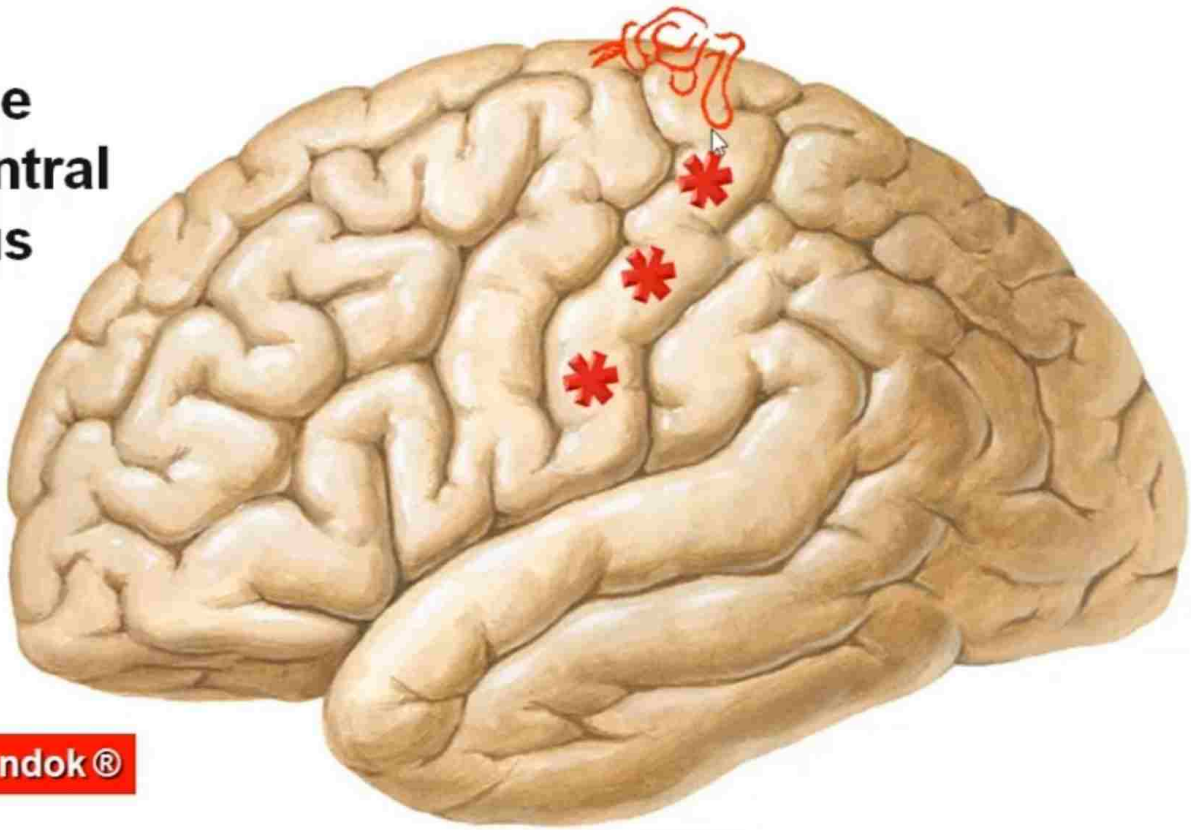
General Sensory Area in the Cerebral Cortex

In the postcentral gyrus



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LOCATION OF ASCENDING TRACTS

Gracile Tract

Cuneate Tract

Dorsal Spinocerebellar Tr

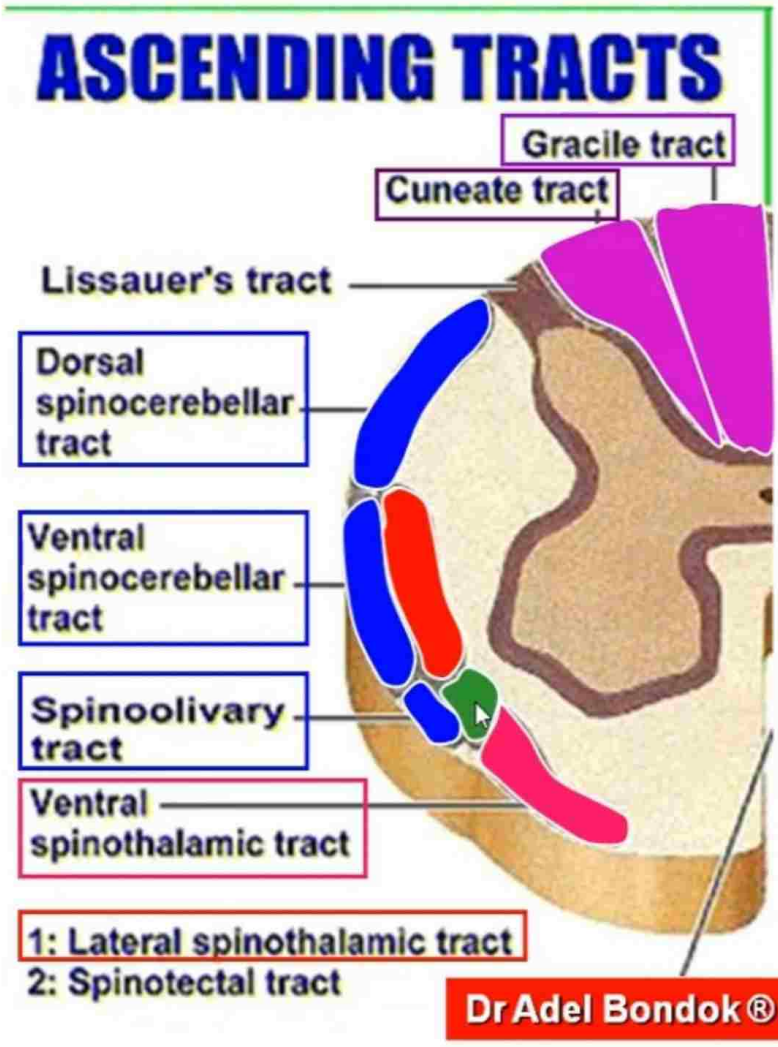
Ventral Spinocerebellar Tr

Spinoolivary Tract

Lateral Spinothalamic Tr

Ventral Spinothalamic Tr

Spinotectal Tract



Kinesthesia
Proprioception

- Sense of movement
- Sense of position

Dr Adel Bondok®

Fine Touch
Discriminative Touch

Dr Adel Bondok®

- Tactile localization

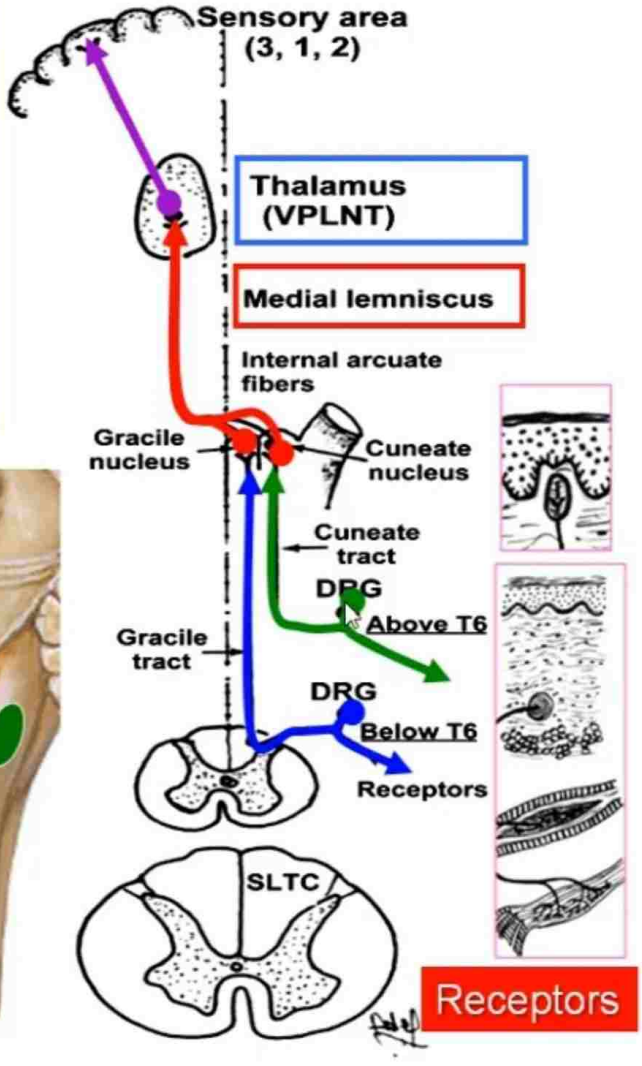
- 2-point discrimination

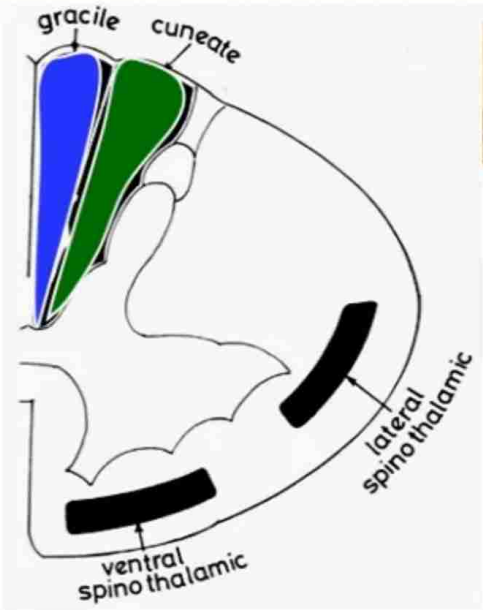
- Stereognosis

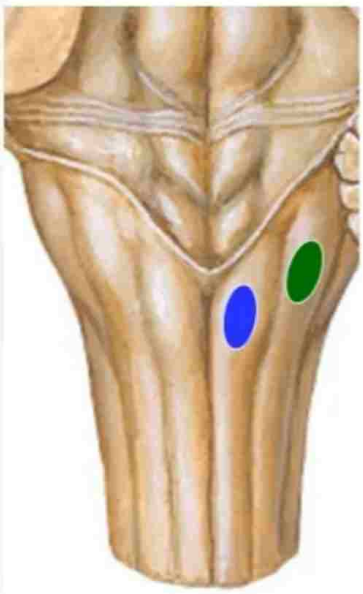
For Any Pathway: You Must Know

- Receptors
- Tract
- First-order Neuron
- Second-order Neuron
- Third-order Neuron
- Effect of a Lesion

Proprioception
Fine Touch
Vibration







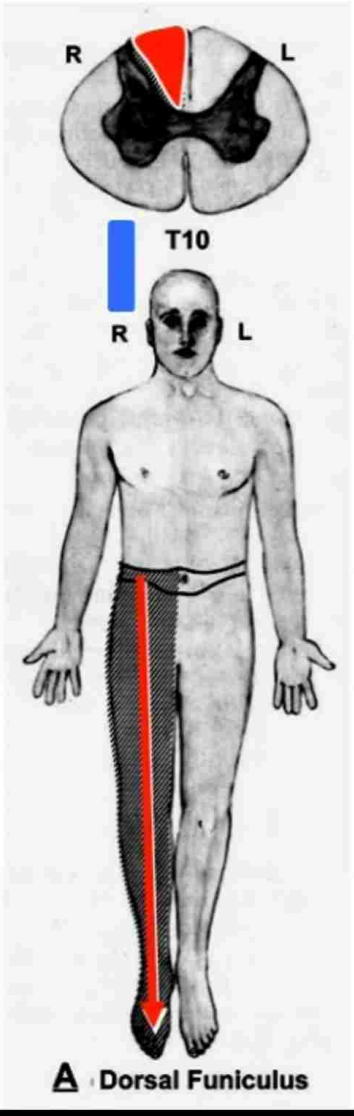
Lesion in the Dorsal Funiculus (Gracile or Cuneate Tract)

Loss of:
1. Fine touch
2. Proprioception
3. Sense of vibration

On the SAME SIDE

Below the level of the lesion

Lesion in the Medial Lemniscus !!!



UNCONSCIOUS PROPRIOCEPTION

DORSAL SPINOCEREBELLAR TRACT

- Sensation from trunk and Lower Limb
- Arises from Clark's nucleus (lamina VII)
- Reaches cerebellum via Inferior Cerebellar Peduncle

VENTRAL SPINOCEREBELLAR TRACT

- Sensation from Lower Limb
- Arises from the spinal border cells (L2 – S2; lamina VII)
- Reaches cerebellum via Superior Cerebellar Peduncle

CUNEOCEREBELLAR TRACT

- Sensation from Upper Limb
- Arises from the accessory cuneate nucleus in the medulla
- Reaches cerebellum via Inferior Cerebellar Peduncle

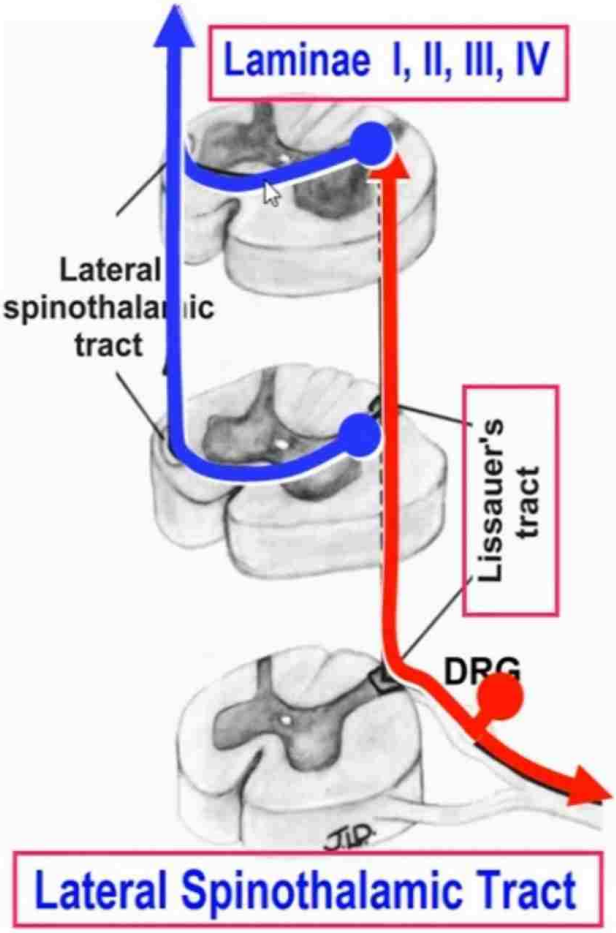
FUNCTION OF THE ABOVE TRACTS

Convey information from muscles to the cerebellum for coordination

LESION OF THE ABOVE TRACTS

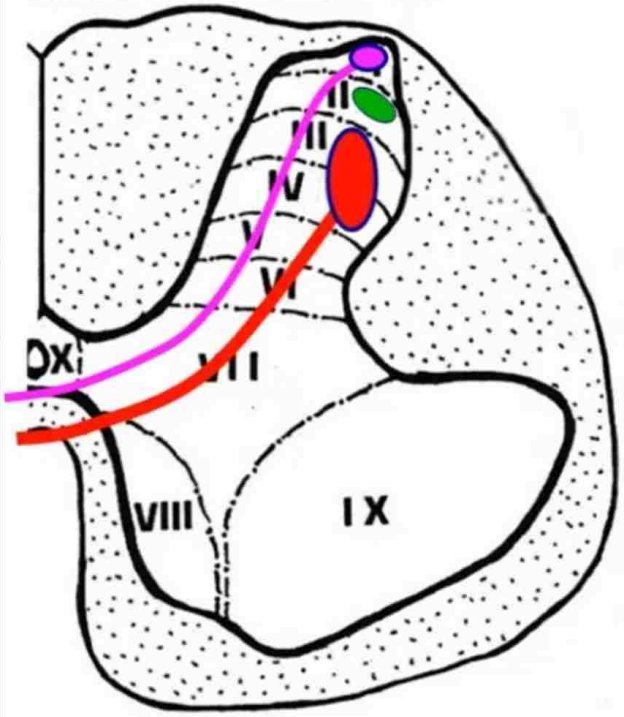
- Ataxia: loss of muscle coordination

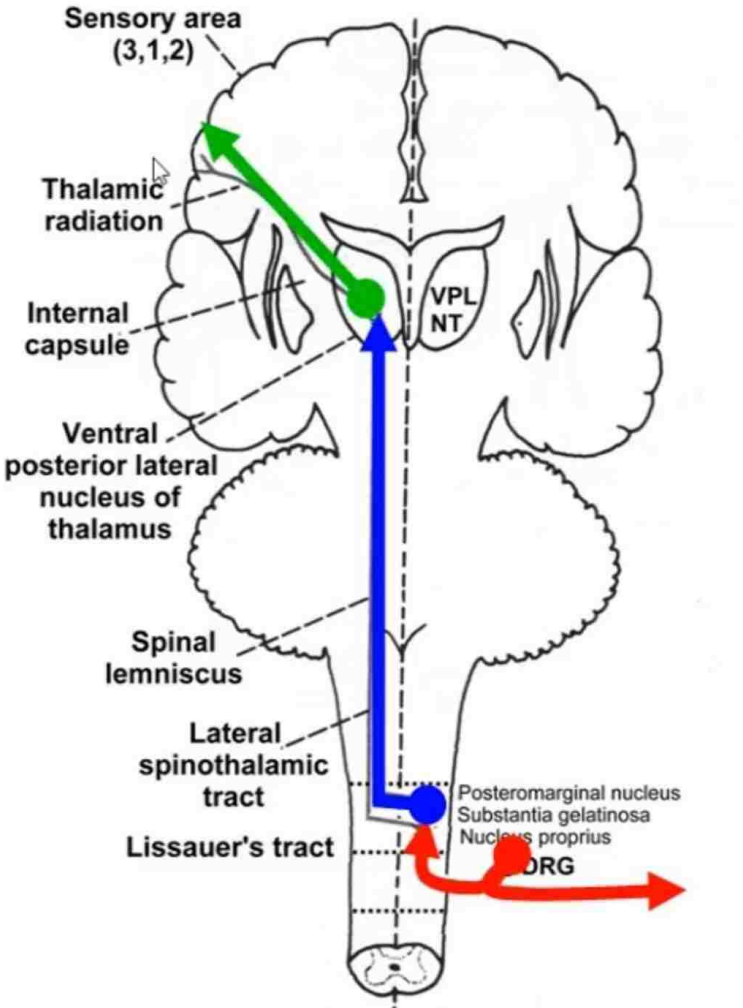
PATHWAY OF PAIN & TEMP



- ❑ **Receptors:**
- ❑ **Pain fibers:** A-delta (acute fast pain) & C (slow chronic)
- ❑ **Tract:** Lat spinothalamic
- ❑ **1st order - N:** DRG
- ❑ **2nd order - N:** PMN, SGR, MSN
- ❑ **3rd order - N:** VPLNT

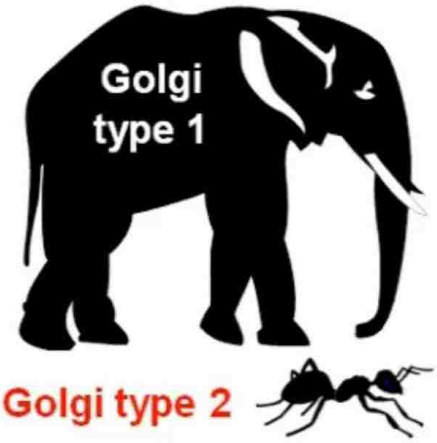
PAIN & TEMP SENSATION

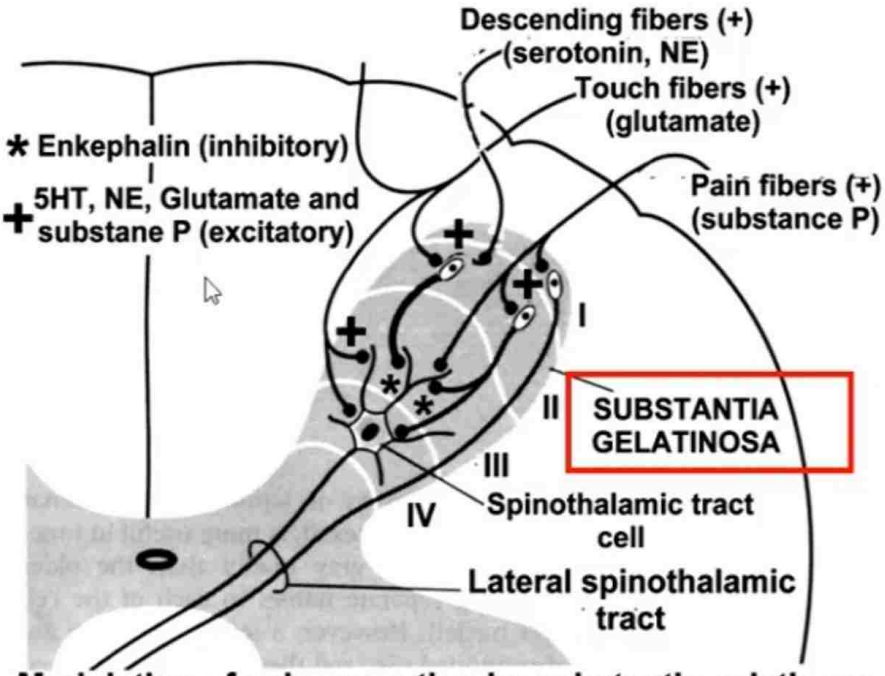




PATHWAY OF PAIN AND TEMPERATURE

Function of Substantia Gelatinosa





Modulation of pain sensation by substantia gelatinosa by the influence of descending fibers and touch fibers

Cerebral Cortex ➡ + NE

Raphe Magnus ➡ + Ser

Touch Fibers ➡ + Gluta

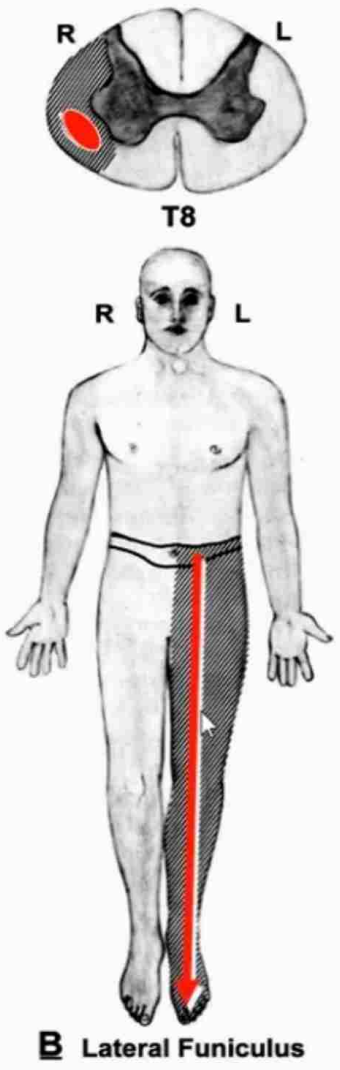
SG

➡ Release Enkephalins

⬇ Release of substance P

⬇ Synaptic transmission

Lesion in the Lateral Spinothalamic Tract



Loss of:

Pain and Temperature sensation

On the OPPOSITE SIDE

2 segments below the level of the lesion

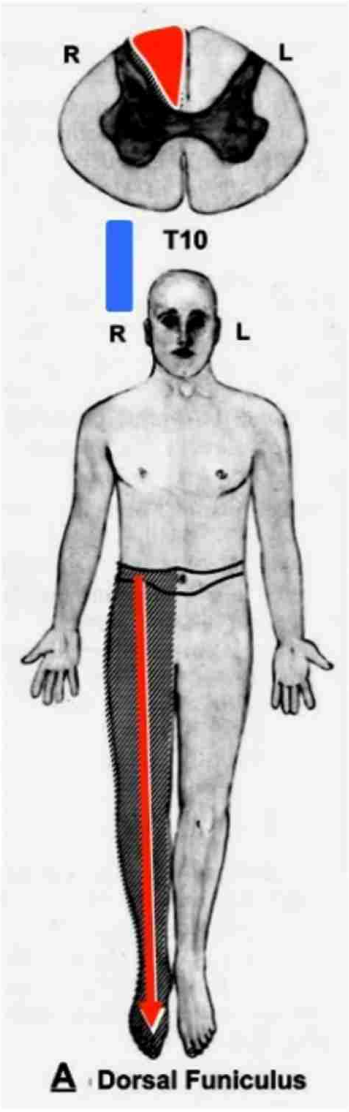
Lesion in the Dorsal Funiculus
(Gracile or Cuneate Tract)

Loss of:
1. Fine touch
2. Proprioception
3. Sense of vibration

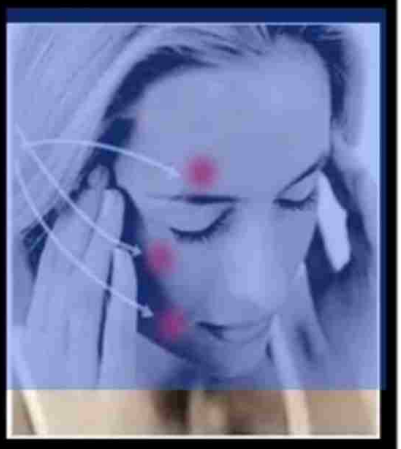
On the SAME SIDE

Below the level of the lesion

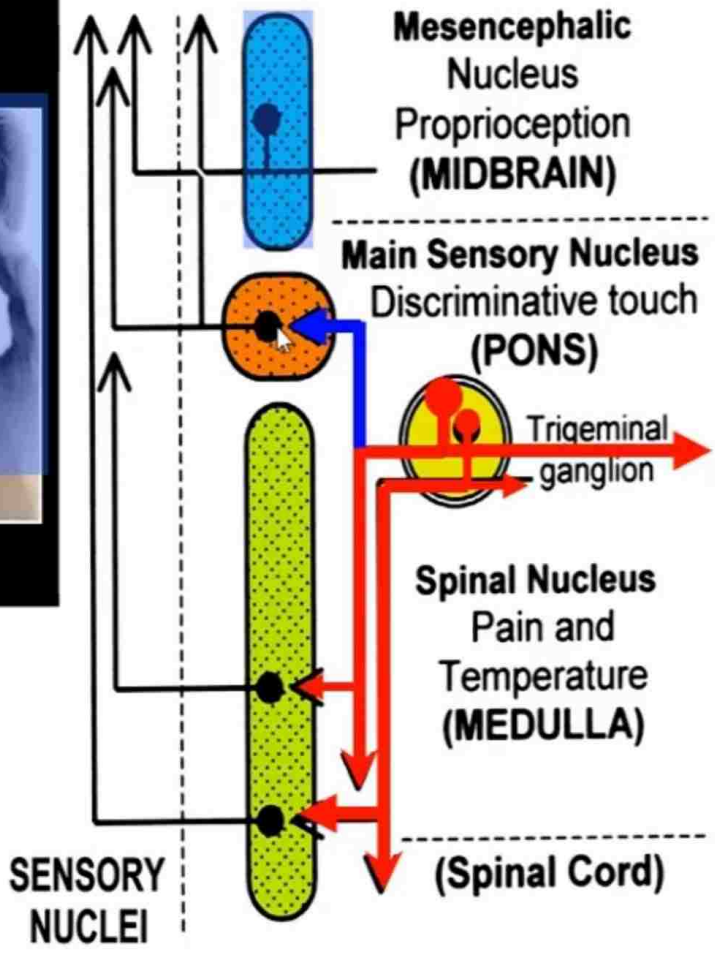
Lesion in the Medial Lemniscus !!!



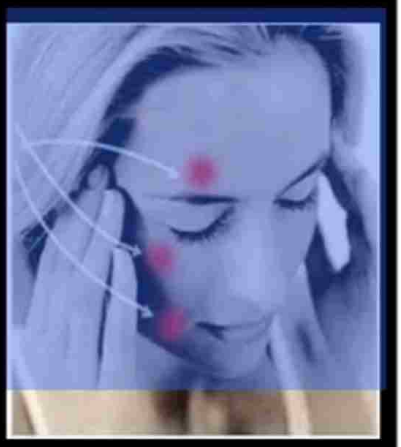
SENSORY PATHWAY From the FACE



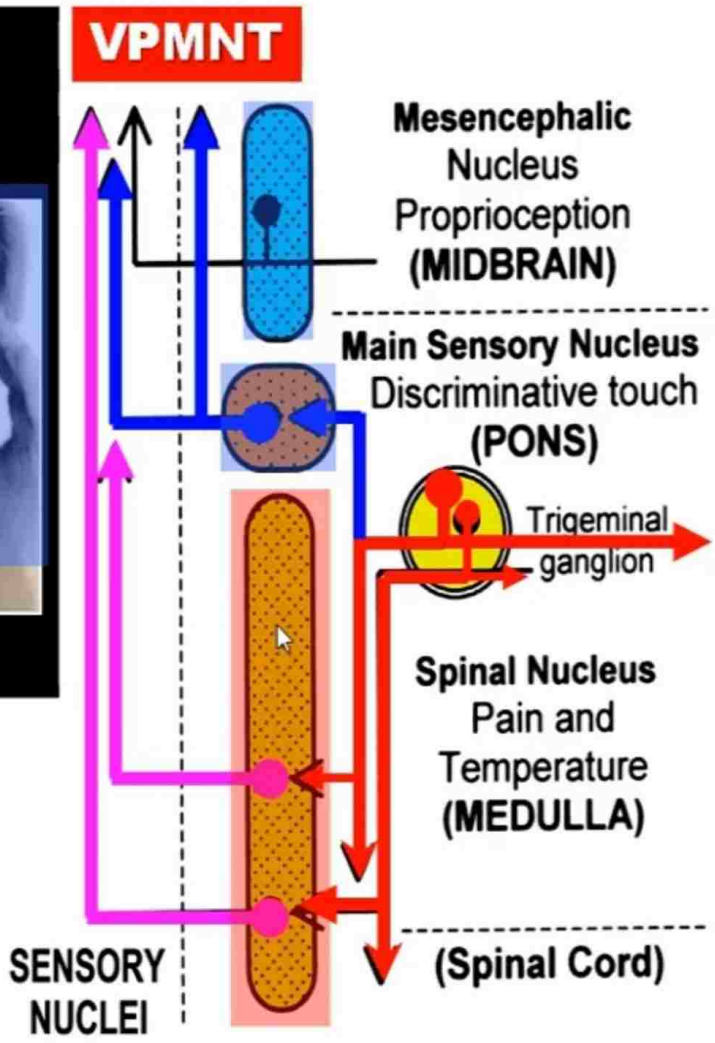
3 ORDER NEURONS



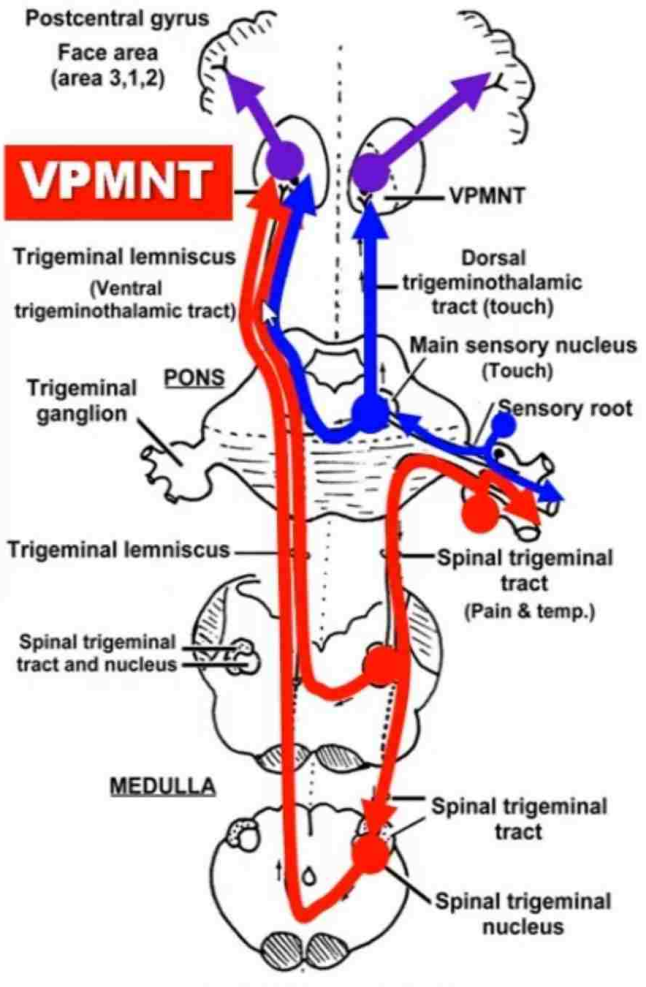
SENSORY PATHWAY From the FACE



3 ORDER NEURONS



PAIN, TEMPERATURE, TOUCH FROPM THE FACE



TRIGEMINAL PATHWAY
(PAIN, TEMPERATURE AND TOUCH SENSATIONS)

What is Proprioception or Kinesthesia?

Sense of movement
Awareness that the body is moving

Sense of position
Awareness of the position of the body

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PROPRIOCEPTION

CONSCIOUS
To the Cerebral Cortex

UNCONSCIOUS
To the Cerebellum

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Gracile Tract: below T6

Cuneate Tract: above T6

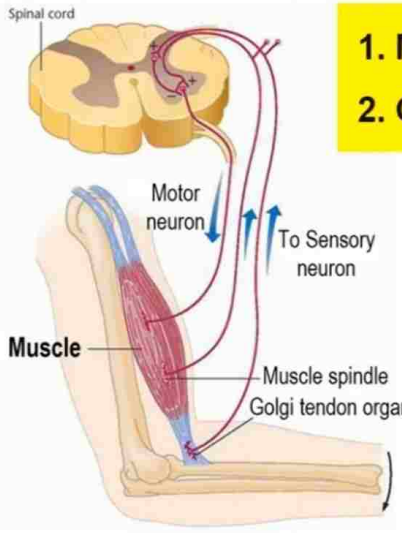
Dorsal Spinocerebellar Tract

Ventral Spinocerebellar Tract

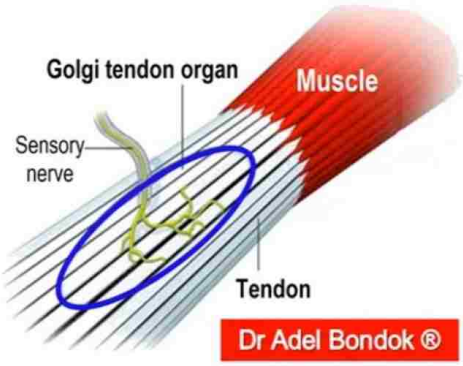
Cuneocerebellar Tract

Conscious Proprioception Pathway

Sensory Receptors



1. Muscle spindles
2. Golgi tendon organs (GTO)



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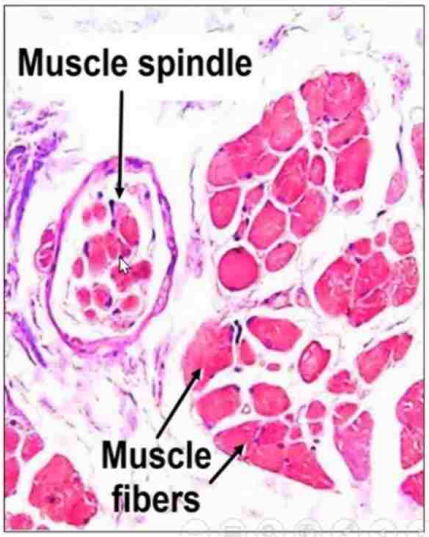
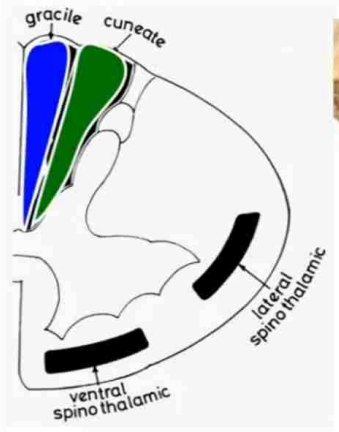
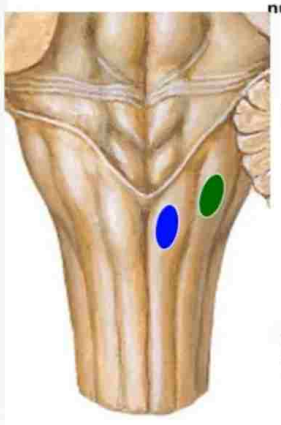
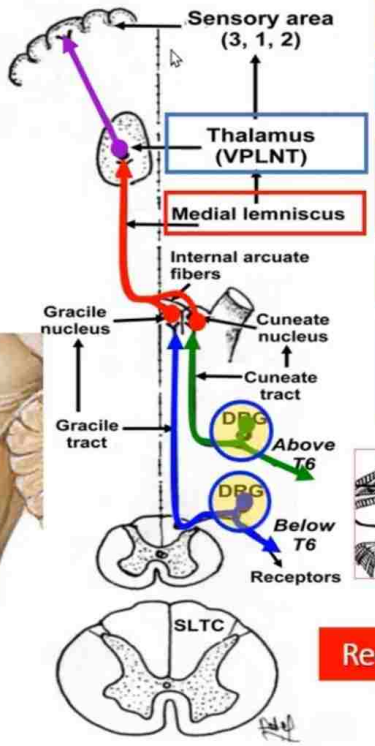


Pathway of Proprioception







Tract: GT & CT

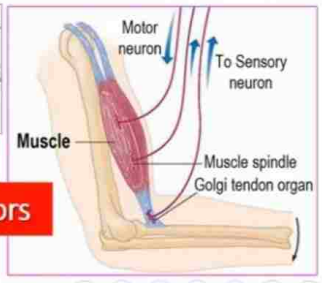
1st O-N: DRG

2nd O-N: Gracile and cuneate nuclei

3rd O-N: VPLNT

General sensory area: Postcentral gyrus

Receptors



Effect of Lesion in the Dorsal Funiculus
(Gracile or Cuneate Tract)
What is lost & where is the loss?

Loss of:

1. Proprioception (sense of movement & position
2. Fine (discriminative) touch
3. Sense of vibration

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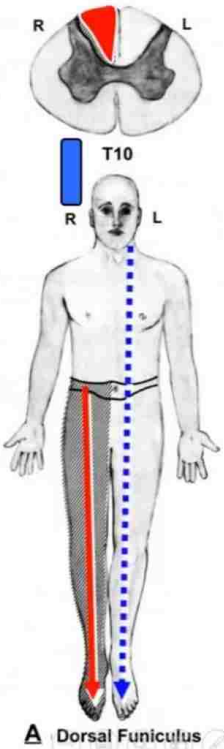
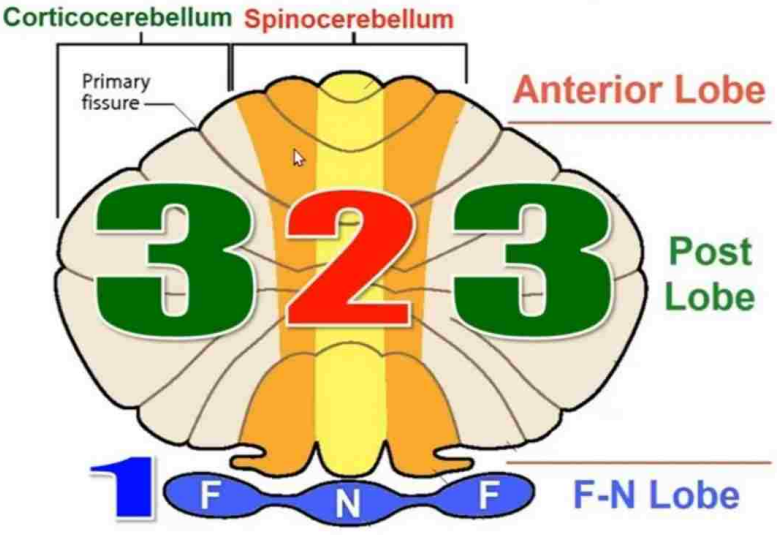
On the SAME SIDE

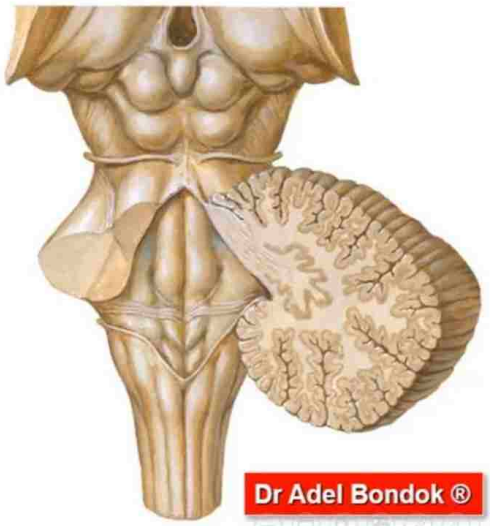
Below the level of the lesion

Lesion in the Medial Lemniscus !!!



Unonscious Proprioception
To the cerebellum





Tracts For Unconscious Proprioception

Dorsal Spinocerebellar Tract

- Sensation from trunk and Lower Limb
- Arises from Clarke's nucleus (lamina VII)
- Reaches cerebellum via the Inferior Cerebellar Peduncle

Ventral Spinocerebellar Tract

- Sensation from Lower Limb
- Arises from the spinal border cells (L2 – S2; lamina
- Reaches cerebellum via the Superior Cerebellar Peduncle

Cuneocerebellar Tract

- Sensation from Upper Limb
- Arises from the accessory cuneate nucleus in the medulla
- Reaches cerebellum via the Inferior Cerebellar Peduncle

Function of the Above Tracts

Convey information from muscles to the cerebellum for coordination

Lesion Of the Above Tracts

- Ataxia: loss of muscle coordination

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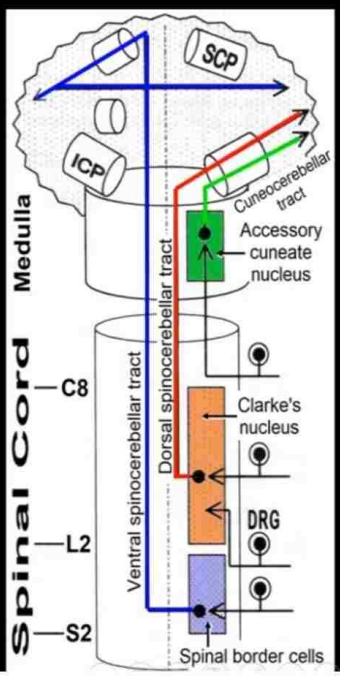

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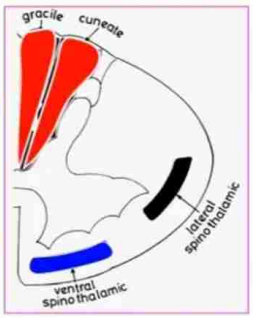
TOUCH

Simple Touch

Light / Crude



Fine Touch

Discriminative

Ventral Spinothalamic Tract

Gracile Tract: below T6

Cuneate Tract: above T6

Fine Touch Discriminative Touch

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Tactile localization

Localization of which part of the skin has been touched

2-point discrimination

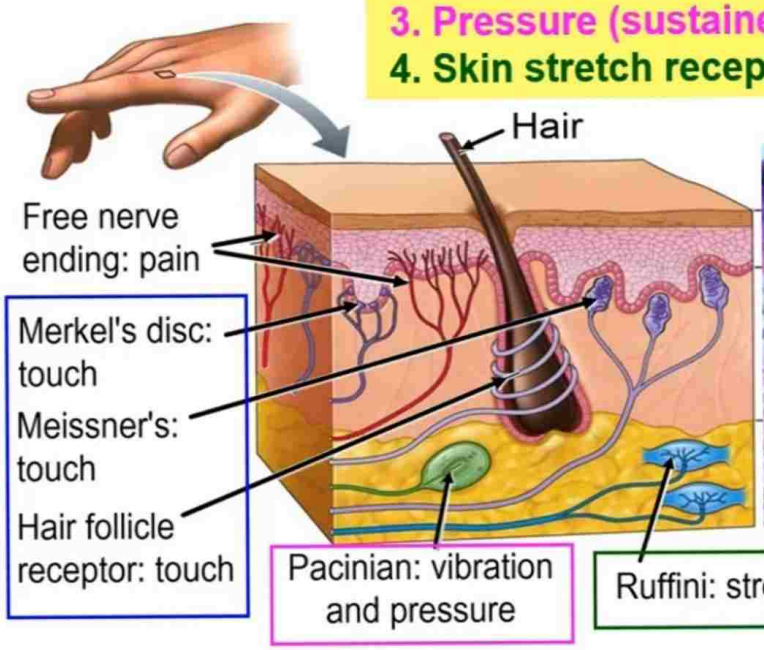
Identify if 1 or 2 points on the skin are being stimulated

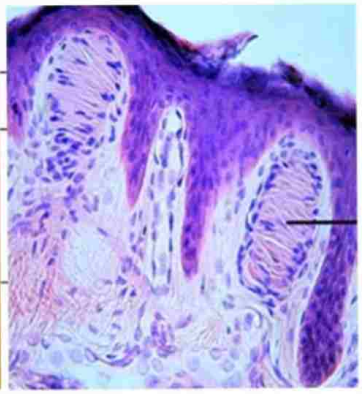
Stereognosis

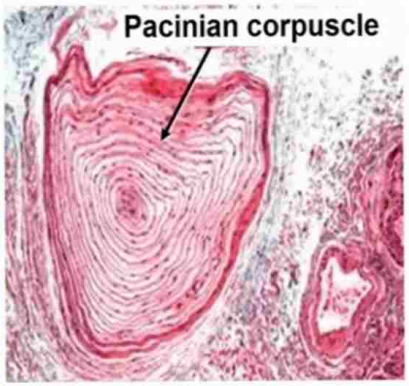
Recognition of the objects by sense of touch

Touch & Pressure Receptors

1. **Fine touch:** Meissner's corpuscle
2. **Simple (crude) touch:** Merkel's disc, hair follicle receptor
3. **Pressure (sustained touch):** Pacinian corpuscle
4. **Skin stretch receptors:** Ruffini corpuscle







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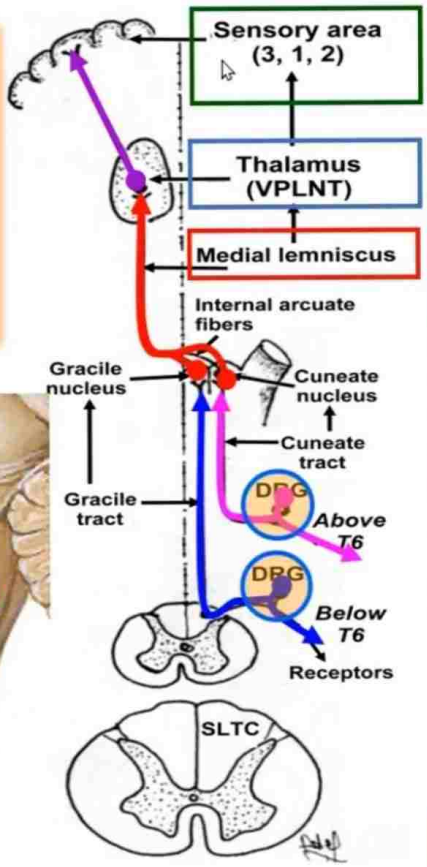
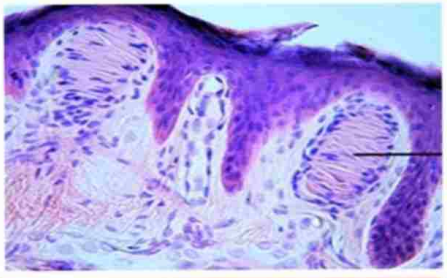
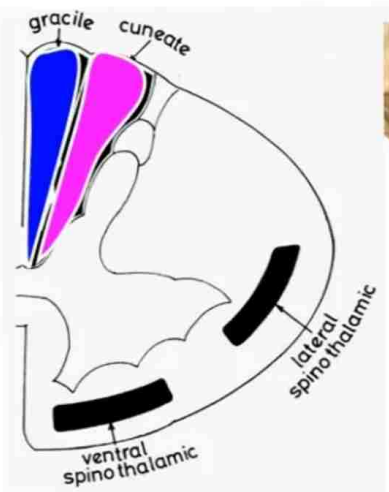
Pathway of Fine Touch



- Tract: GT & CT
- 1st O-N: DRG
- 2nd O-N: Gracile and cuneate nuclei
- 3rd O-N: VPLNT
- General sensory area: Postcentral gyrus (3,1,2) ➡ somatosensory association area (5, 7)



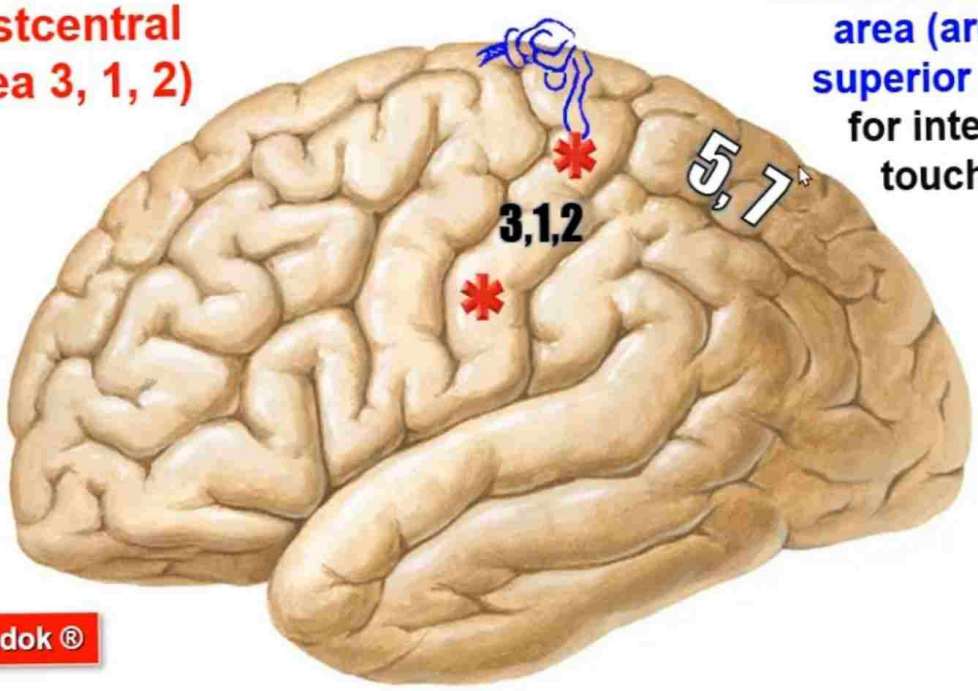
Receptors



Where is the General Sensory Area?

In the postcentral gyrus (area 3, 1, 2)

Somatosensory association area (area 5, 7) in the superior parietal lobule for interpretation of touch sensation



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Effect of Lesion in the Dorsal Funiculus

(Gracile or Cuneate Tract)

What is lost & where is the loss?

Loss of:

1. Proprioception (sense of movement & position)
2. Fine (discriminative) touch
3. Sense of vibration

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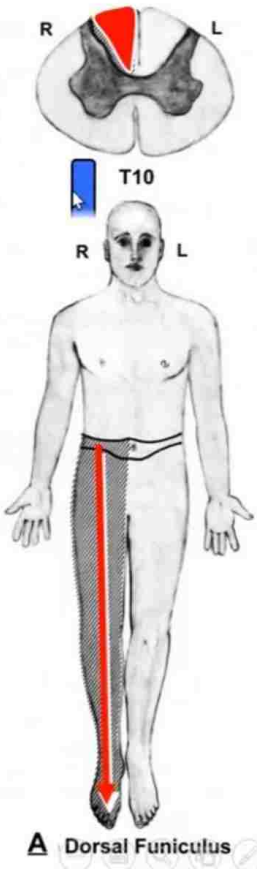
On the SAME SIDE

Below the level of the lesion

Lesion in the Medial Lemniscus !!!



Effect of Lesion in the Lateral Spinothalamic Tract

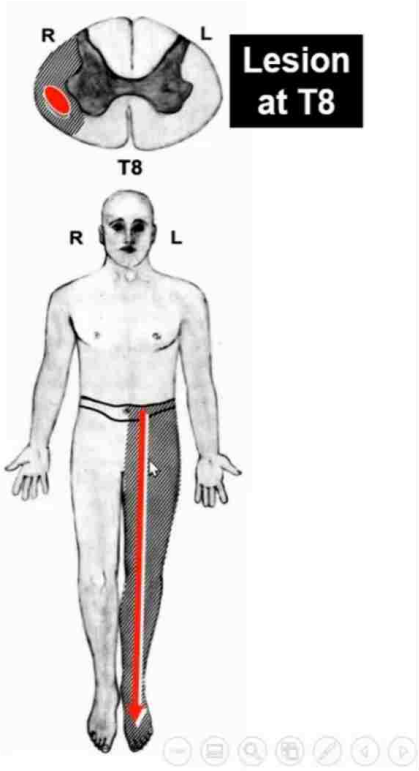
What is lost & where?

Loss of:

Pain and Temperature sensation

On the opposite side

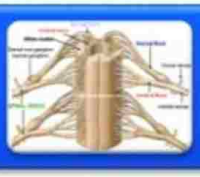
2 segments below the level of the lesion



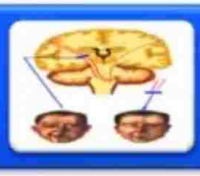
OBJECTIVES

Organization of the motor system

Origin of the UMN & LMN



Corticospinal tract

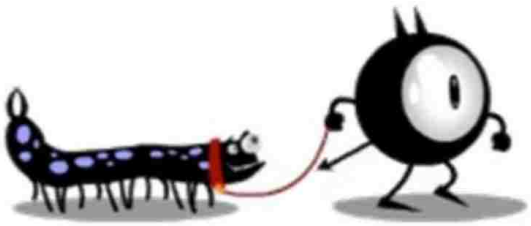


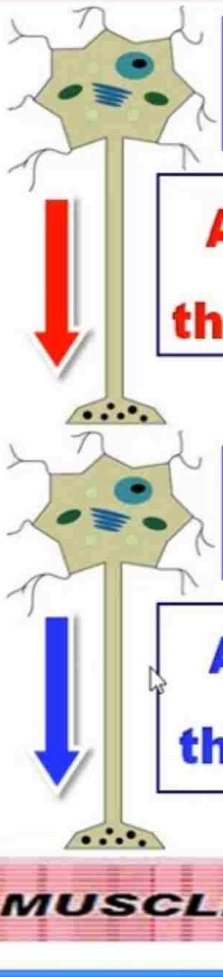
Corticobulbar tract

UMNL & LMNL

Organization of the UMN & LMN

Muscles are innervated by 2 neurons





1. UMN

Axons of UMN form the descending tracts

2. LMN

Axons of LMN form the peripheral nerves

MUSCLE

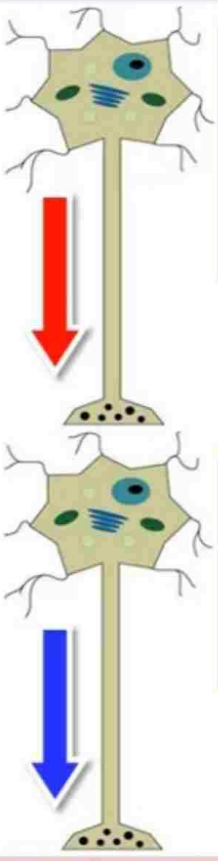
Location of the UMN & LMN

UMN is located in the brain:

1. Cerebral cortex
2. Brainstem nuclei like red nucleus & vestibular nuclei

LMN is located in the:

1. Spinal cord: muscles of the trunk & limbs
2. Brainstem: muscles of the head and neck

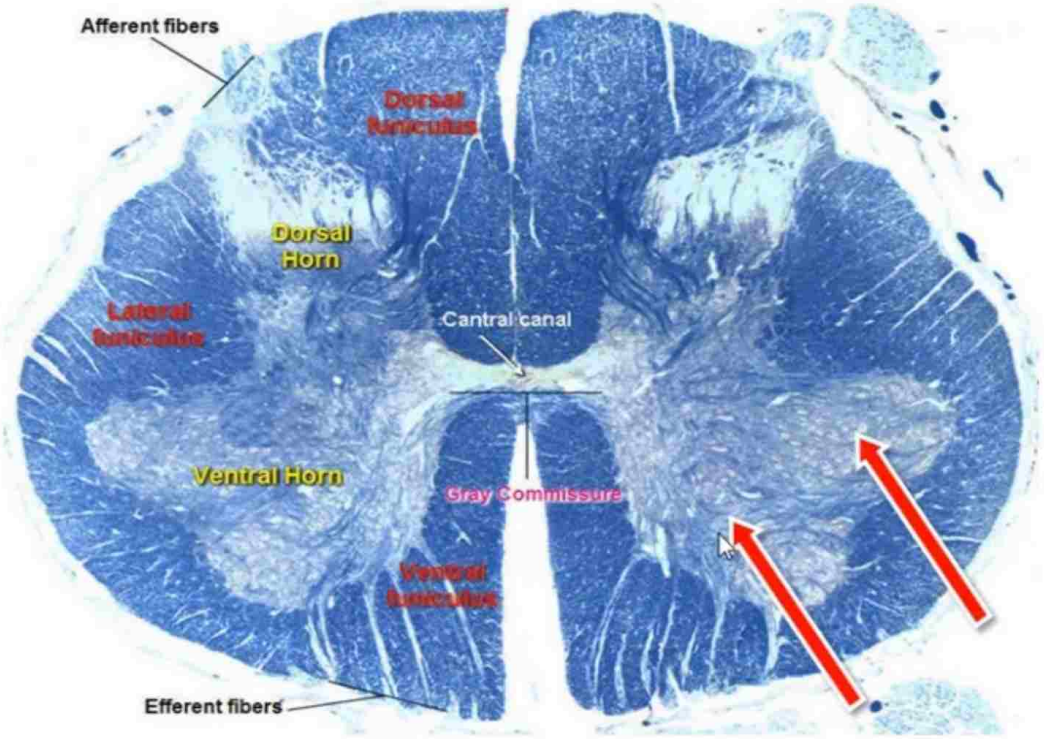


1 UMN

2 LMN

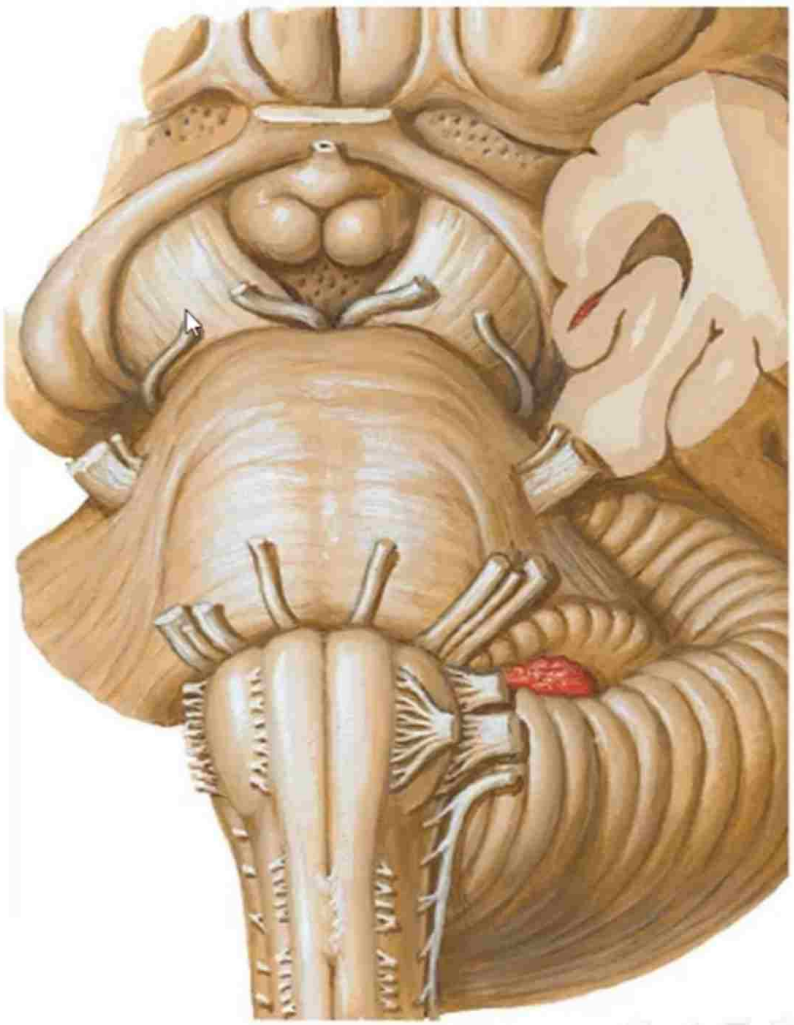
MUSCLE

Location of the LMN in the Spinal Cord: Anterior Horn Cells



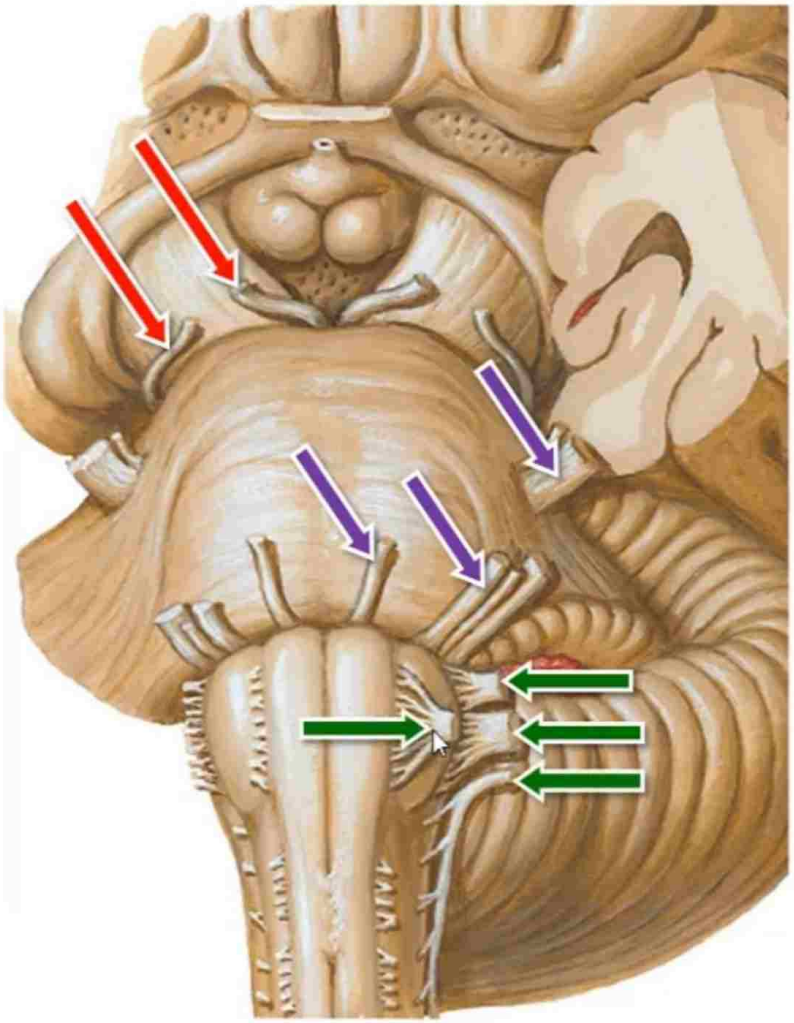
Location of the LMN in the Brainstem:

Cranial nerve motor nuclei



Location of the LMN in the Brainstem:

Cranial nerve motor nuclei

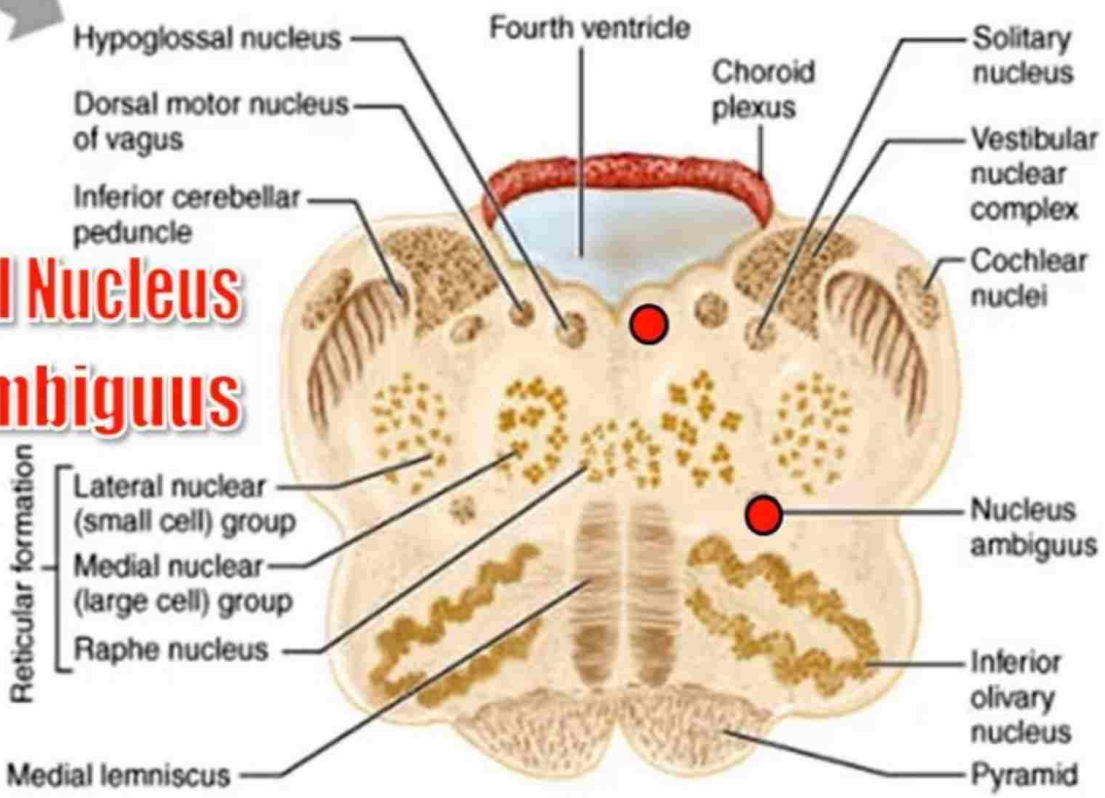


Motor Nuclei in the Medulla

Hypoglossal Nucleus

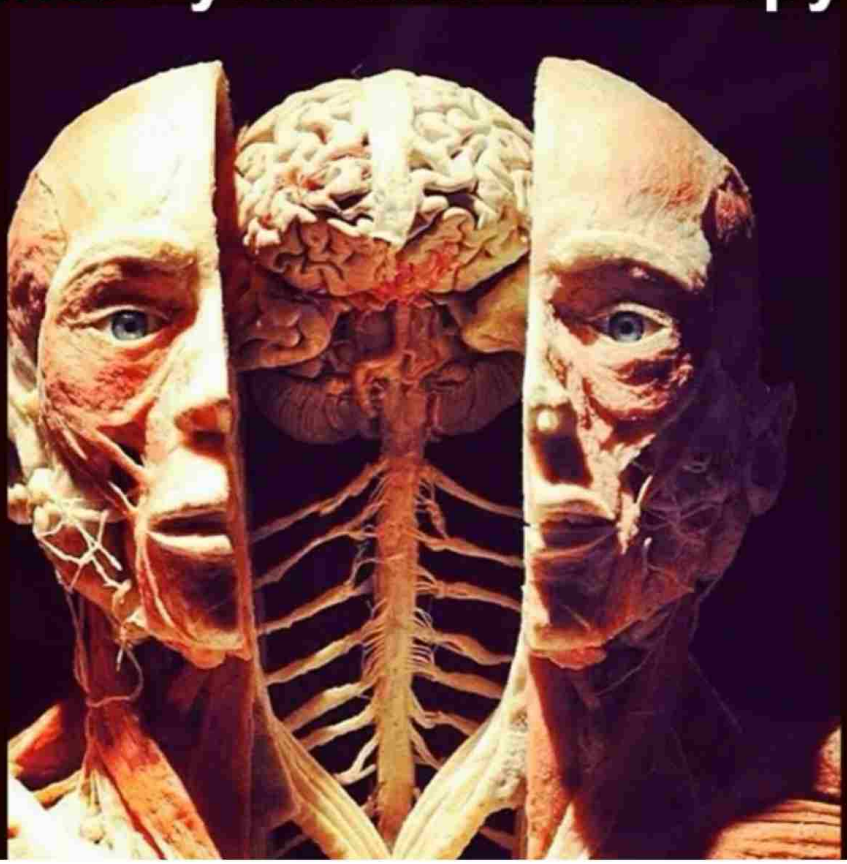
Nucleus ambiguus

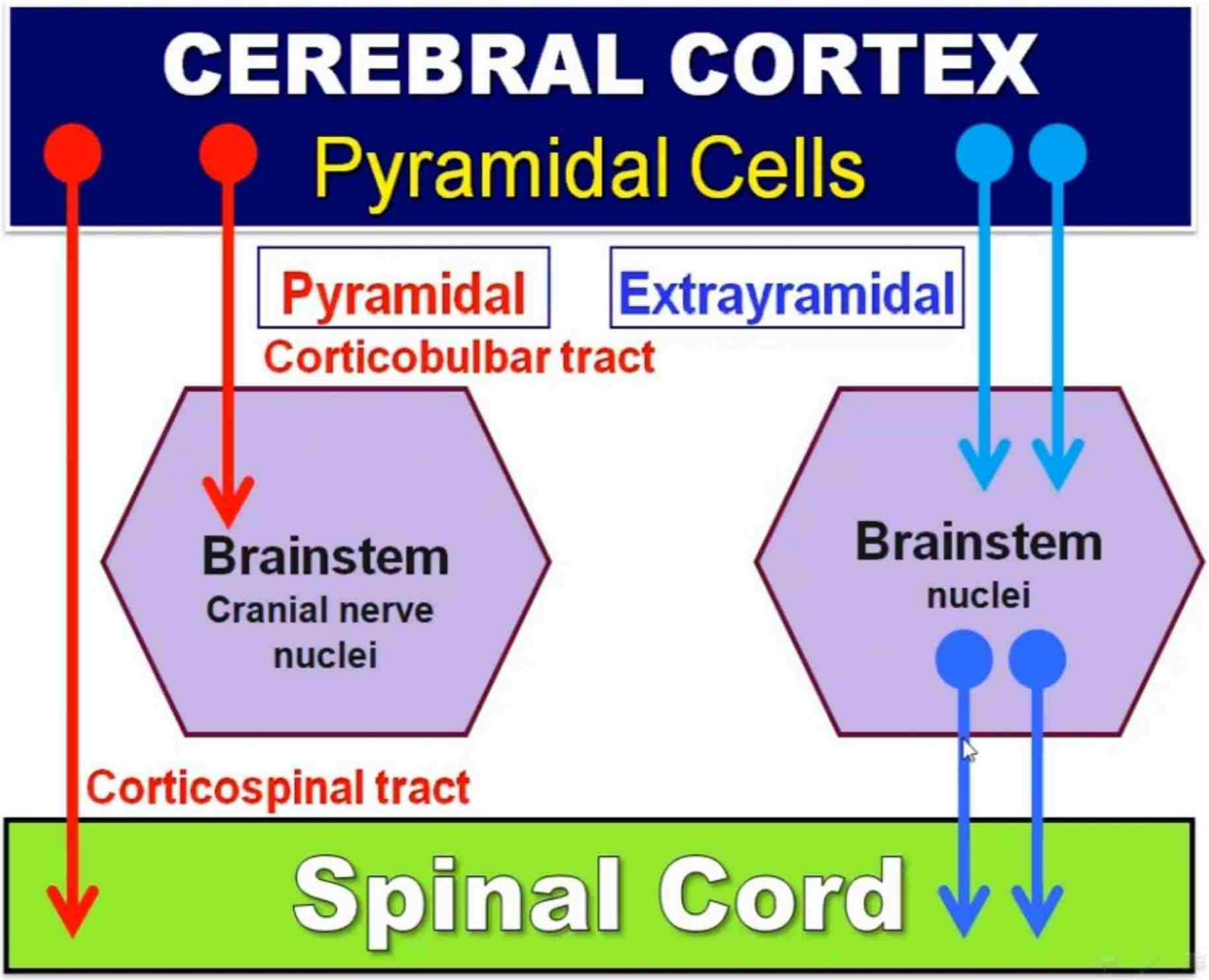
1. Pharynx
2. Larynx
3. Palate



Organization of the Motor System

2 Systems: Pyramidal & Extrapyramidal





ORIGIN OF DESCENDING TRACTS

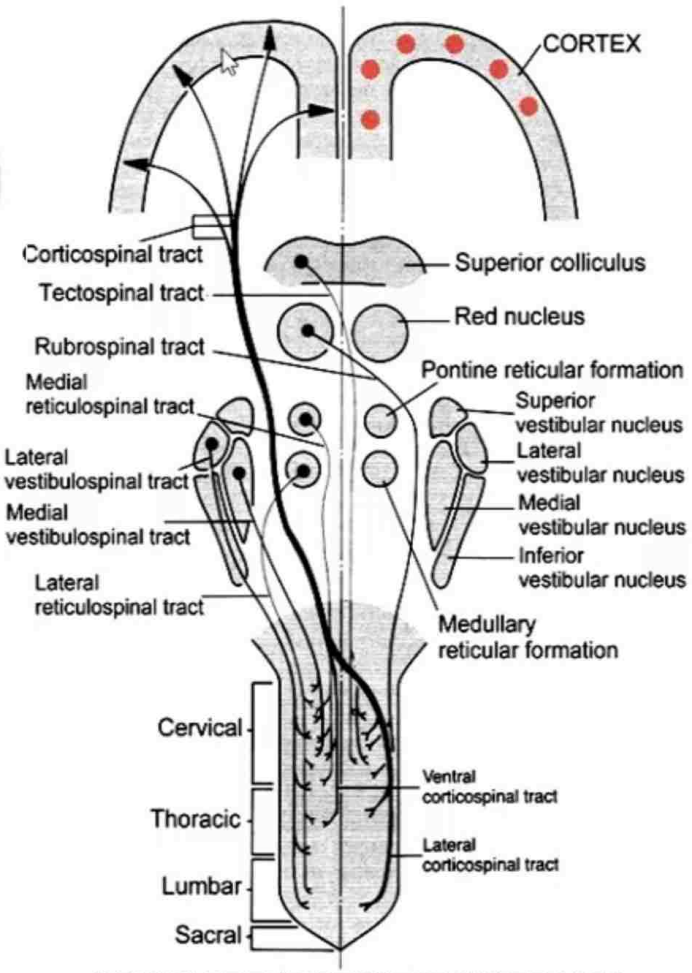
2 from cerebral cortex

2 from midbrain

2 from vestibular nuclei

2 from reticular formation

Descending autonomic fibers



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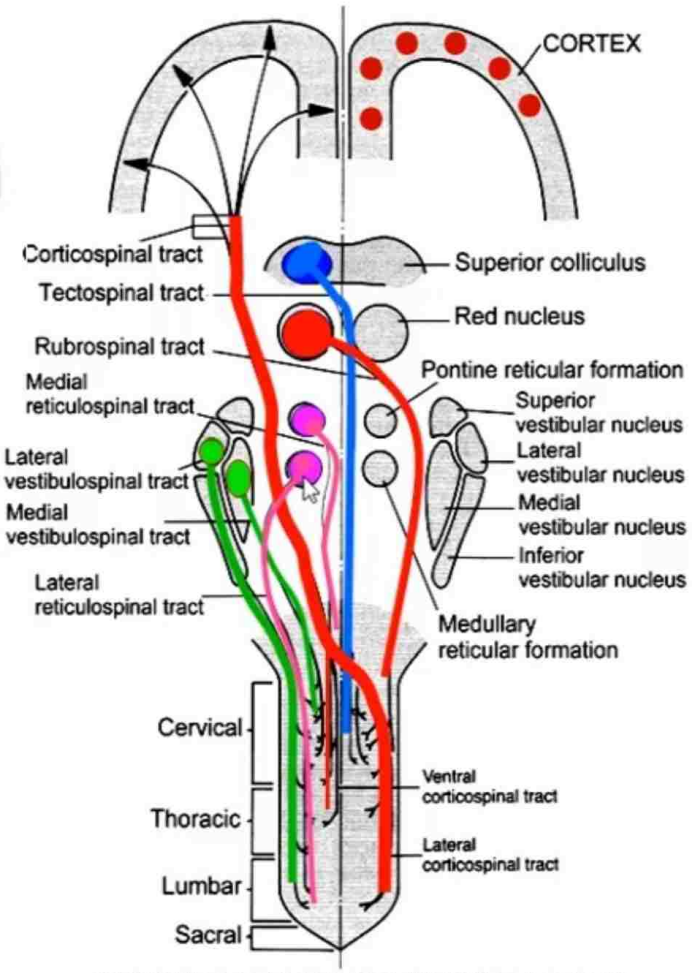


ORIGIN OF THE DESCENDING TRACTS

UMN DESCENDING TRACTS

2 Pyramidal Tracts:

1. Lateral corticospinal T: crossed
2. Ventral corticospinal T: direct

6 Extrapyramidal Tracts:

1. Rubrospinal tract: crossed
2. Tectospinal tract: crossed
3. Vestibulospinal tract (lateral)
4. Sulcomarginal tract (medial)
5. Medullary reticulospinal tract
6. Pontine reticulospinal tract

Origin
Termination
Function

FUNCTION OF THE DESCENDNG TRACTS

All facilitate flexor motor neurons **except** the 2 tracts arising from the pons:

1. Lateral vestibulospinal tract
2. Pontine (medial) reticulospinal tract

LESION OF THE DESCENDNG TRACTS

UMNL (Upper Motor Neuron Lesion)

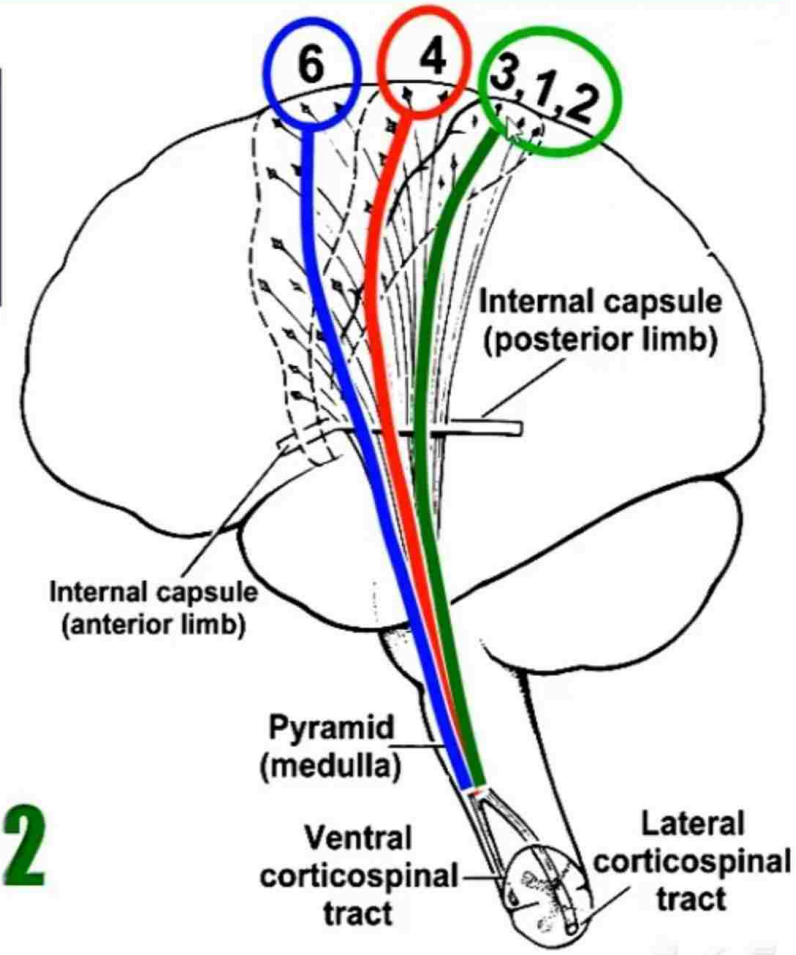
CORTICOSPINAL TRACT

ORIGIN

40%: Area 4

40%: Area 6

20%: Area 3, 1, 2



COURSE

⇒ corona radiata

⇒ posterior limb of int capsule

⇒ middle 3/5 of crus cerebri

⇒ basis pontis (pons)

⇒ pyramid (medulla):

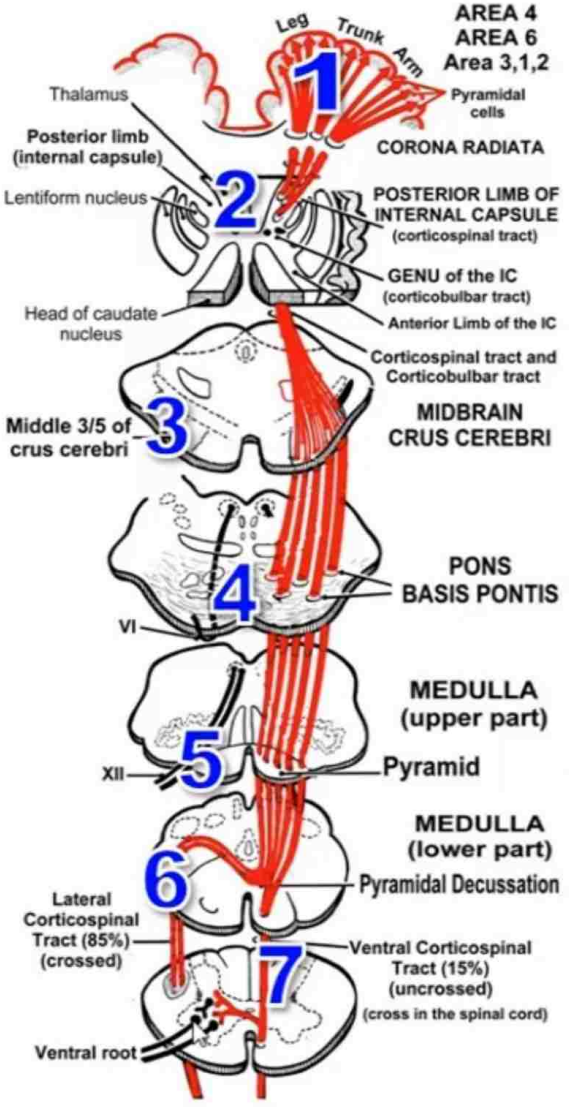
⇒ 85% cross to opposite side

⇒ 15% remain uncrossed

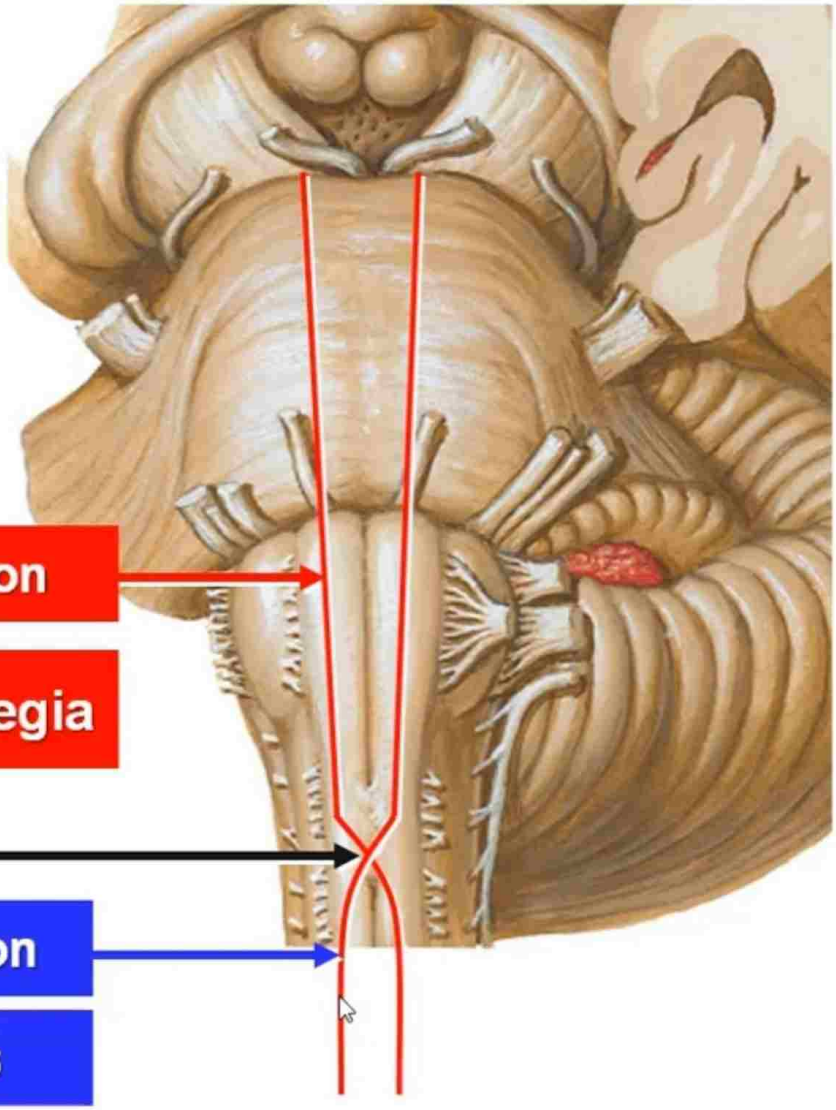
Termination:

Function:

Lesion: UMNL



LESION of CST



Above the decussation

Contralateral Hemiplegia

Below the decussation

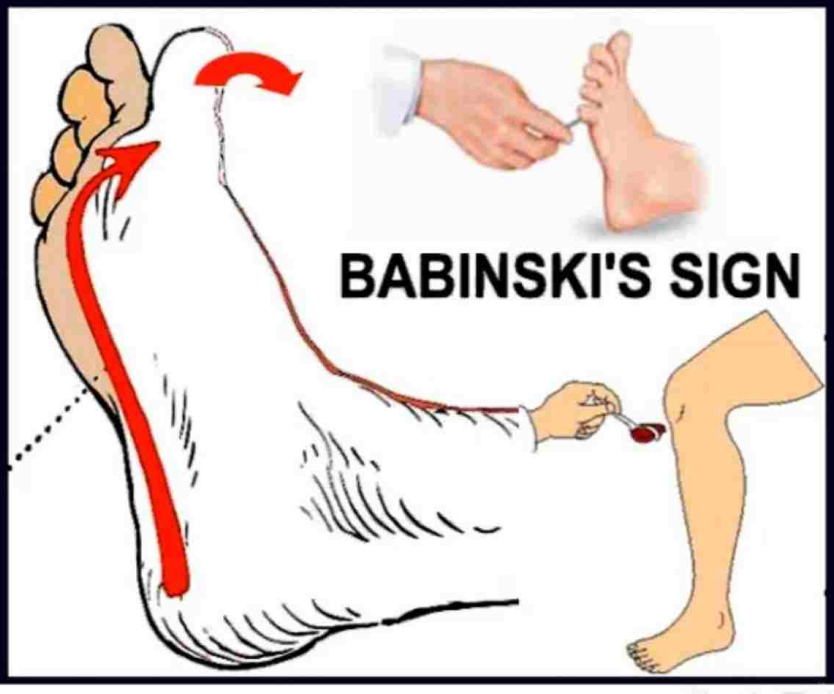
Ipsilateral Paralysis

SIGNS of UMNL

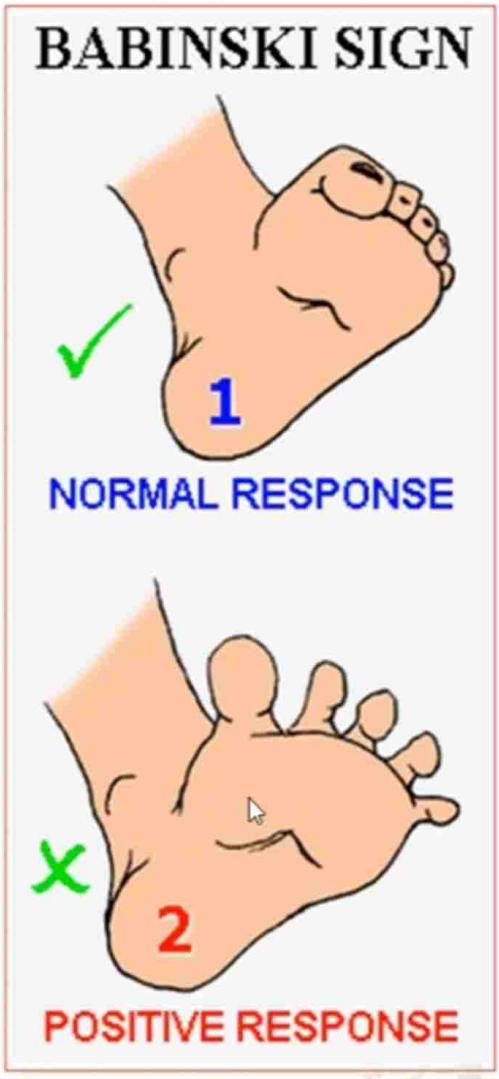
5 SIGNS

1. Hypertonia
2. Hyperreflexia
3. Spasticity
4. Babinski sign
5. Clonus

No atrophy



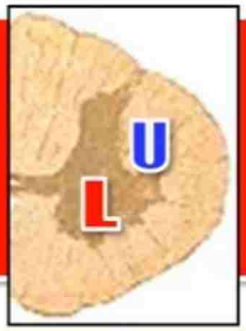
POSITIVE RESPONSE:
Dorsiflexion of the great toe with fanning of the remaining toes



BABINSKI SIGN

POSITIVE RESPONSE:
Dorsiflexion of the great toe with fanning of the remaining toes

LMNL



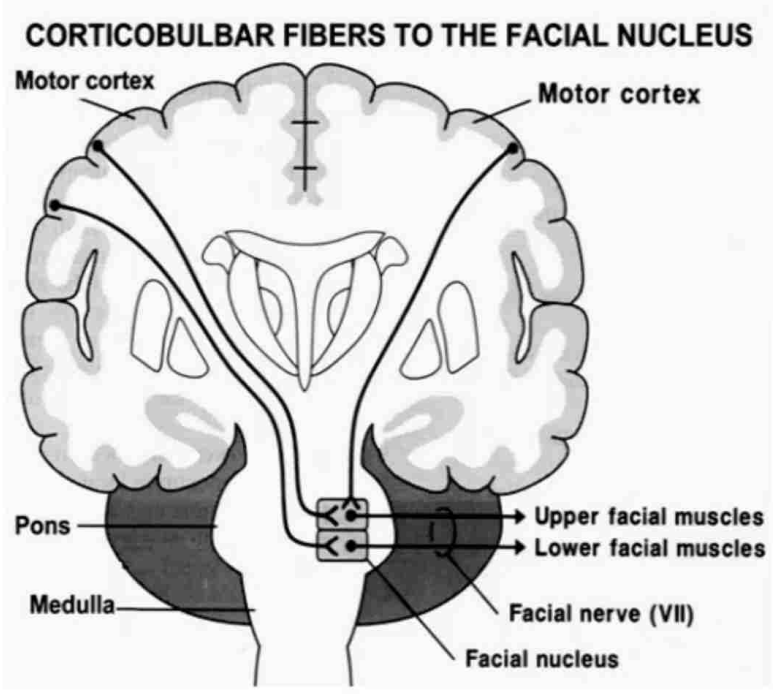
UMNL

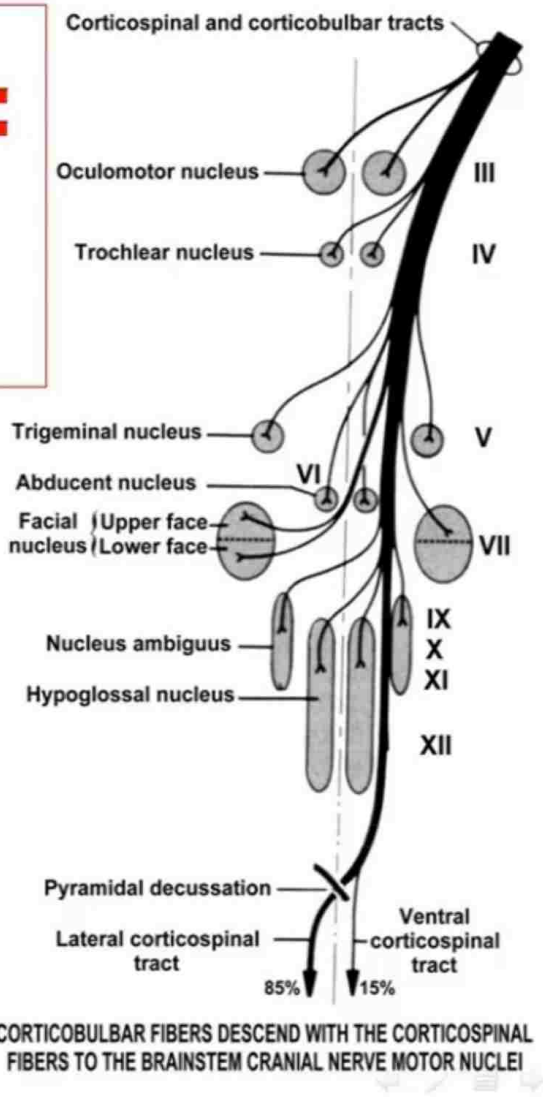
In ant horn cells or axons	In descending tracts
Hypotonia or atonia	Hypertonia
Hyporeflexia or areflexia	Hyperreflexia
Flaccidity	Spasticity
Fibrillation / fasciculation	Babinski sign
Atrophy of muscles	Clonus

CORTICO-BULBAR TRACT:

From the: cerebral cortex

To the: cranial nerve m nuclei





CORTICO-BULBAR TRACT:

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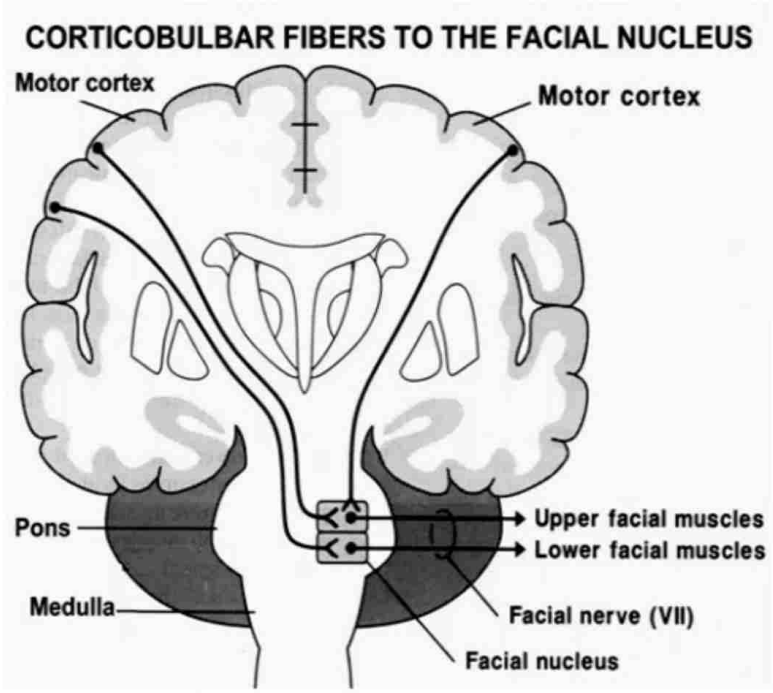
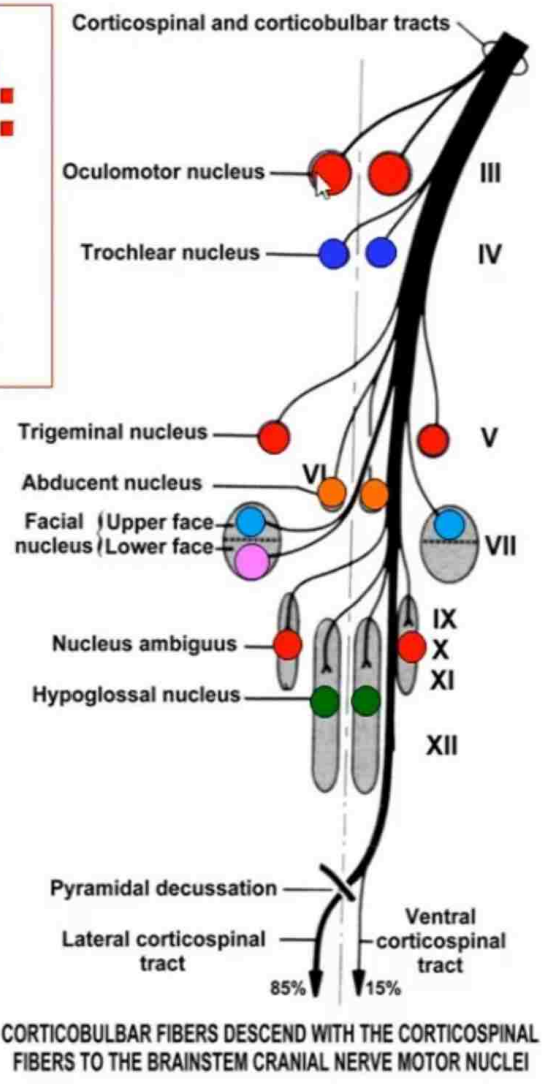


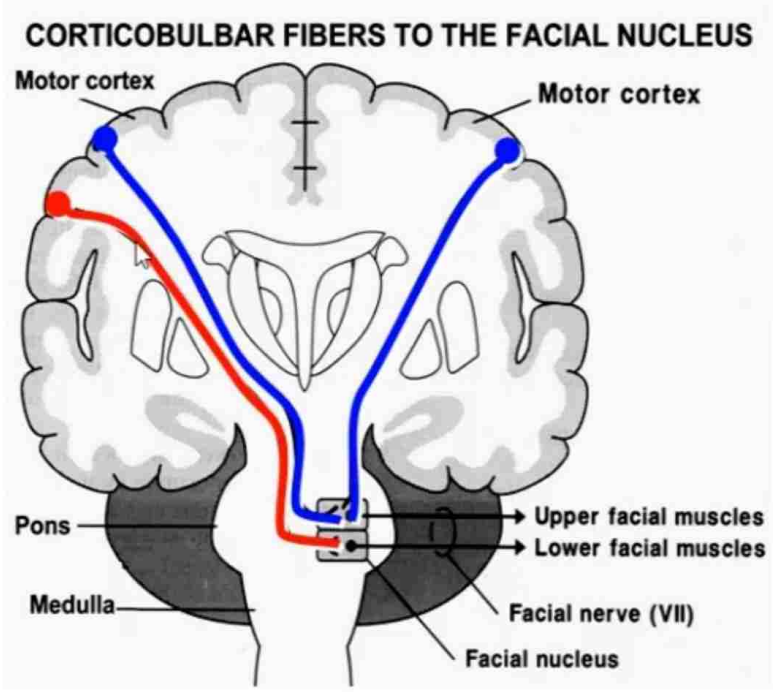


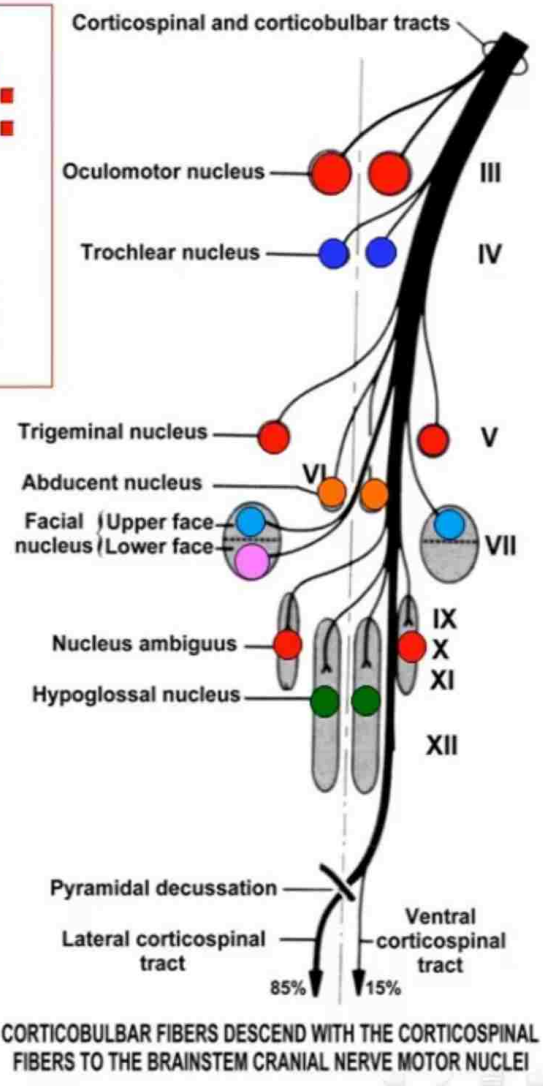
CORTICOBULBAR FIBERS DESCEND WITH THE CORTICOSPINAL FIBERS TO THE BRAINSTEM CRANIAL NERVE MOTOR NUCLEI

CORTICO-BULBAR TRACT:

From the: cerebral cortex

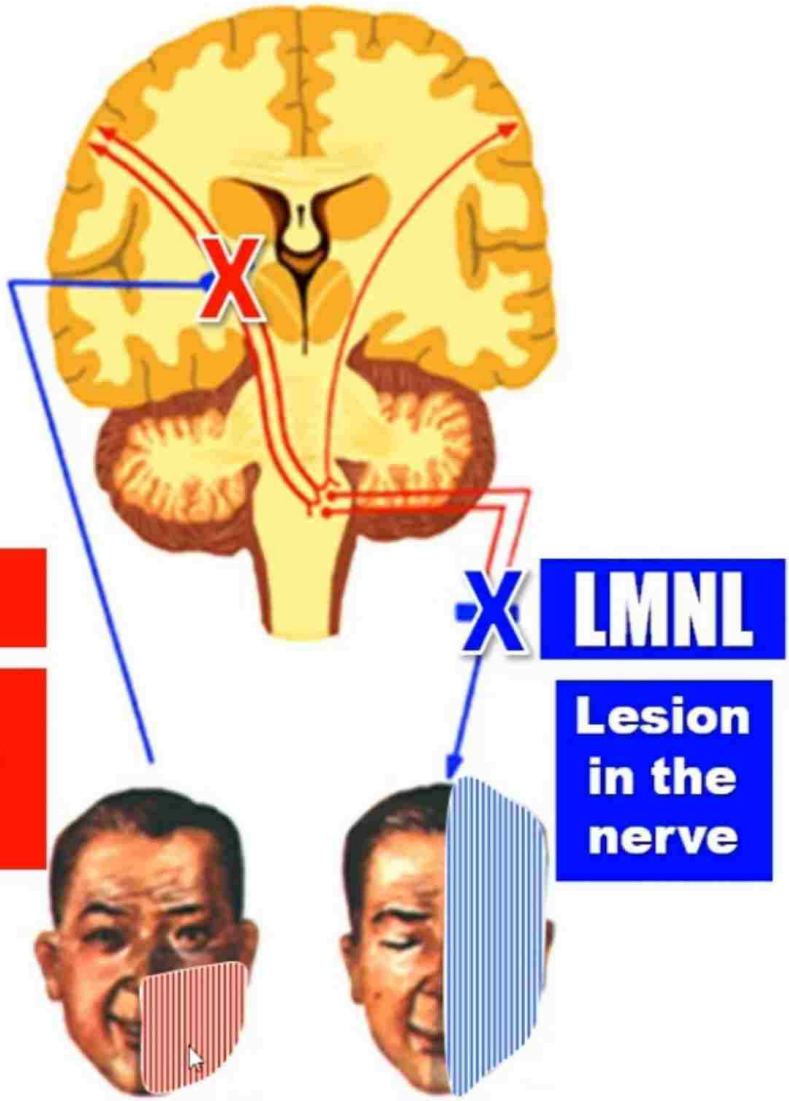
To the: cranial nerve m nuclei



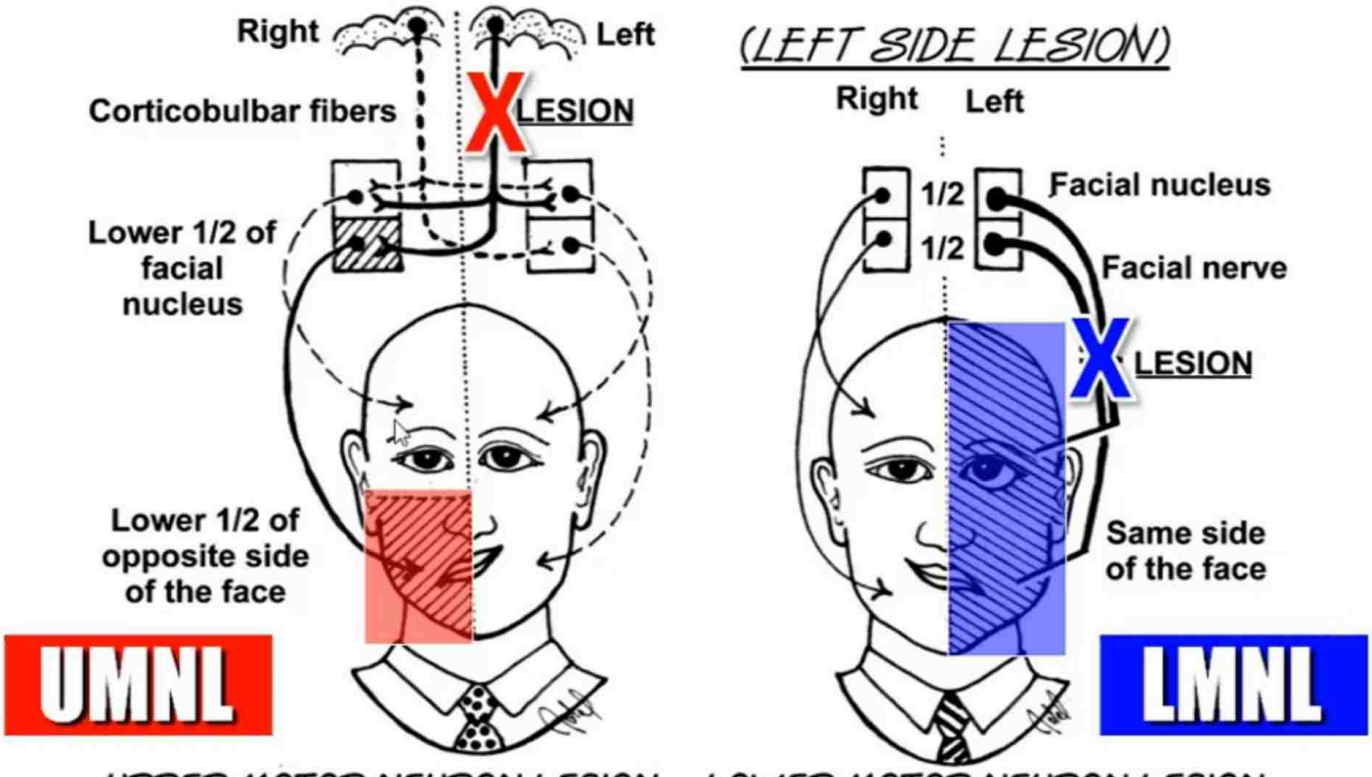


CORTICOBULBAR FIBERS DESCEND WITH THE CORTICOSPINAL FIBERS TO THE BRAINSTEM CRANIAL NERVE MOTOR NUCLEI

FACIAL NERVE LESIONS

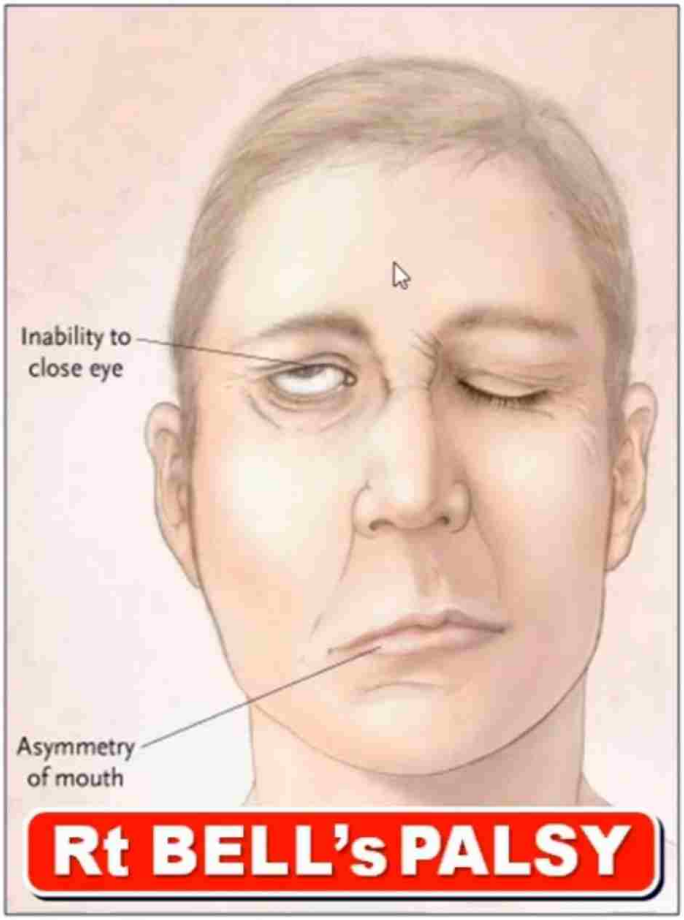


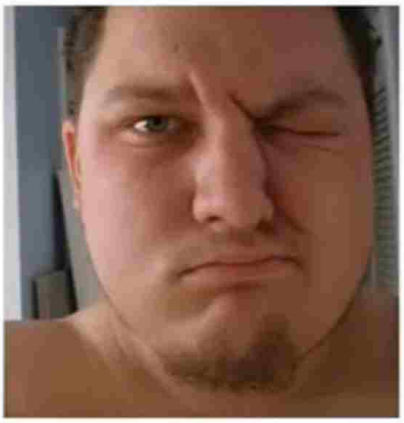
FACIAL NERVE LESIONS



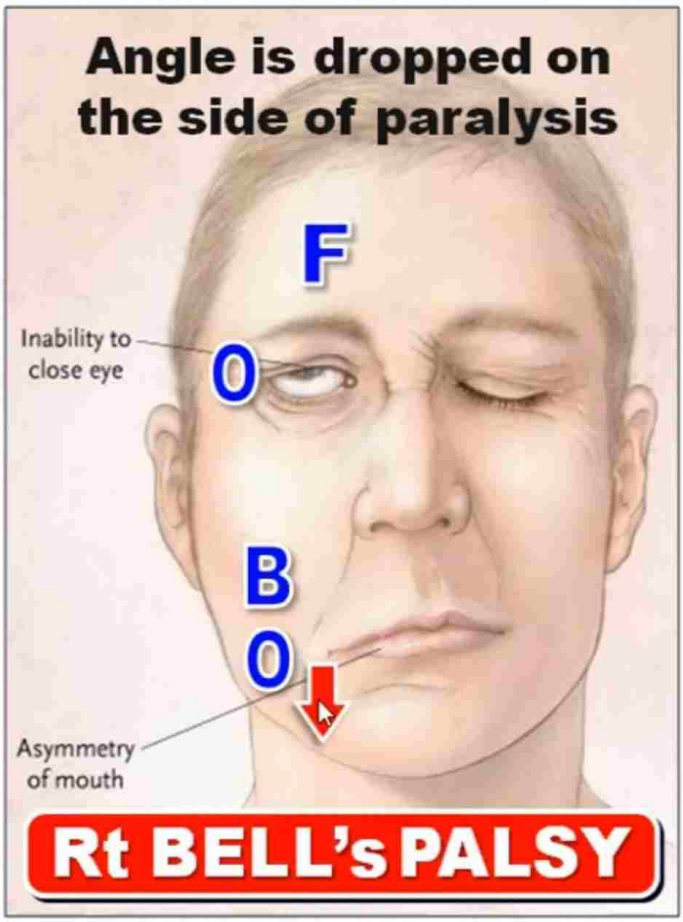
FACIAL NERVE LESIONS (UMNL and LMNL)

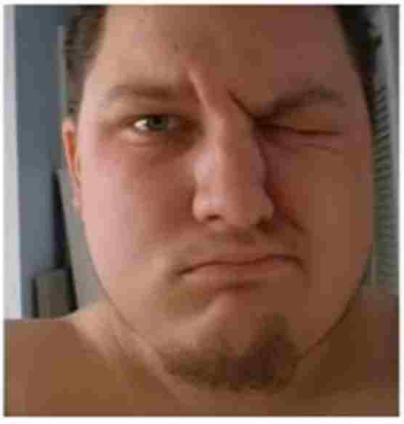
LMNL of FACIAL NERVE

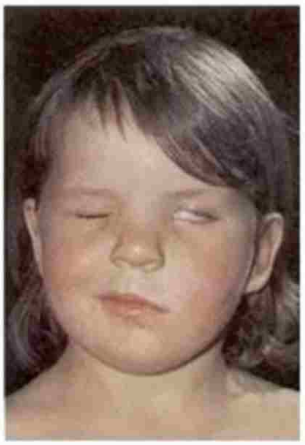




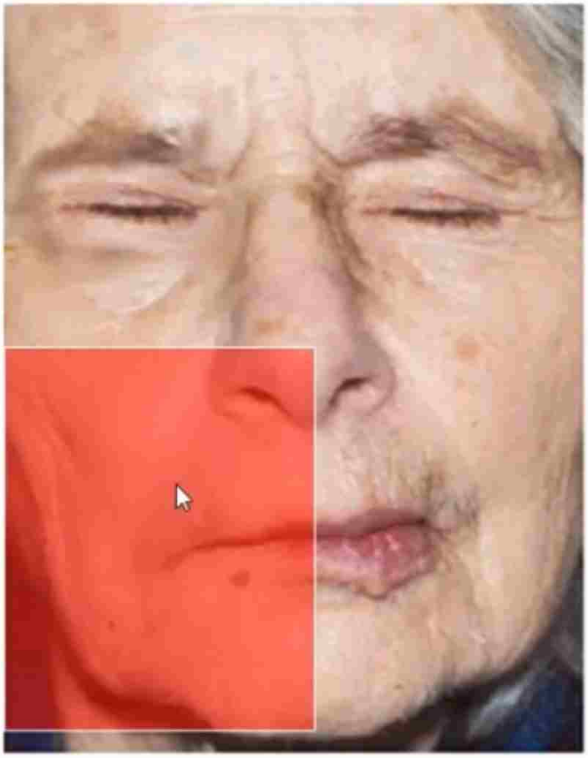
LMNL of FACIAL NERVE







UMNL & LMNL of the Facial Nerve



UMNL

LMNL

DESCENDING AUTONOMIC FIBERS

Origin:

1. **Reticular Formation:** visceral centers
2. **Hypothalamus**

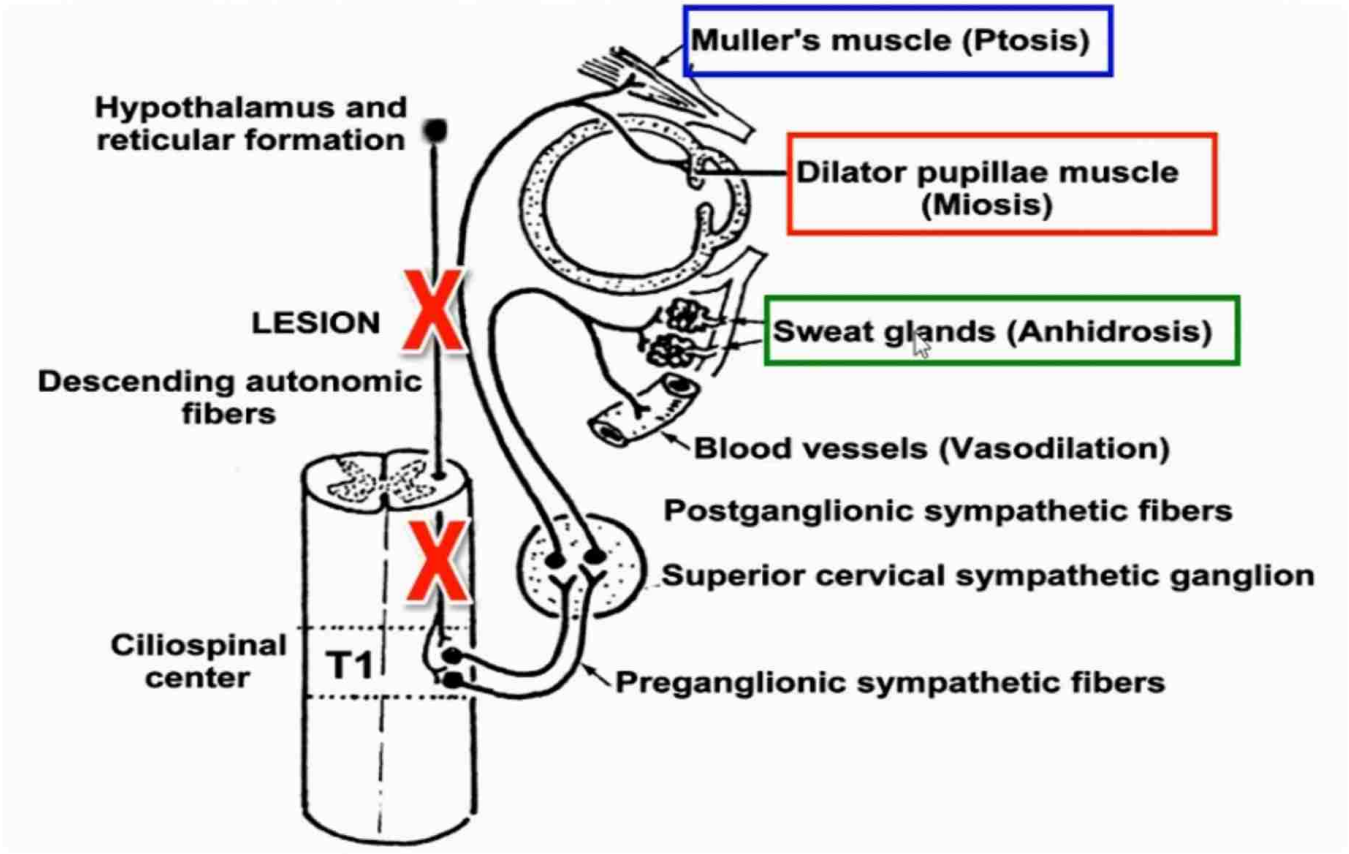
Course: with the reticulospinal tract

Termination: autonomic centers

1. **Sympathetic nucleus: T1 – L2 or 3**
2. **Parasympath nucleus: S2, 3, 4**

LESION: Horner's Syndrome

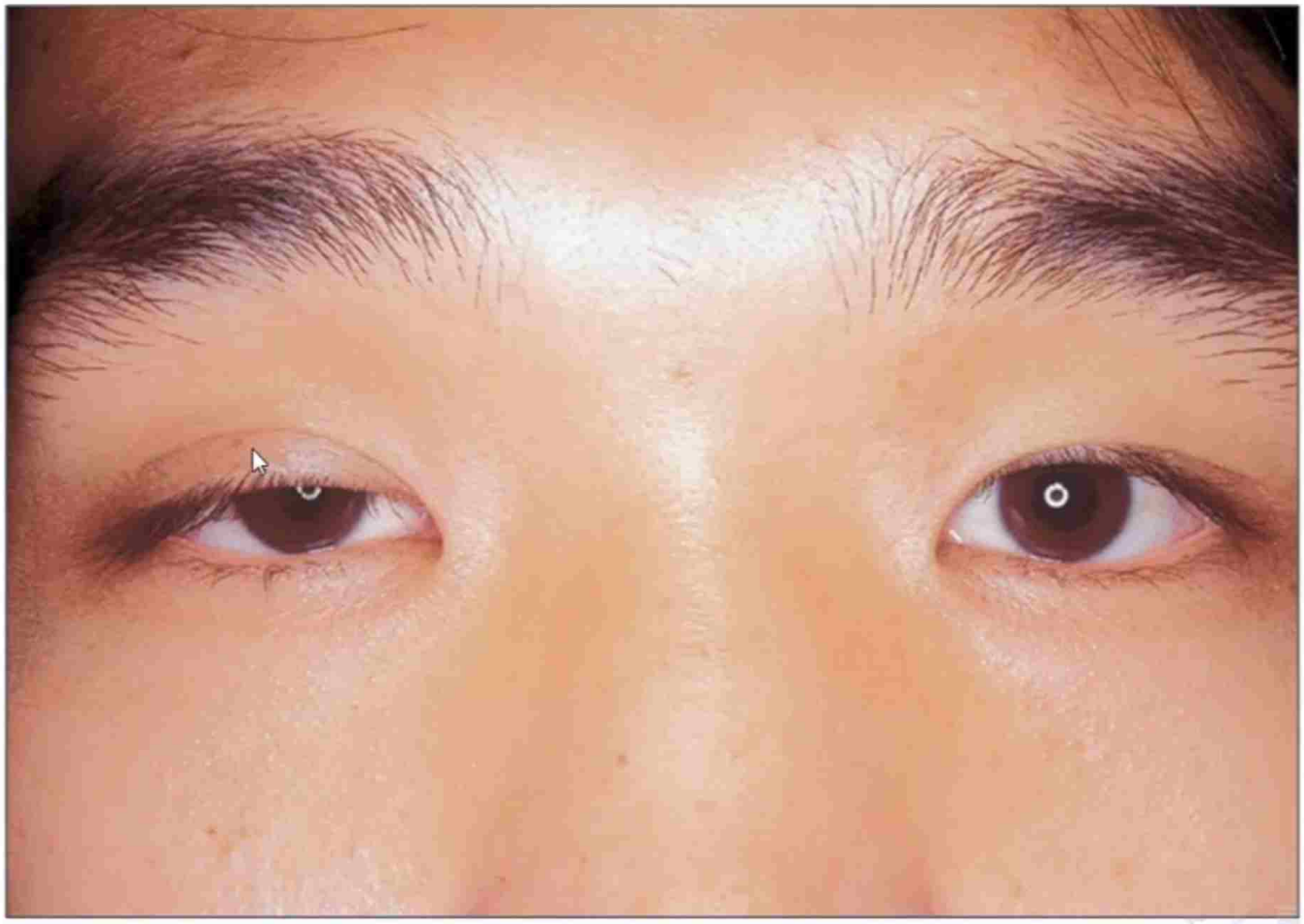
AUTONOMIC FIBERS & HORNER'S SYNDROME

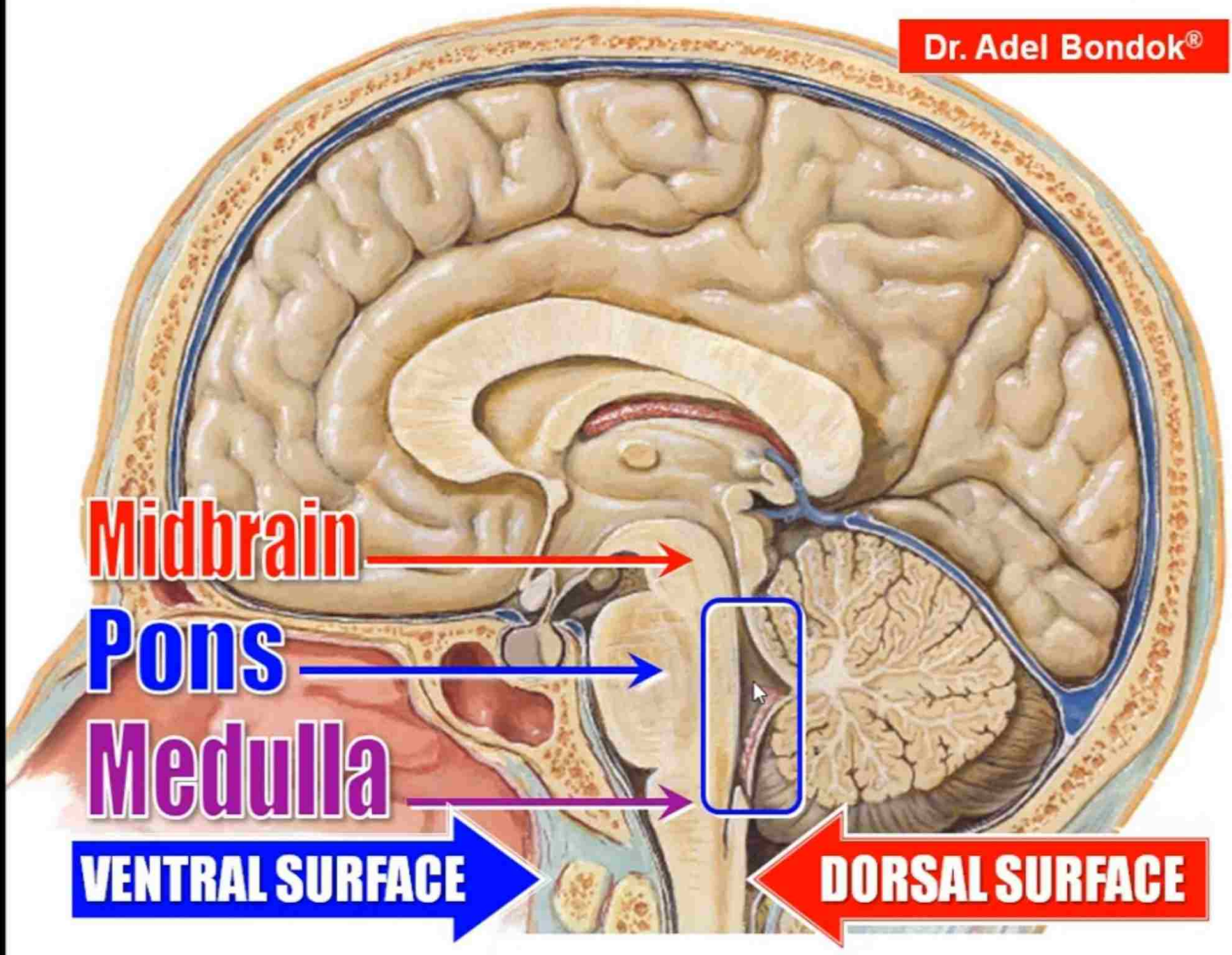


HORNER'S SYNDROME

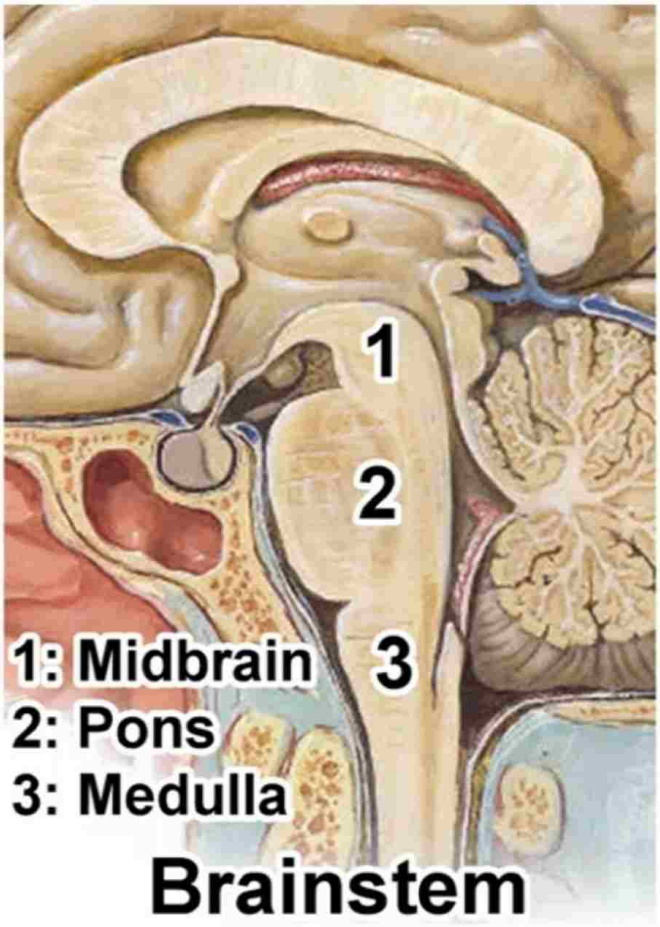
1. Ptosis: incomplete
2. Miosis
3. Anhidrosis
4. Enophthalmos

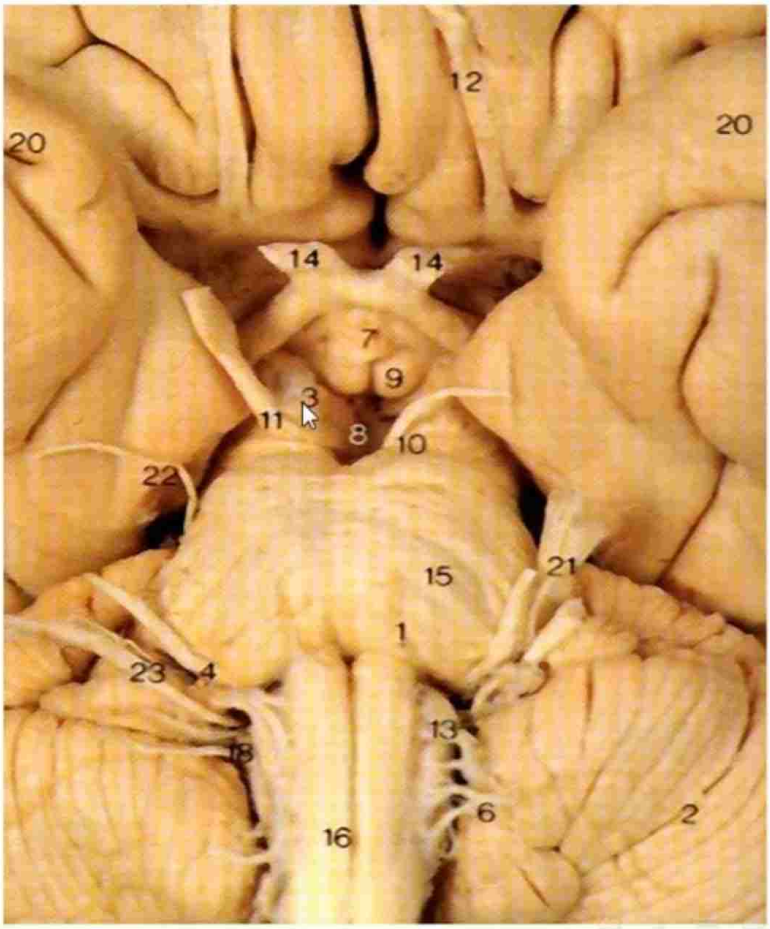
HORNER'S SYNDROME





BRAINSTEM

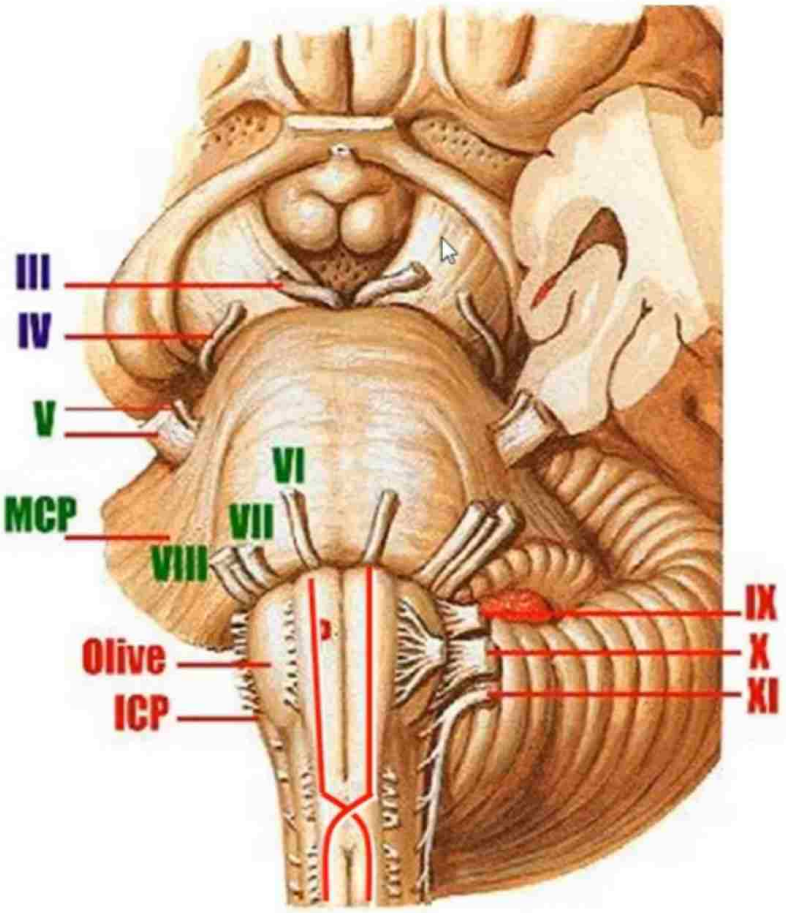


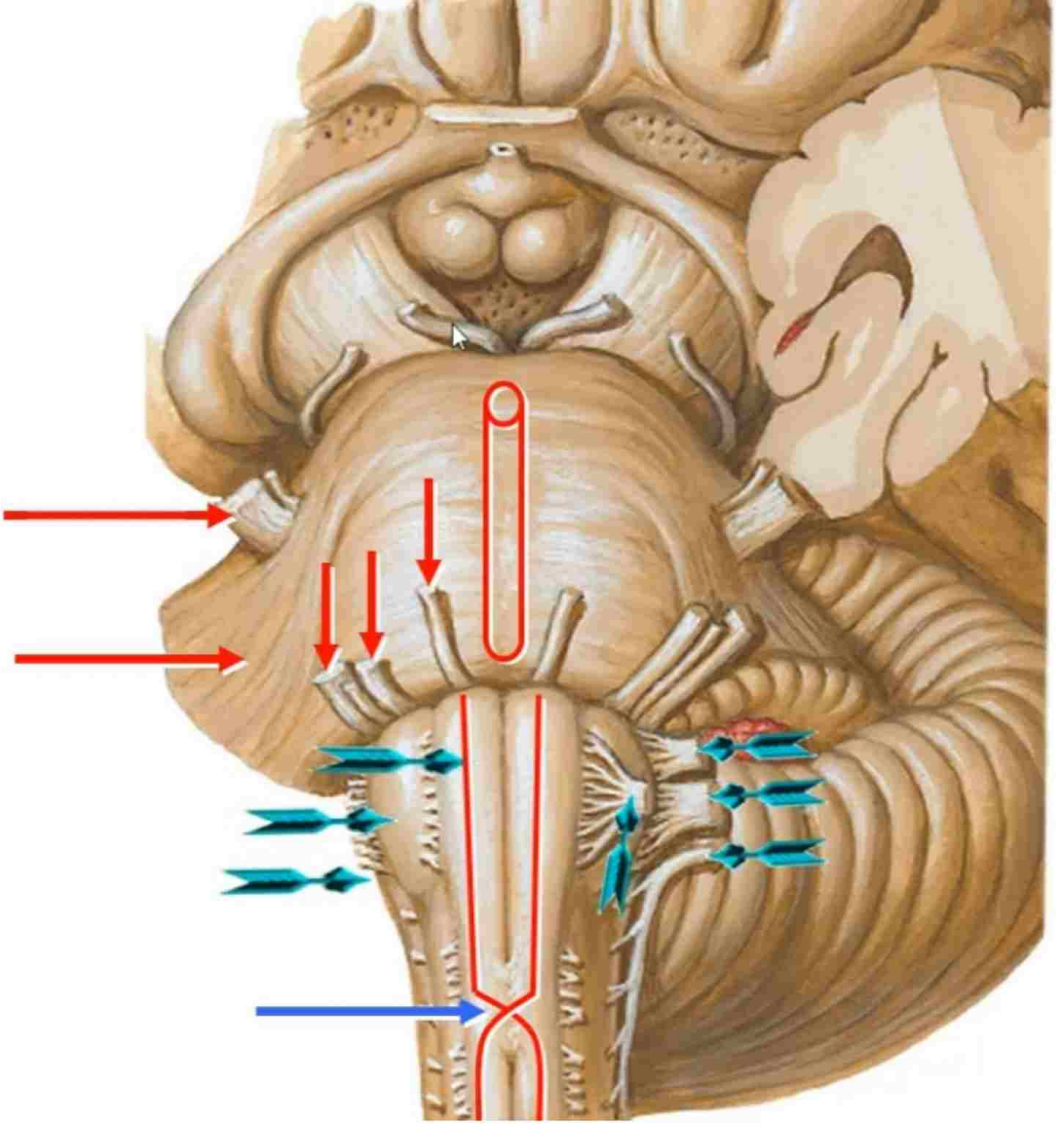


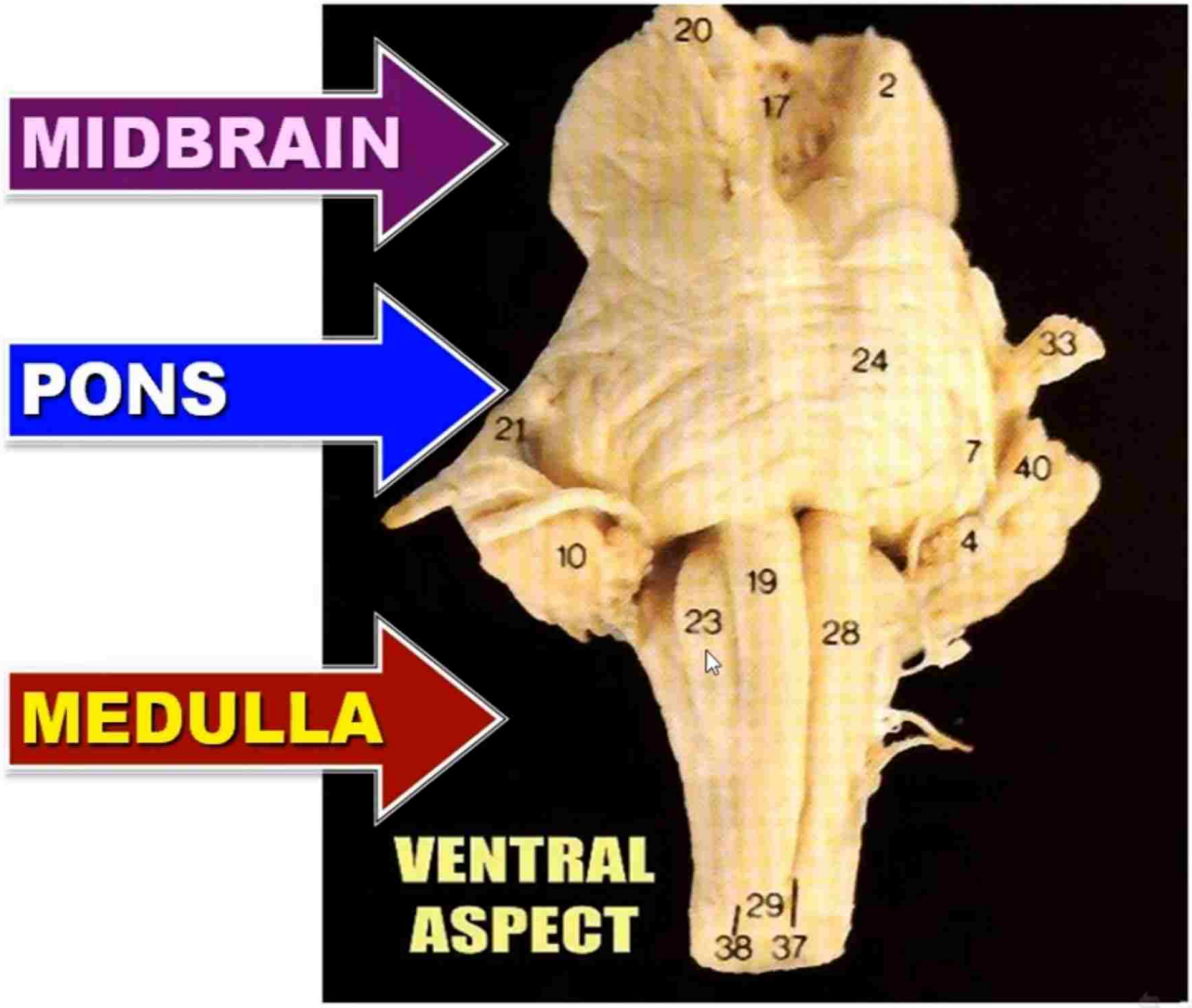
VENTRAL SURFACE

U should identify:

- Elevations
- Fissures
- Cranial Nerves

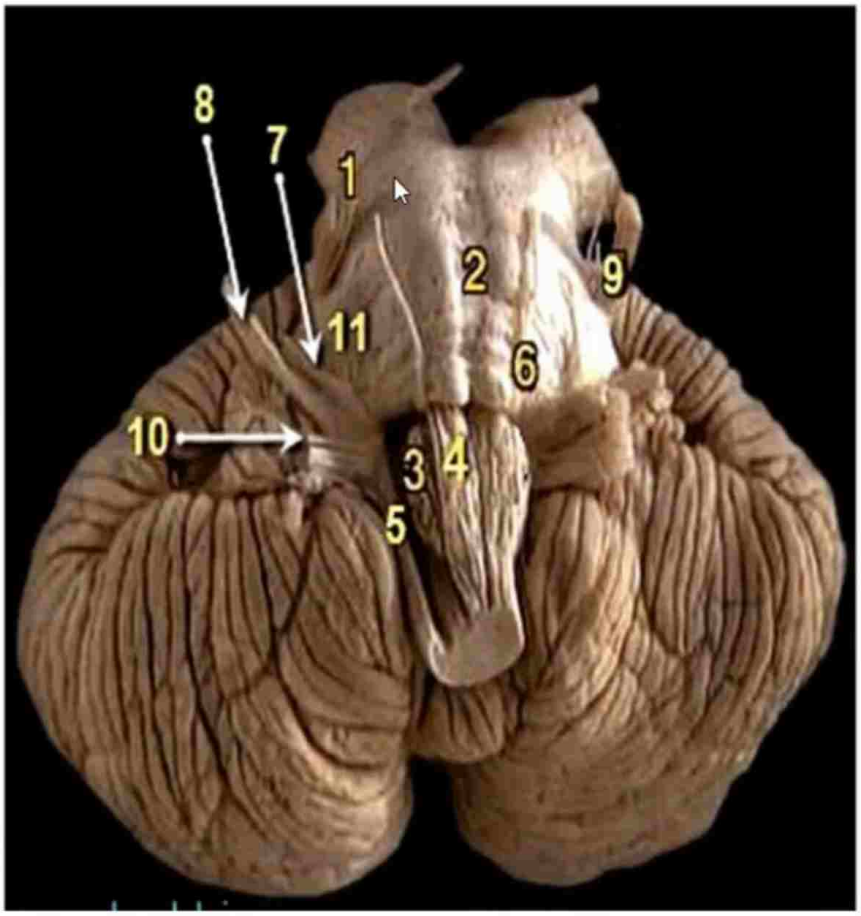





MIDBRAIN
PONS
MEDULLA
VENTRAL ASPECT
20
17
2
24
33
21
7
40
4
10
19
23
28
29
38
37

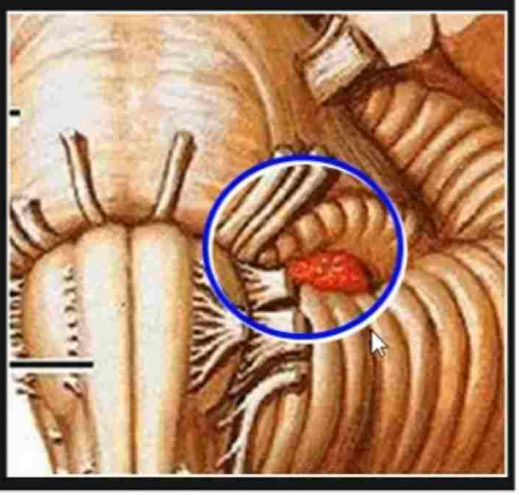
VENTRAL ASPECT OF THE BRAINSTEM

1: Cerebral peduncle: crus cerebri
2: Basilar groove
3: Olive
4: Pyramid
5: Inferior cerebellar peduncle
6: Abducent nerve
7: Facial nerve
8: Vestibulocochlear nerve
9: Trigeminal nerve
10: Glossopharyngeal nerve
11: Middle cerebellar peduncle

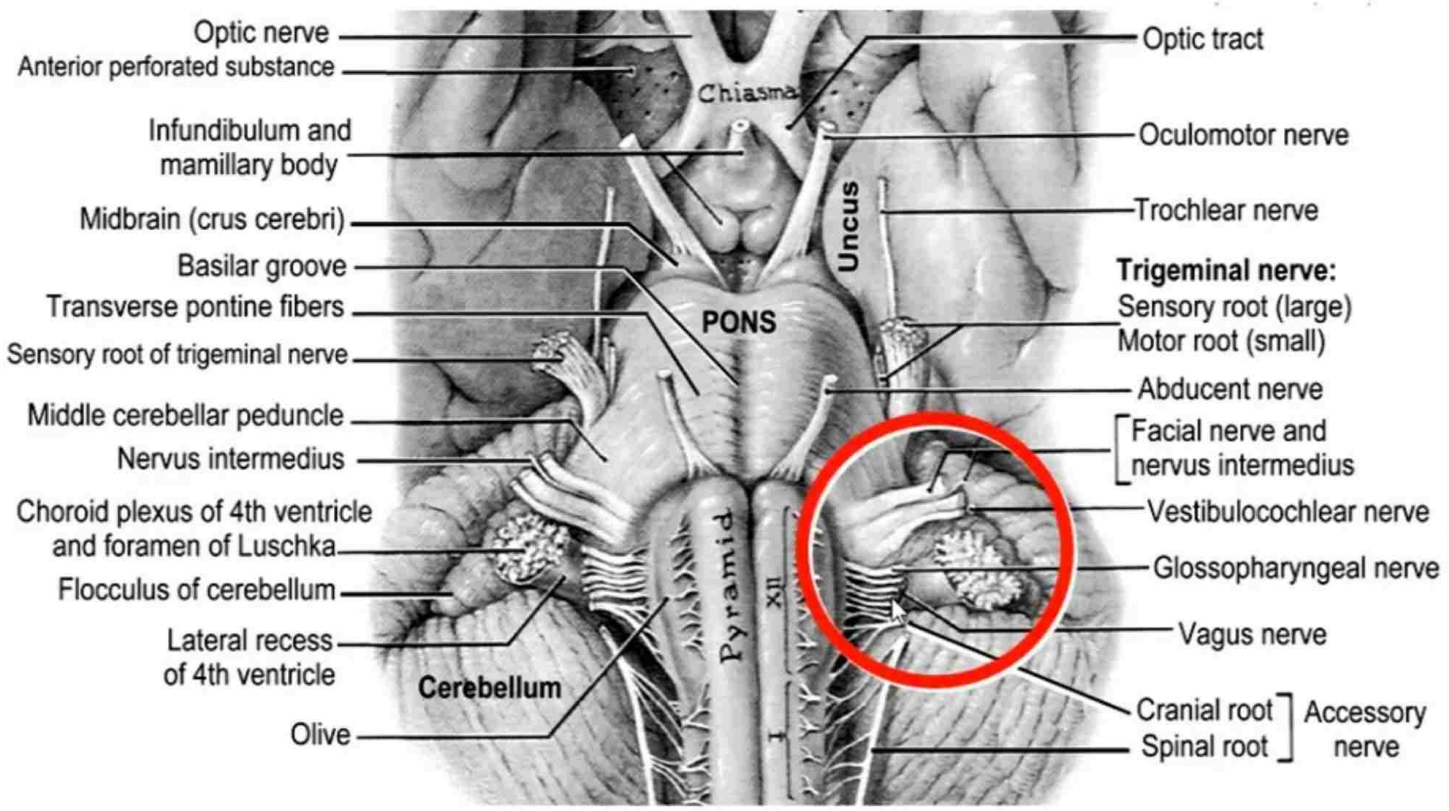


CEREBELLO-PONTINE ANGLE

1. **Cranial nerves:** VII, VIII & IX
2. **Foramen of Luschka & the lateral recess**
3. **Choroid plexus**
4. **AICA**

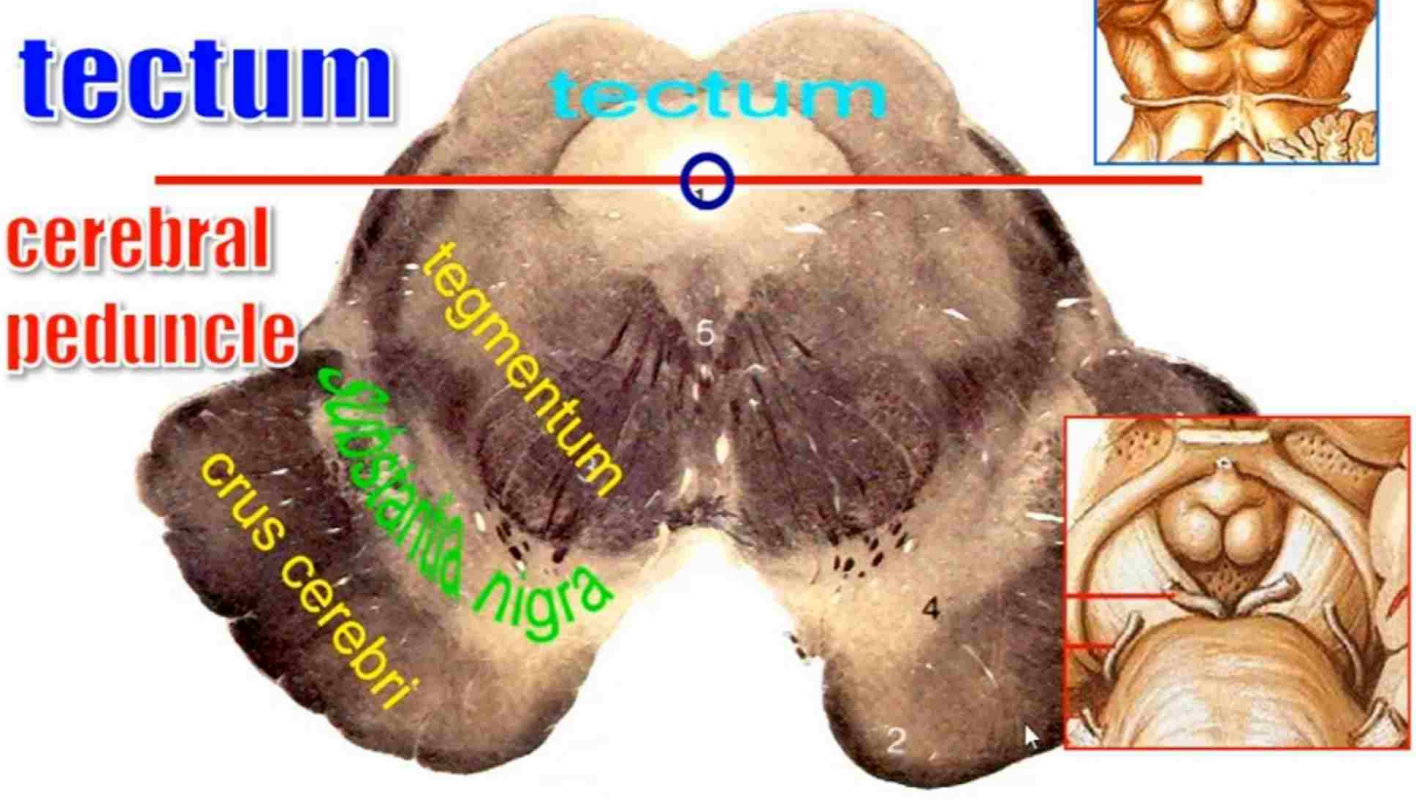


CEREBELLO-PONTINE ANGLE

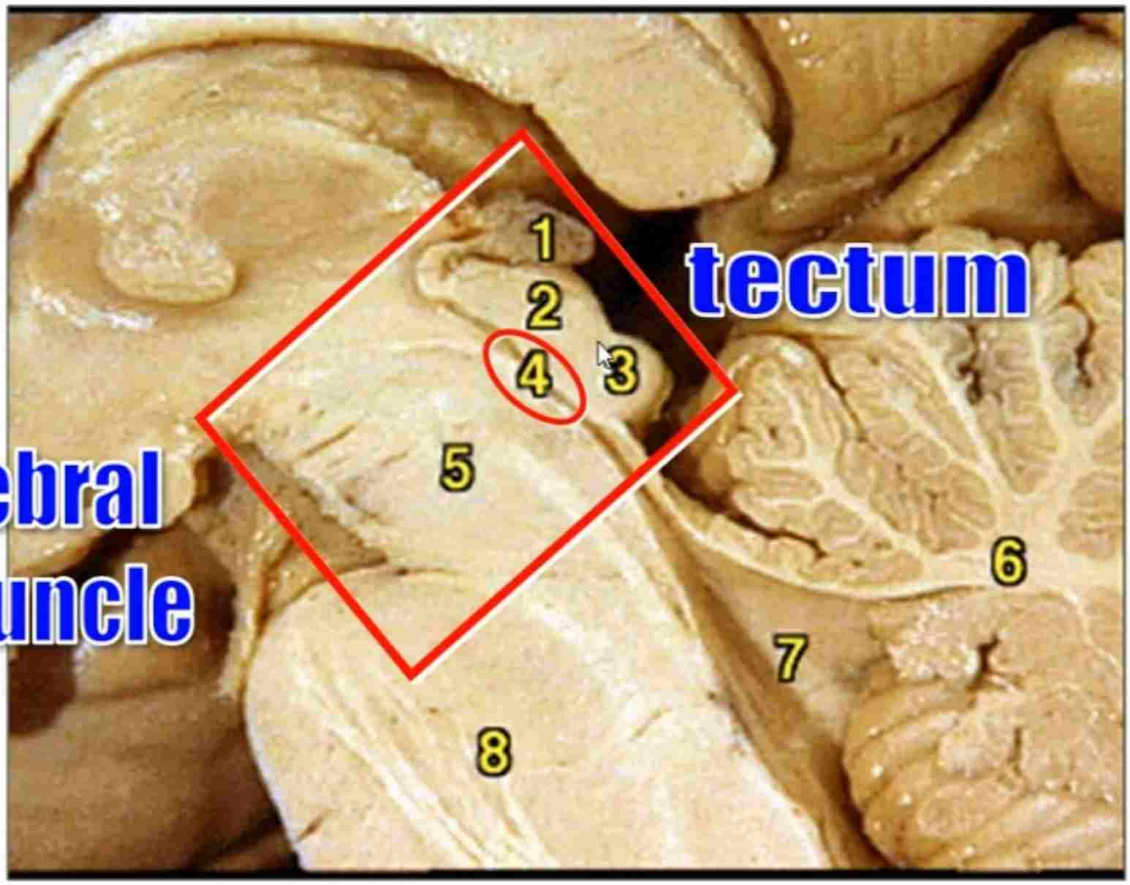


BRAINSTEM AND CEREBELLOPONTINE ANGLE

MIDBRAIN



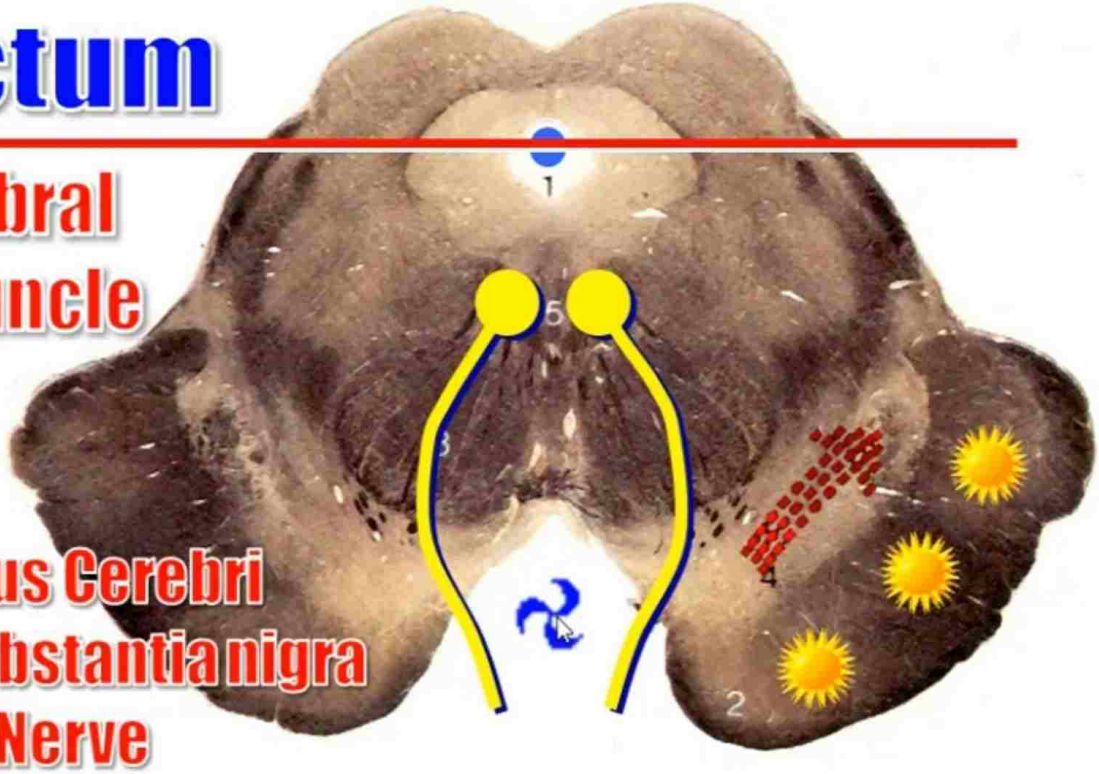
MIDBRAIN



MIDBRAIN

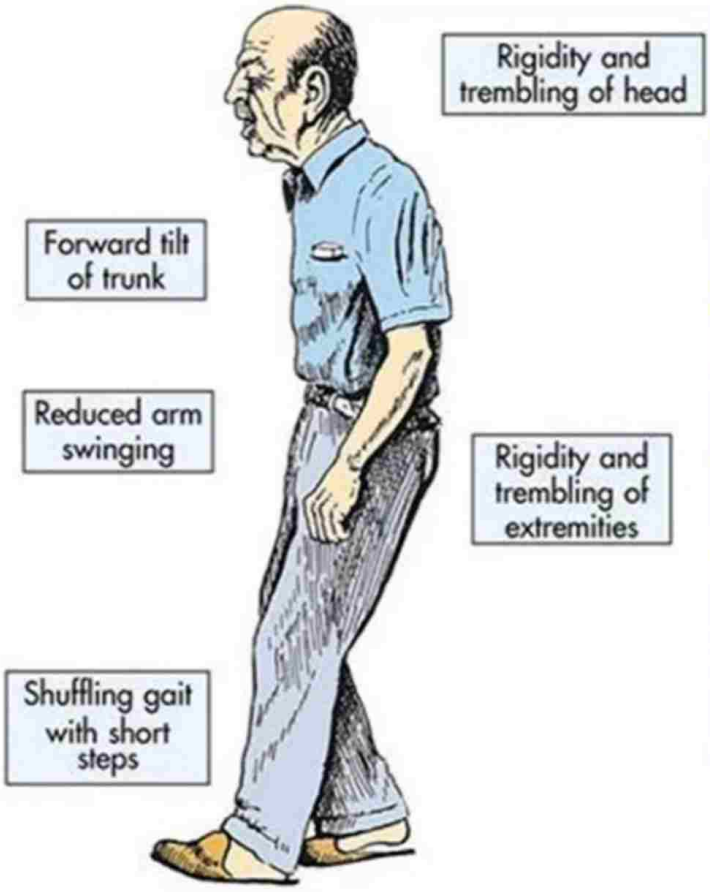
tectum

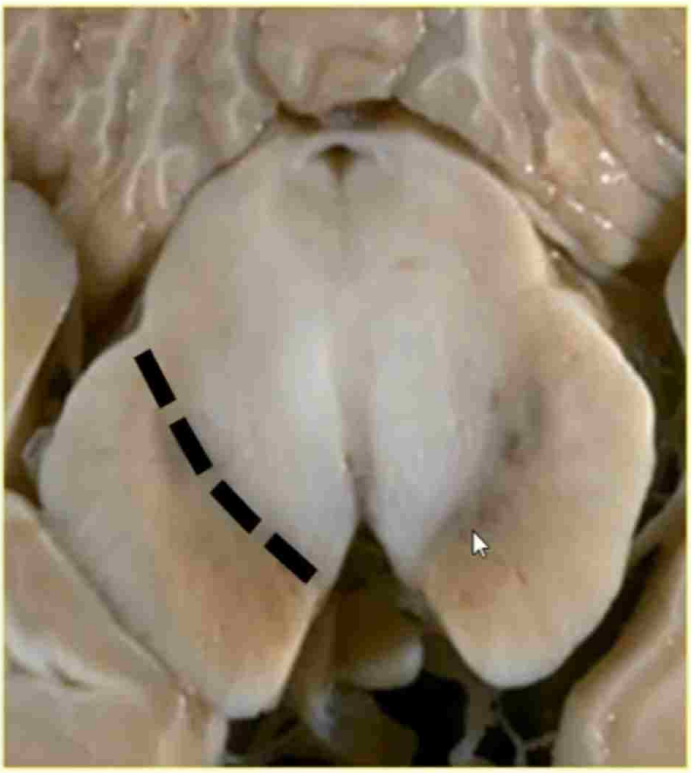
cerebral peduncle



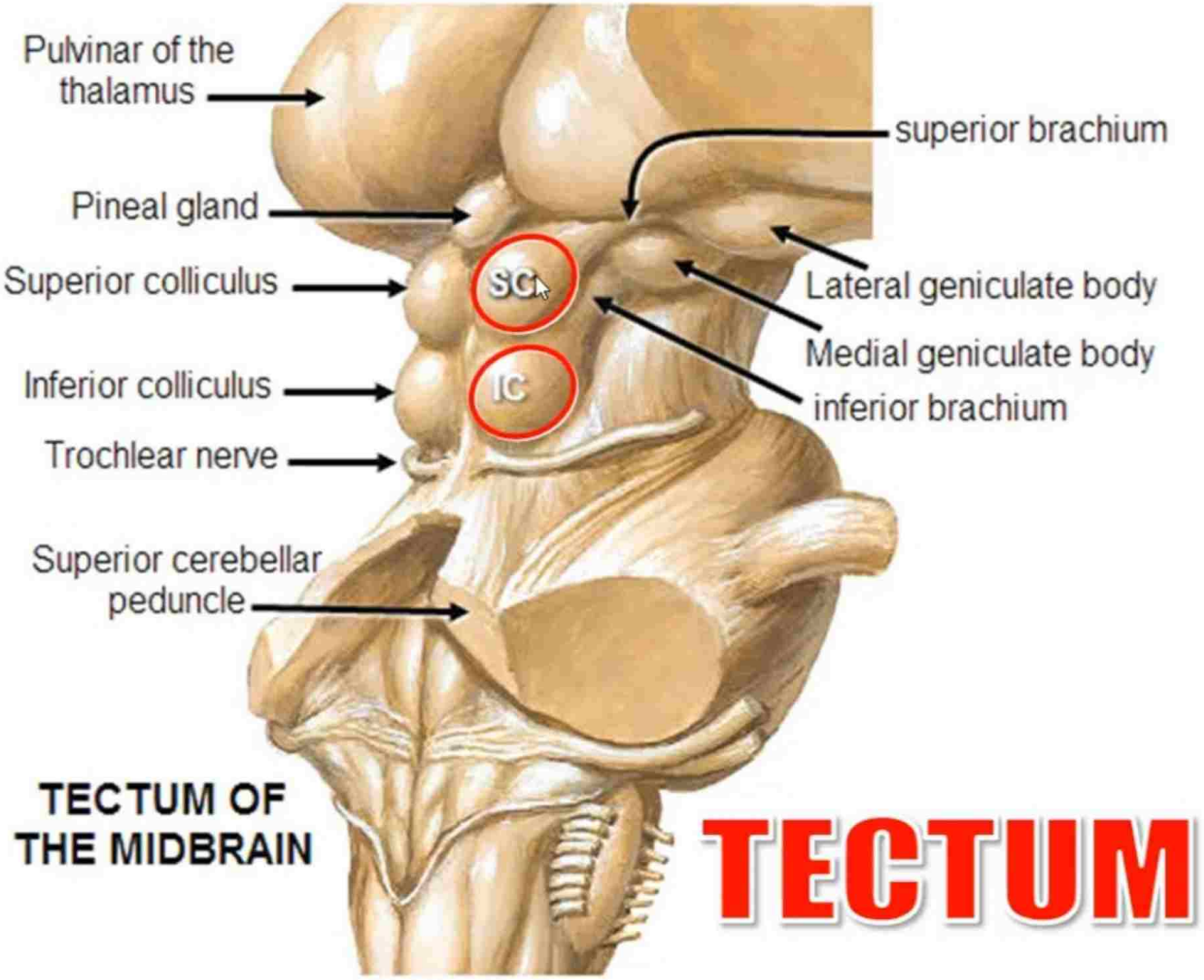
- Crus Cerebri
- Substantia nigra
- III Nerve
- Interpeduncular fossa

PARKINSON'S DISEASE



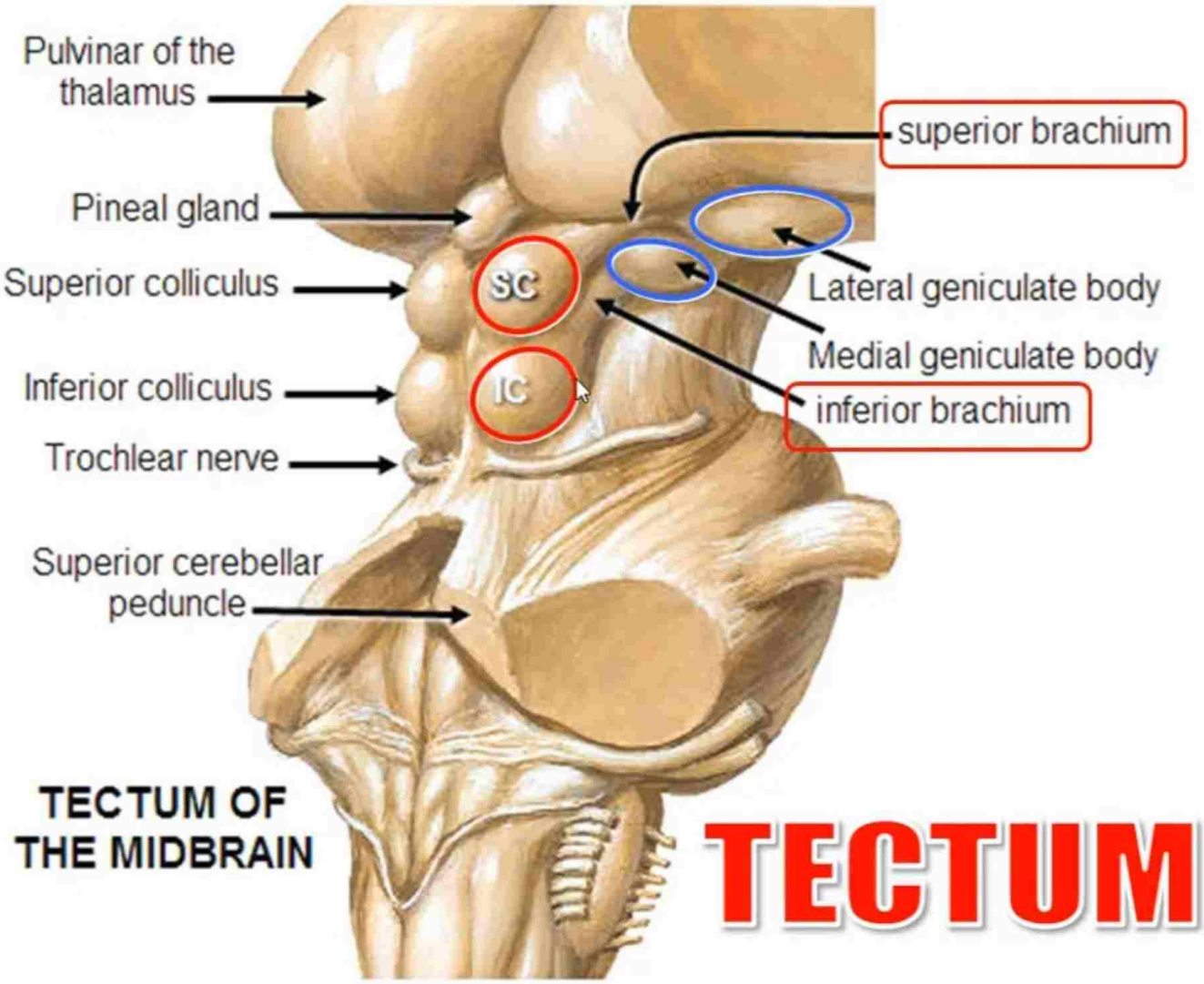


Substantia Nigra



TECTUM OF THE MIDBRAIN

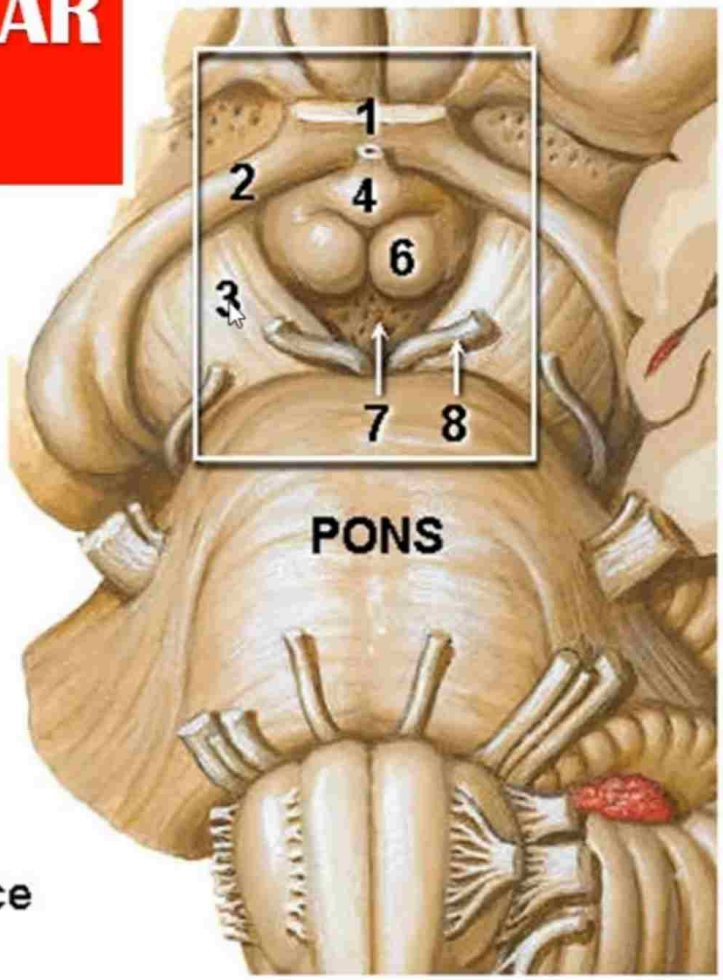
TECTUM



INTERPEDUNCULAR FOSSA

BOUNDARIES

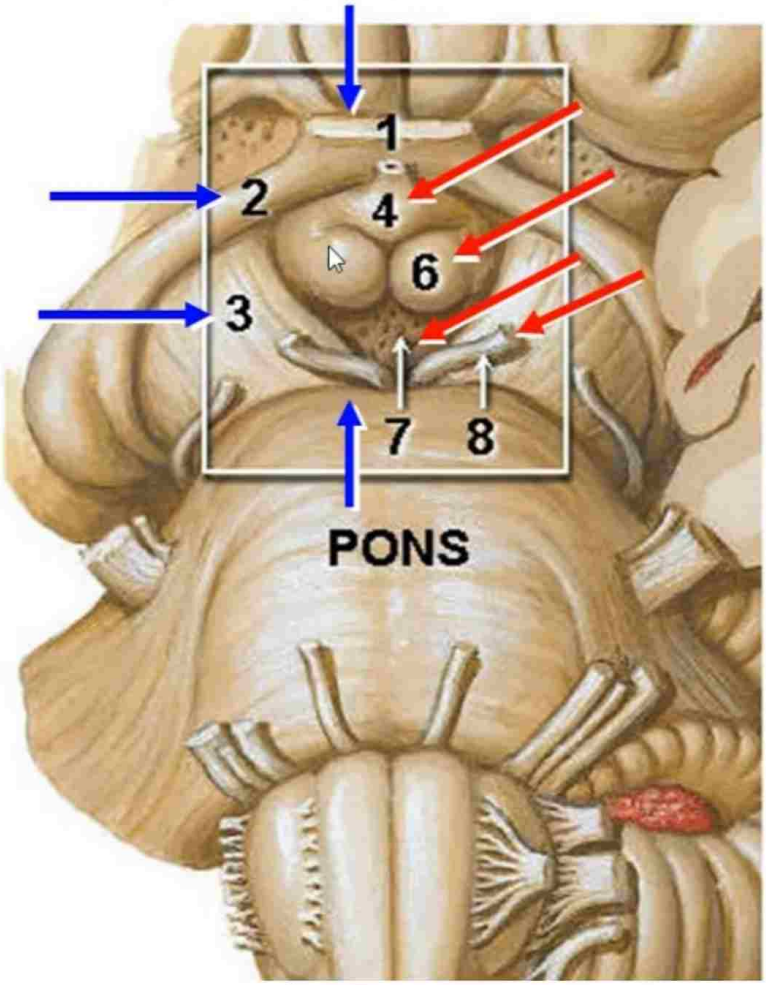
CONTENTS



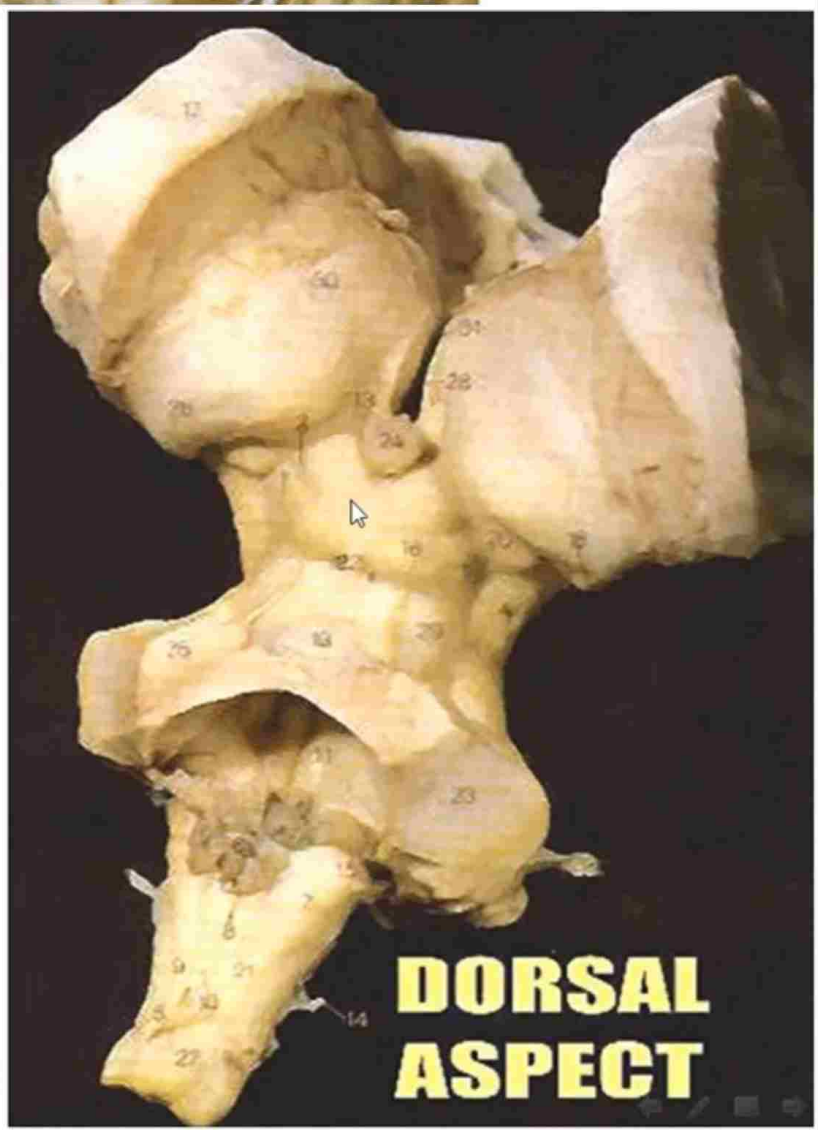
INTERPEDUNCULAR FOSSA

1: Optic chiasma
2: Optic tract
3: Crus cerebri
4: Tuber cinereum
5: Pituitary gland
6: Mamillary body
7: Posterior perforated substance
8: Oculomotor nerve

INTERPEDUNCULAR FOSSA



Dorsal Aspect Of the Brainstem

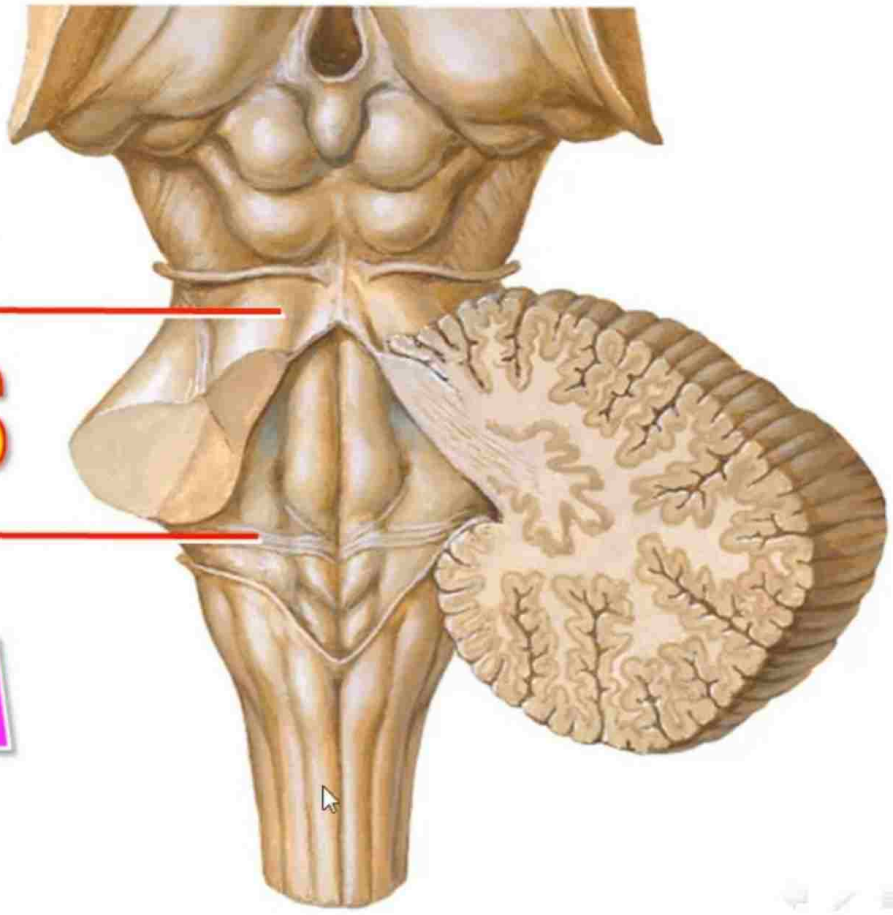


BRAINSTEM: DORSAL ASPECT

MIDBRAIN

PONS

MEDULLA

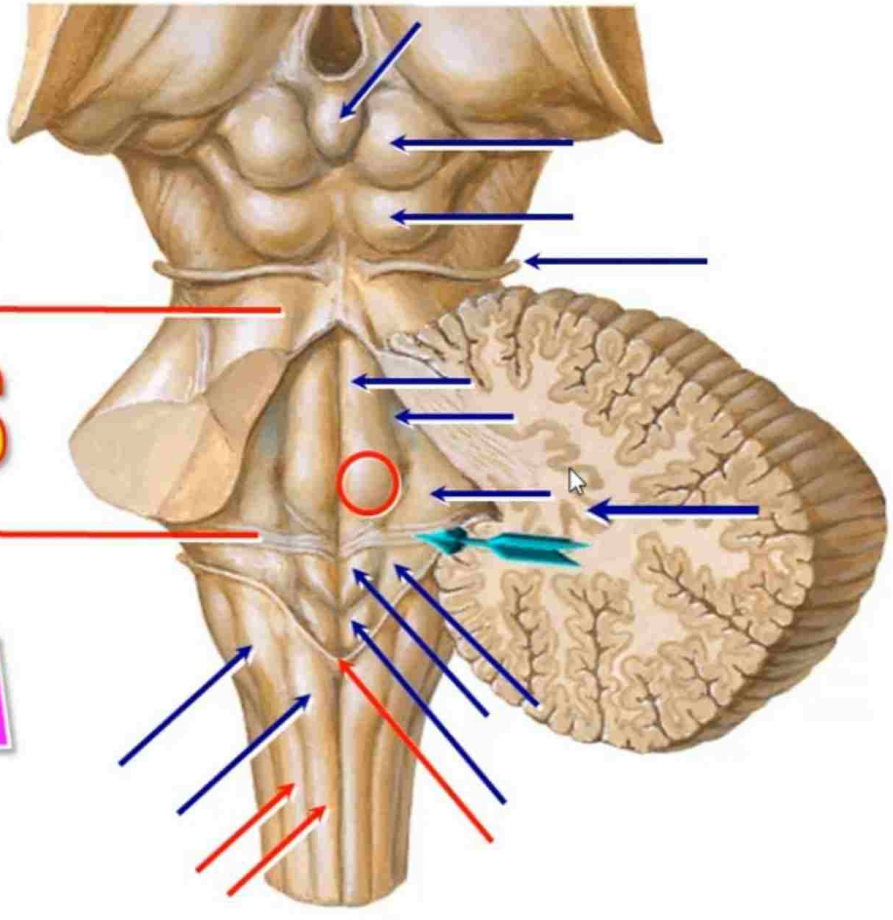


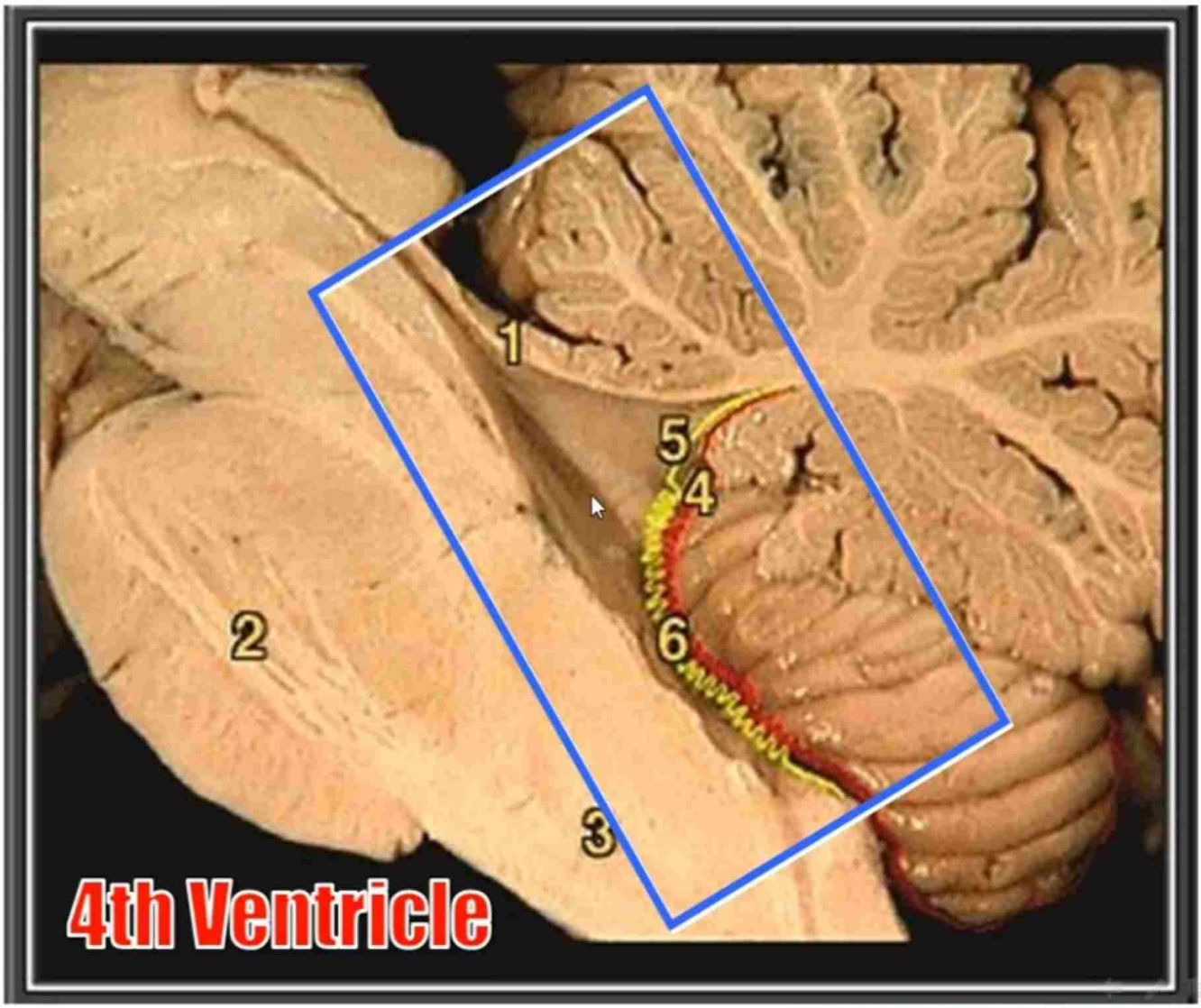
BRAINSTEM: DORSAL ASPECT

MIDBRAIN

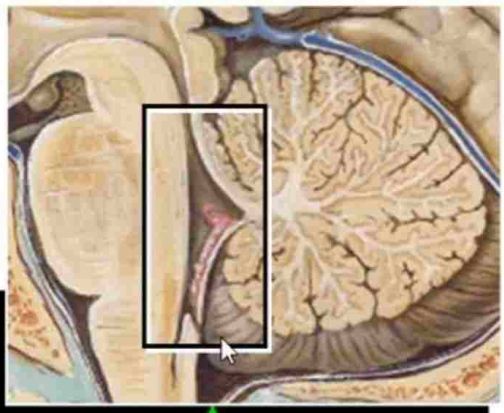
PONS

MEDULLA

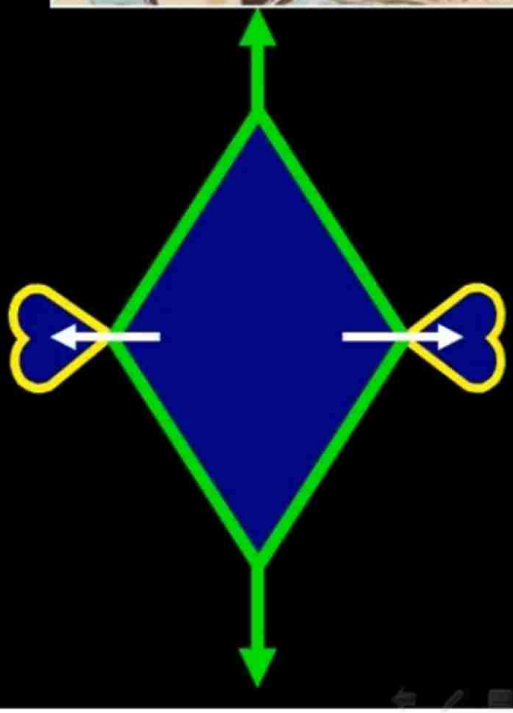




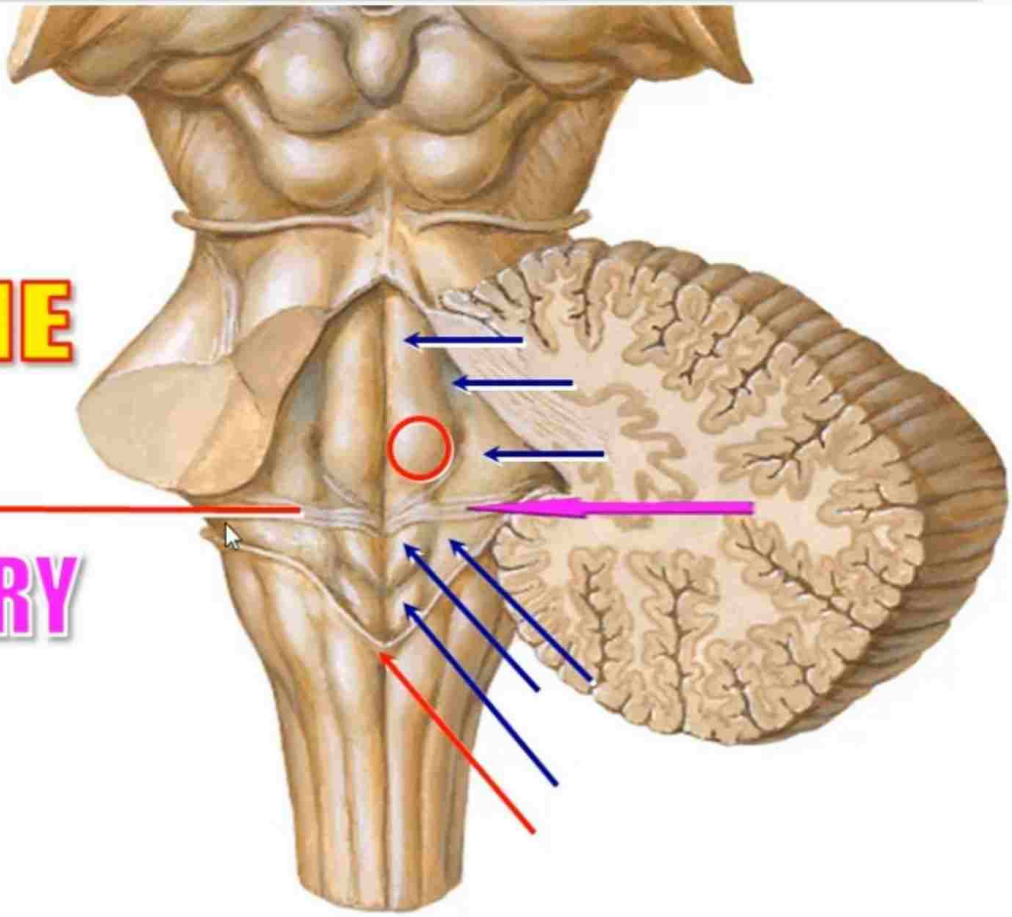
4th VENTRICLE



- Definition:
- Position:
- Shape: has 4 angles
- Boundaries: L + R + F
- Foramina: 3
- Communications: 3

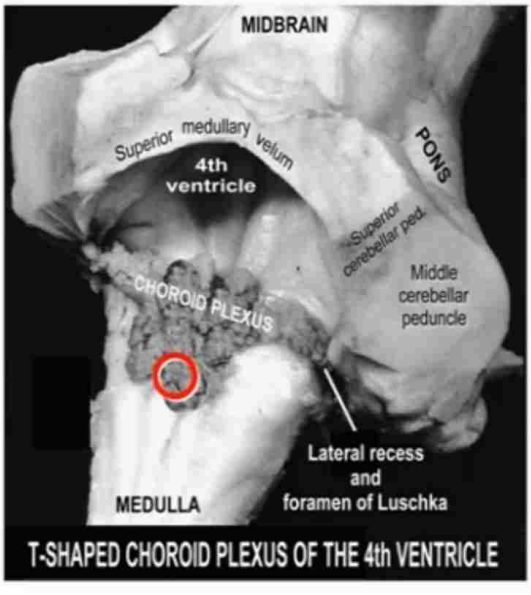


FLOOR: 4th Ventricle

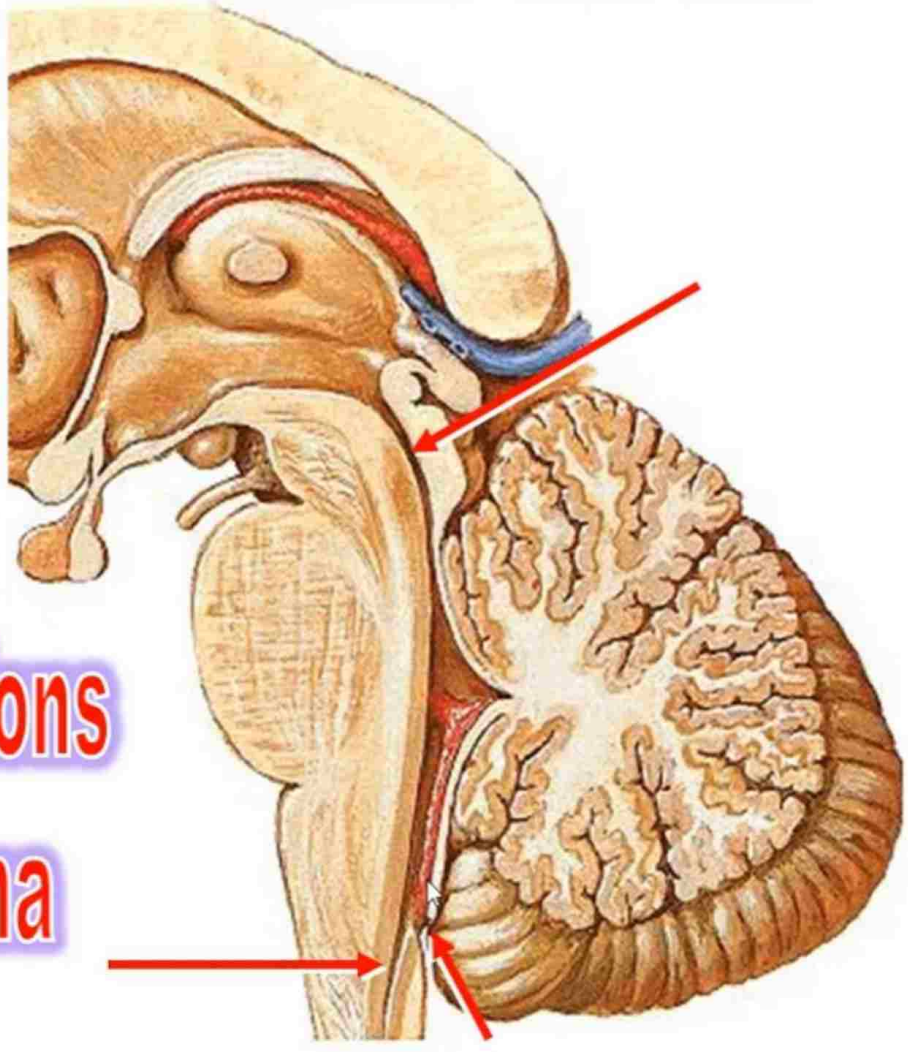


PONTINE PART

MEDULLARY PART

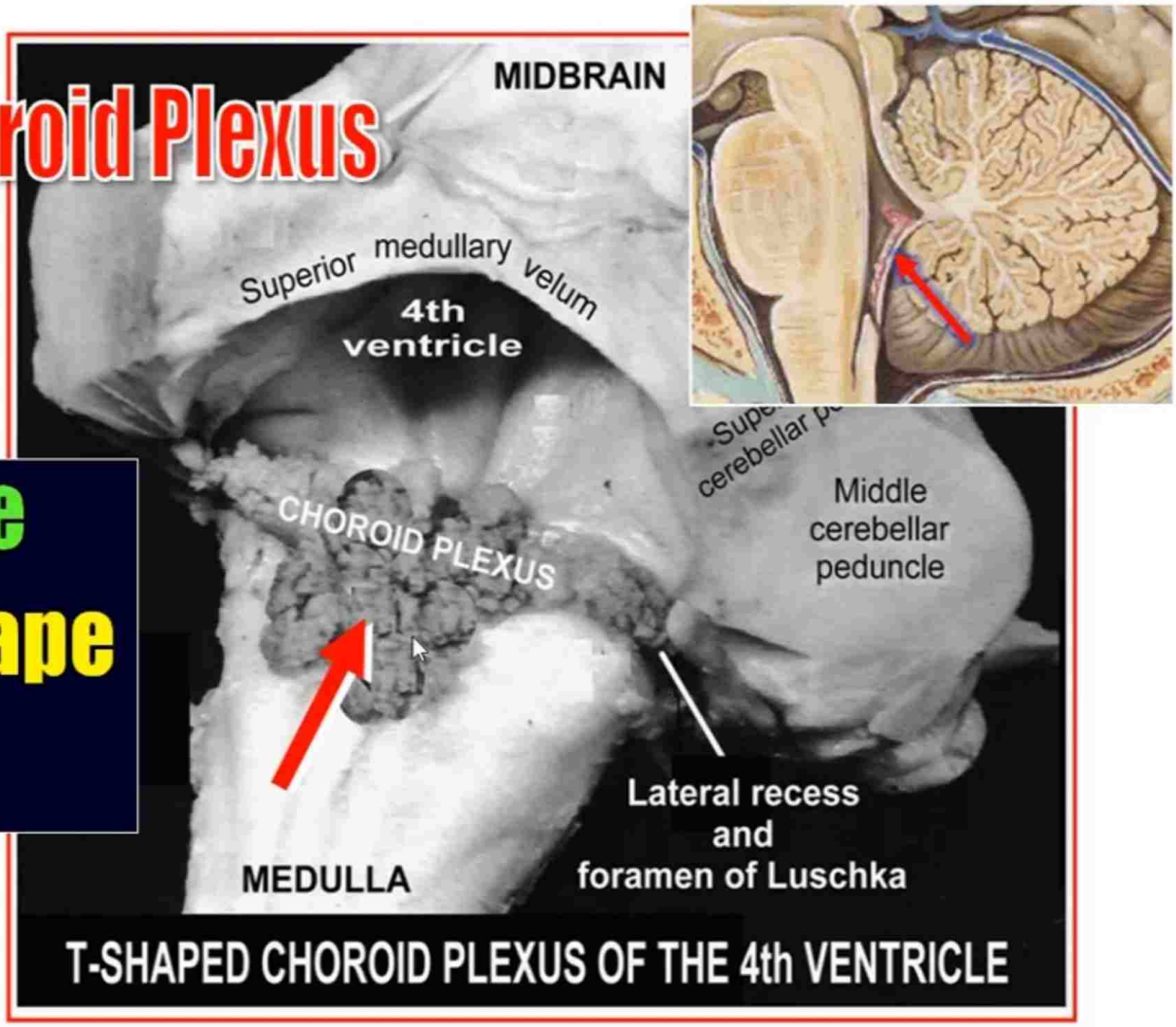


T-SHAPED CHOROID PLEXUS OF THE 4th VENTRICLE



Communications and Foramina

Choroid Plexus



Site

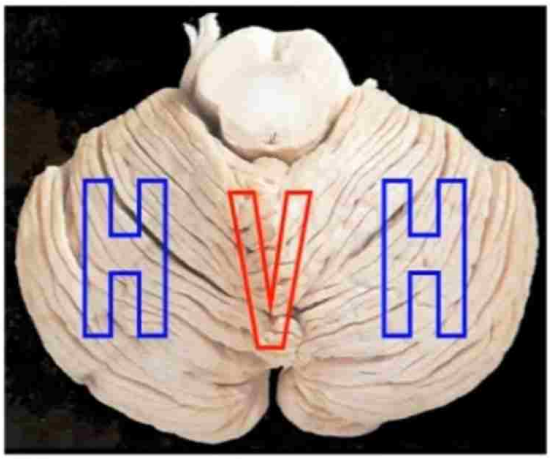
Shape

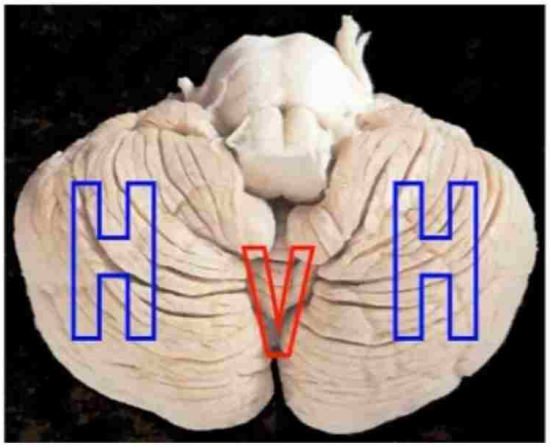
AS

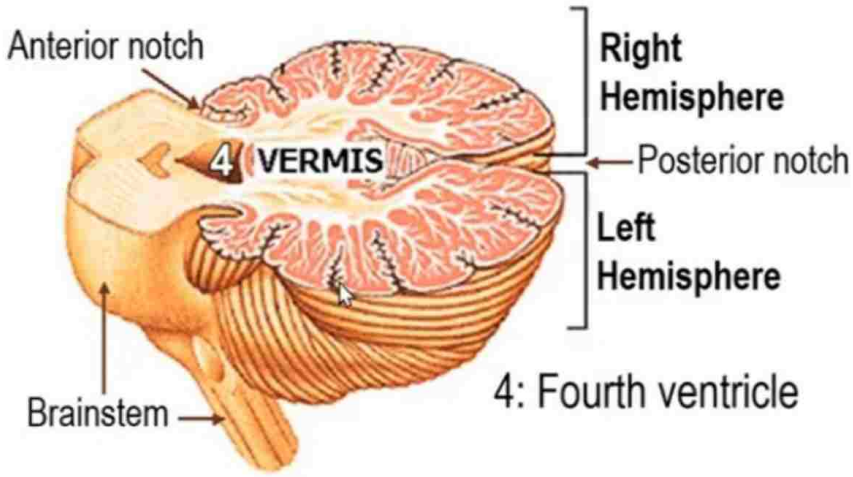
CEREBELLUM

Gross features:

1. Vermis
2. 2 hemispheres







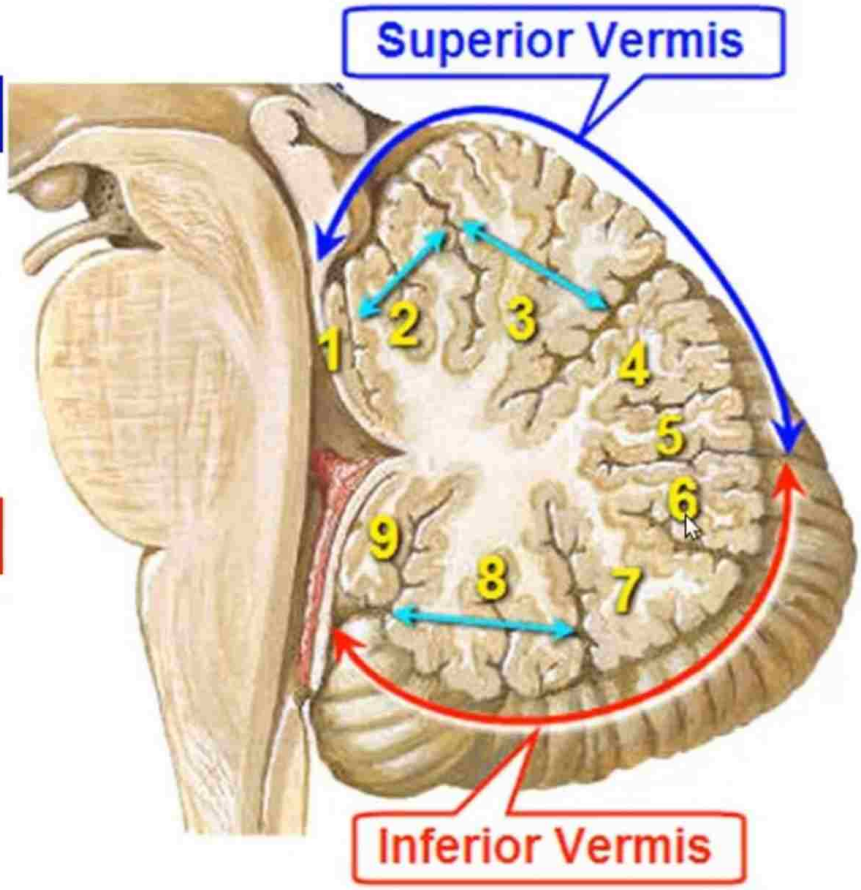
VERMIS

Superior Vermis:

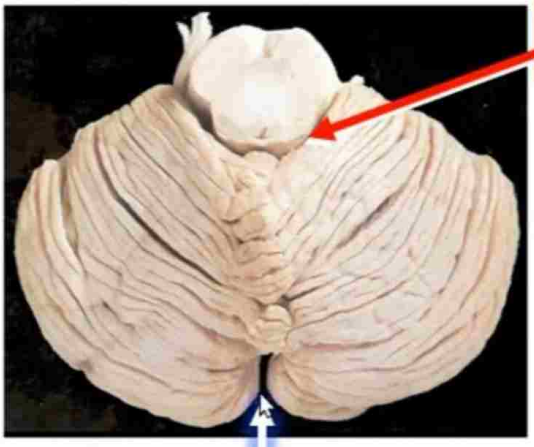
1: Lingula
2: Central lobule
3: Culmen
4: Declive
5: Folium

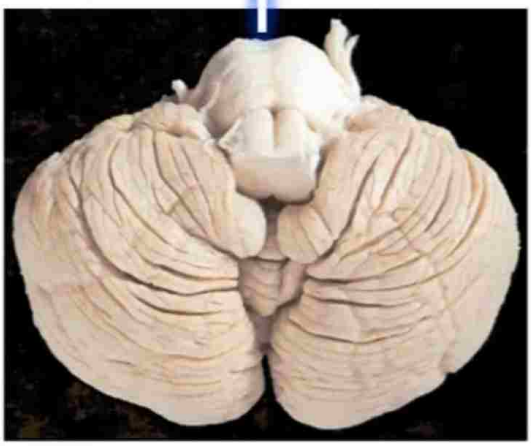
Inferior Vermis:

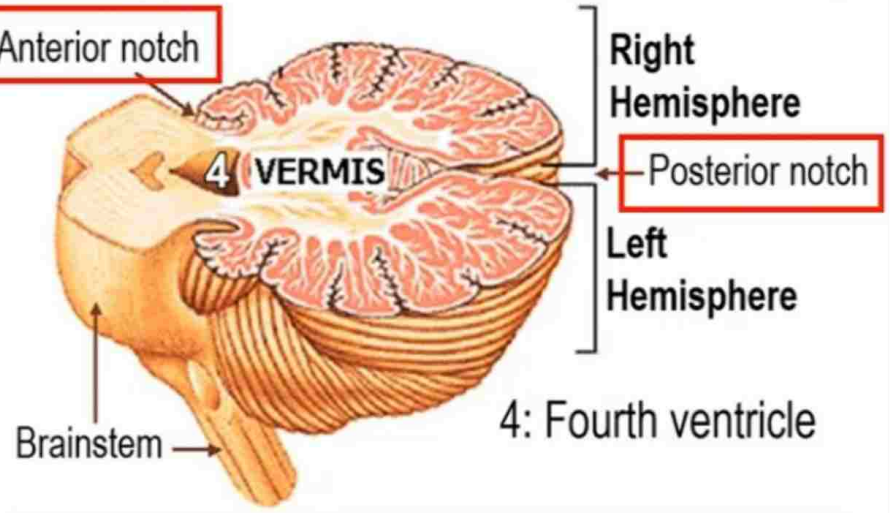
6: Tuber
7: Pyramid
8: Uvula
9: Nodule



2 Notches

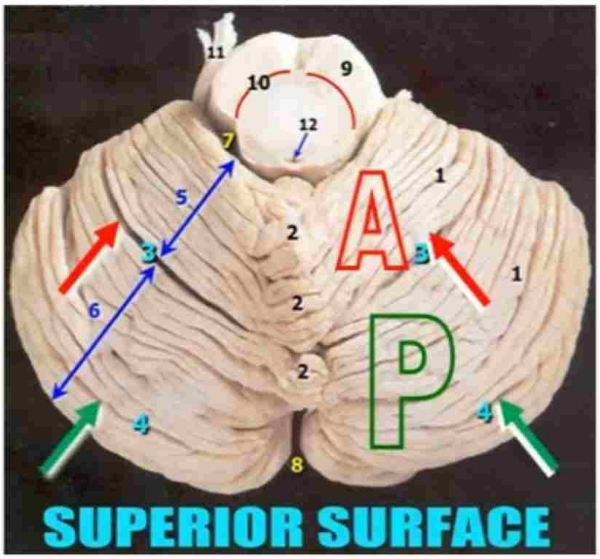


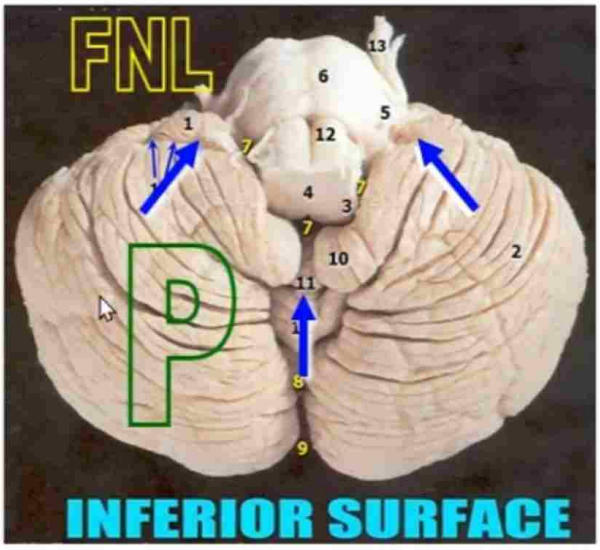




Anterior Notch:
Surrounds the brainstem

Posterior Notch:
Contains falx cerebelli



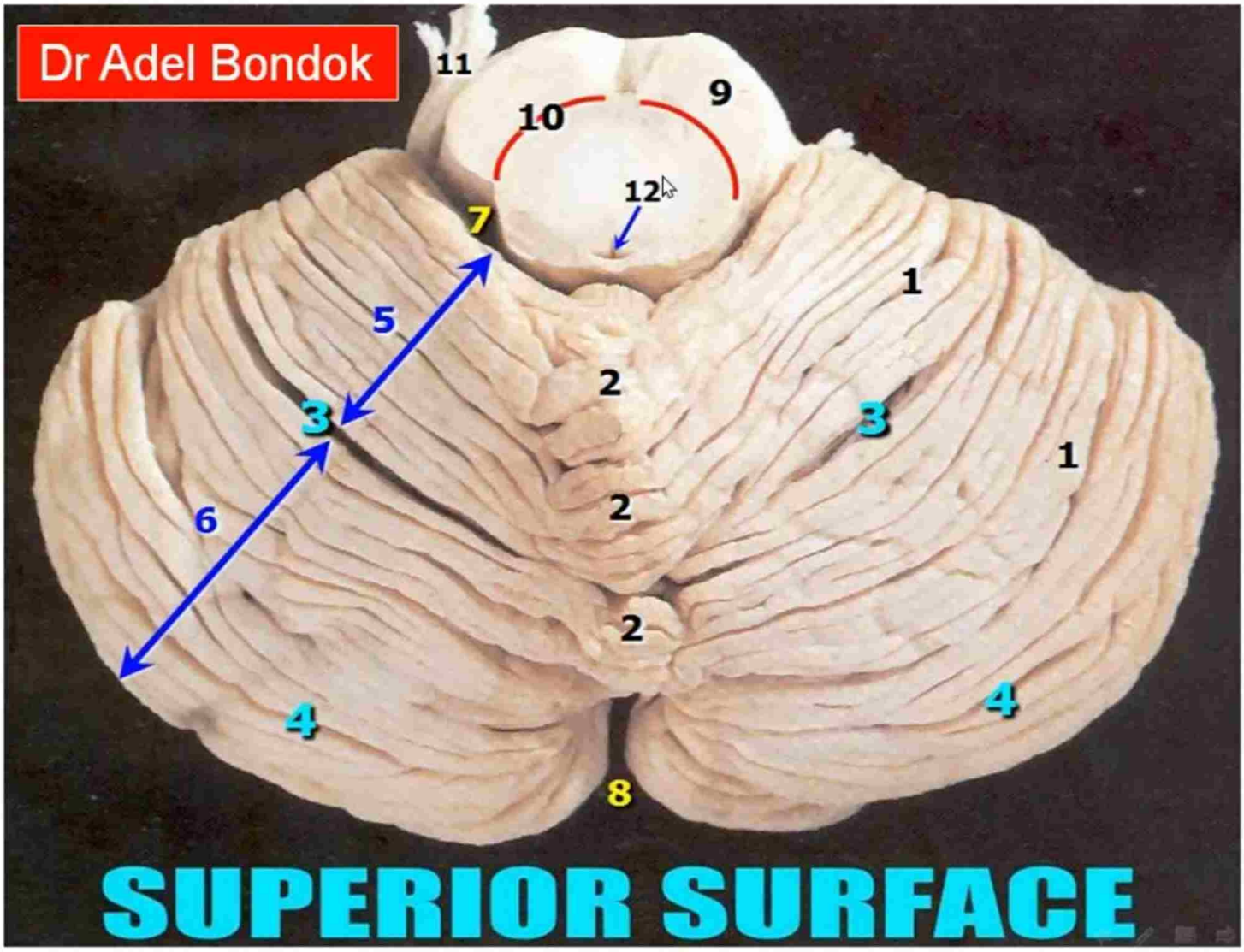


Fissures

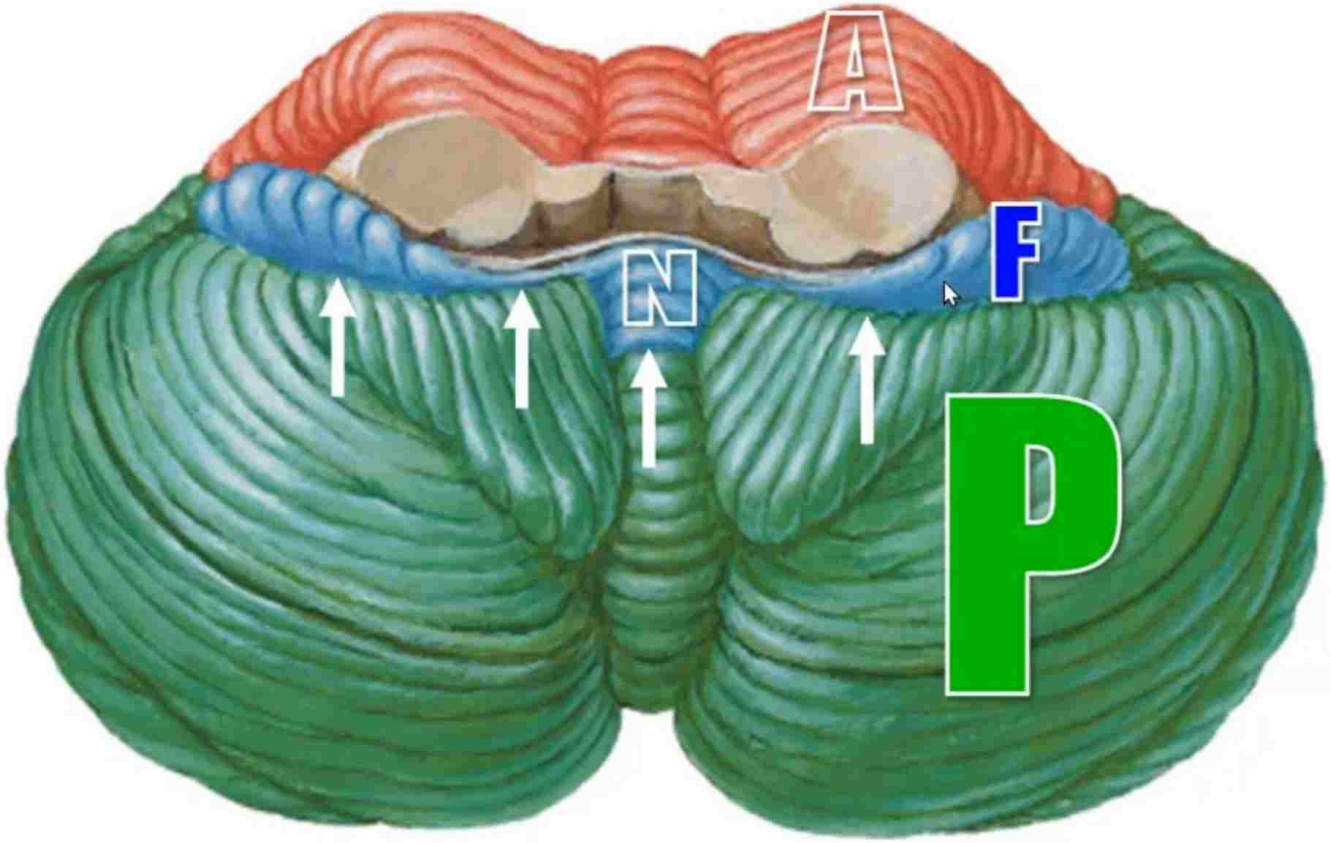
Primary Fissure:
Separates the anterior lobe from the posterior lobe

Horizontal Fissure:
Separates the upper surface from the inferior surface

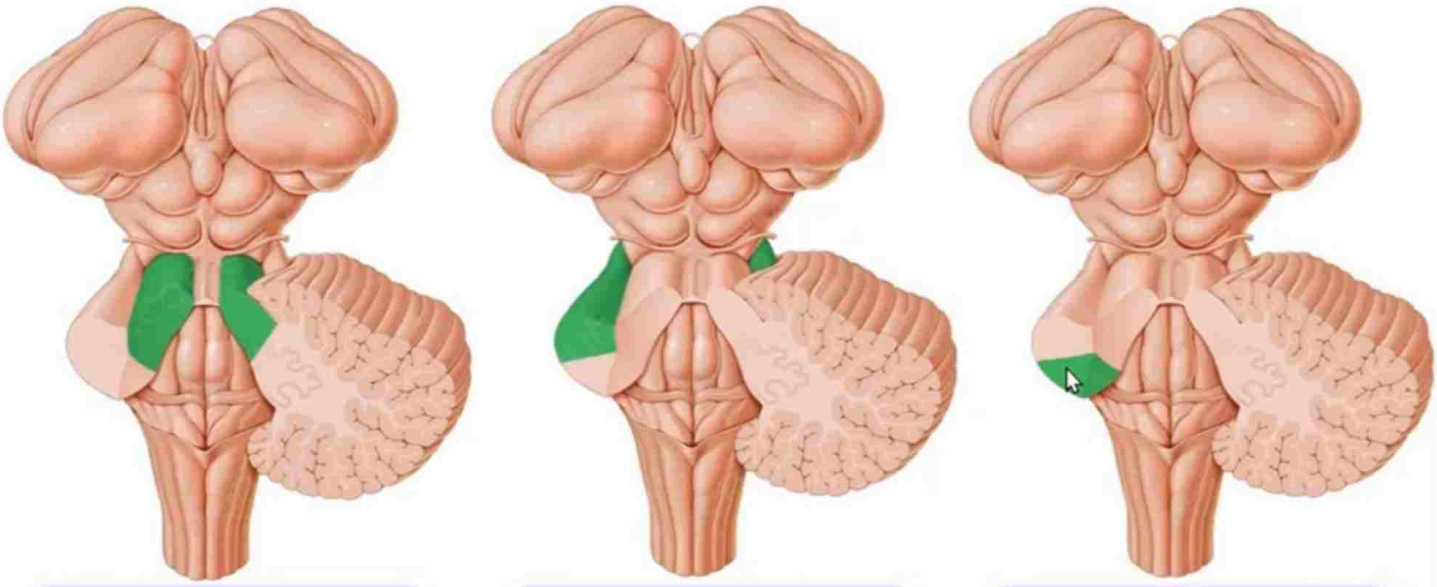
Posterolateral F:
Separates the posterior lobe from the flocculonodular lobe



Inferior Surface



Cerebellar Peduncles

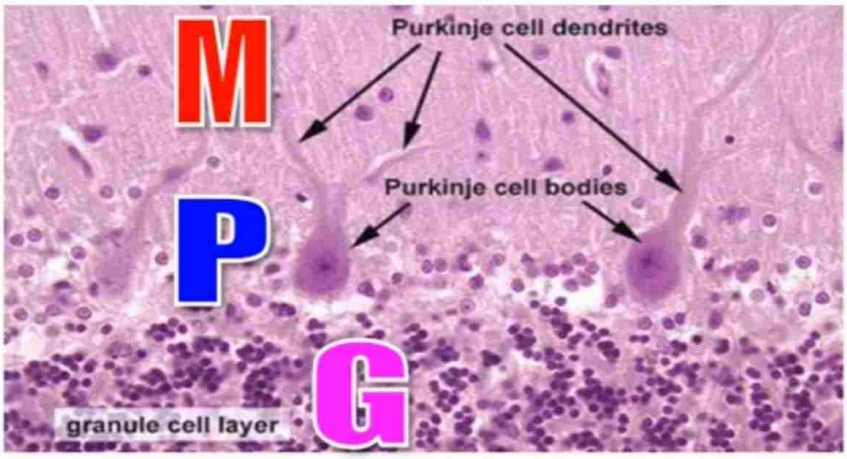


SCP
Midbrain with the cerebellum

MCP
Pons with the cerebellum

ICP
Medulla with the cerebellum

Cerebellar Cortex



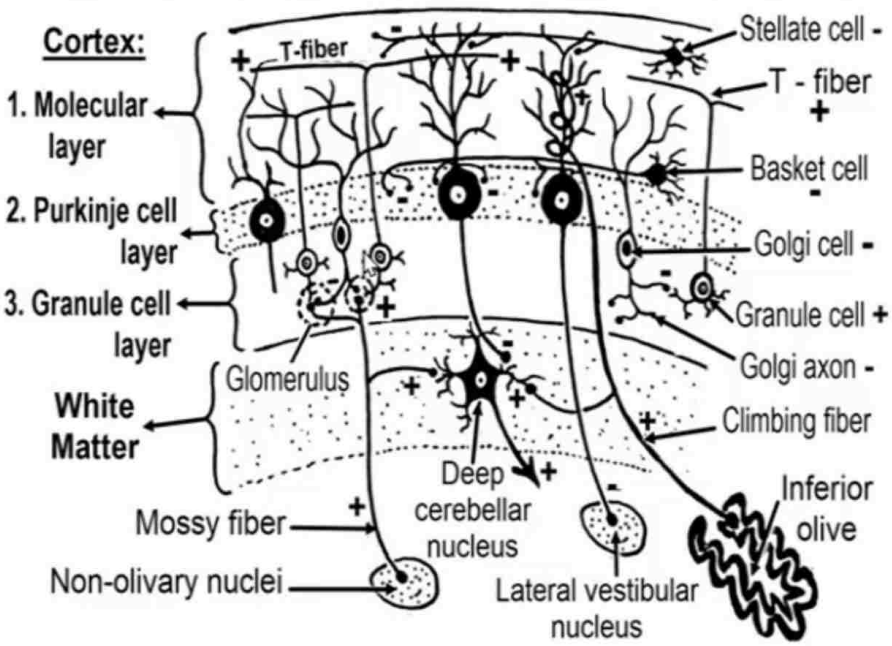
3 Layers:

1: Molecular layer:
Purkinje cell dendrites
granule cell axons +
basket & stellate cells

2: Purkinje cell layer:

3: Granule cell layer:
granule & Golgi cells.

All cells are inhibitory except granule cells which are excitatory



Cerebellar White Matter

Contains

1: 4 Deep cerebellar nuclei: FGED

2: Fibers leaving the cerebellum:

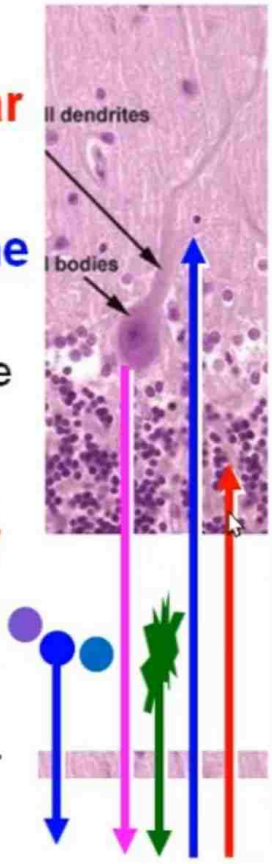
a. Axons of Purkinje cells: inhibitory

b. Axons of deep c nuclei: excitatory

3: Fibers entering the cerebellum:

a. Climbing fibers.

b. Mossy fibers.



Climbing Fibers

- Olivocerebellar fibers
- Synapse with Purkinje cells
- excitatory to Purkinje cells

Mossy Fibers

- Non- olivocerebellar fibers
- Synapse with granule cells
- excitatory to granule cells

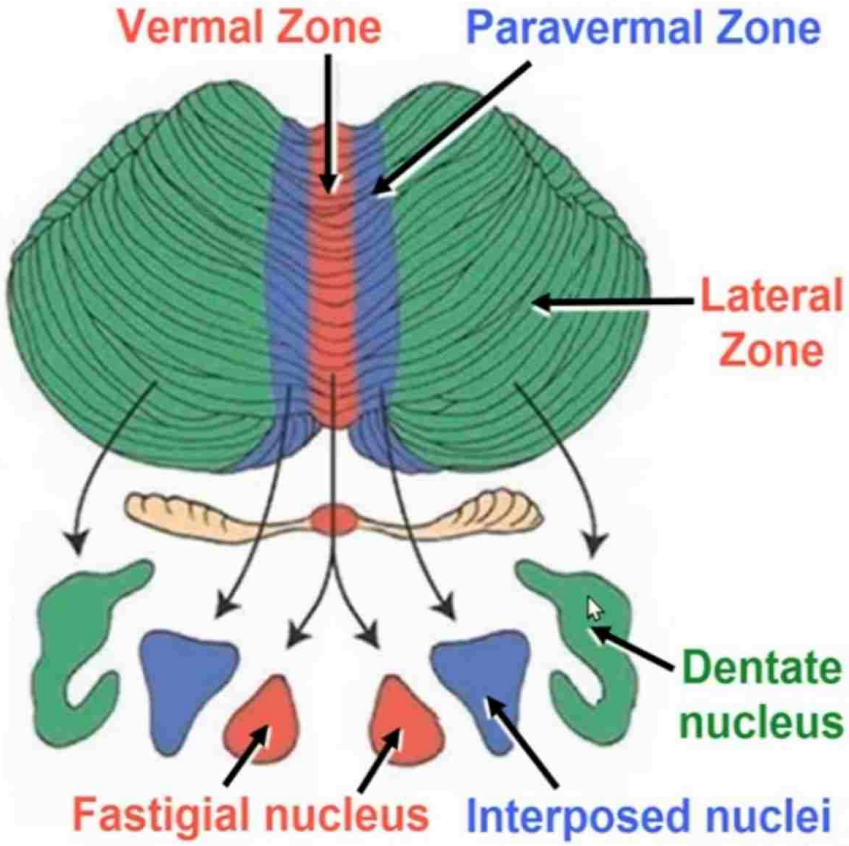
4 Deep Cerebellar Nuclei

From medial to lateral:

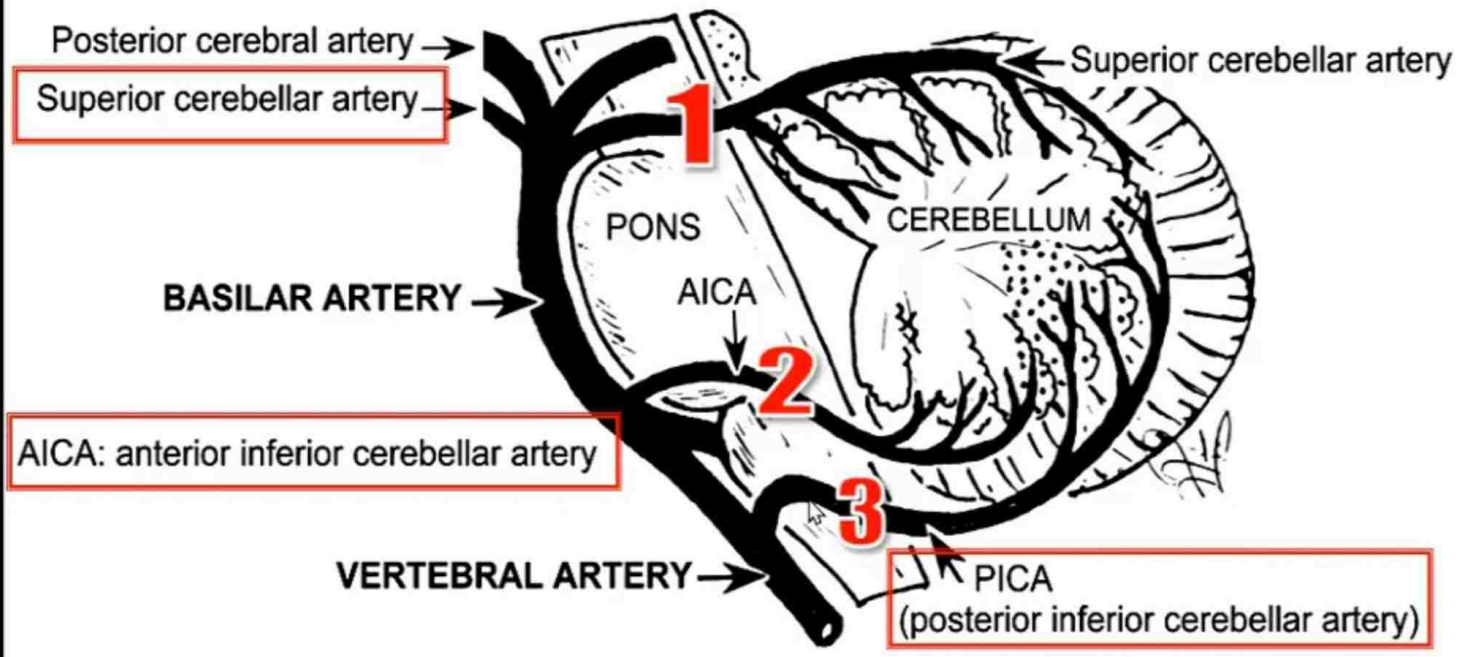
1: Fastigial nucleus: connected with the vermal zone

2 & 3: Globose and emboliform nuclei: connected with the paravermal zone

4: Dentate nucleus: connected with the lateral zone



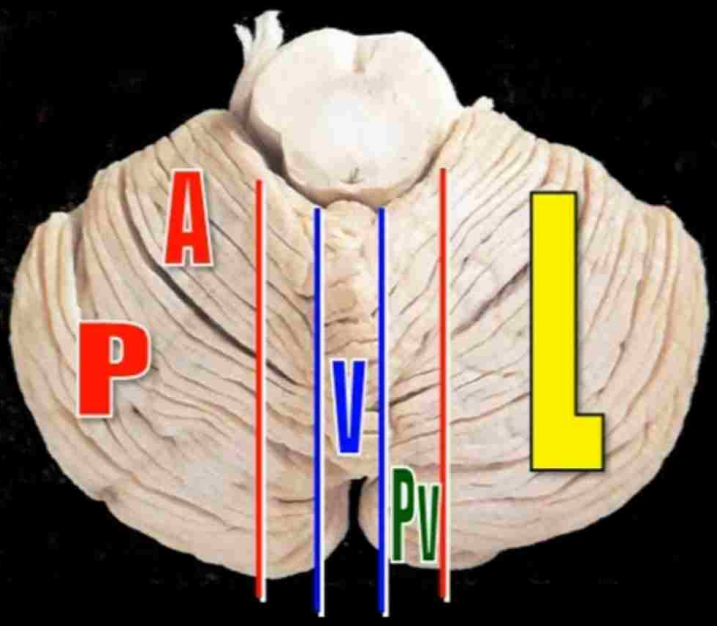
ARTERIAL SUPPLY OF THE CEREBELLUM

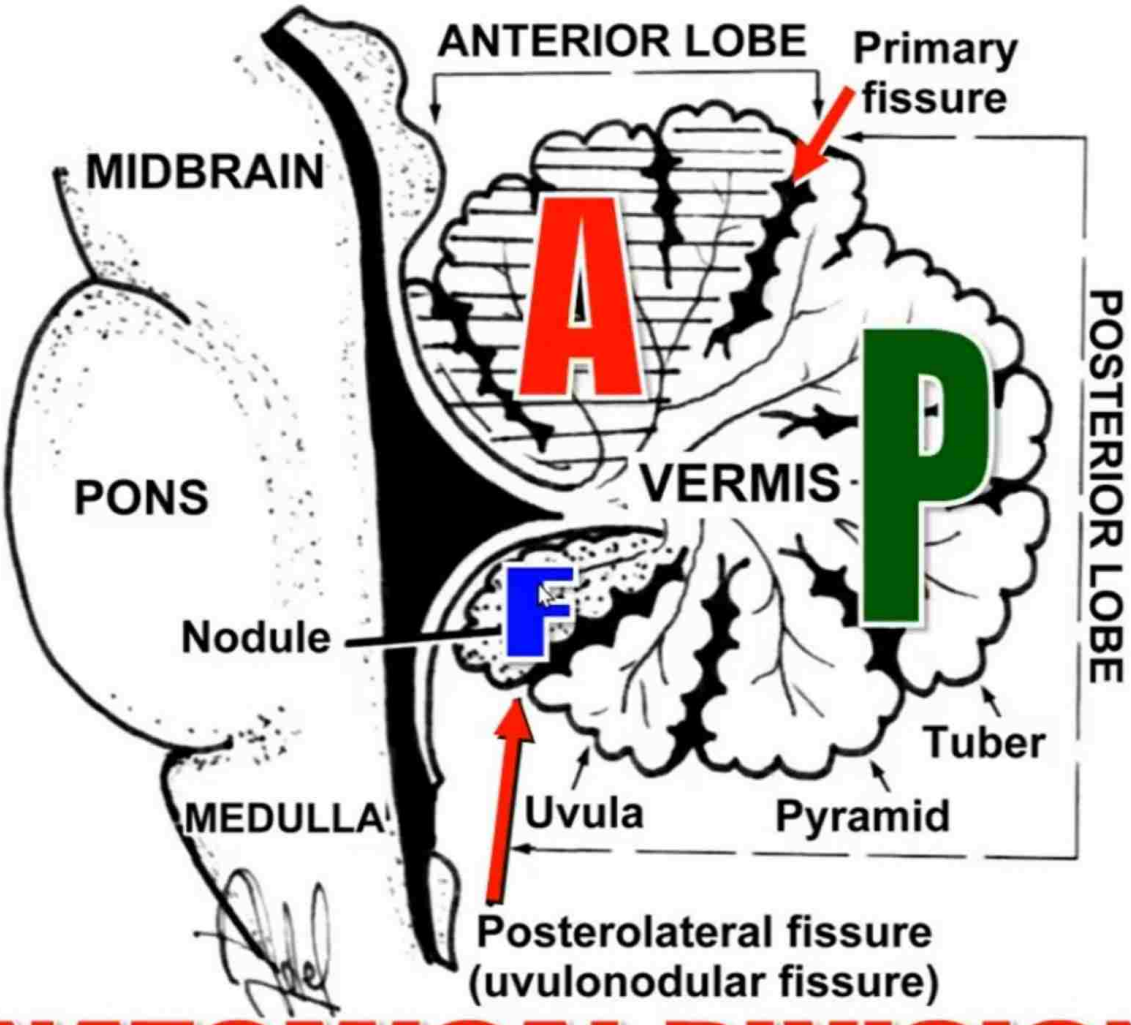


ARTERIAL SUPPLY OF THE CEREBELLUM

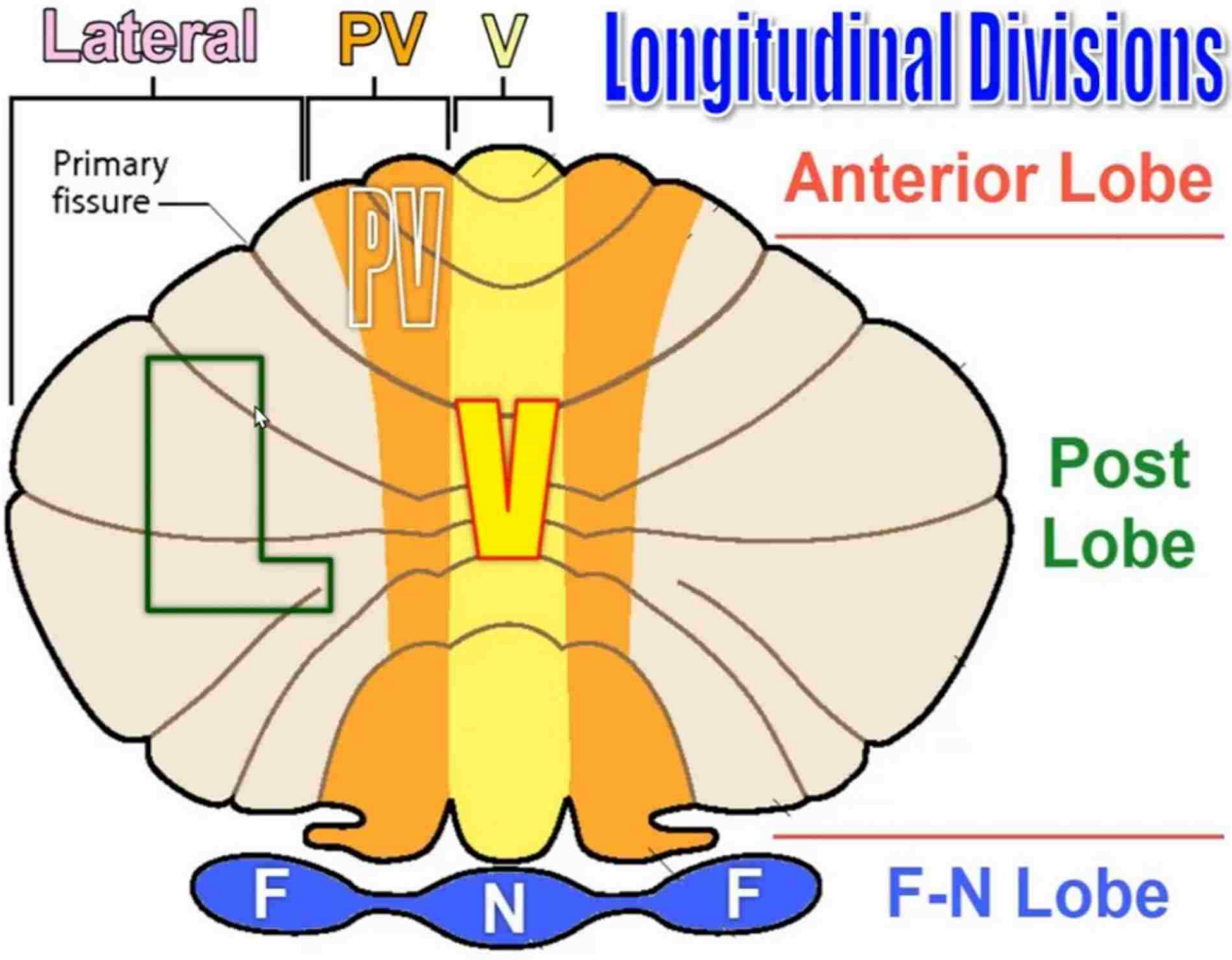
DIVISIONS OF THE CEREBELLUM

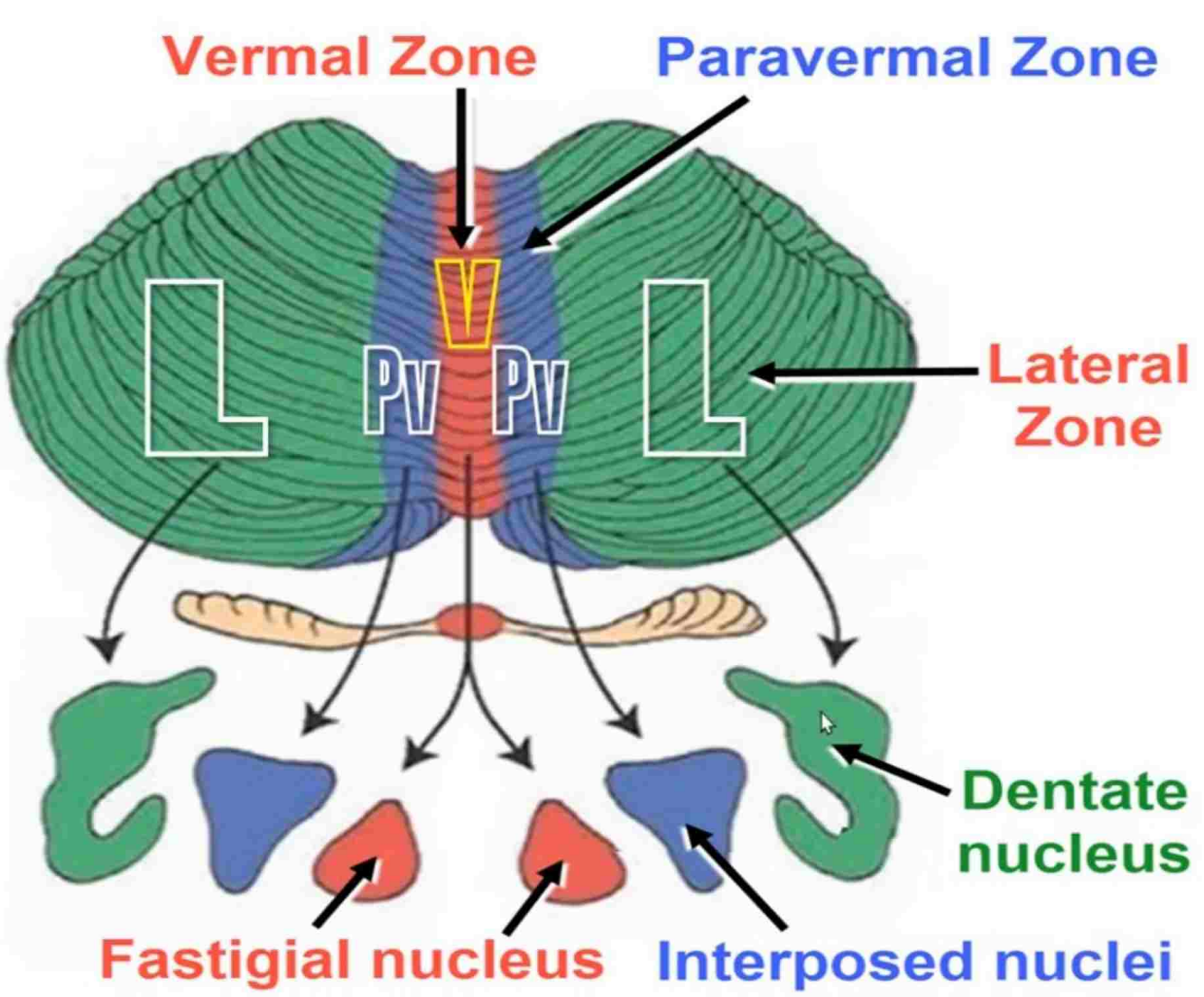
1. Anatomical:
   - 3 lobes
2. Longitudinal:
   - 3 zones
3. Functional:
   - 3 zones



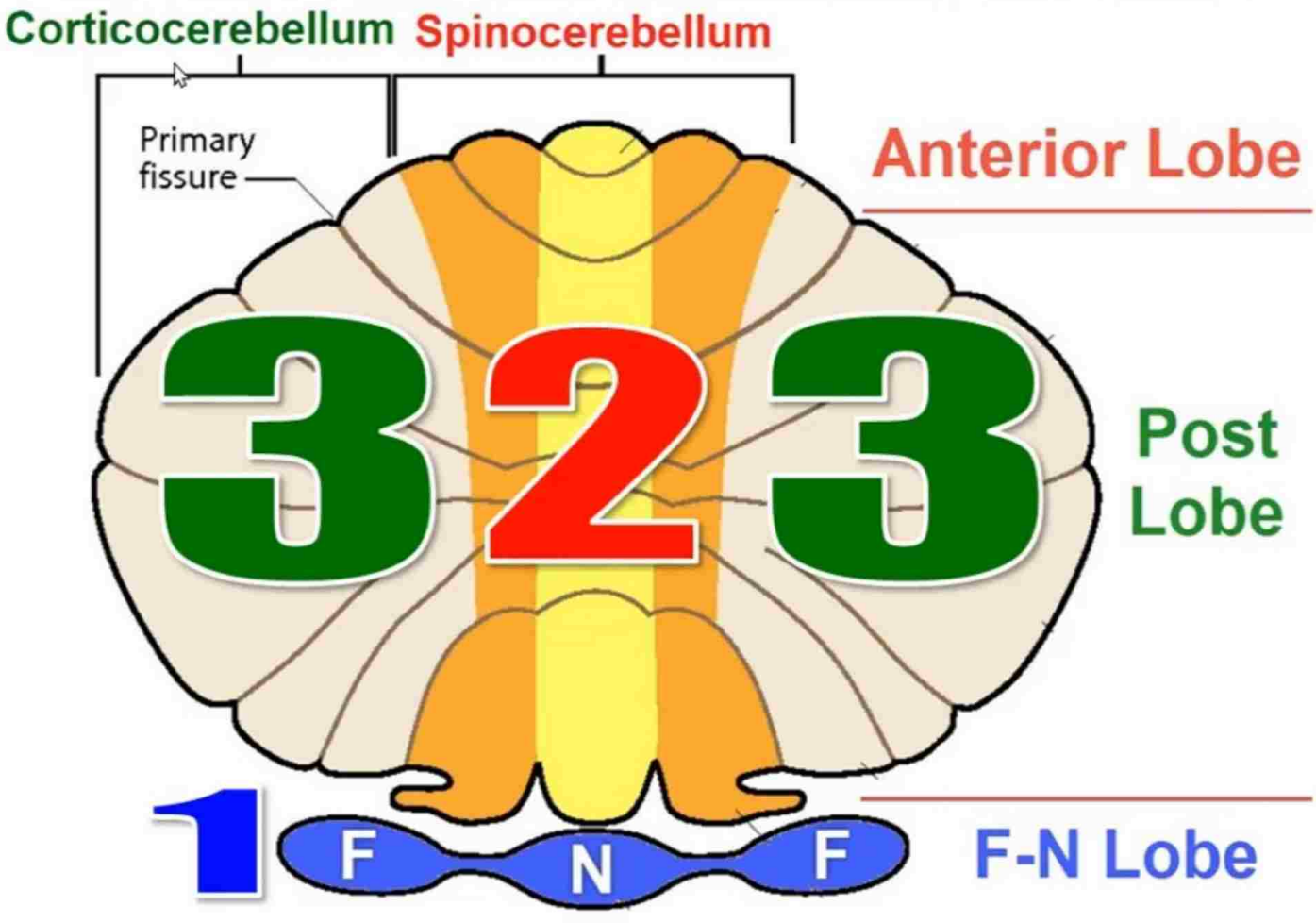


ANATOMICAL DIVISIONS





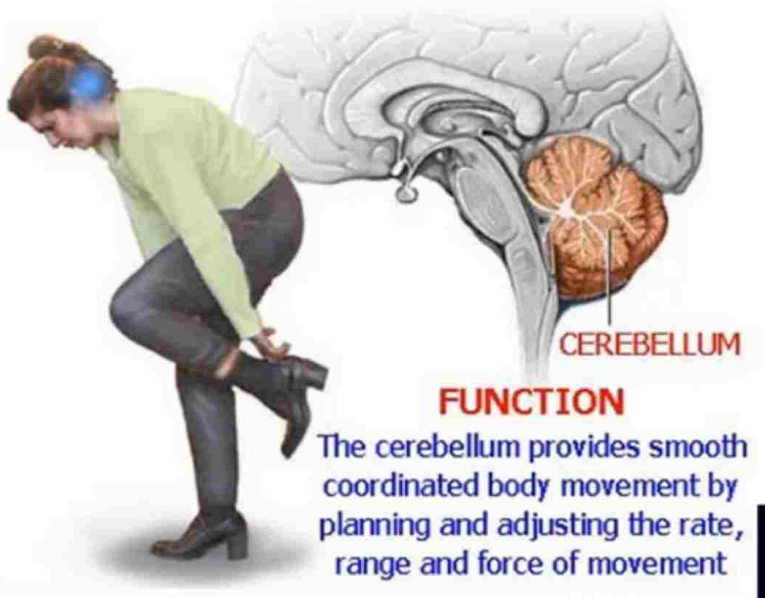
Functional Divisions



FUNCTIONAL DIVISIONS

Flocculonodular Lobe: Vest-Cer	Paleocerebellum Spinocerebellum	Neocerebellum Corticocerebellum
Nodule and the 2 Flocculi	Vermal and paravermal zone	Lateral zone of the cerebellar hemisphere
Connected with vestibular system	Connected with the spinal cord	Connected with cerebral cortex
Maintain equilibrium	Regulate muscle tone & coordination	Automatic control of movement

FUNCTIONS OF THE CEREBELLUM



- ❑ Equilibrium.
- ❑ Coordination & Regulation of muscle tone.
- ❑ Automatic control of movement: planning and control range and force of movement.

Signs of Cerebellar Lesion

Intention tremor: the tremor is absent at rest and appears when the patient moves his limb.

Disturbances in muscle coordination:

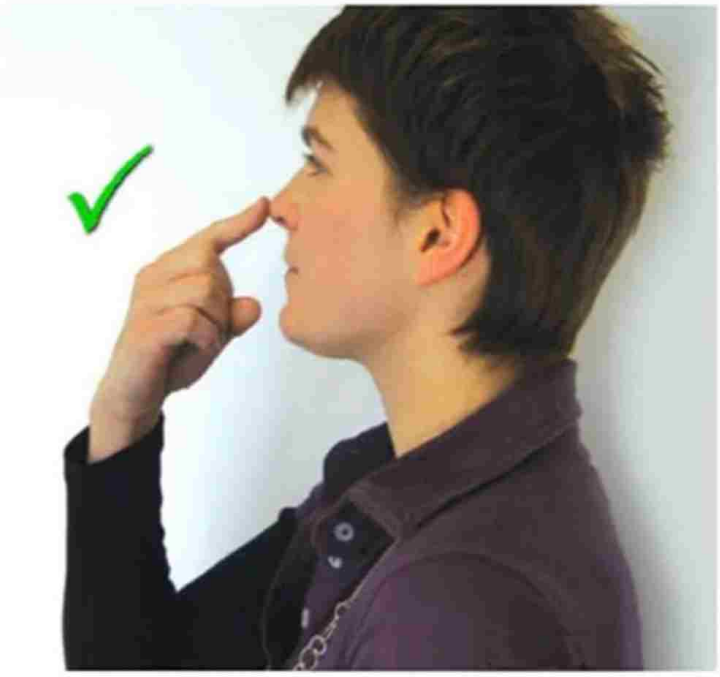
a. **Ataxia:** incoordination of trunk and limb muscles.
b. **Nystagmus:** incoordination (ataxia) of extraocular muscles.
c. **Scanning speech:** incoordination of muscles of speech.

Dysmetria: disturbance in the range of movement.

Test: finger-nose-test.

Disturbance in initiation and termination of movement
dysdiadochokinesia: such as pronation and supination.

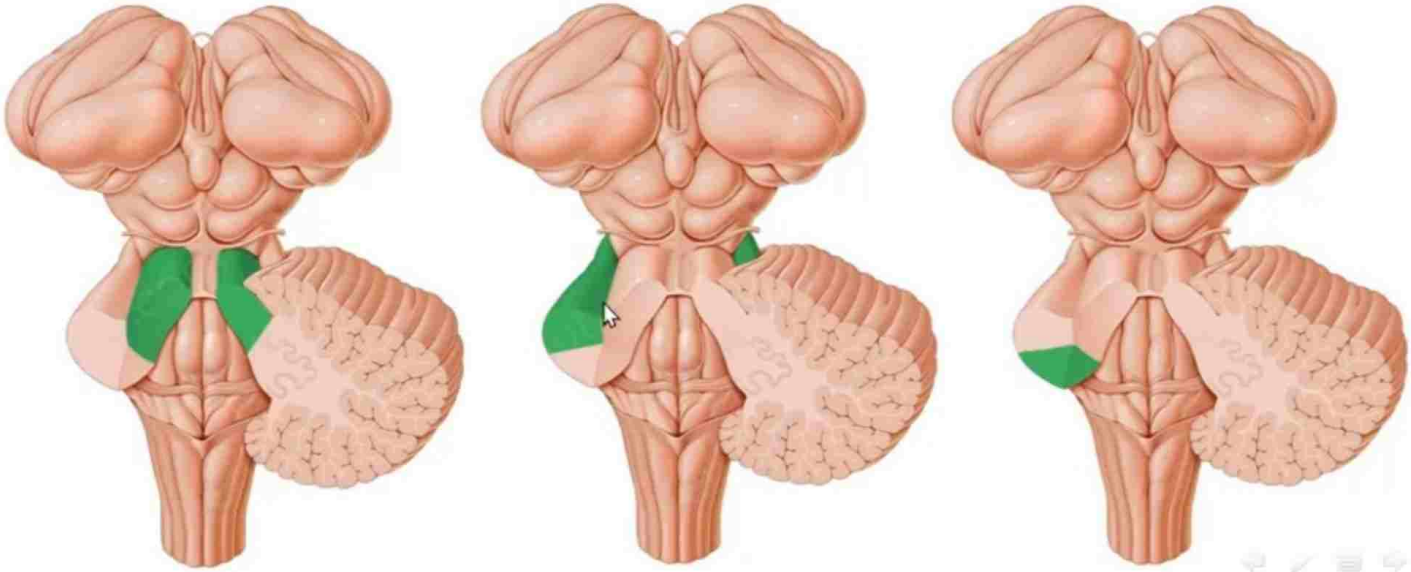
CEREBELLAR TEST



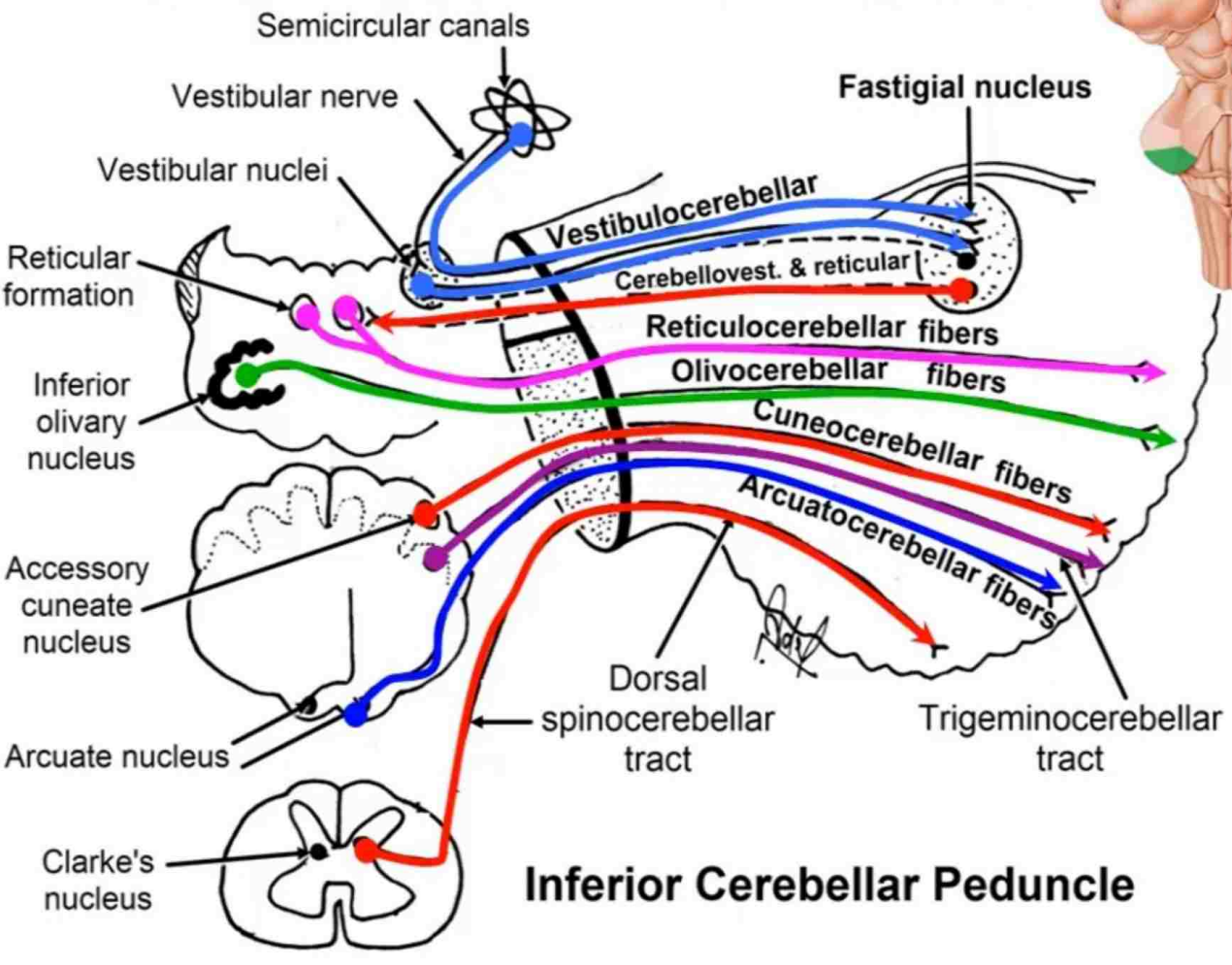
Finger to Nose Test
for testing the cerebellar function

Finger to Nose Test
She failed the test. She was caught while drunk during driving

Cerebellar Connections



Inferior Cerebellar Peduncle



INFERIOR CEREBELLAR PEDUNCLE

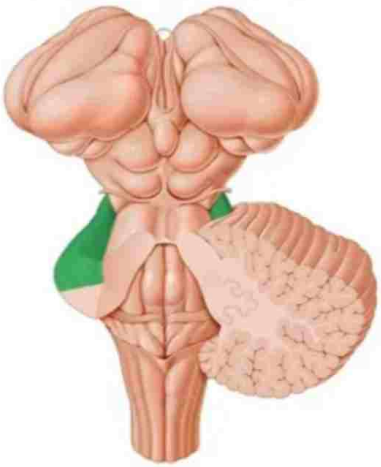
RESTIFORM BODY

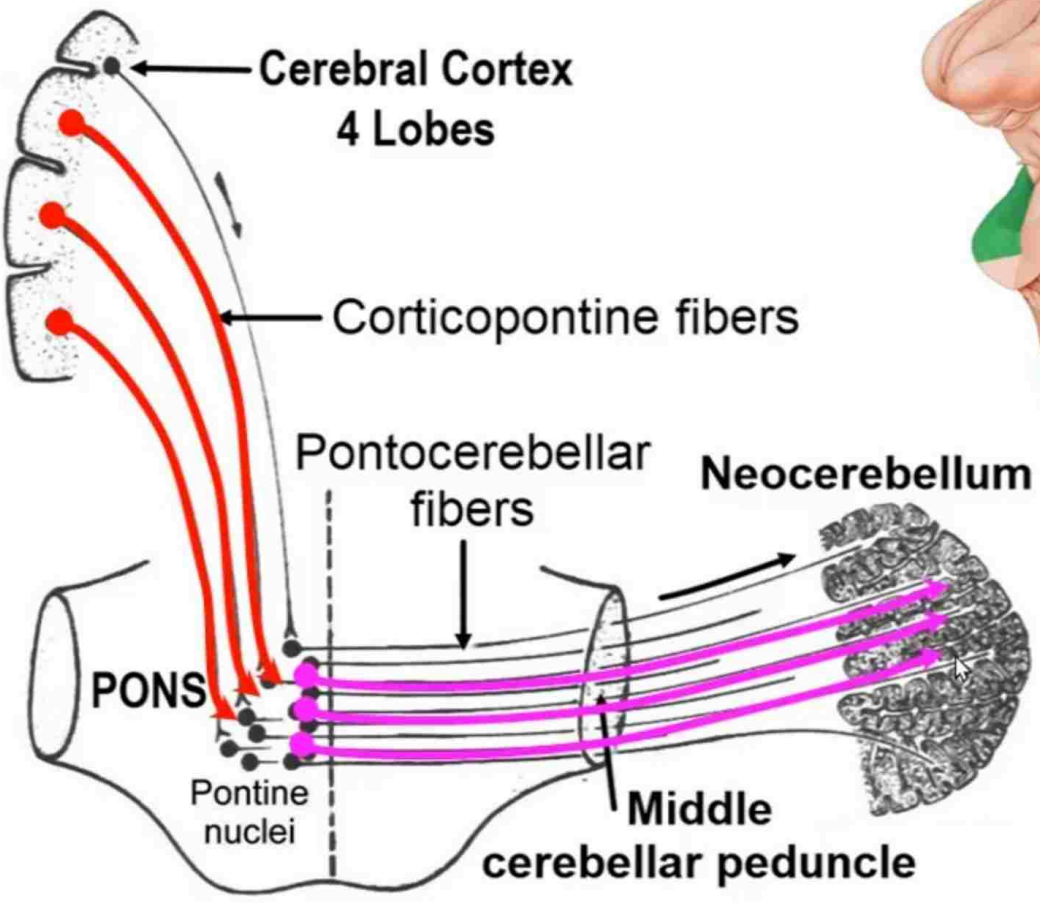
1. Olivocerebellar tract
2. Dorsal spinocerebellar tract
3. Cuneocerebellar tract
4. Arcuatocerebellar tract:
   a. Ventral external arcuate fibers
   b. Stria medullaris of the 4th ventricle
5. Reticulocerebellar tract
6. Trigeminocerebellar tract

JUXTARESTIFORM BODY

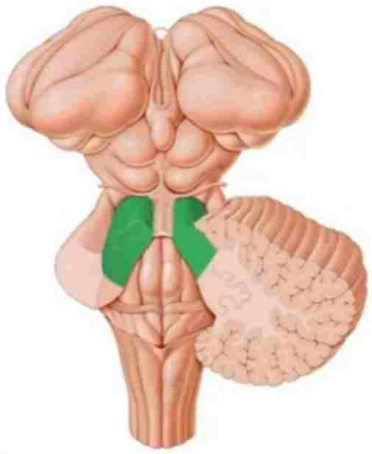
1. Vestibulocerebellar tract
2. Cerebellovestibular tract
3. Cerebelloreticular tract

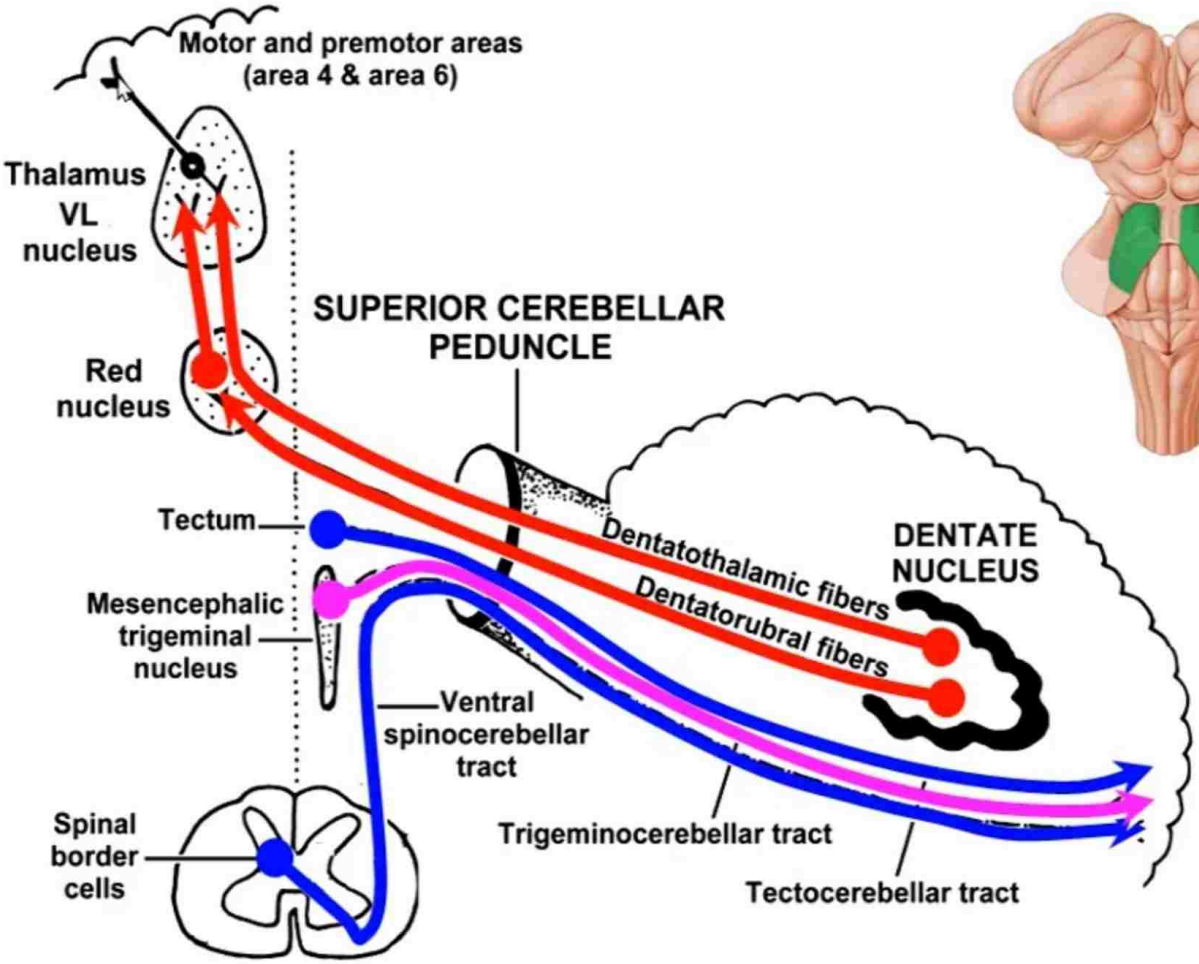
Middle Cerebellar Peduncle





Superior Cerebellar Peduncle

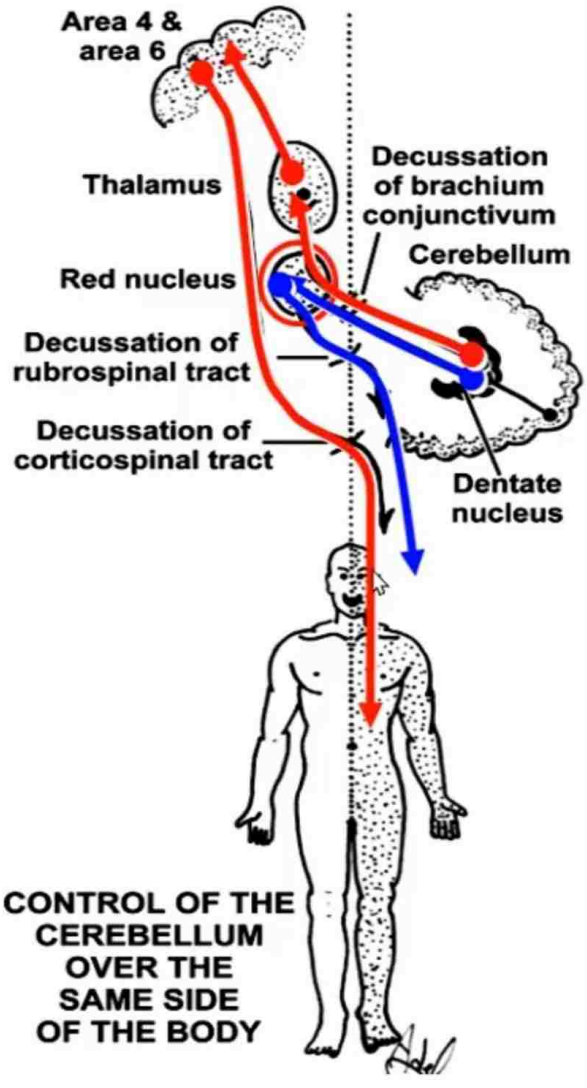




The cerebellar hemisphere controls the muscles of the same side of the body **due to double crossing:**

1. **Dentatorubral and rubrospinal.**

2. **Dentatothalamic and Corticospinal**



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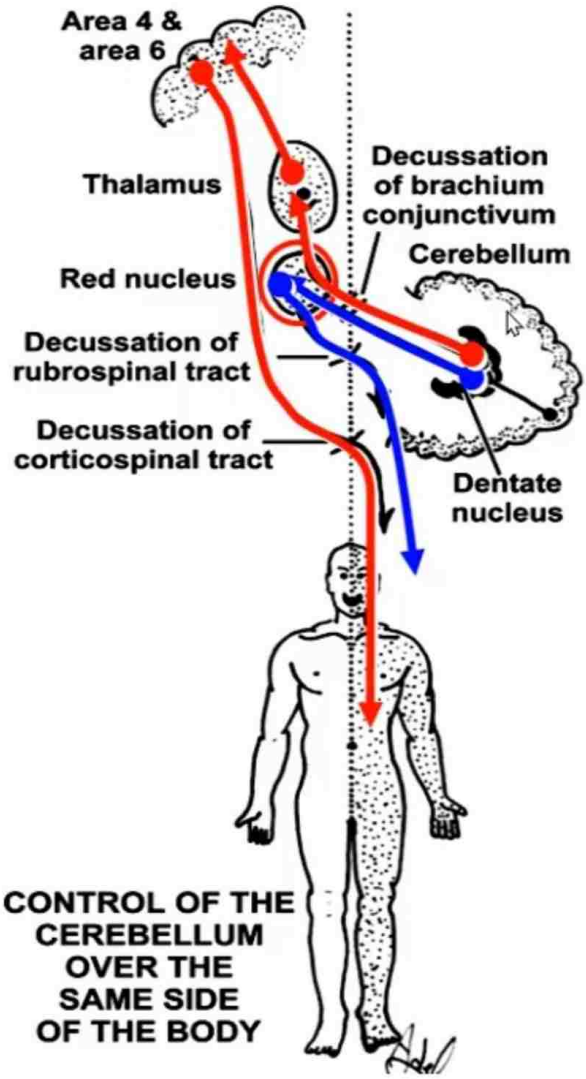
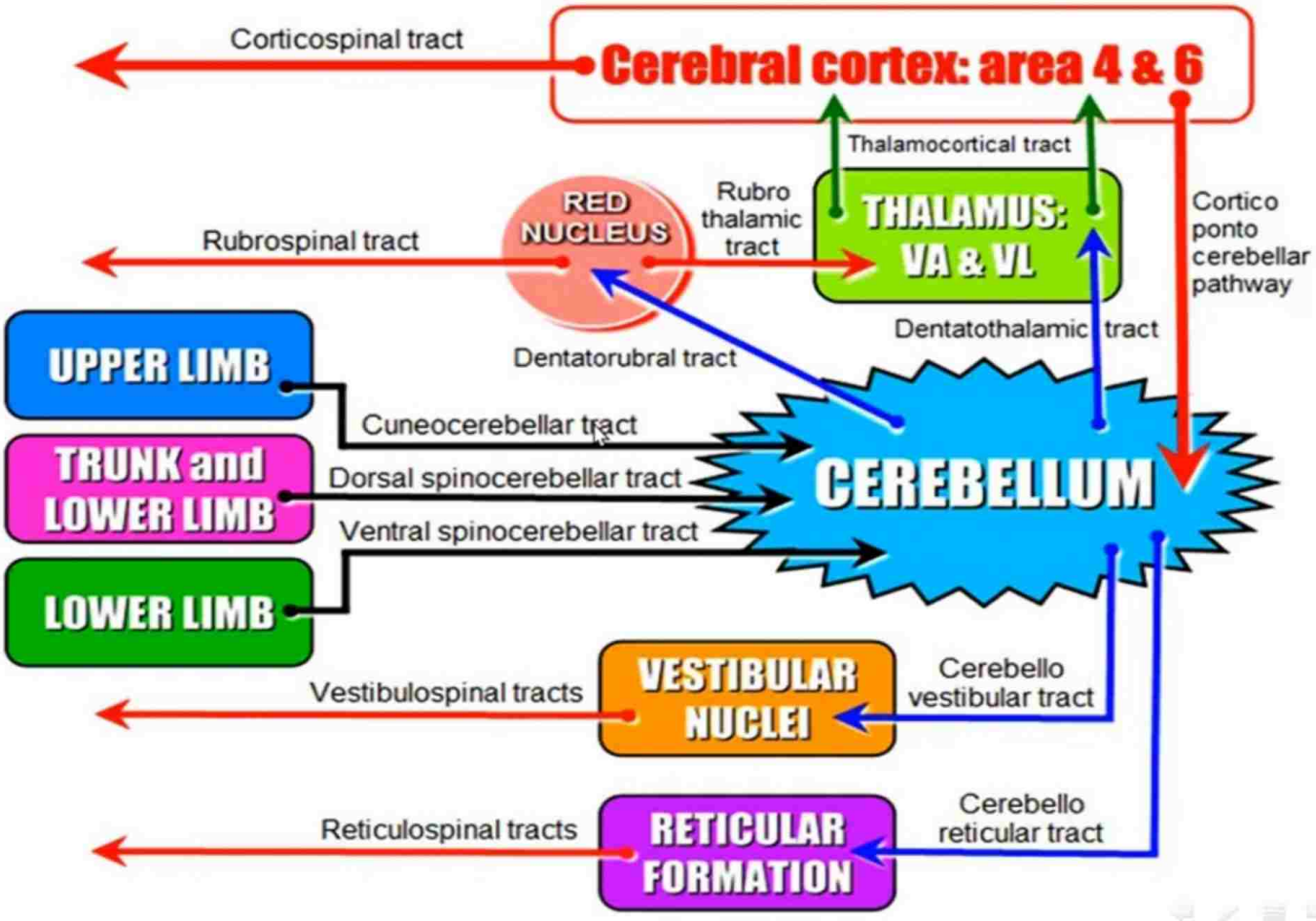


Cerebellar Control of Movement



Medial Longitudinal Fasciculus

MLF

- What is MLF?
- Position
- Formation
- Function

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Medial Longitudinal Fasciculus: MLF

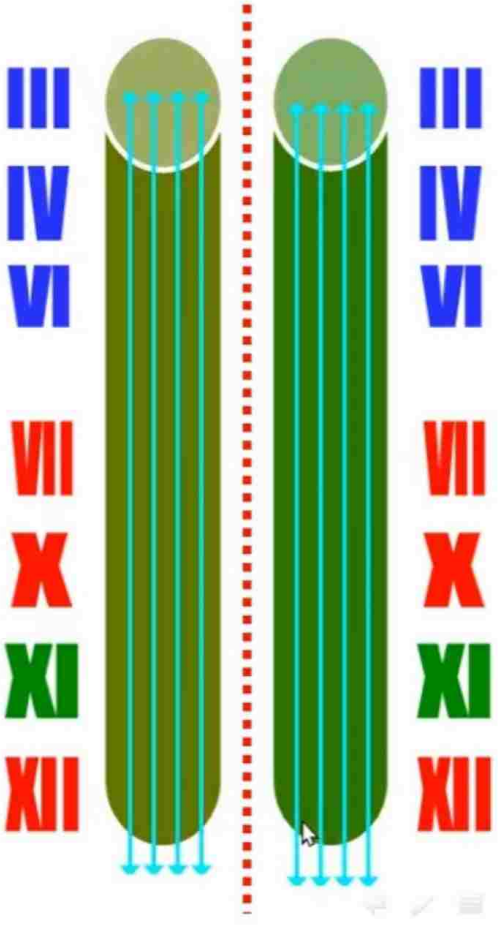
What is MLF?

It is **association bundle connecting**

1. The nuclei which move the 2 eyes (III, IV, VI) and the neck (XI).
2. The nuclei involved in speech.

Position

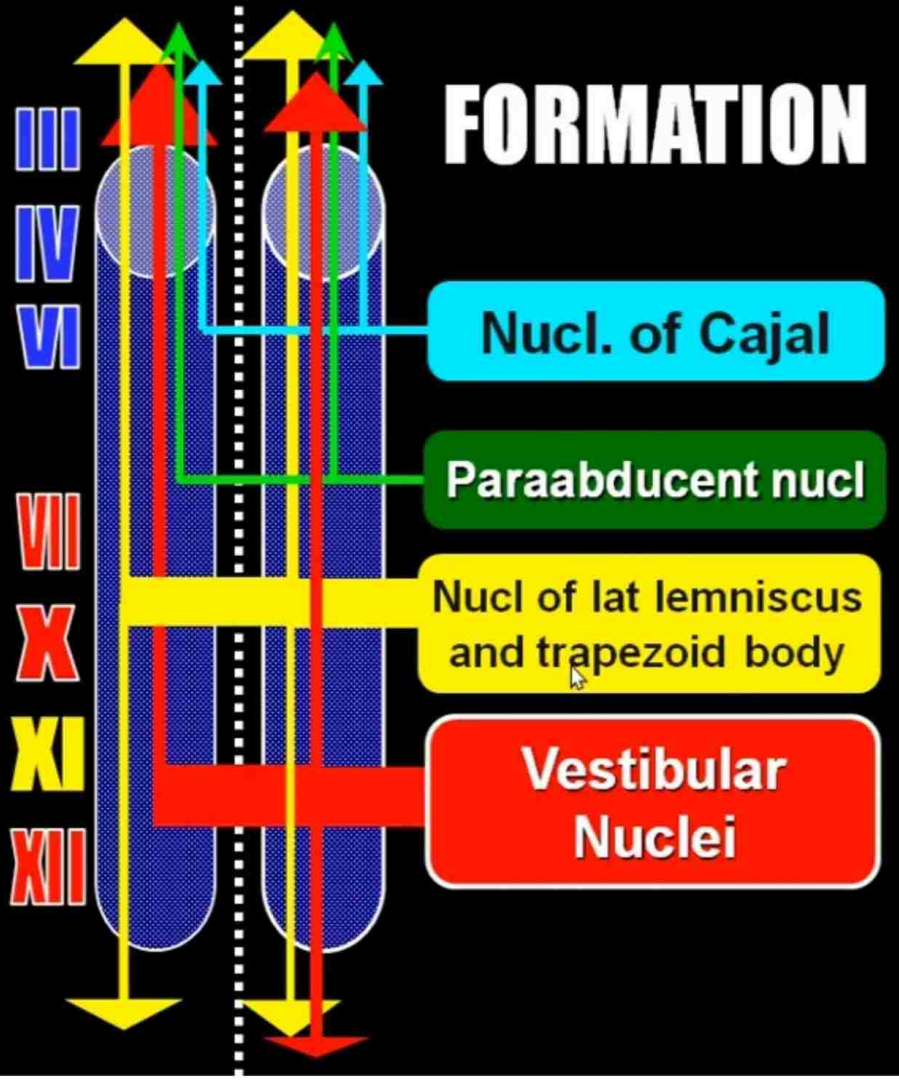
1. **In the brainstem**
2. **On each side** of the midline **from the** upper end of the midbrain **to the** lower end of the medulla.
3. **It extends into** the spinal cord as **sulcomarginal tract**



Formed of fibers that **ascend** to **III, IV & VI** nuclei which move the eye and **descend to** the spinal accessory nucl in the spinal cord

Fibers come from:

1. Vestibular nuclei
2. Nucleus of lateral lemniscus and trapezoid body
3. Paraabducent nucl for the lateral gaze.
4. Interstitial nucleus of Cajal for the downward gaze.



1. Vestibular reflex function: and

2. Auditory reflex function:

Coordinates movement of the 2 eyes and neck (spinal accessory nerve) in response to vestibular stimuli and in response to sound.

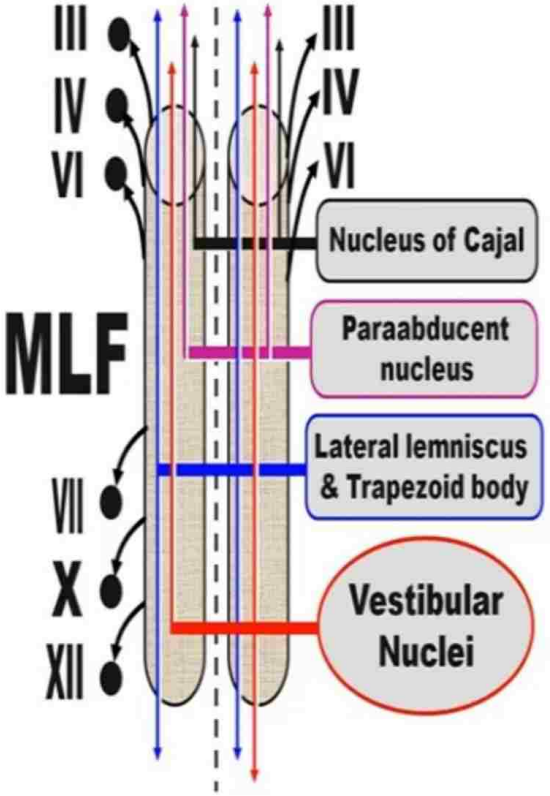
3. Internuclear function:

a. **Connects** the **III** nucleus with the **VI** nucleus of the opposite side for the **lateral** movement of the 2 eyes

b. **Connects** the **III** & **IV** nuclei of the 2 sides for the **downward** movement of the 2 eyes.

c. **Connects the** motor nuclei of the **VII** nerve, **X** nerve and **XII** nerve **to coordinate movement of** the lips, larynx and tongue during speech.

Function of the MLF



Gaze Centers

How the 2 Eyes Move Together

Vertical Gaze
- Up and Down
- Nucleus of Cajal

Horizontal Gaze
- Right and Left
- Paraabducent nucl

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Post commissure

III

SR + IO — SR + IO

Upward Gaze

Nucleus of Cajal

Downward Gaze

IR + SO — IR + SO

III + IV

MLF

GAZE

LESIONS

Parinaud's Syndrome

- Loss of upward gaze
- Lesion in the posterior commisure
- May be due to Pinealoma

Internuclear Ophthalmoplegia

- Loss of horizontal or downward gaze
- Lesion in the MLF
- May be due to MS

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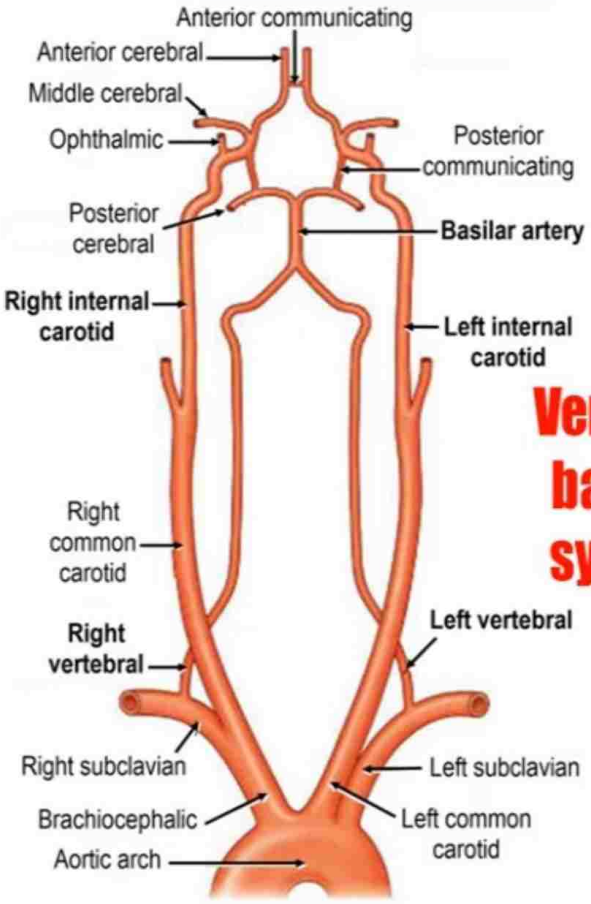
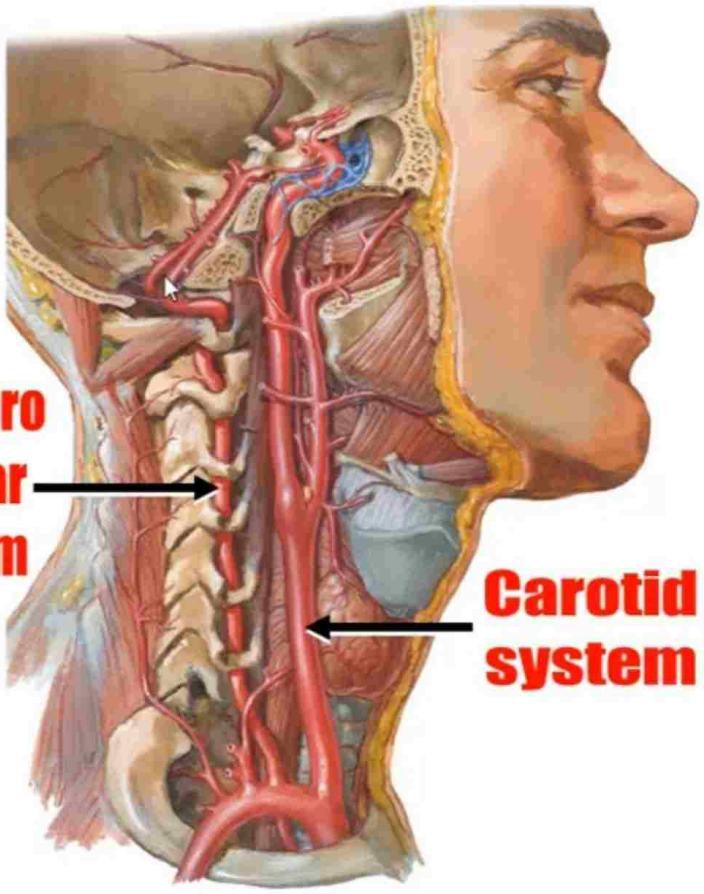
BLOOD SUPPLY OF THE BRAIN

2 SYSTEMS

1. Internal Carotid System
2. Vertebro-basilar System

ARTERIAL SUPPLY OF THE BRAIN





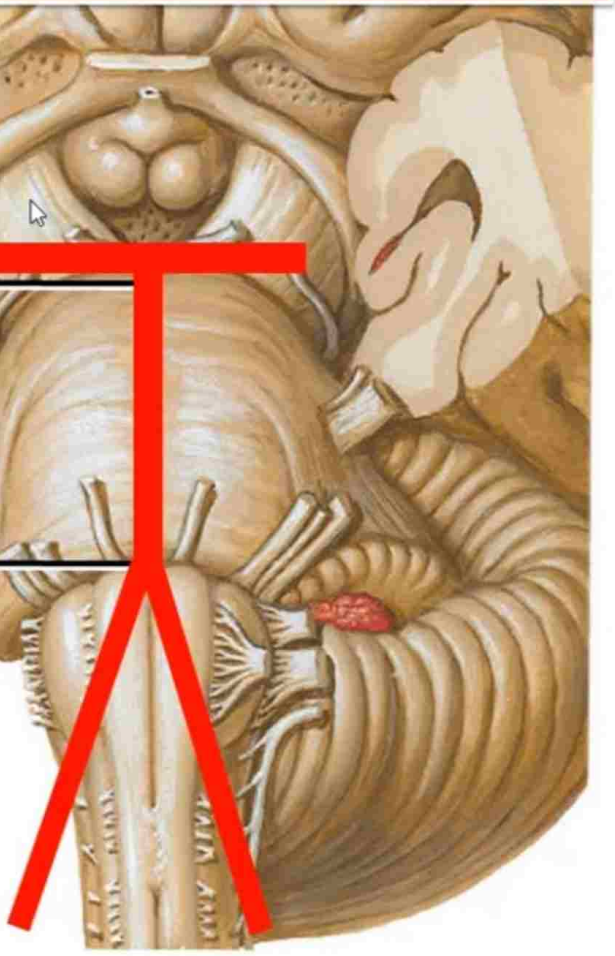
VERTEBRO BASILAR SYSTEM

Formation of the VB System

MIDBRAIN PCA

PONS BA

MEDULLA VA



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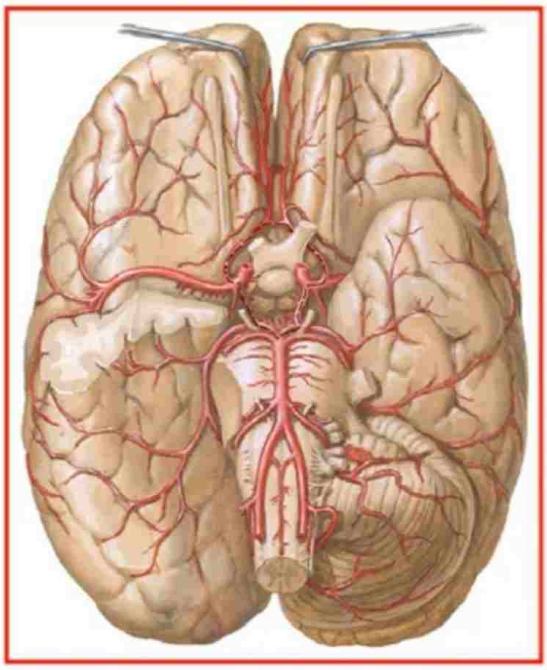
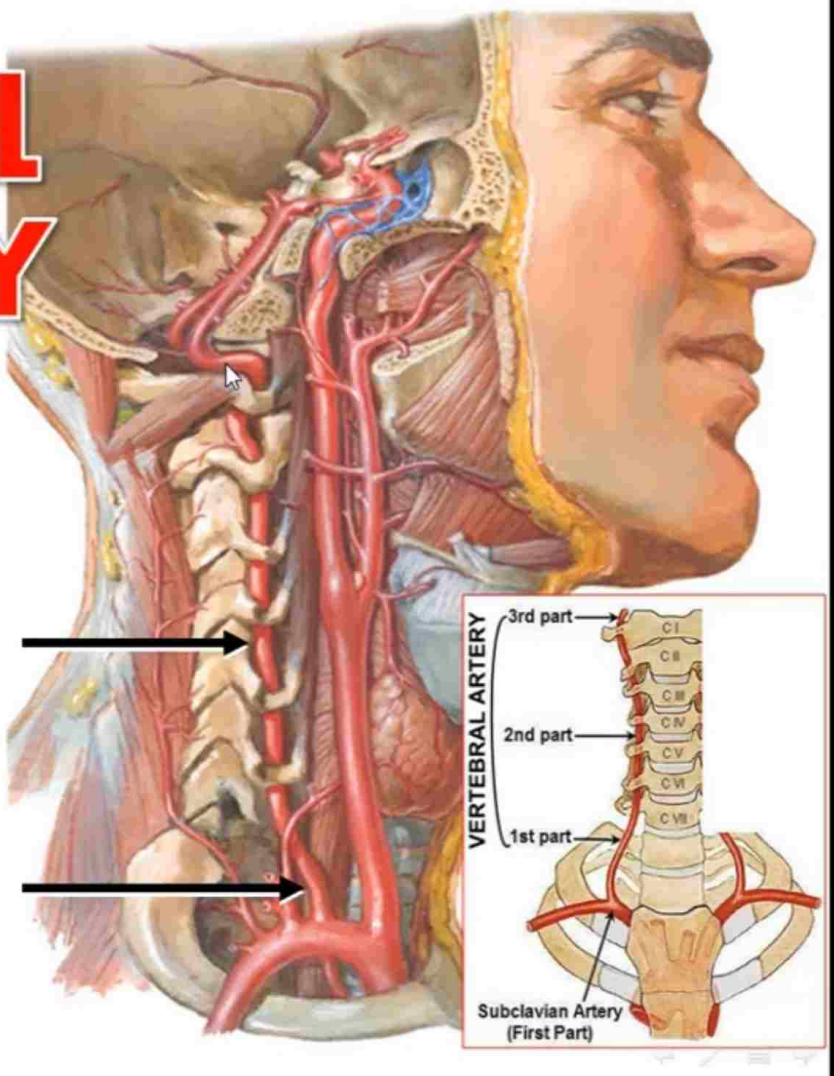
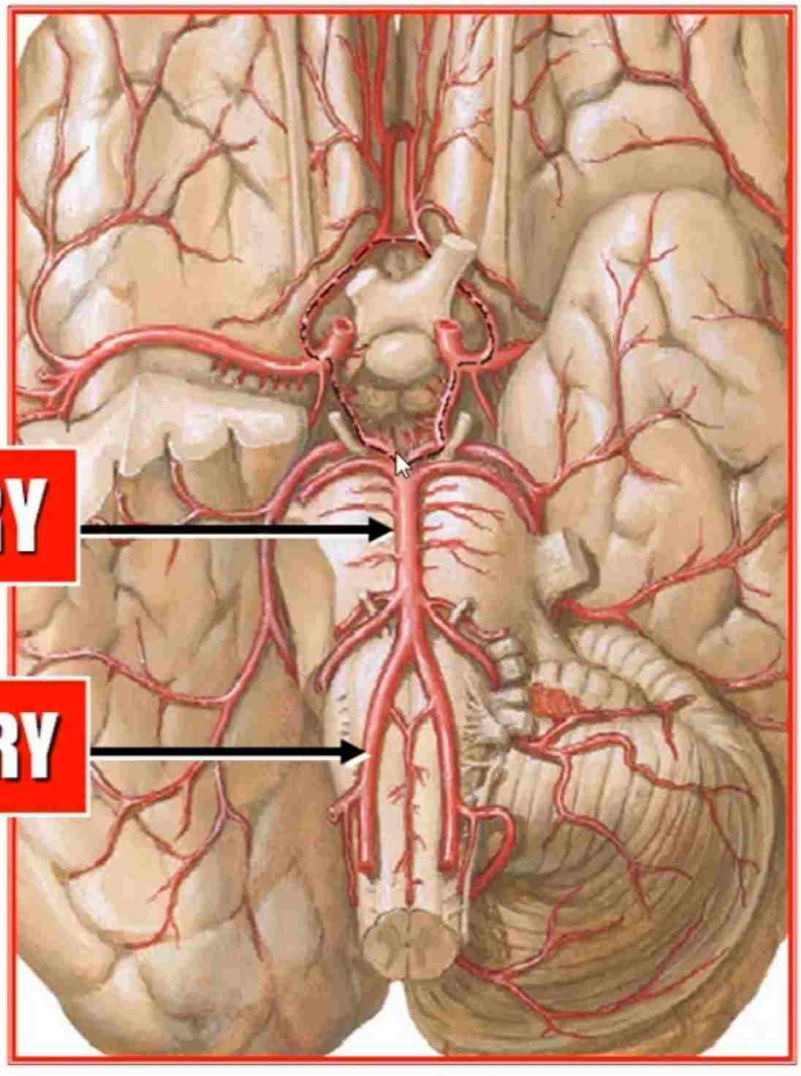
ANY ARTERY

- Origin
- Termination
- Brief course
- Branches

VERTEBRAL ARTERY





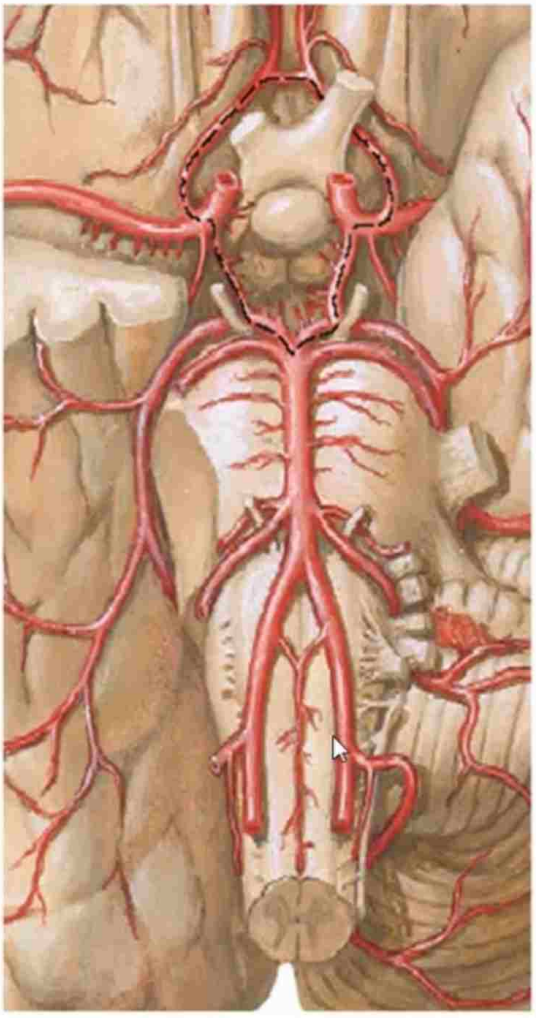


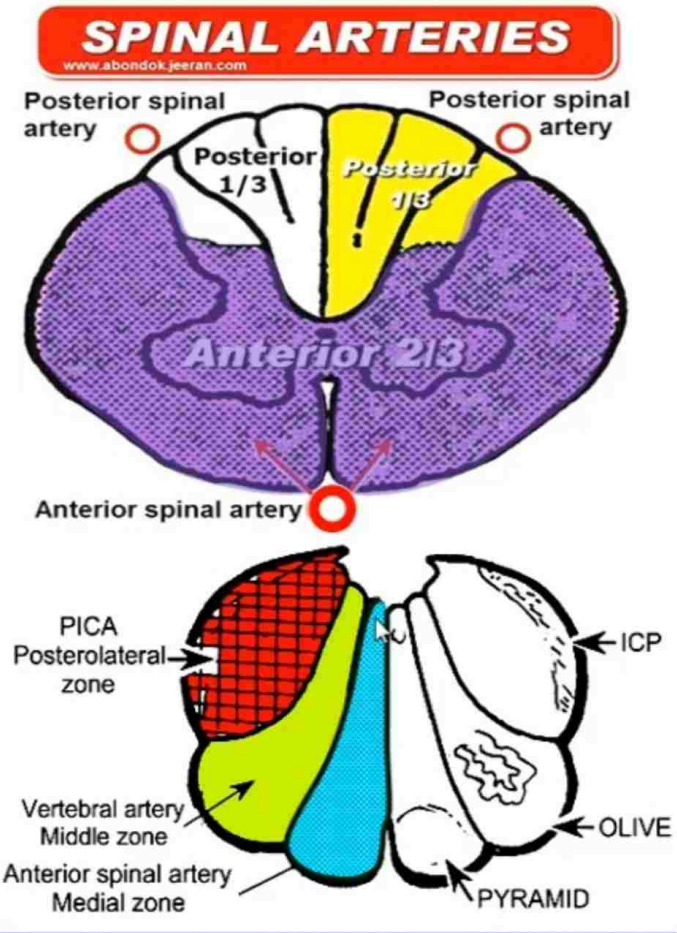
BASILAR ARTERY

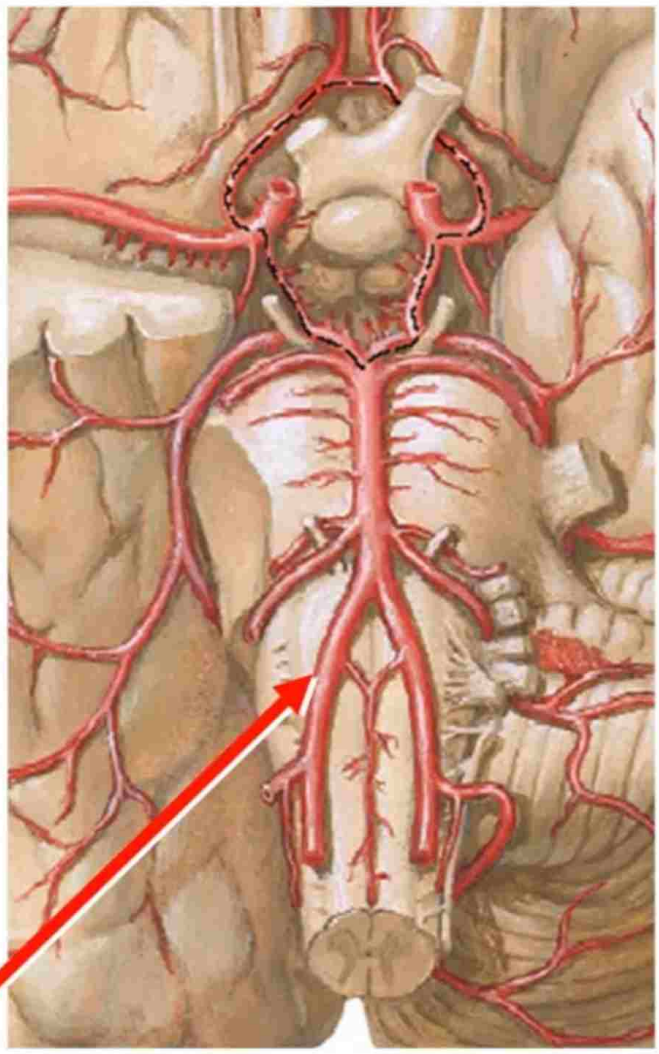
VERTEBRAL ARTERY

5 BRANCHES OF THE VERTEBRAL ARTERY

1. Anterior Spinal Artery
2. Posterior Spinal Artery
3. Posterior Inferior Cerebellar Artery (PICA)
4. Medullary Branches
5. Posterior Meningeal Artery

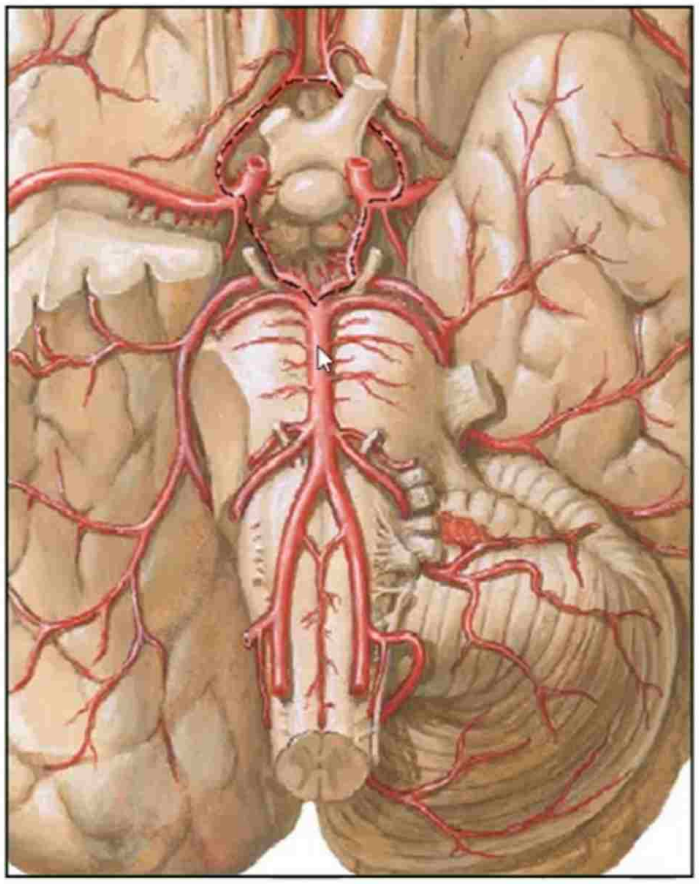






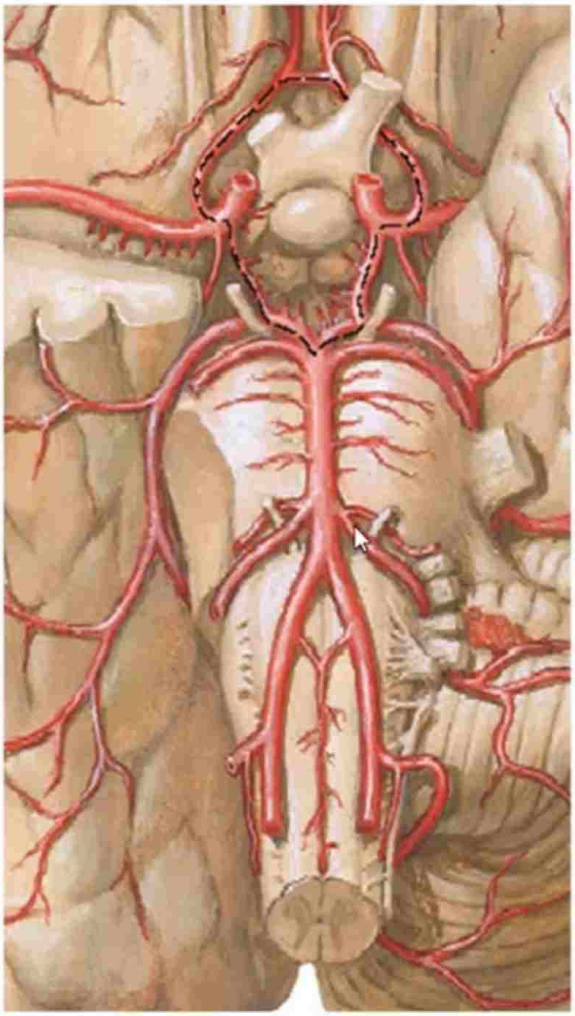
VERTEBRAL ARTERY

BASILAR ARTERY

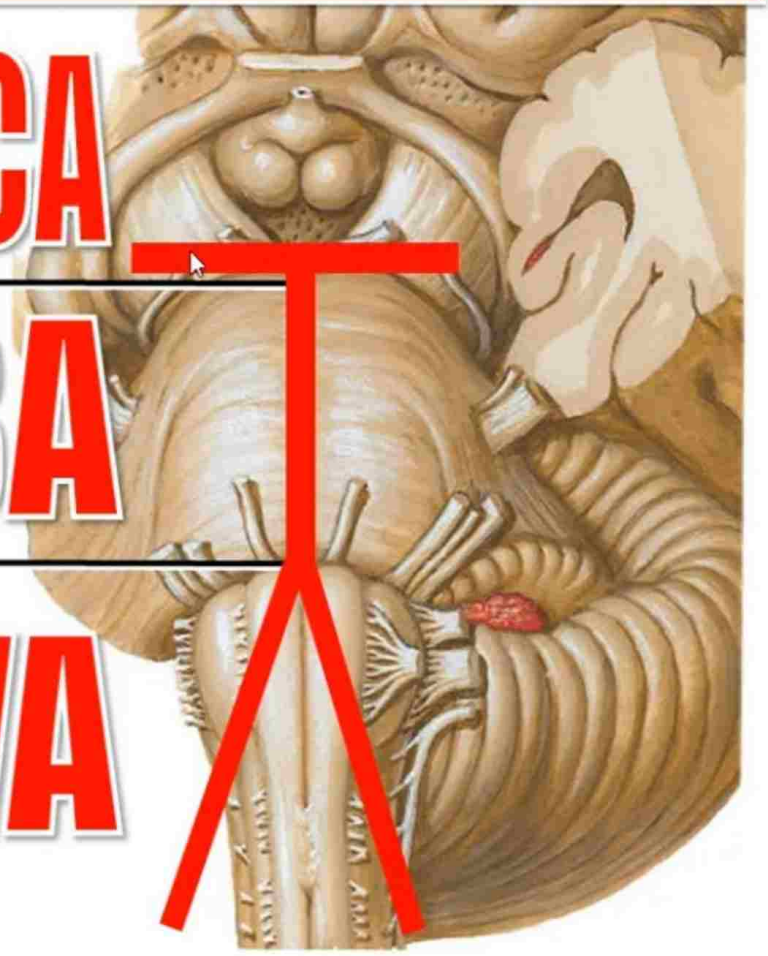


5 BRANCHES OF THE BASILAR ARTERY

1. Pontine branches
2. Anterior Inferior Cerebellar Artery (AICA)
3. Labyrinthine artery
4. Superior cerebellar artery
5. 2 Terminal branches:
   Posterior cerebral arteries



ARTERIAL SUPLY OF THE BRAINSTEM



MIDBRAIN PCA

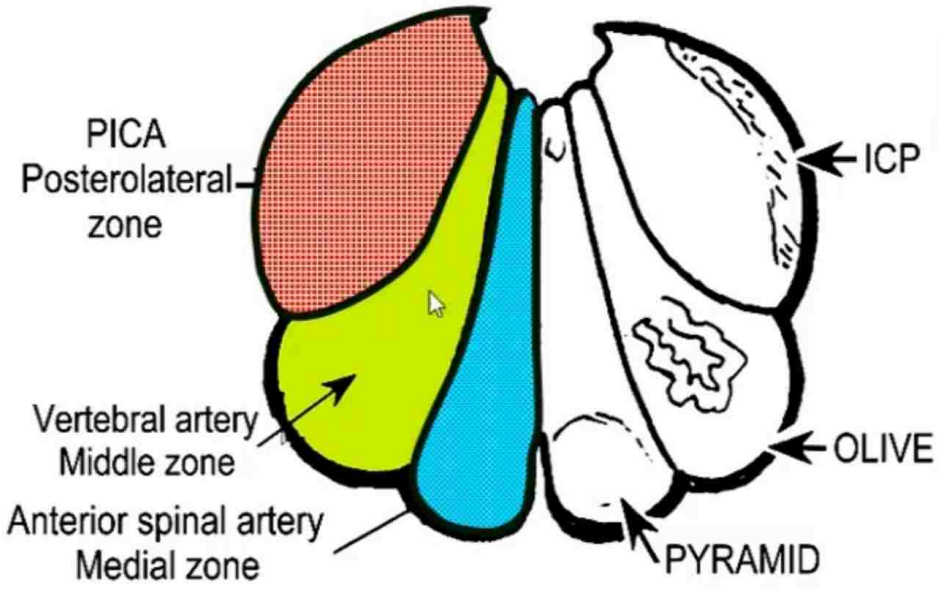
PONS BA

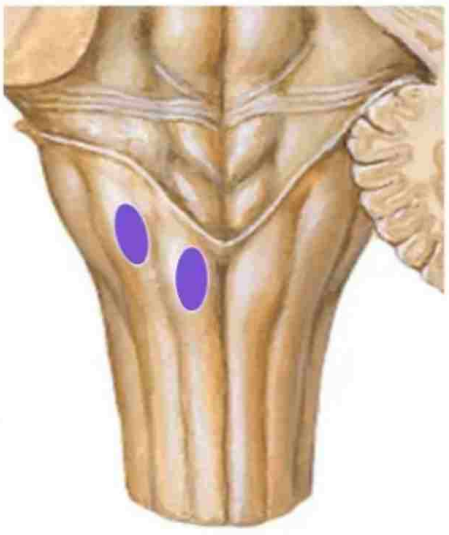
MEDULLA VA

Dr Adel Bondok

ARTERIAL SUPLY OF THE MEDULLA

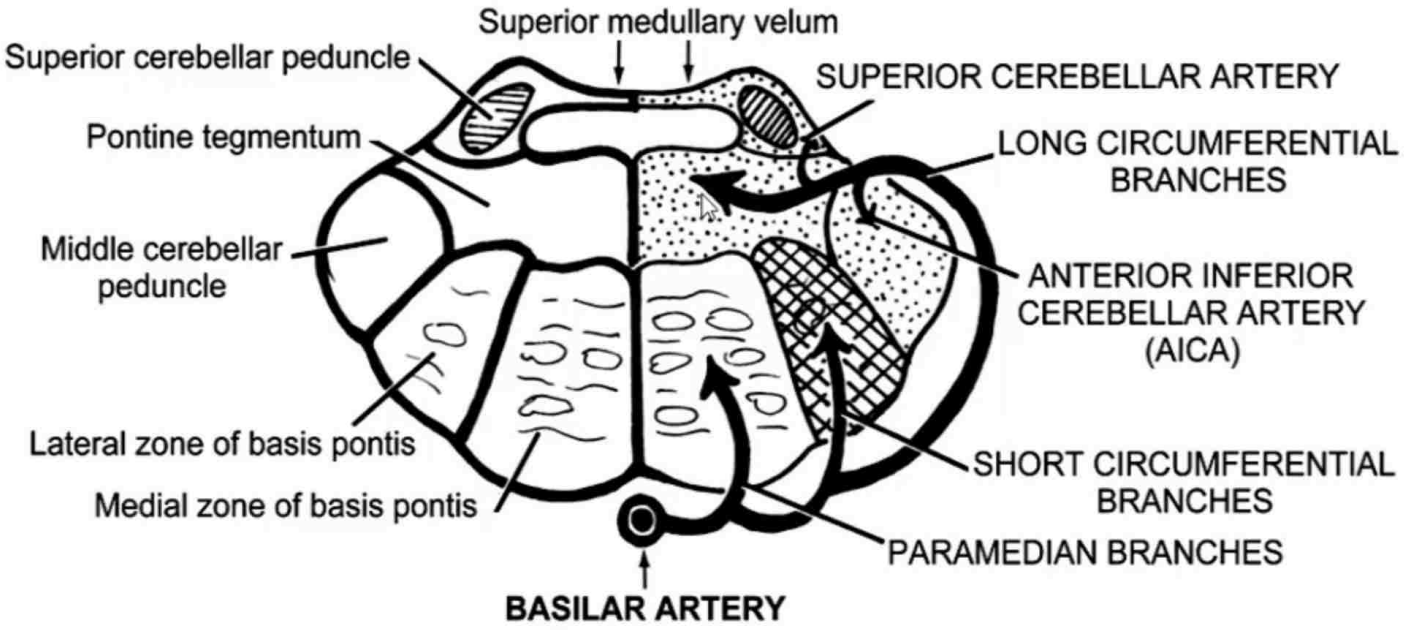
1. Ant Spinal art
2. Post Spinal art
3. PICA
4. Medullary branches





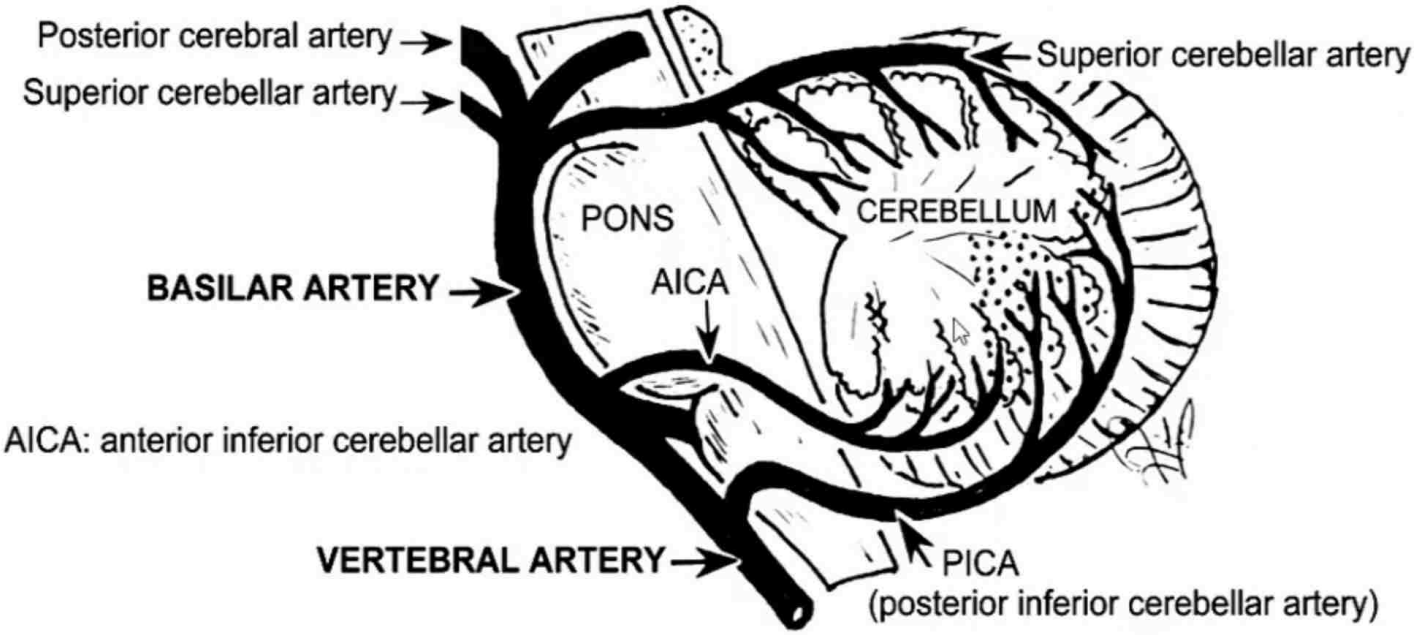
Branches of the Vertebral Artery

ARTERIAL SUPPLY OF THE PONS



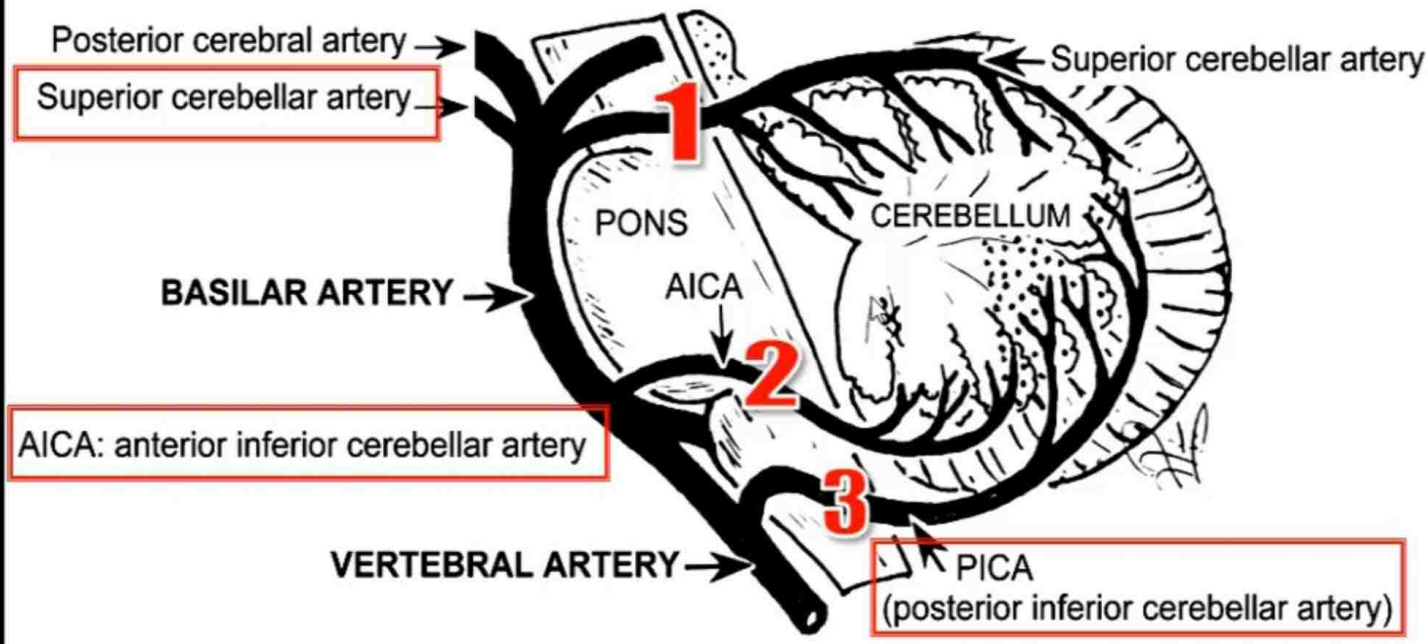
Branches of the Basilar Artery

ARTERIAL SUPPLY OF THE CEREBELLUM



ARTERIAL SUPPLY OF THE CEREBELLUM

ARTERIAL SUPPLY OF THE CEREBELLUM



ARTERIAL SUPPLY OF THE CEREBELLUM

COMPARE BETWEEN PICA & AICA

PICA	AICA
From vertebral art	From basilar art
To the ICP	To the MCP
To lat zone of medulla & Ch plexus of 4th v	To tegmentum of the pons
May give posterior spinal artery	In 85%, May give labyrinthine art

Vascular Lesions of the Medulla

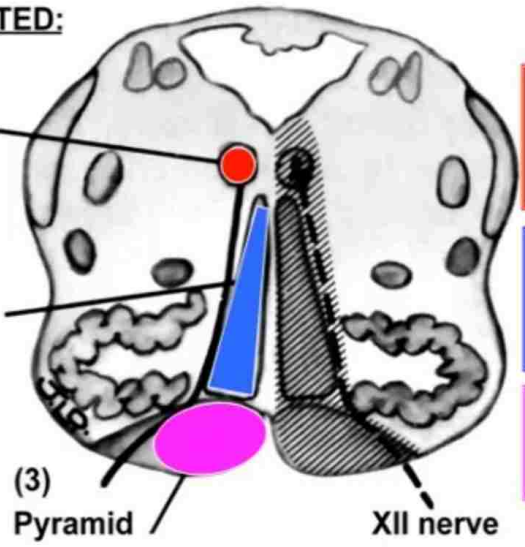
MEDIAL MEDULLARY SYNDROME

Cause:
Structures:
Signs:

STRUCTURES AFFECTED:

(1)
Hypoglossal nucleus

(2)
Medial lemniscus



SIGNS:

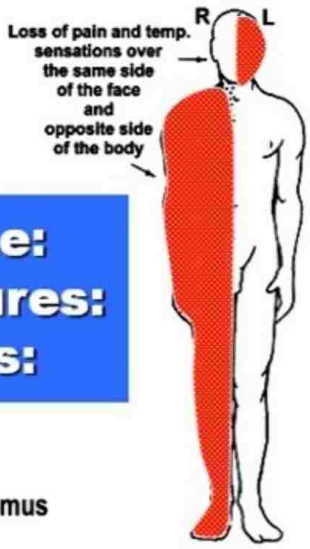
(1)
Lower motor neuron paralysis of the same side of the tongue

(2)
Contralateral loss of kinesthesia and discriminative touch

(3)
Contralateral hemiplegia

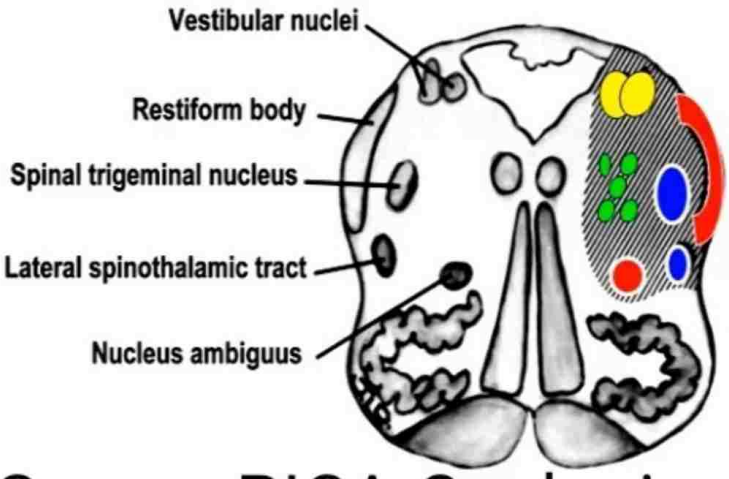
MEDIAL MEDULLARY SYNDROME

LATERAL MEDULLARY SYNDROME



Cause:
Structures:
Signs:

STRUCTURES AFFECTED:



SIGNS:

Vertigo, vomiting & nystagmus

Ataxia (loss of coordination)

Loss of pain & temperature sensations over the same side of the face

Loss of pain & temperature sensations over the opposite side of the body

Dysphagia, loss of gag reflex, hoarsness of voice, uvula deviates to the normal side

Ipsilateral Horner's syndrome

Cause: PICA Occlusion

INTERNAL CAROTID ARTERY

Origin:

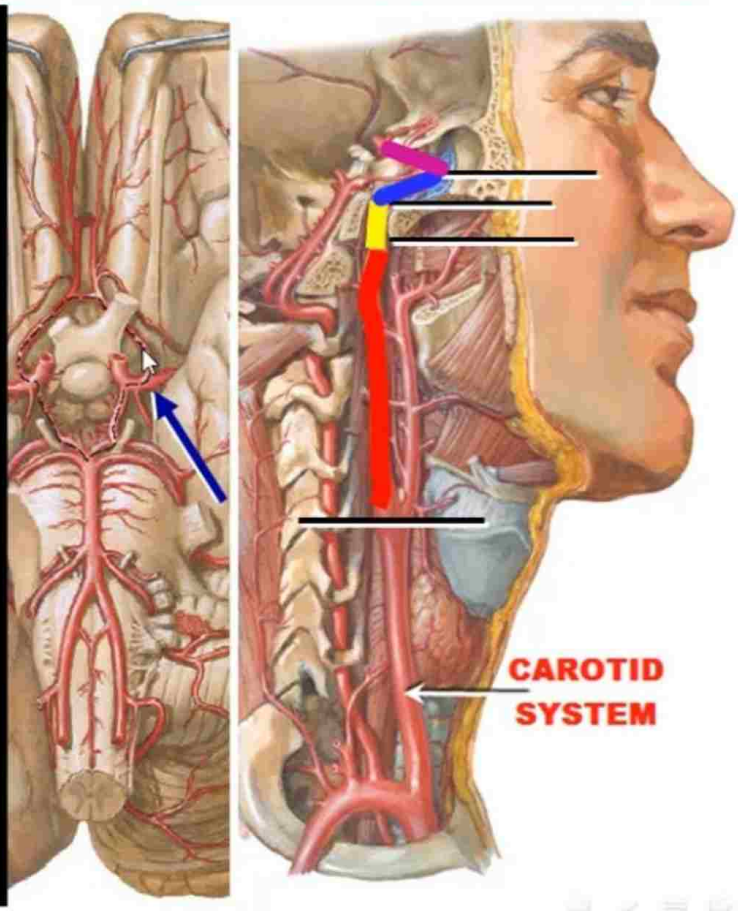
Termination:

Course: 4 parts

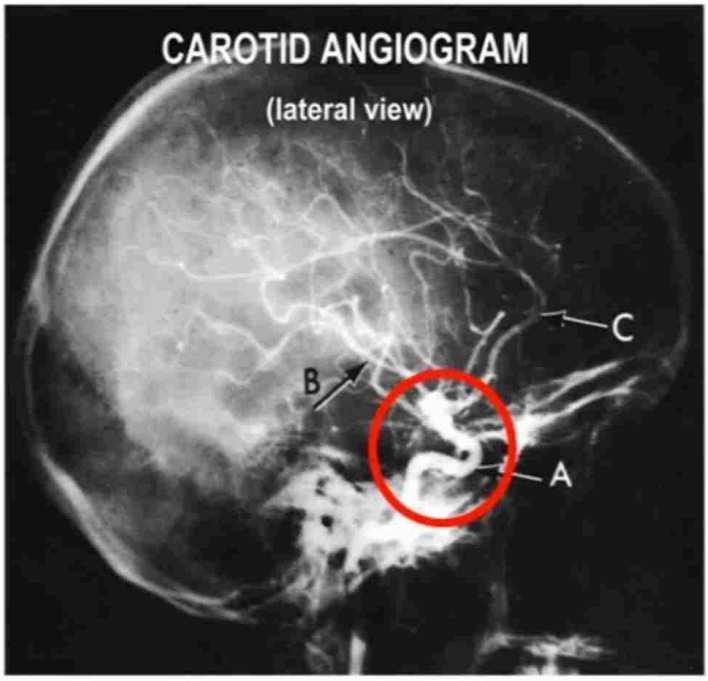
1. **Cervical** Part: carotid sheath
2. **Petrous Part:** in the petrous temporal bone
3. **Cavernous Part:** in the cavernous sinus
4. **Supracavernous Part:** above the cavernous Sinus

Branches: 6

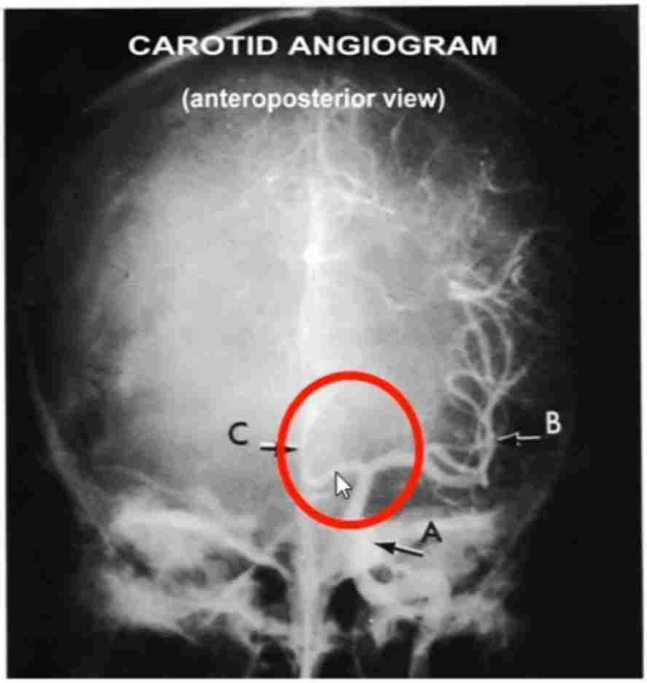
1. Ophthalmic artery
2. Hypophyseal arteries
3. Anterior choroidal artery
4. Posterior communicating artery
5. 2 Terminal branches: ACA & MCA



CAROTID ANGIOGRAM

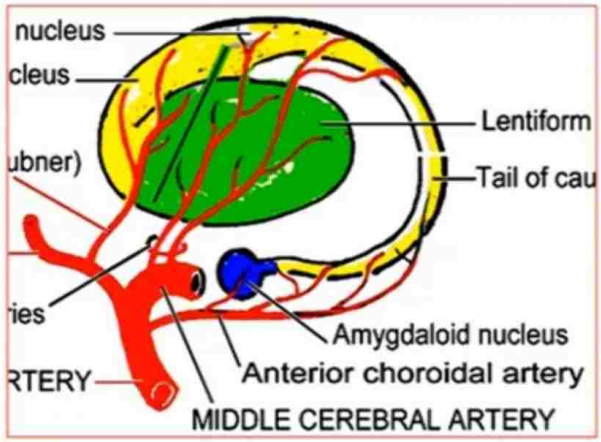


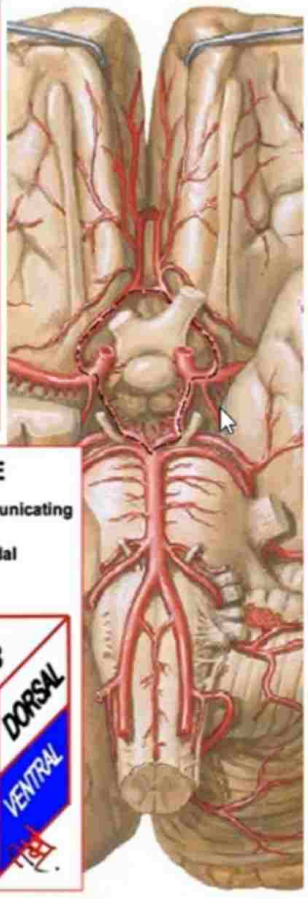
A: Carotid siphon of the internal carotid artery
B: Branches of the middle cerebral artery
C: Anterior cerebral artery

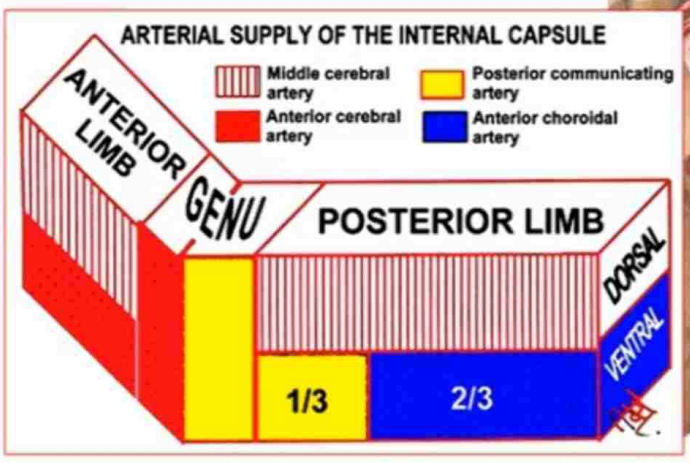


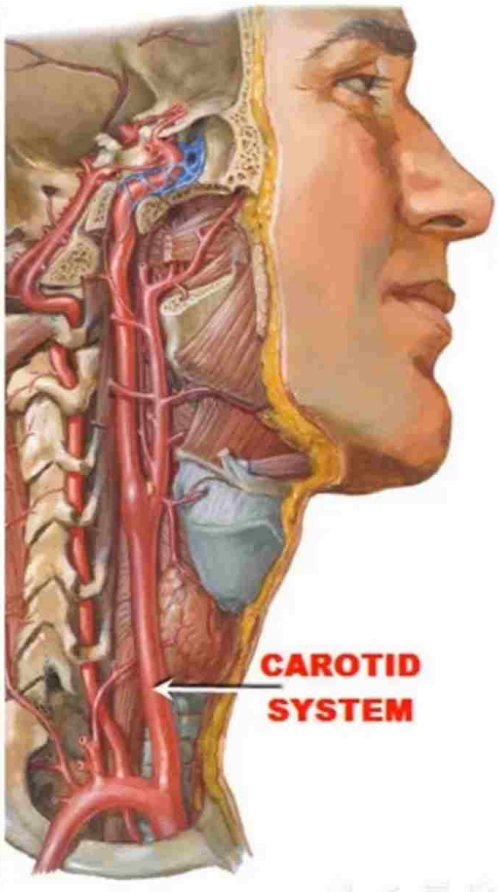
A: Internal carotid artery
B: Branches of middle cerebral artery
C: Anterior cerebral artery

Anterior Choridal & Posterior Communicating Arteries



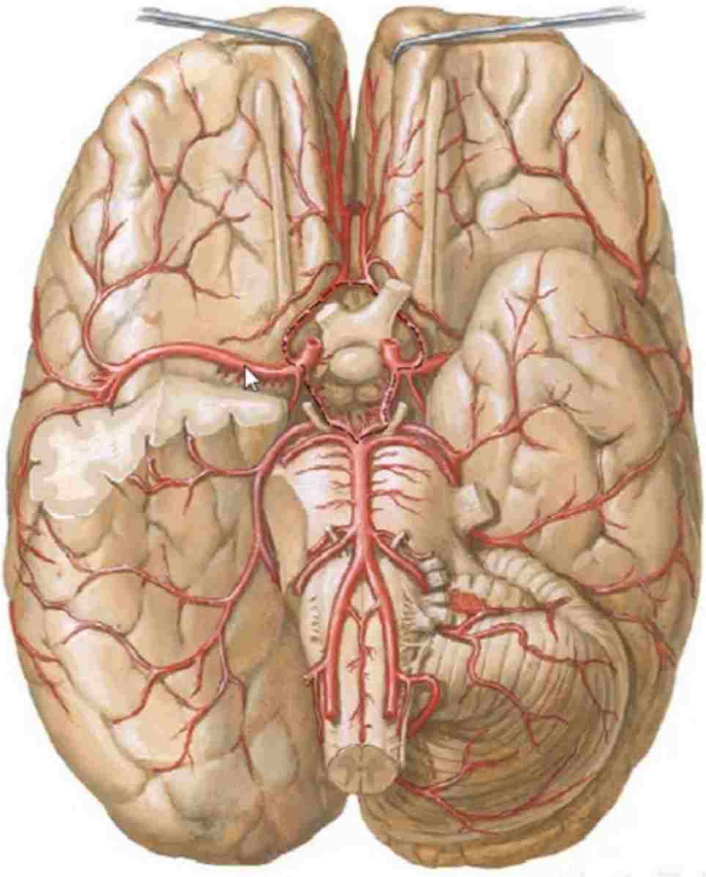






3 CEREBRAL ARTERIES

1. ANTERIOR
2. MIDDLE
3. POSTERIOR



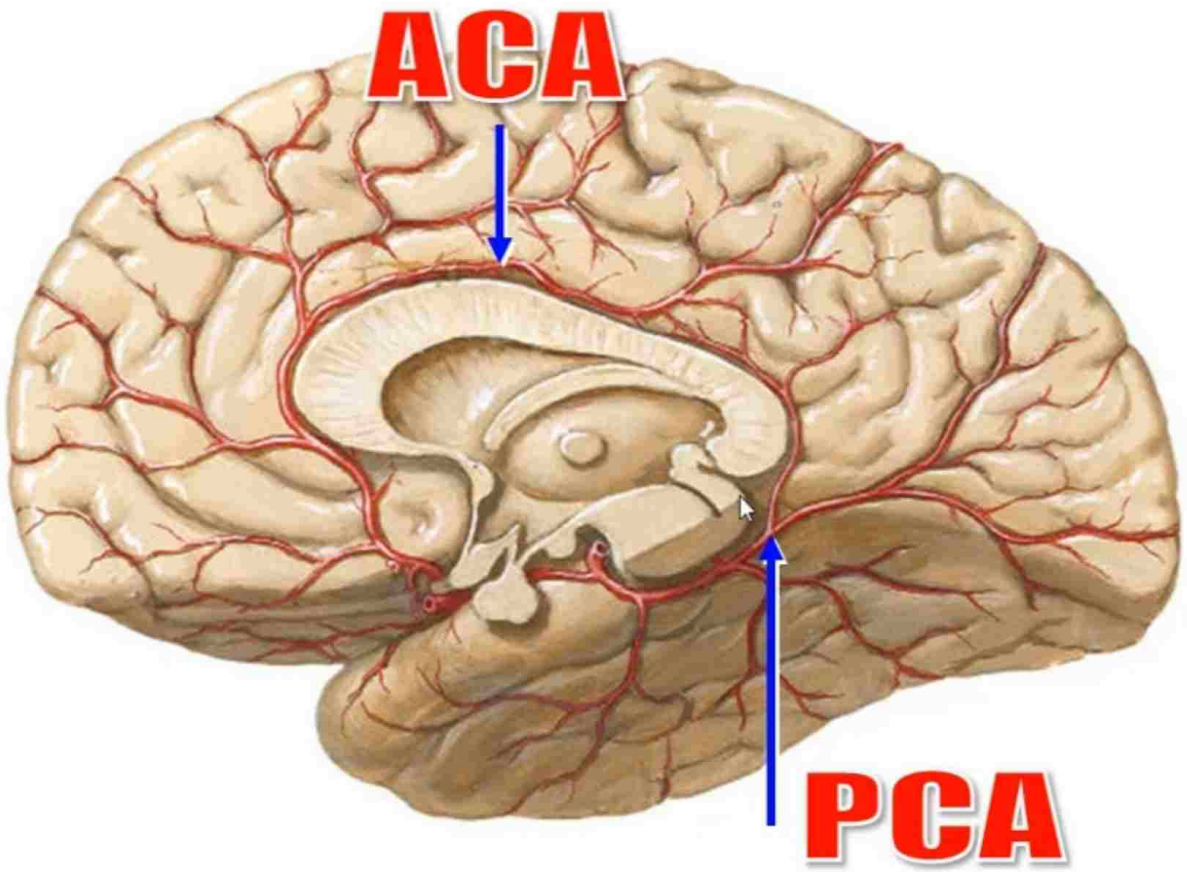
ORIGIN:

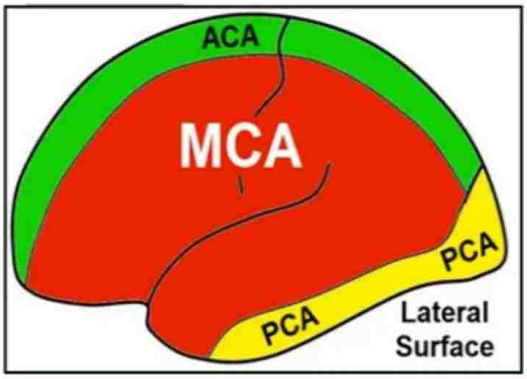
LANDMARK:

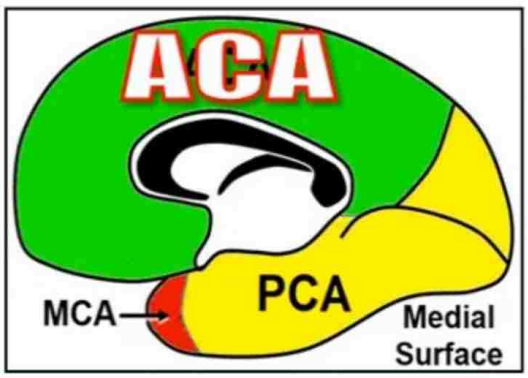
BRANCHES:

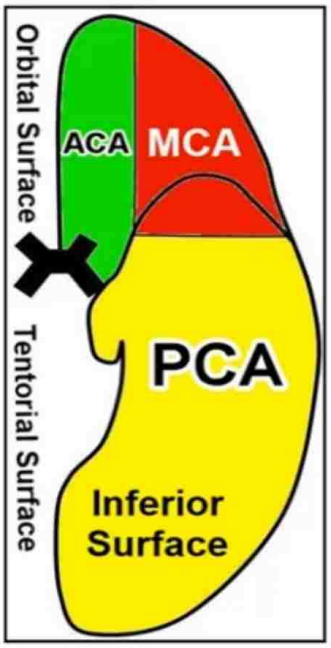
1. Central
2. Cortical
3. Others

ANTERIOR & POSTERIOR CEREBRAL ART

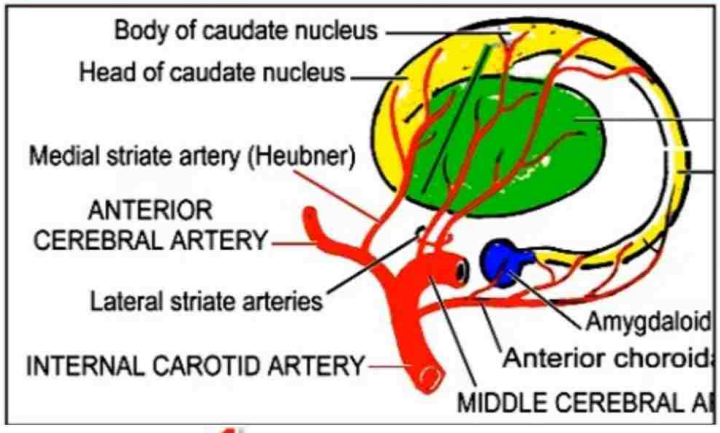


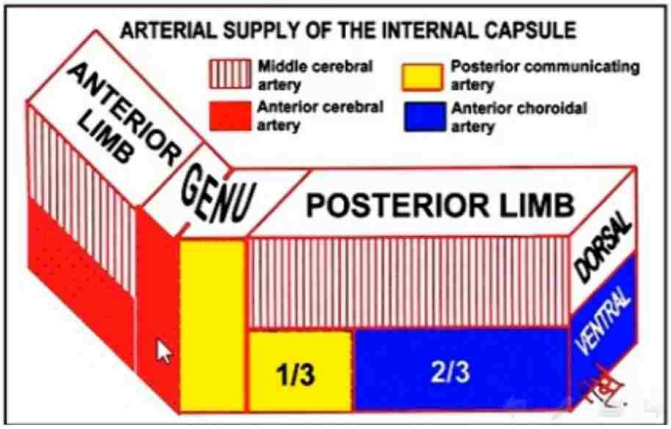


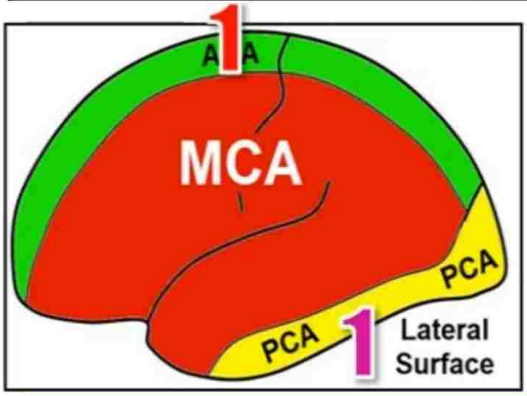


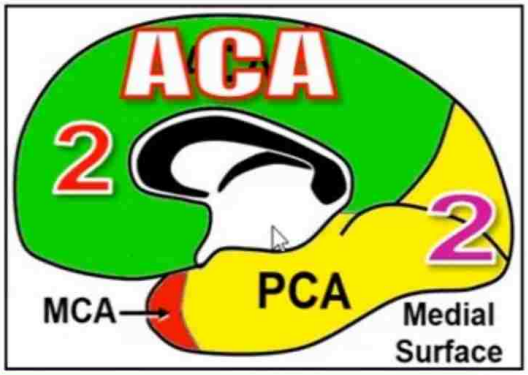


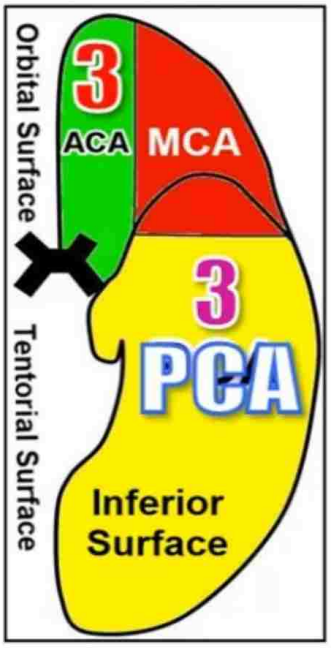
ANTERIOR CEREBRAL ARTERY



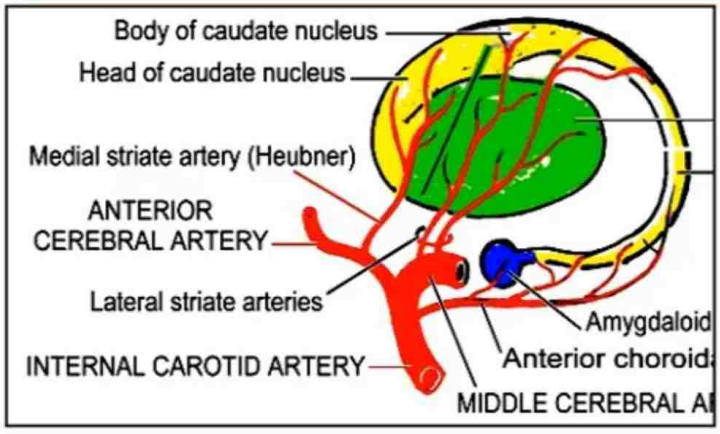


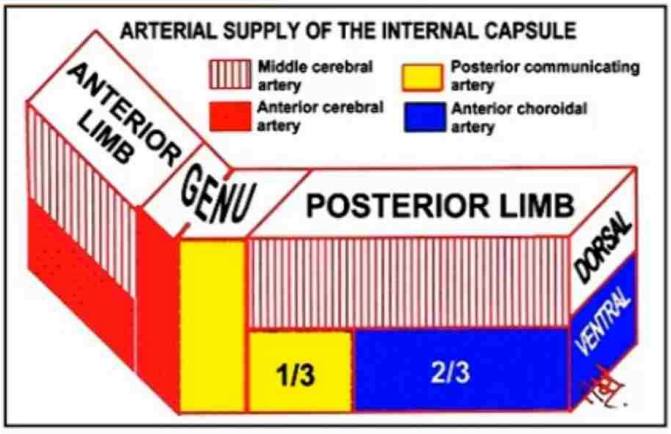




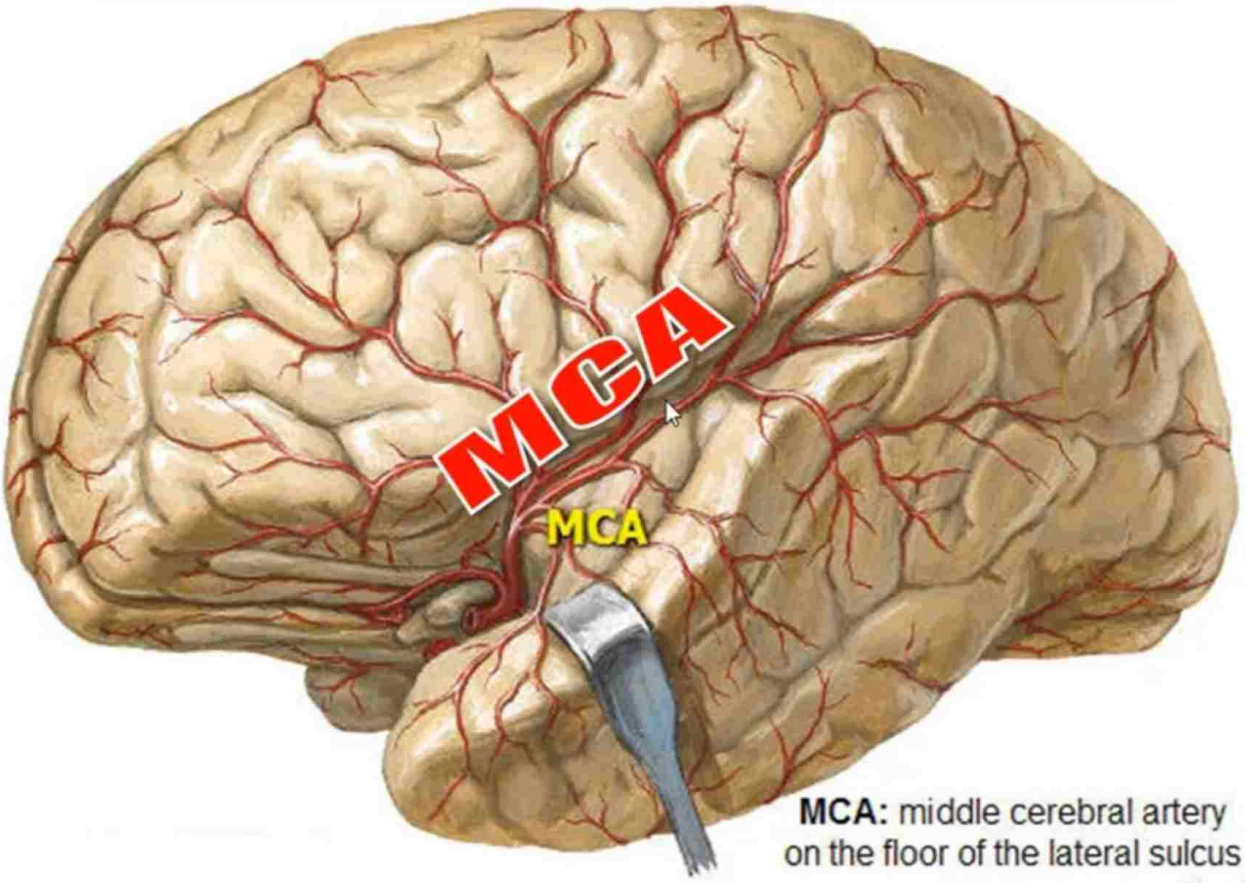


POSTERIOR CEREBRAL ARTERY

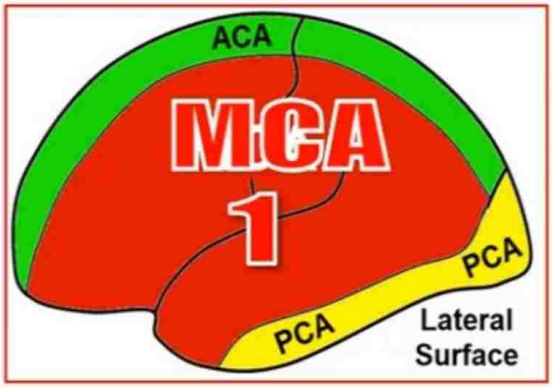


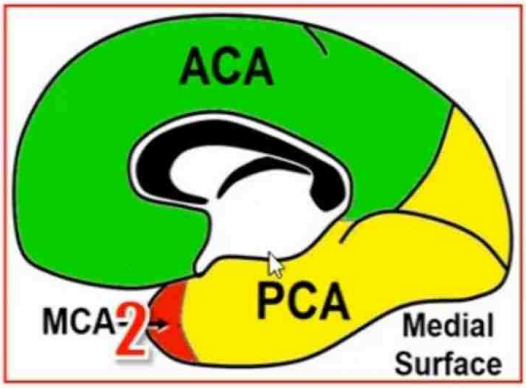


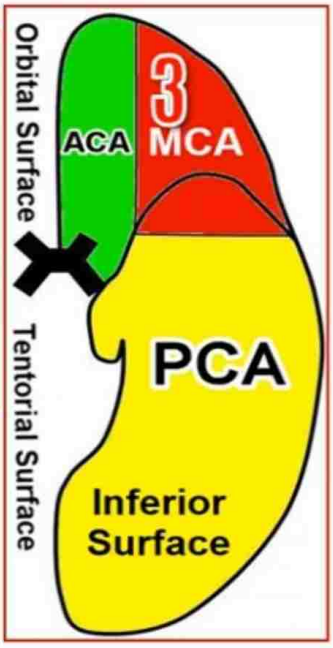
MIDDLE CEREBRAL ARTERY



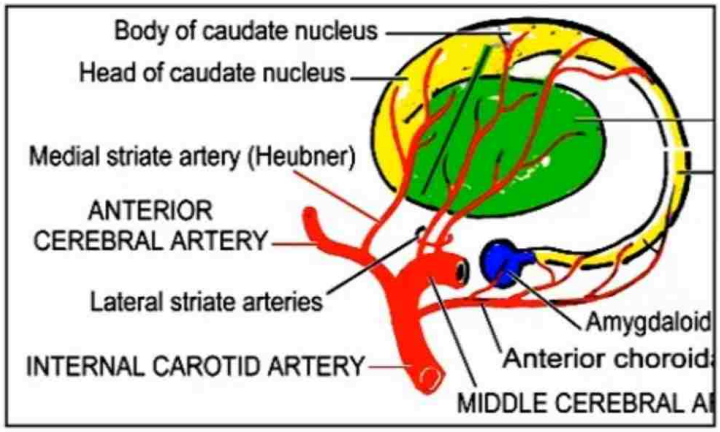
MCA: middle cerebral artery
on the floor of the lateral sulcus

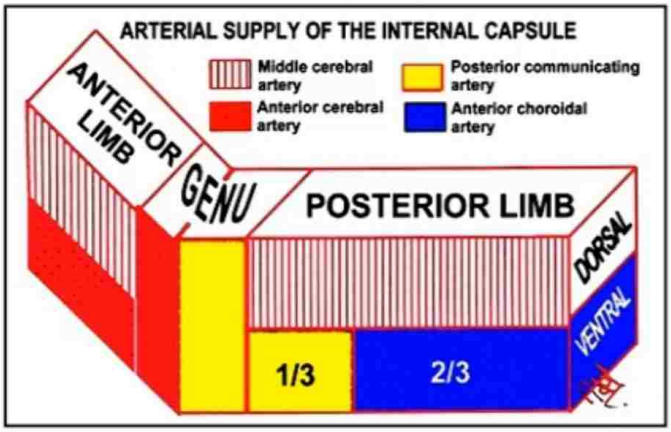






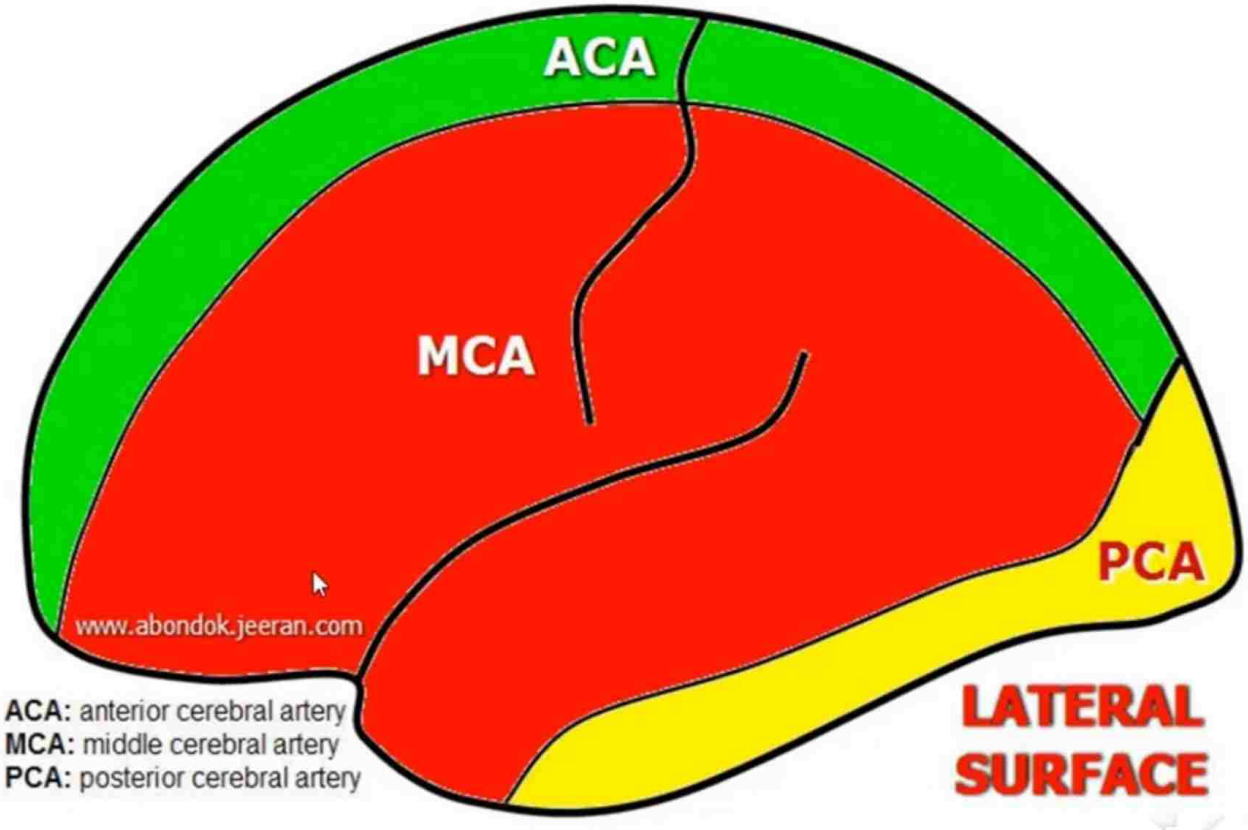
MIDDLE CEREBRAL ARTERY



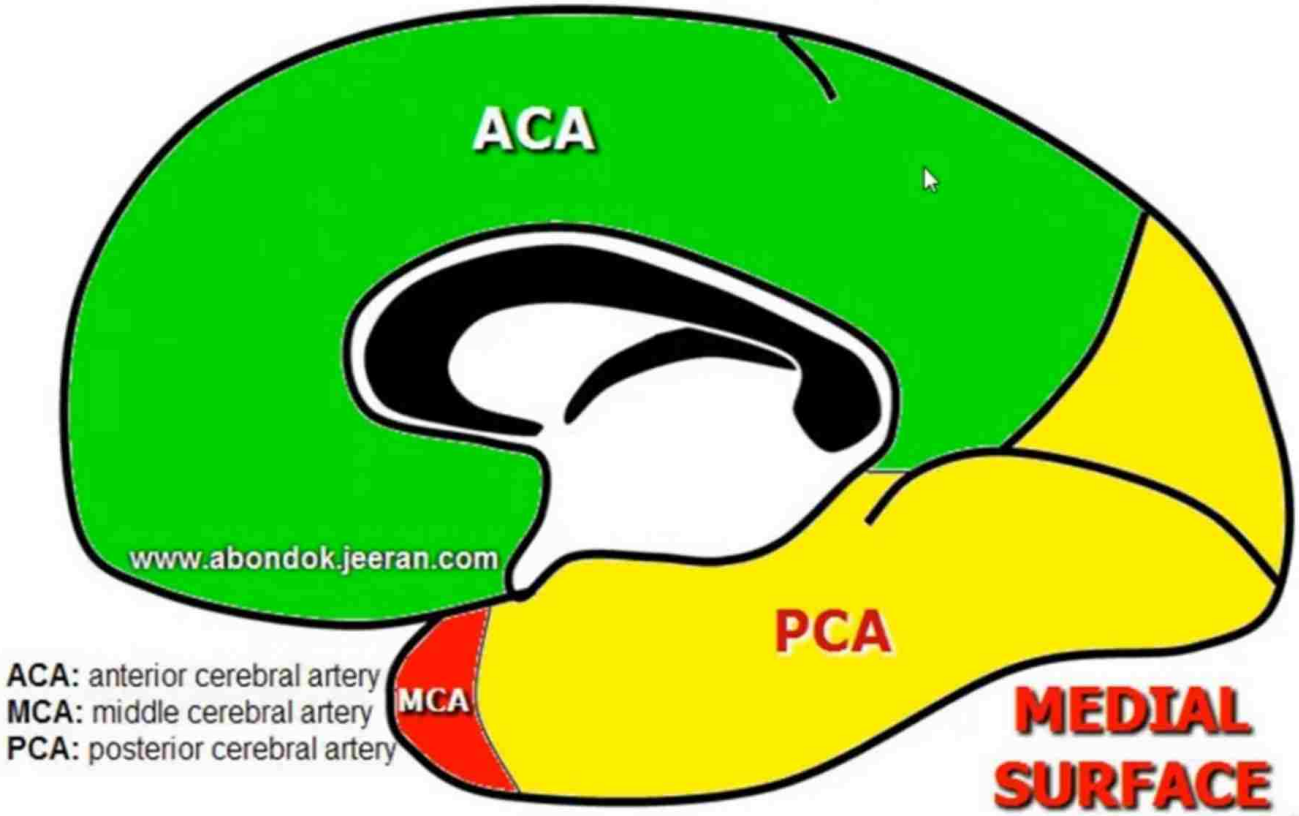


Arterial Supply of the Cerebral Cortex and Internal Structures (Summary)

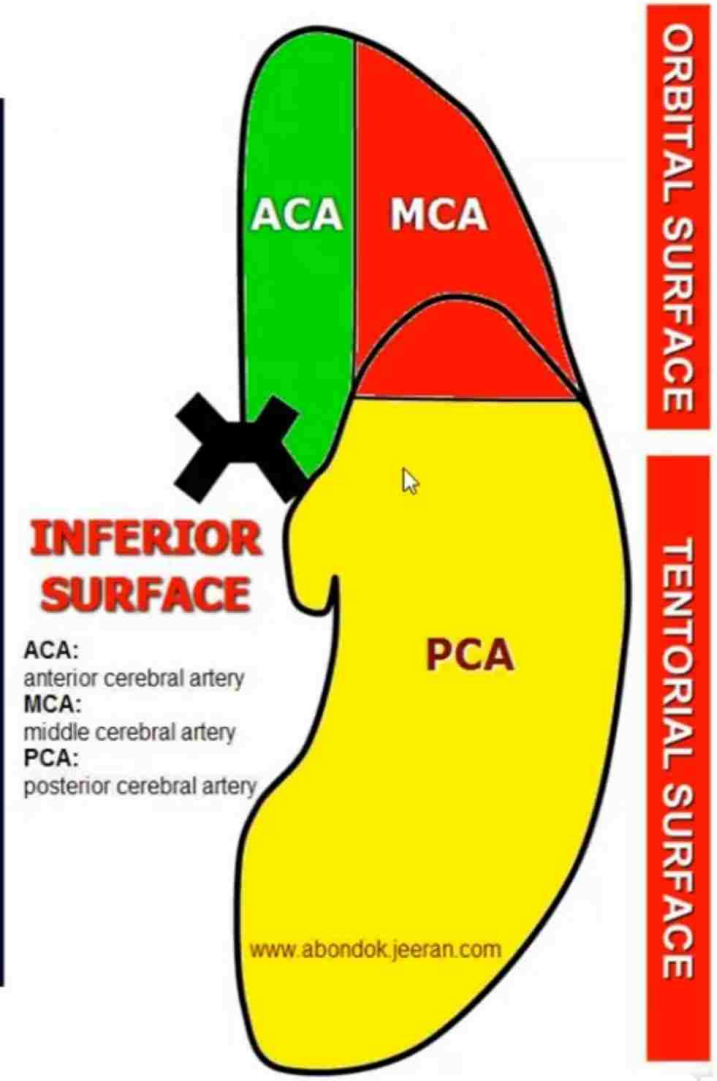
ARTERIAL SUPPLY OF THE LATERAL SURFACE



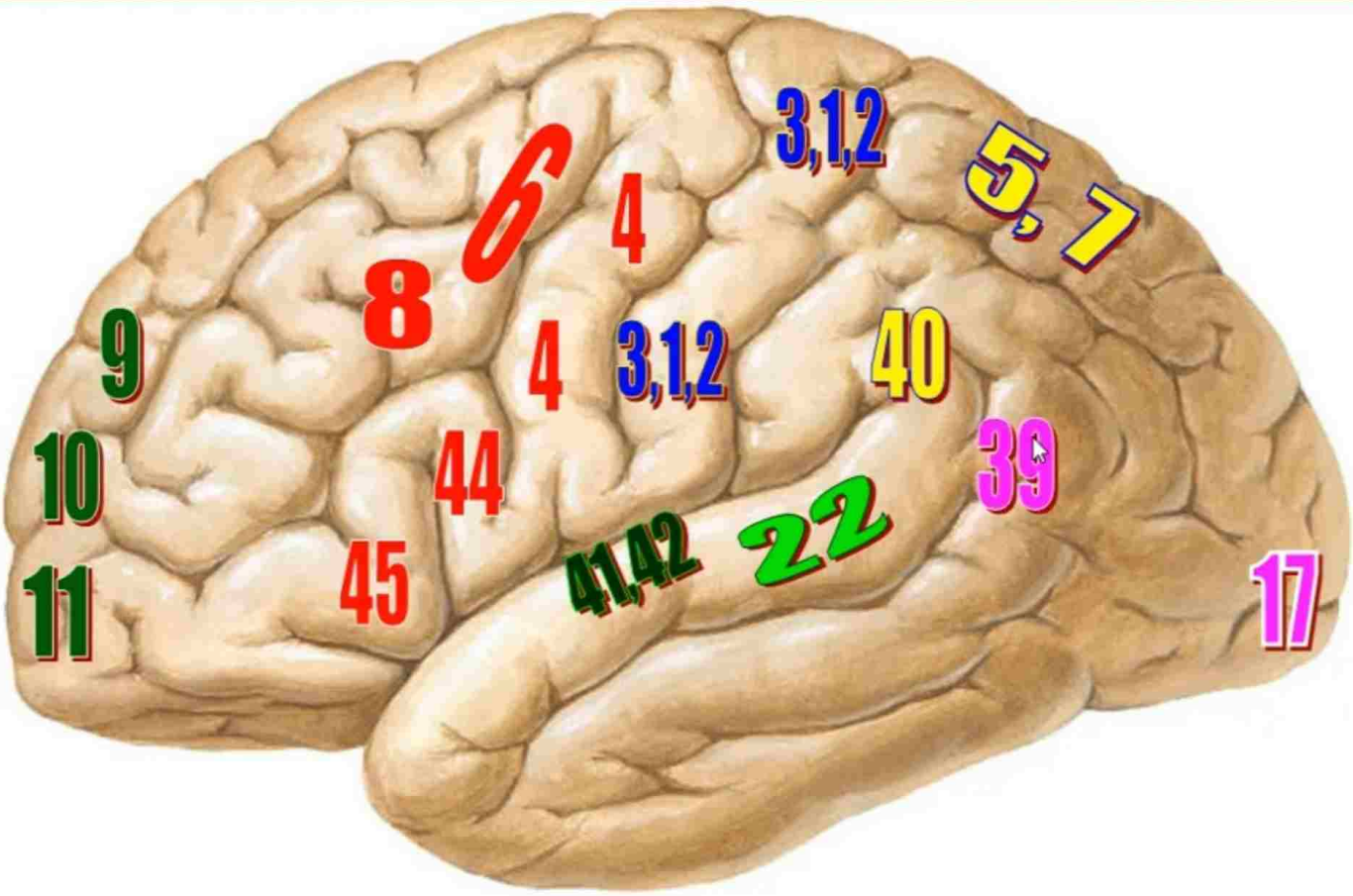
ARTERIAL SUPPLY OF THE MEDIAL SURFACE



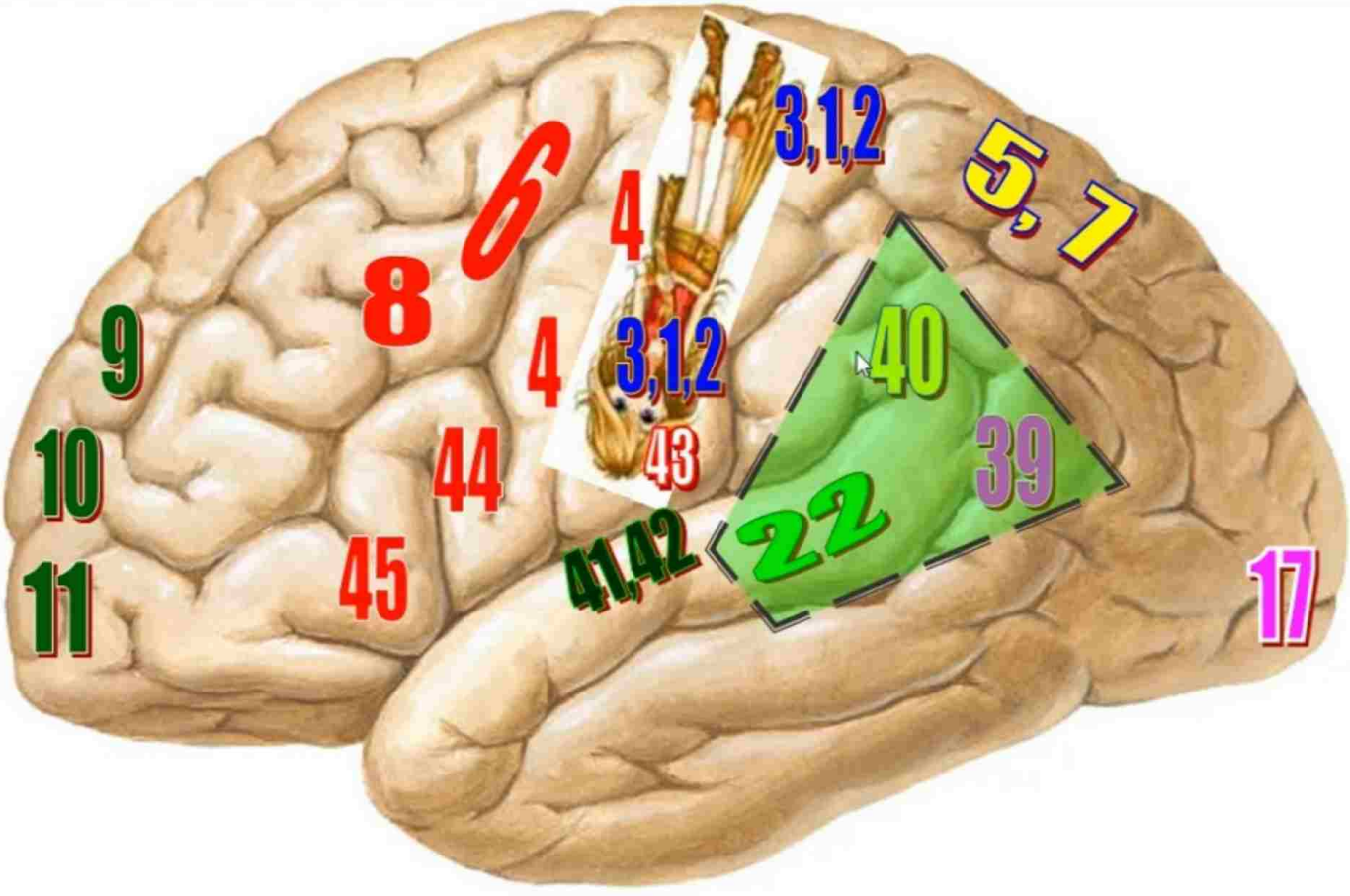
ARTERIAL SUPPLY OF THE INFERIOR SURFACE



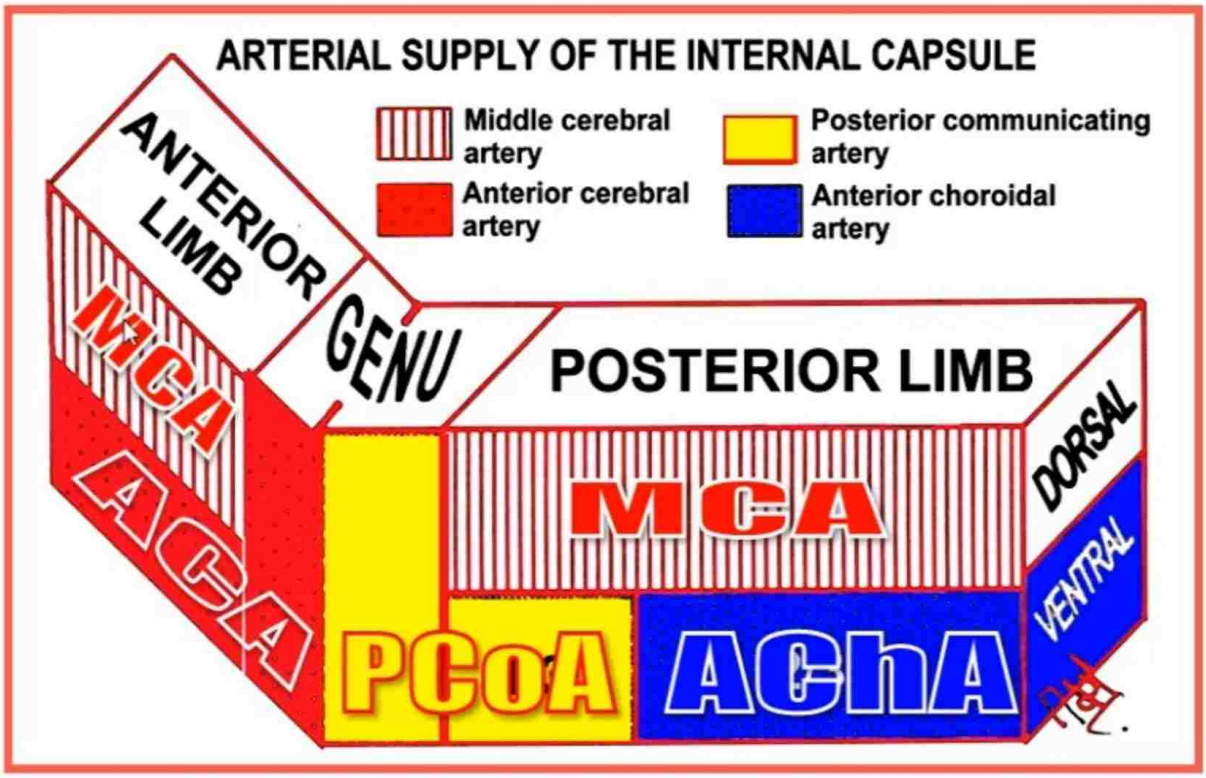
CORTICAL AREAS



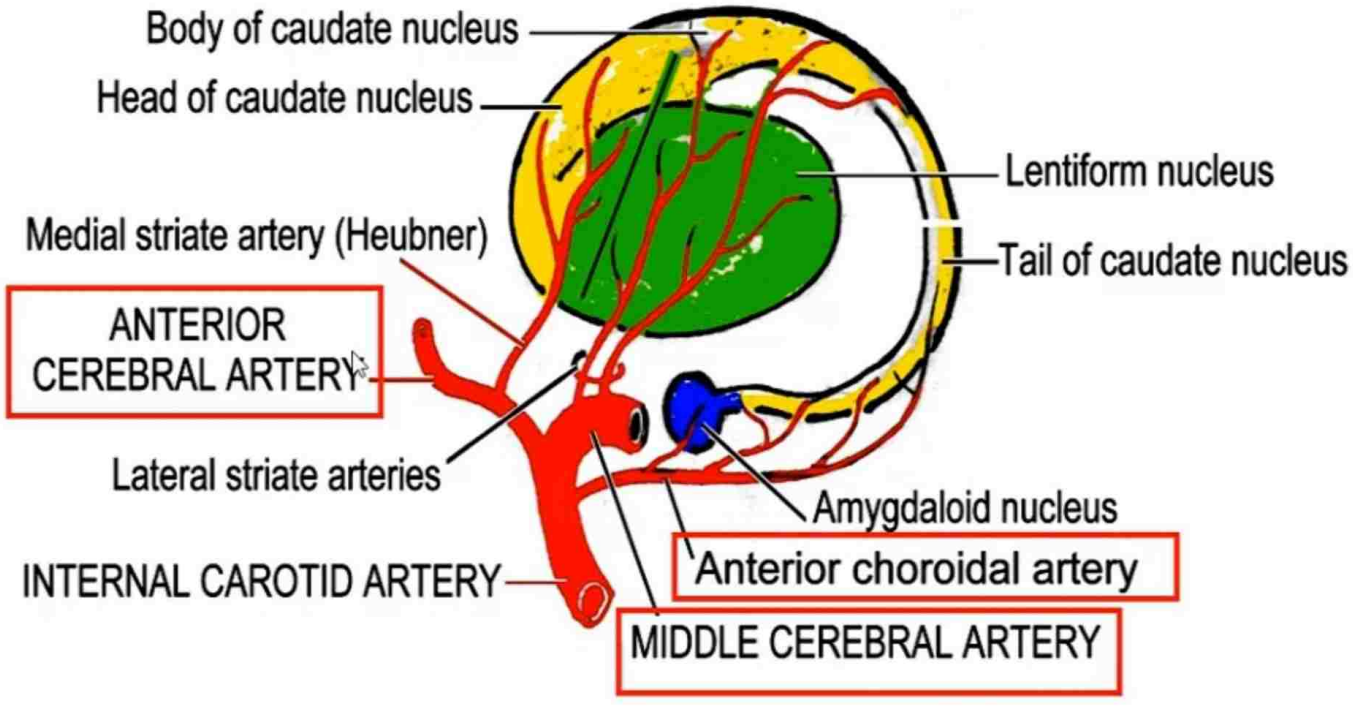
CORTICAL AREAS



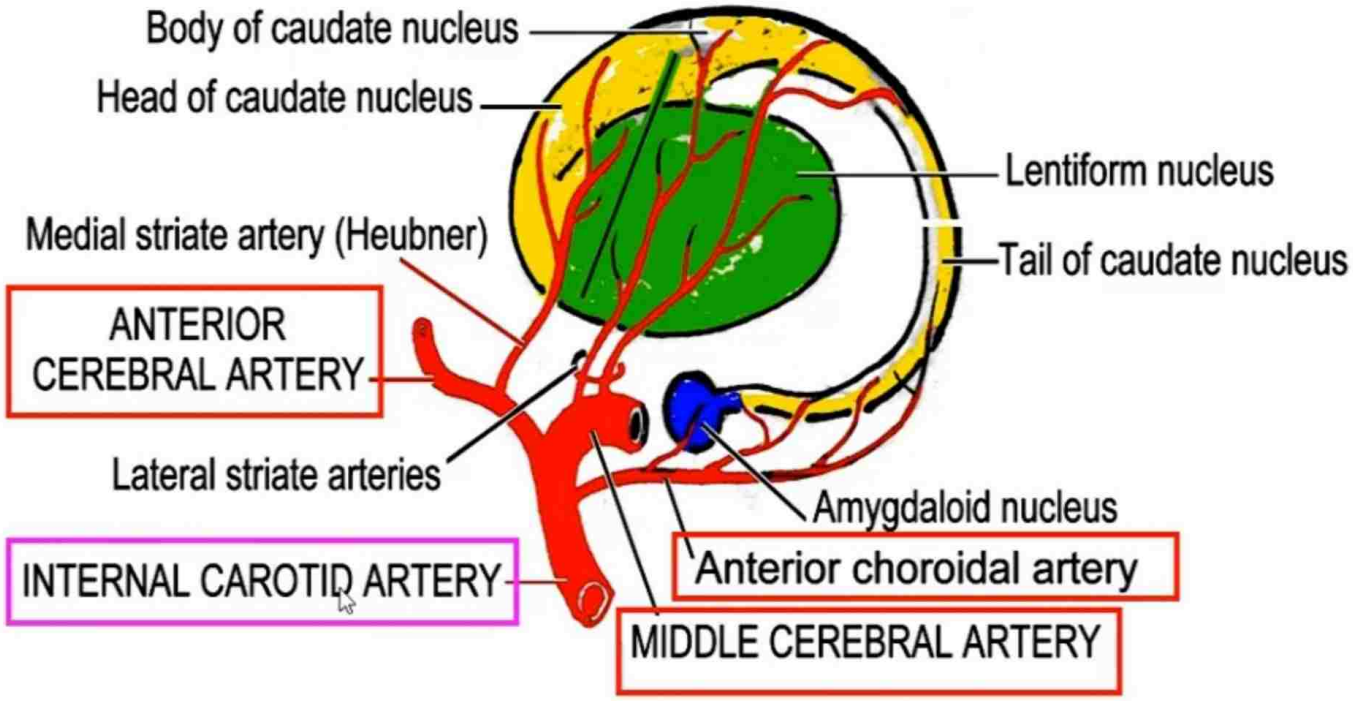
ARTERIAL SUPPLY OF THE INTERNAL CAPSULE



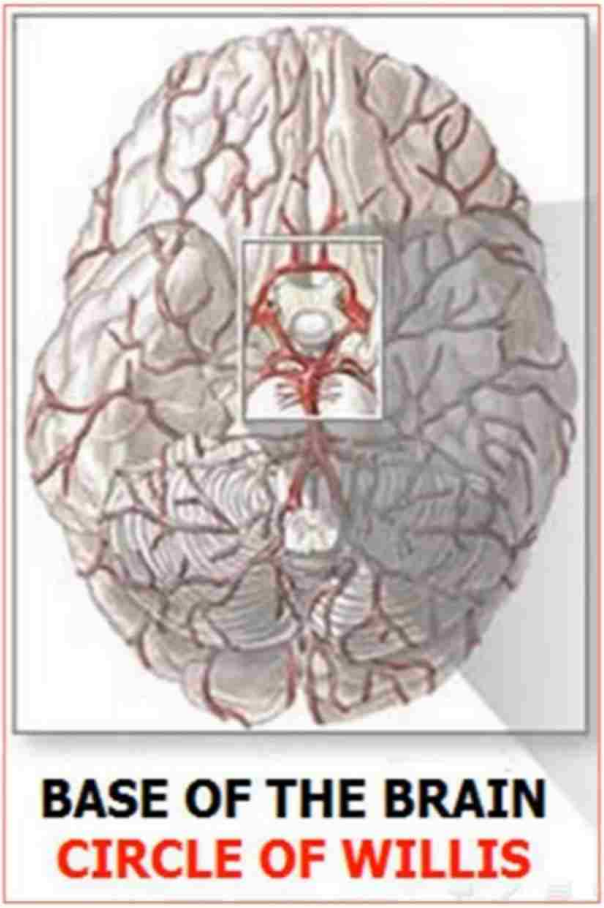
ARTERIAL SUPPLY OF THE BASAL GANGLIA 3



ARTERIAL SUPPLY OF THE BASAL GANGLIA 3



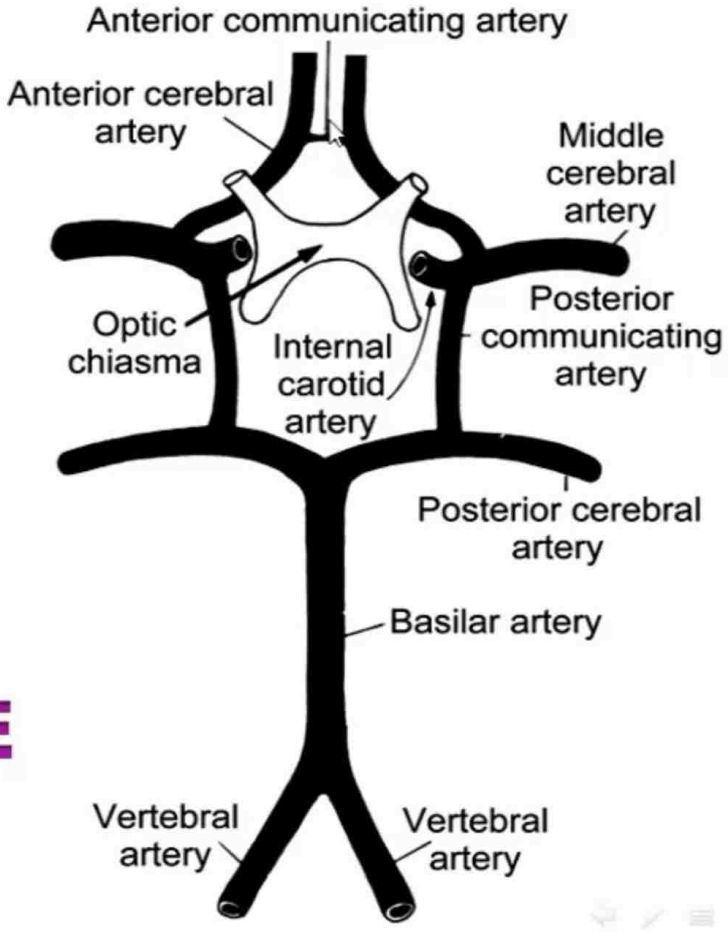
Circle of Willis



CIRCULUS ARTERIOSUS

CIRCLE OF WILLIS

- SITE
- FORMATION
- IMPORTANCE



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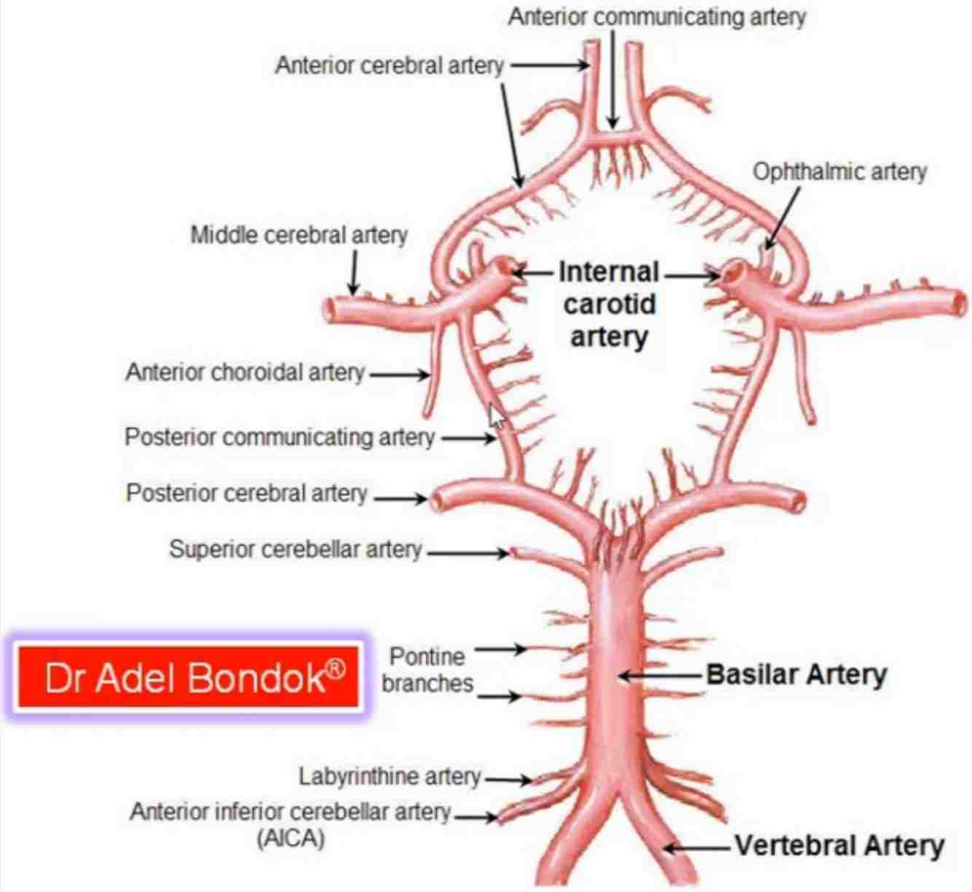
CIRCLE OF WILLIS



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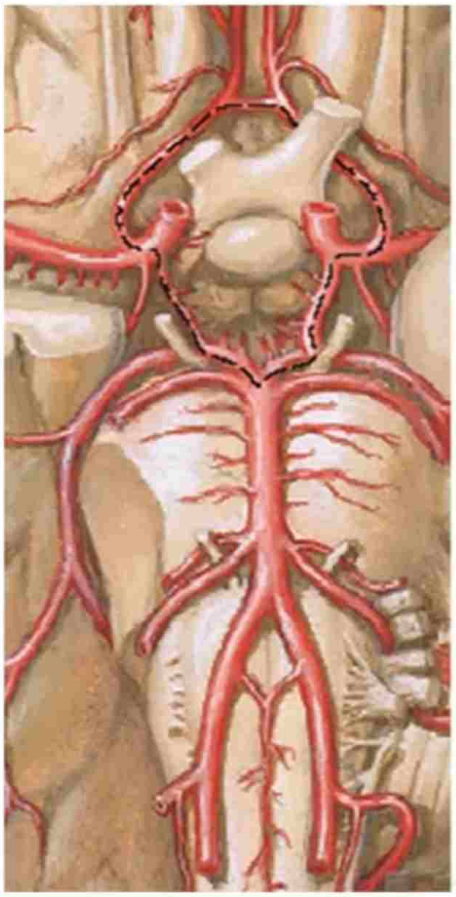
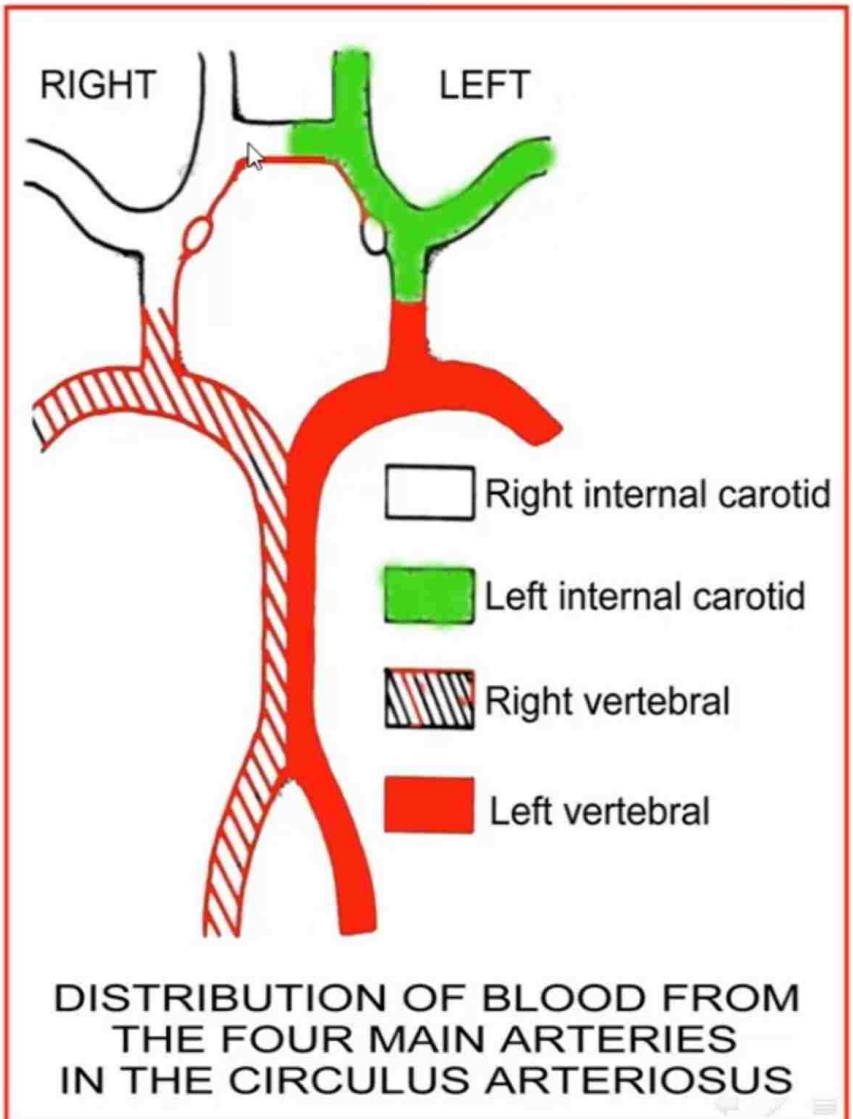
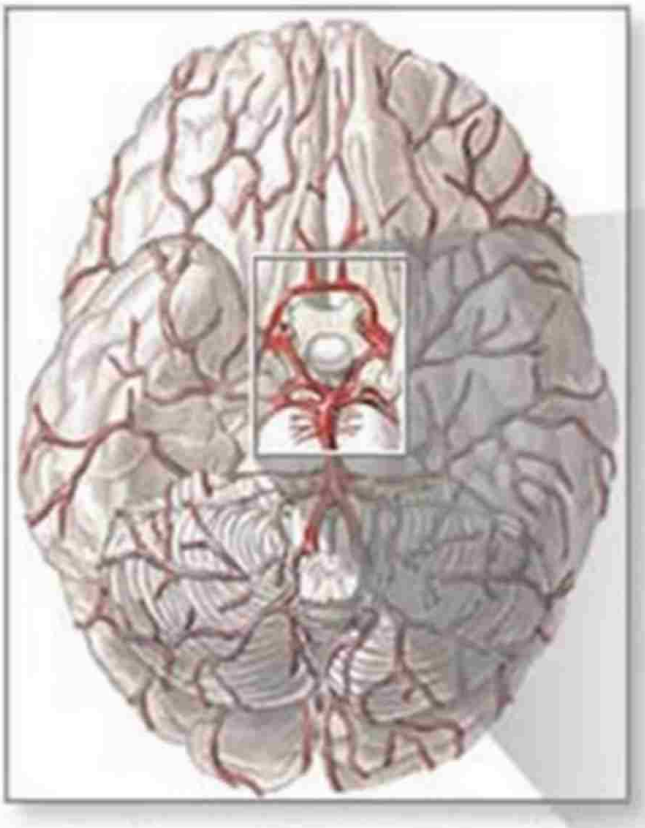


Circle of Willis

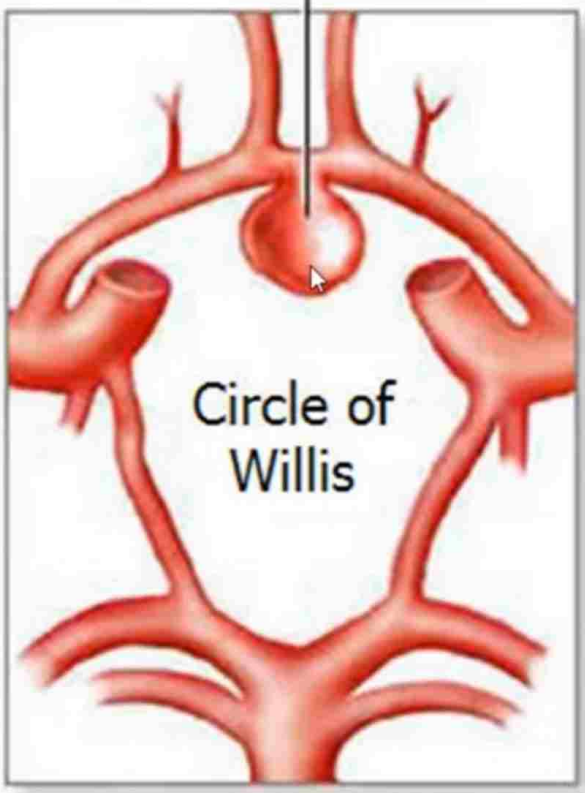
No mixing of blood between the 2 sides



DISTRIBUTION OF BLOOD FROM THE FOUR MAIN ARTERIES IN THE CIRCULUS ARTERIOSUS



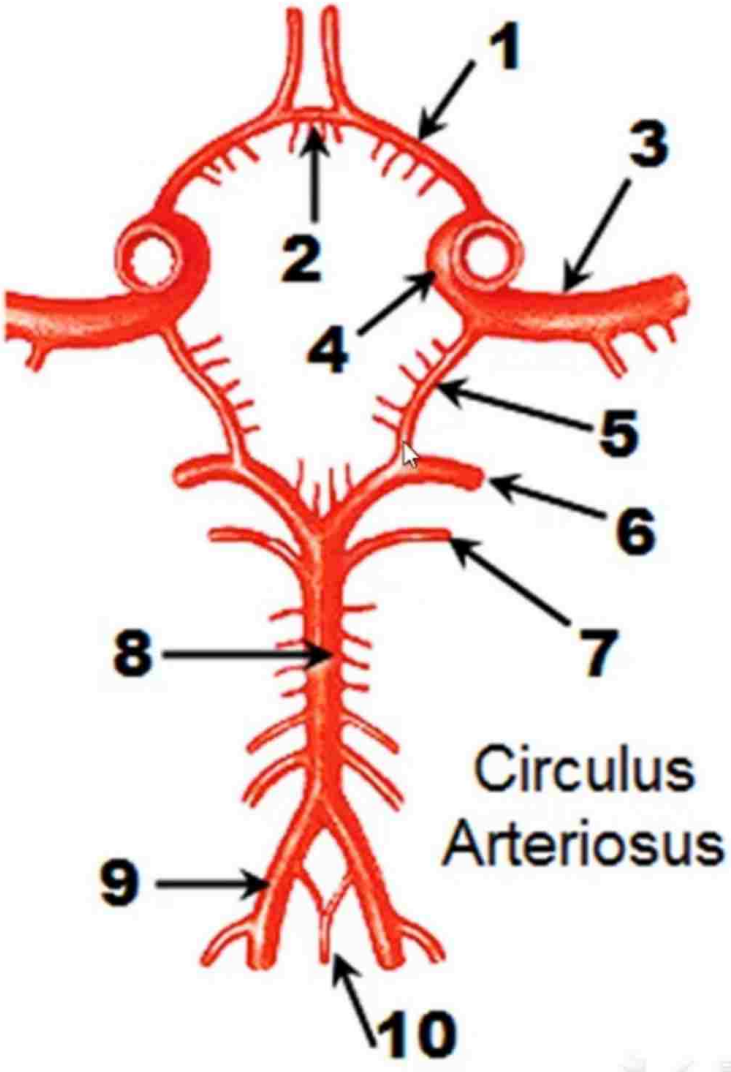
Aneurysm of the anterior communicating artery



BASE OF THE BRAIN
CIRCLE OF WILLIS

Circle of Willis

Identify the arteries



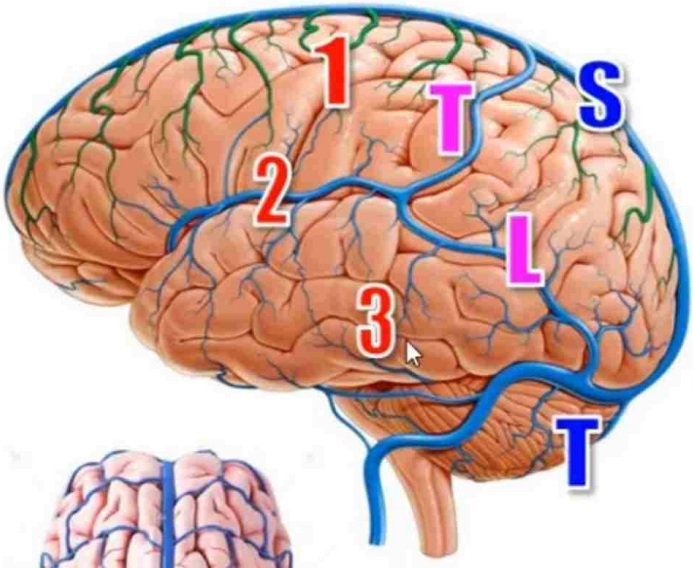
VENOUS DRAINAGE OF THE BRAIN

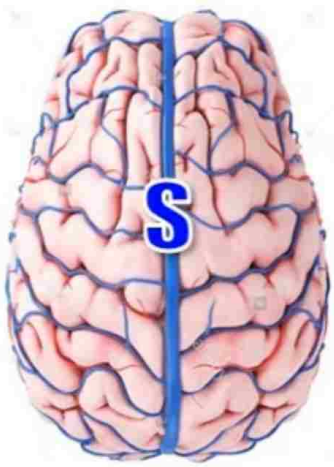
2 SYSTEMS

3 Superficial Veins

3 Deep Veins

3 Superficial Cerebral Veins





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1. **Superior Cerebral Veins:** drain into the superior sagittal sinus
2. **Middle Cerebral Veins:** Superficial & Deep

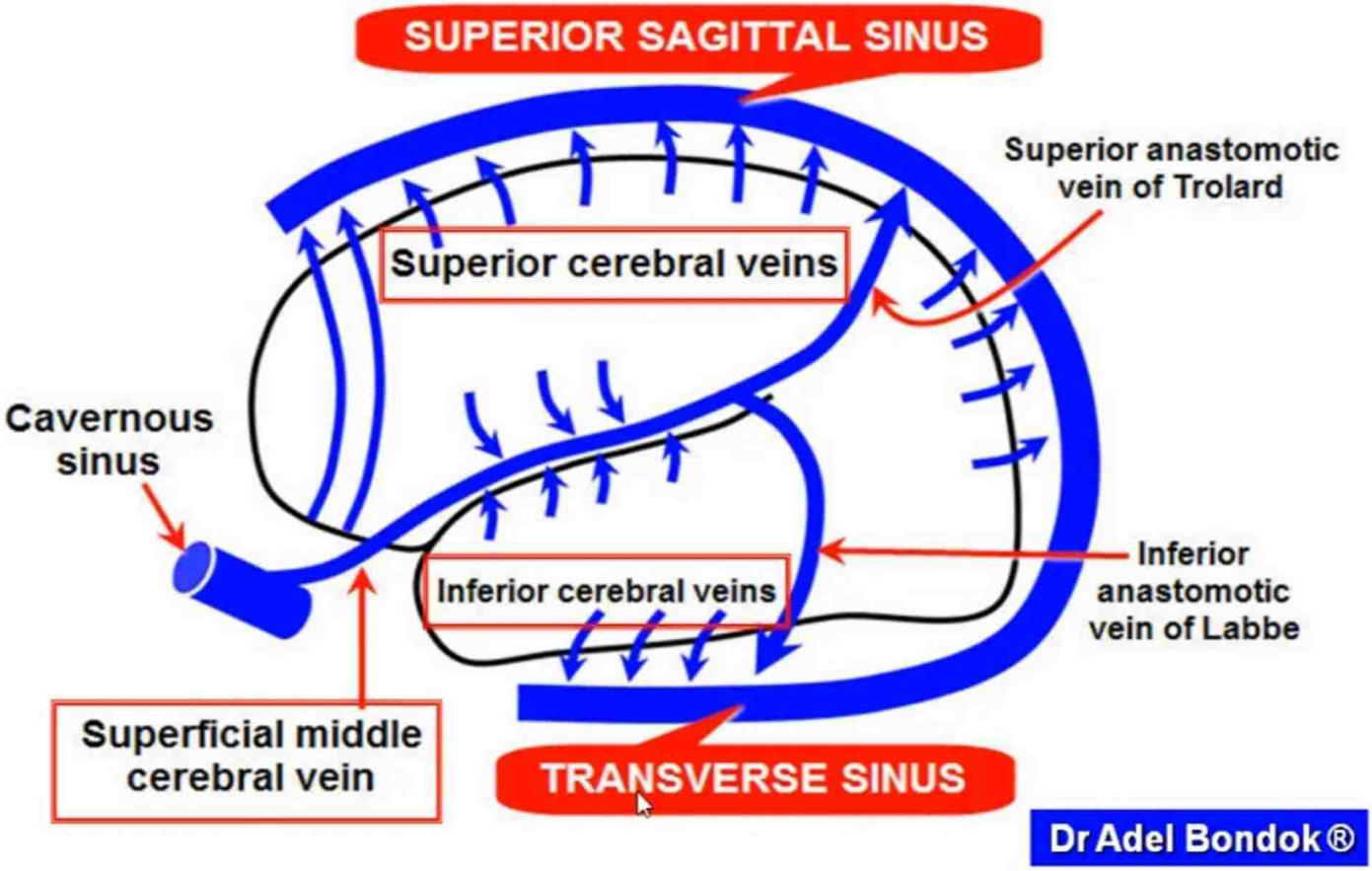
Superficial: drains into the cavernous sinus.

Connedted with the SSS by anastomotic vein of Trolard

Connedted with the TS by anastomotic vein of Labbe.

3. **Inferior Cerebral Veins:** drain into cavernous & transverse sinus

3 Superficial Cerebral Veins



3 Deep Cerebral Veins

1. 2 Internal cerebral Veins.
2. Great Cerebral Vein.
3. 2 Basal Veins.

3 Deep Cerebral Veins

Thalamostriate vein

+

Choroidal vein

=

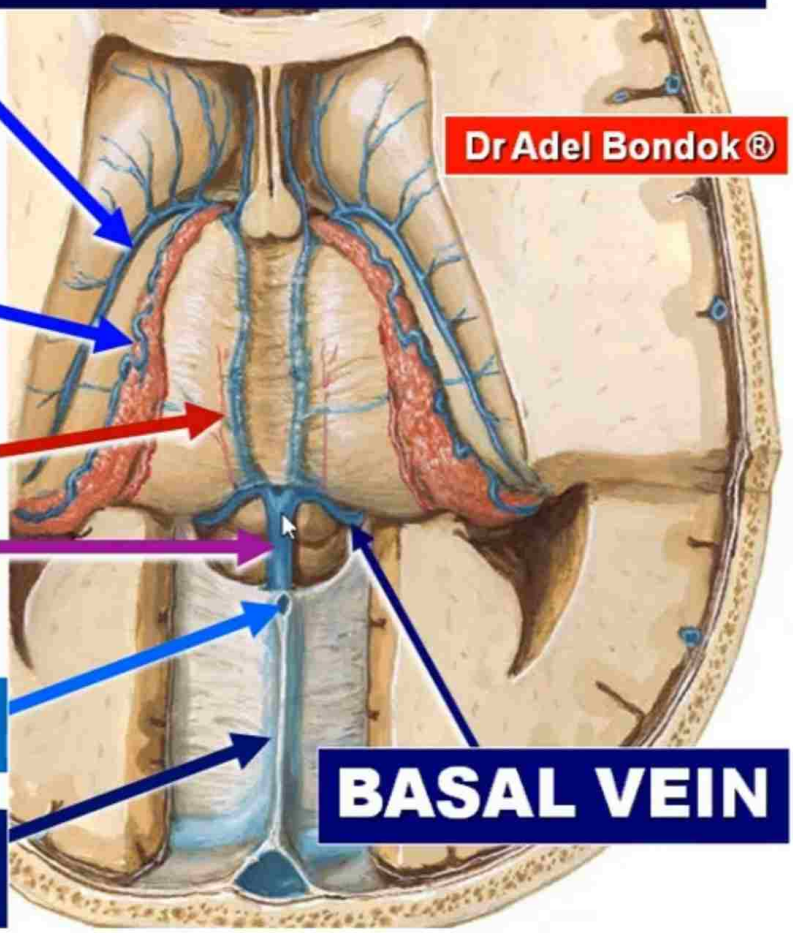
Internal cerebral vein

Great cerebral vein

+

Inferior sagittal sinus

= Straight sinus



Anterior cerebral vein

+

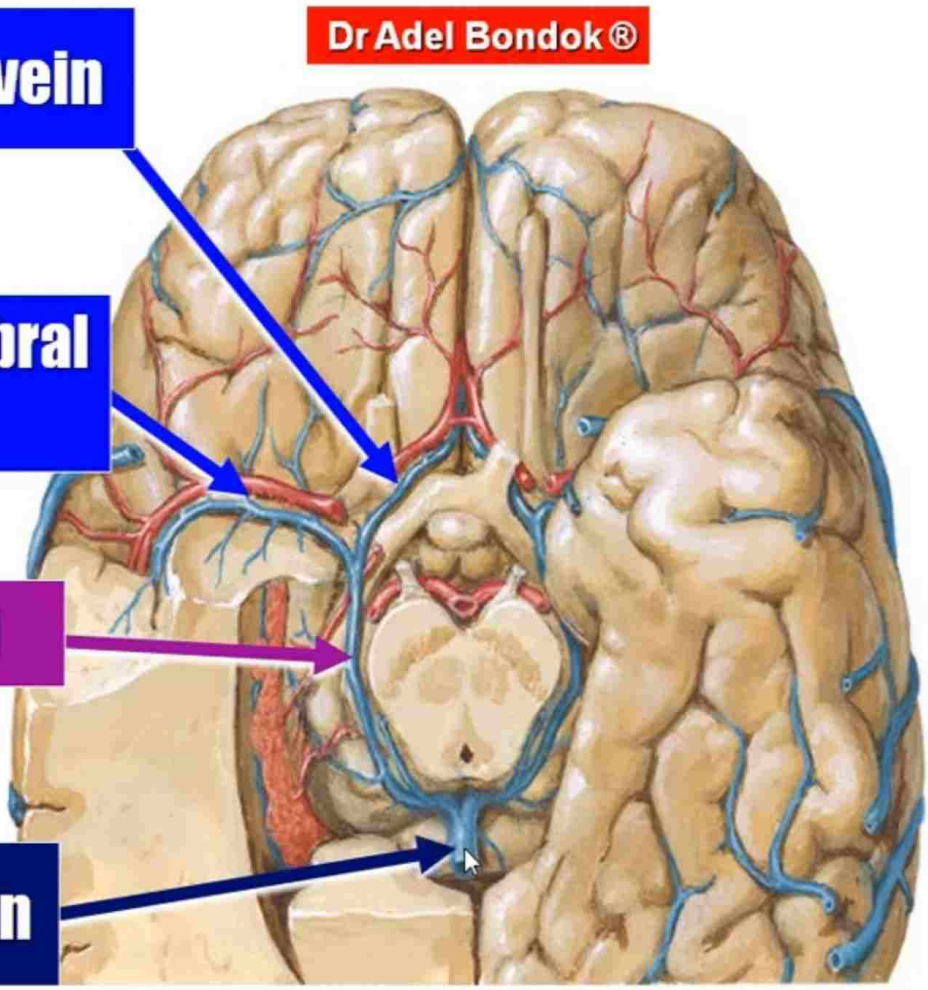
Deep middle cerebral vein

=

BASAL VEIN

↓

Great cerebral vein



3 Superficial Veins

Superior ➡ Superior Sagittal Sinus

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Inferior ➡ Transverse Sinus & Cavernous S

Superficial Middle ➡ cavernous sinus

3 Deep Veins

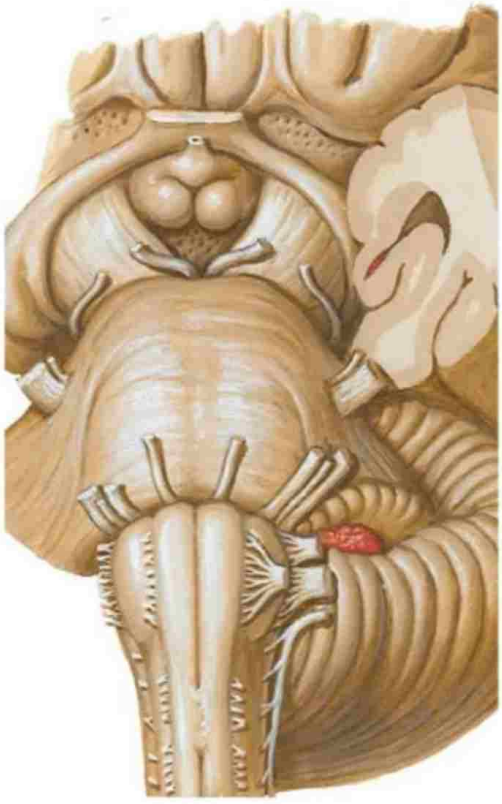
Internal Cerebral V = thalamostriate vein + choroidal vein

Great Cerebral V = union of 2 internal cerebral veins

Basal Vein = ant cerebral vein + deep middle cerebral v

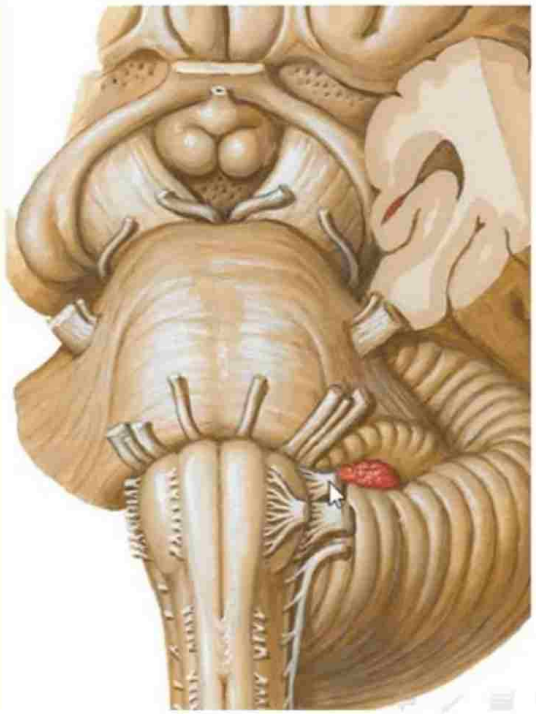
CRANIAL NERVES

- Origin From The Brain
- Exit From The Brain
- Exit From The Skull
- Brief Course
- Distribution
- Lesion

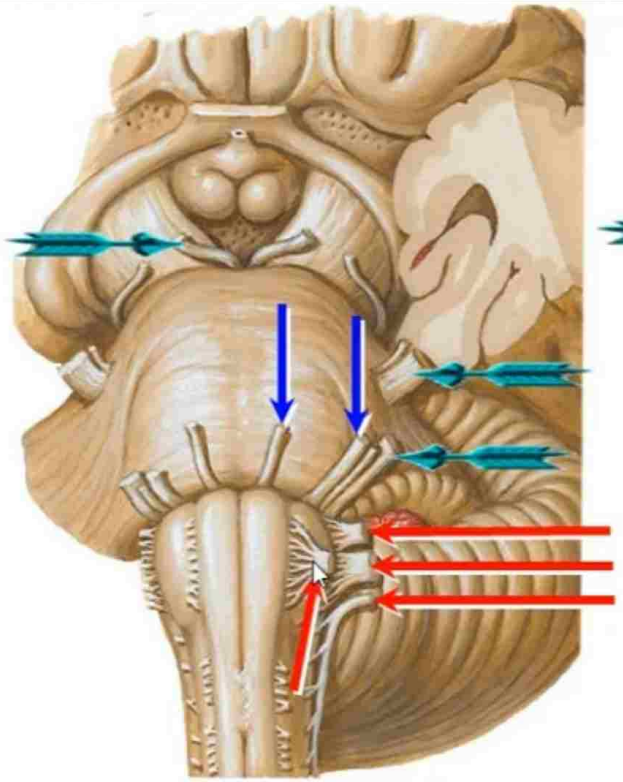


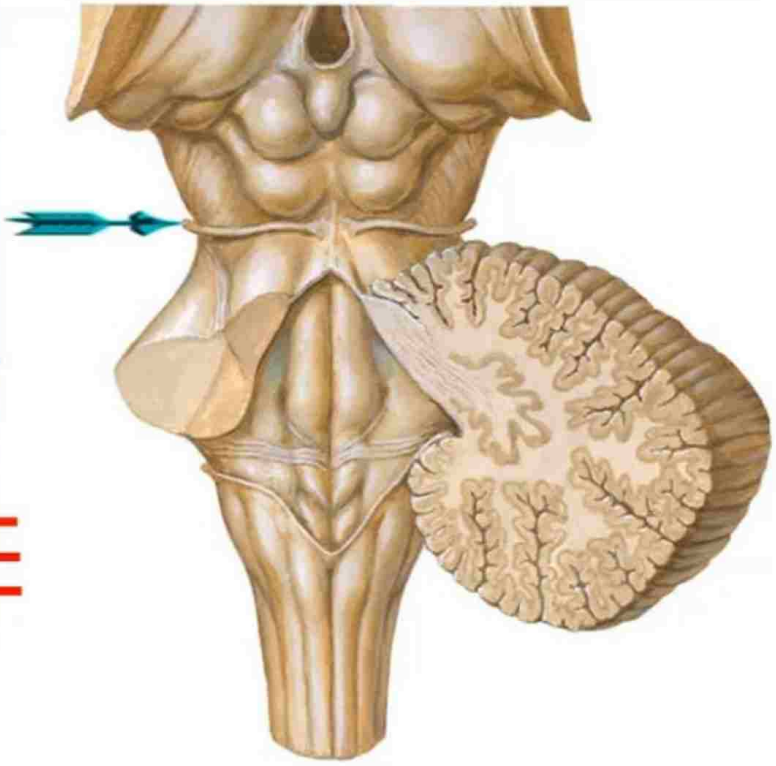
ORIGIN OF THE CRANIAL NERVES

1. Olfactory N: from nose
2. Optic Nerve: from retina
3. III & IV: from midbrain
4. Middle 4: from pons
5. Last 4: from medulla

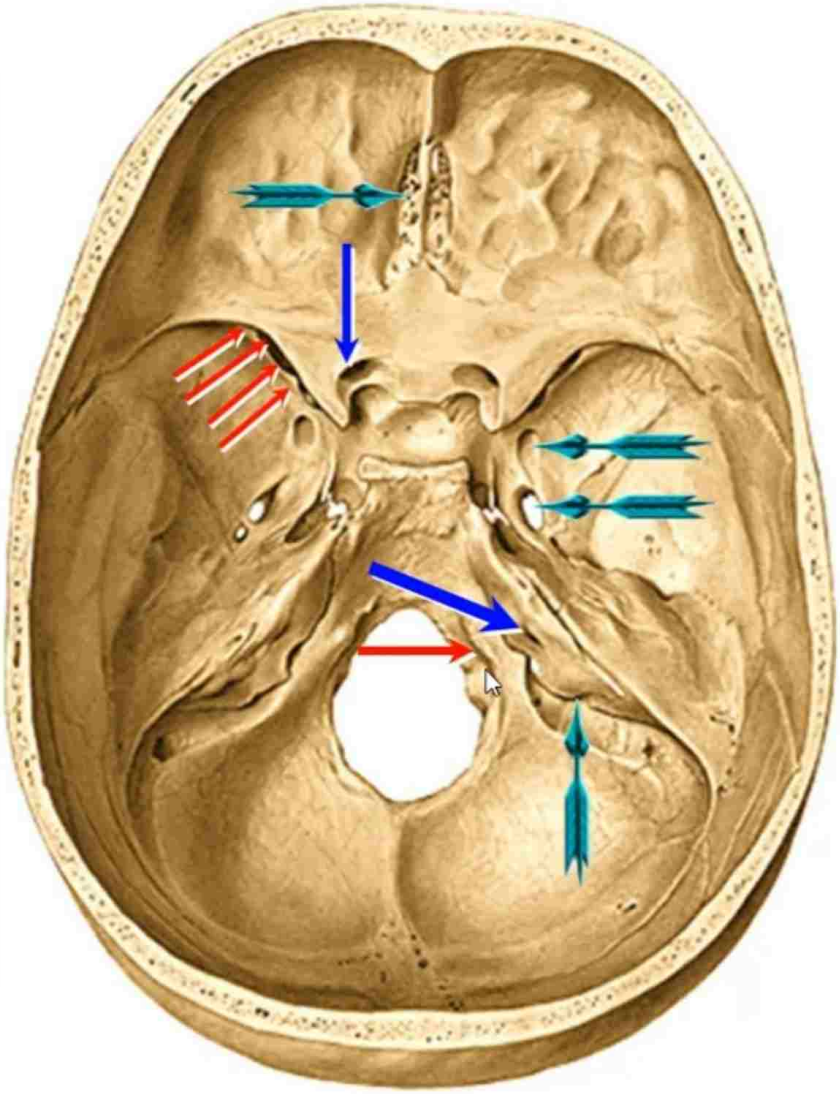


EXIT OF THE CRANIAL NERVES FROM THE BRAIN





EXIT OF THE CRANIAL NERVES FROM THE SKULL



OLFACTORY NERVE

Origin:

Olfactory receptors

in the roof & upper part of the nasal septum & lateral wall

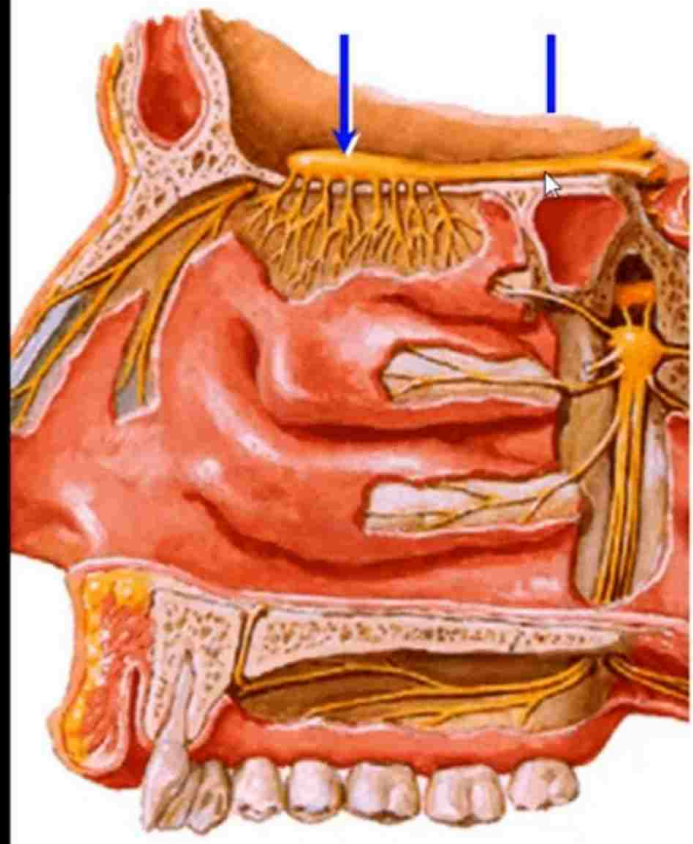
Exit from the nose:

20 rootlets through the cribriform plate of ethmoid

Termination:

Olfactory bulb

then olfactory tract



OLFACTORY PATHWAY

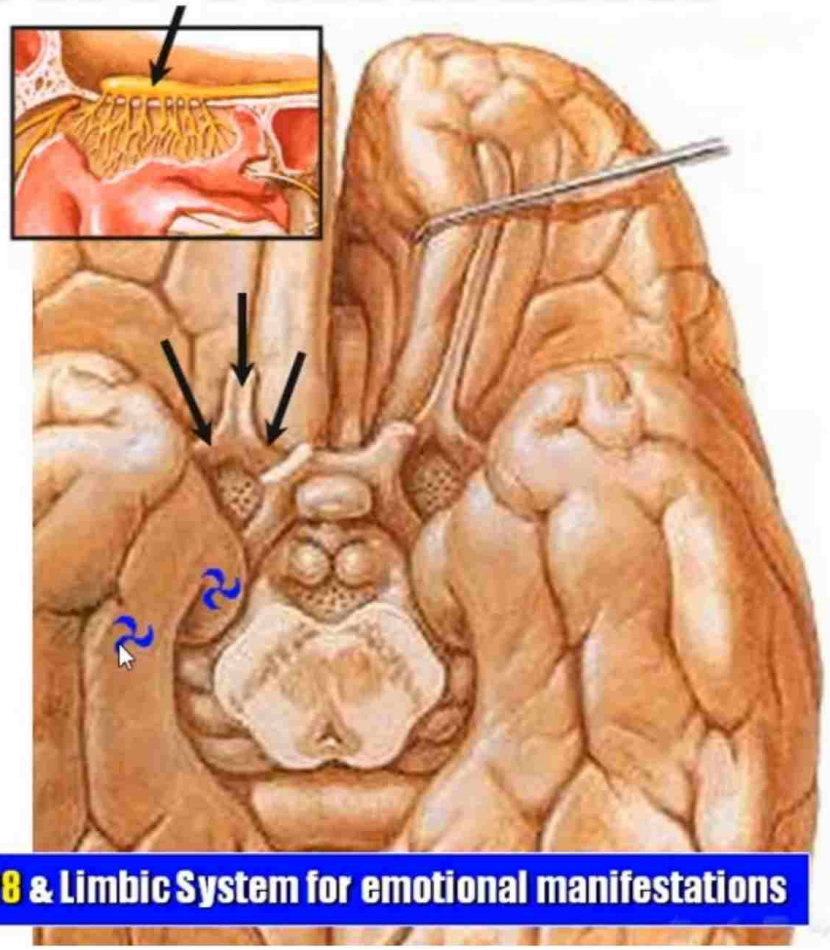
Olfactory Receptors

Olfactory Nerve

Olfactory Bulb

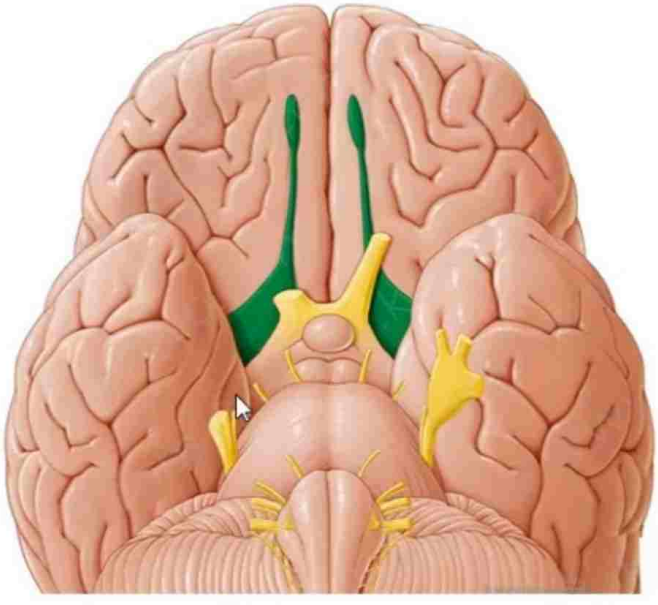
Olfactory Tract

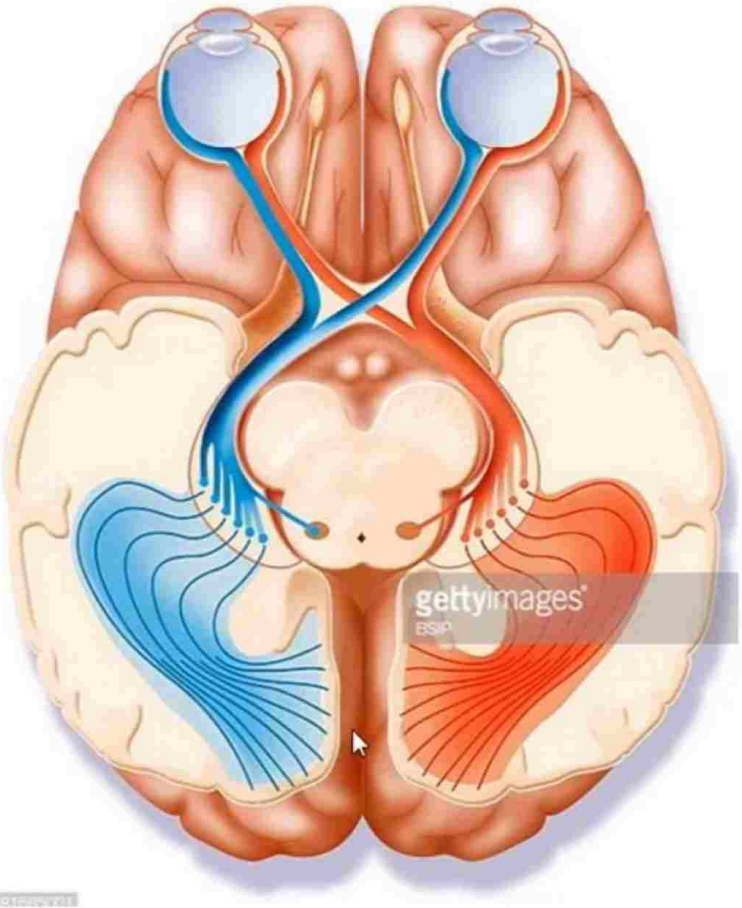
Medial Olfactory Stria	Lateral Olfactory Stria
Medial Olfactory Area Septal Area	Lateral Olfactory Area Uncus 34
Hypothalamus	Entorhinal Area 28 & Limbic System for emotional manifestations

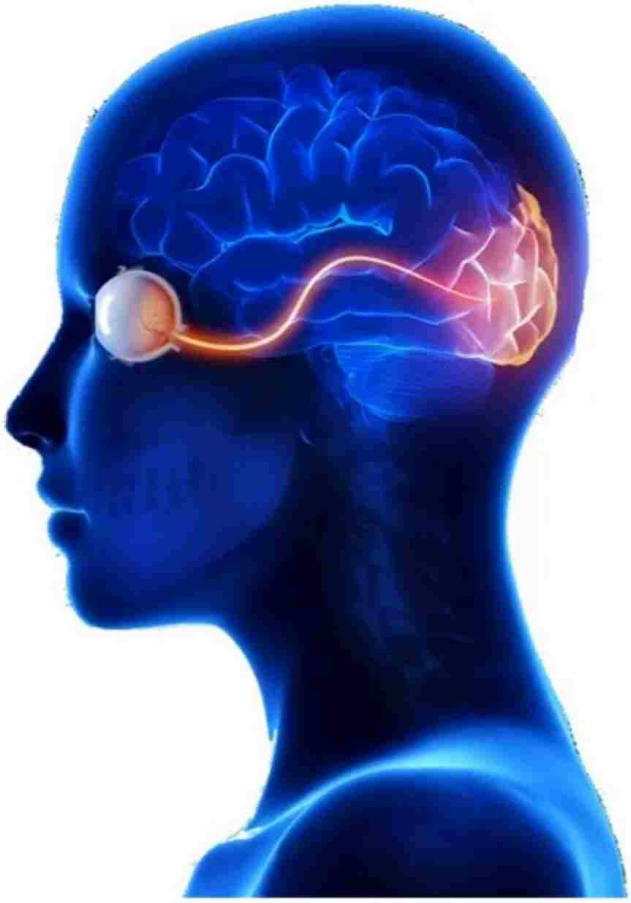


Lesion of the Olfactory Nerve

1. **Anosmia:** loss of smell
2. **Olfactory hallucination:** irritative lesion of uncus

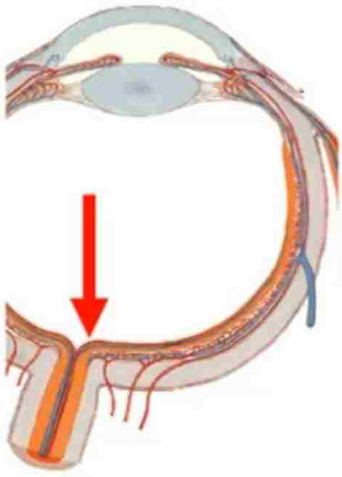






OPTIC NERVE

OPTIC NERVE



Origin: axons of ganglion cells of the retina

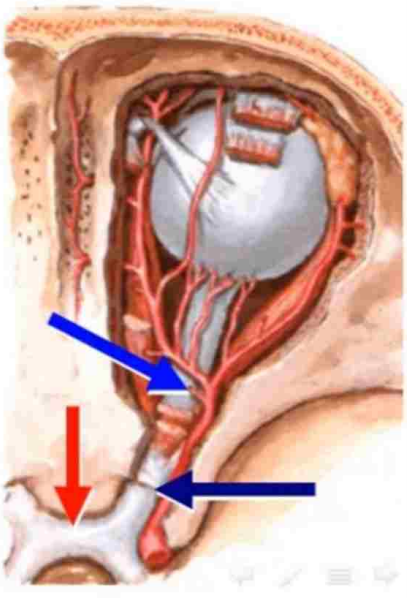
Termination: optic chiasma

Course:

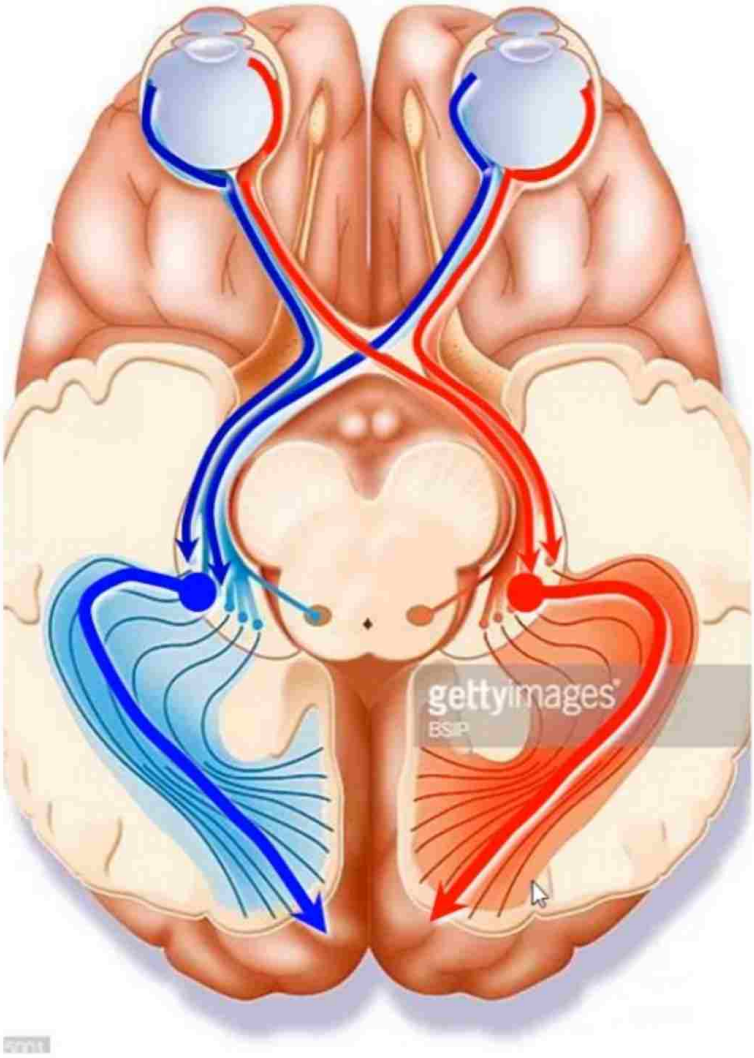
1. Pass through the optic canal
2. Pierced by central retinal artery & vein

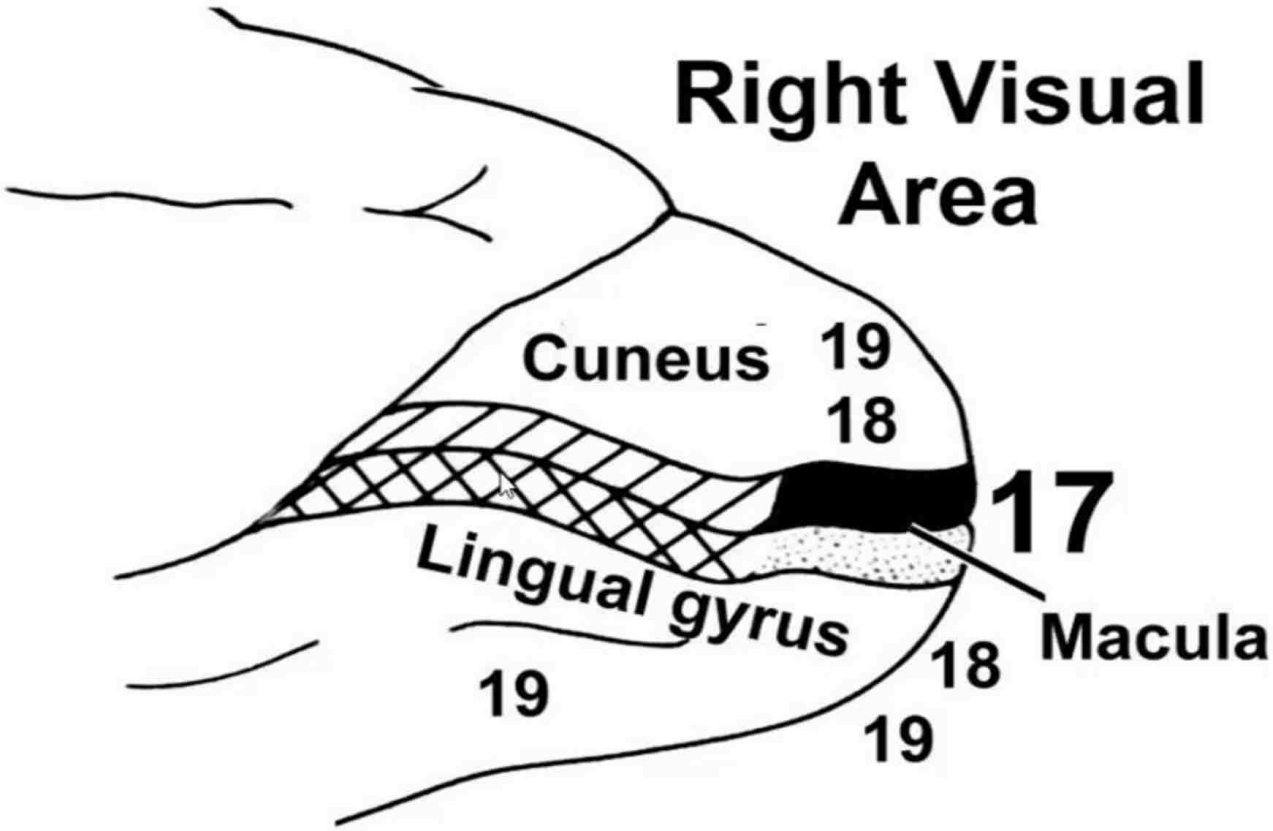
3 Differences from peripheral nerves:

1. It is surrounded by meninges & CSF
2. It has glial cells & no Schwann cells
3. It doesn't regenerate after injury.



VISUAL PATHWAY



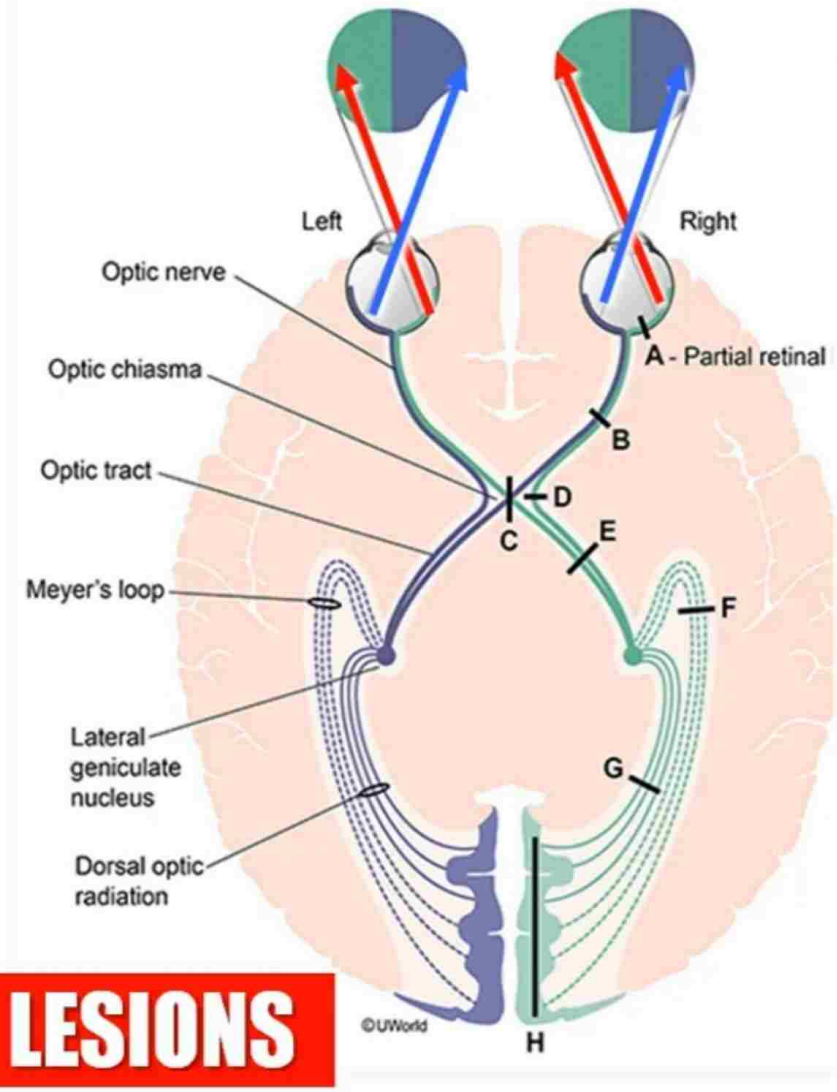


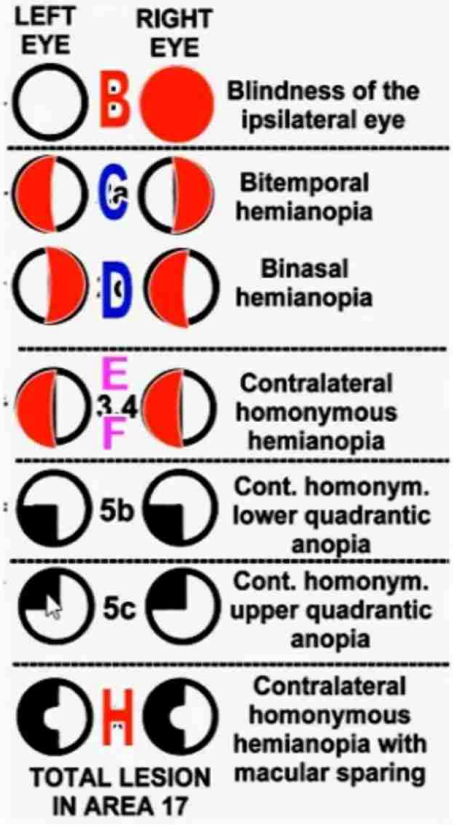
Representation of the Retina and Field of Vision in the Visual Area

Circle of willis located in region of interpeducular fossa at the base of the brain

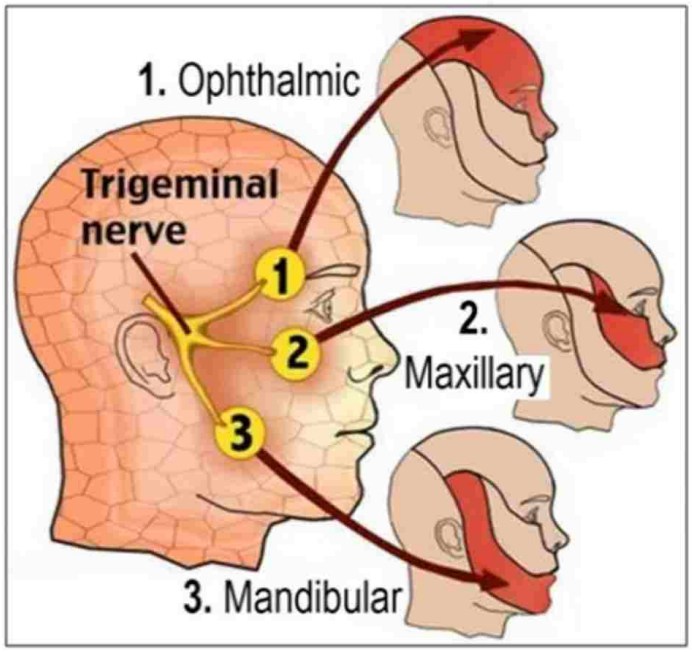
The nasal part of retina sees temporal field of vision.

The temporal part of retina sees nasal field of vision.





LESIONS



Trigeminal Nerve

Dr Adel Bondok

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TRIGEMINAL NERVE

ORIGIN: 4 NUCLEI

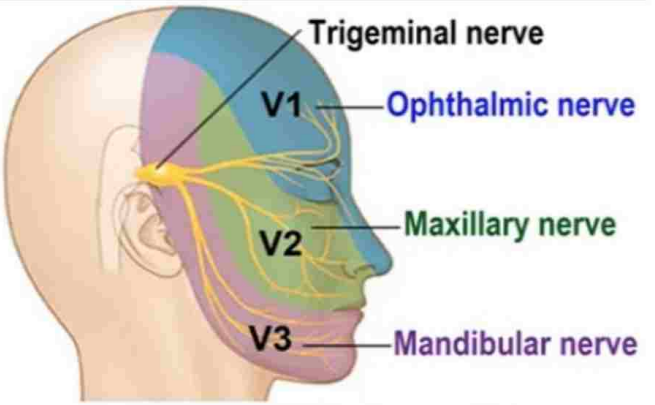
Motor Nucleus: Pons →
to muscles of mastication

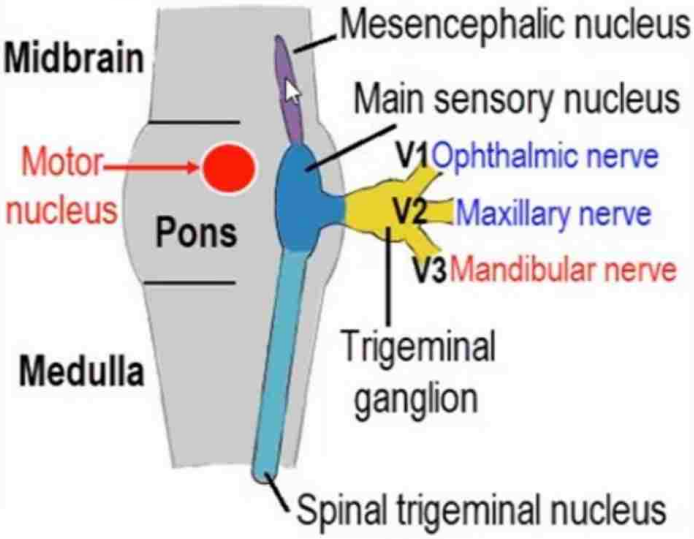
3 Sensory Nuclei:

1. Spinal Trig. Nucleus:
→ medulla → pain

2. Main Sensory Nucleus:
→ pons → touch

3. Mesencephalic Nucl: →
midbrain → proprioception



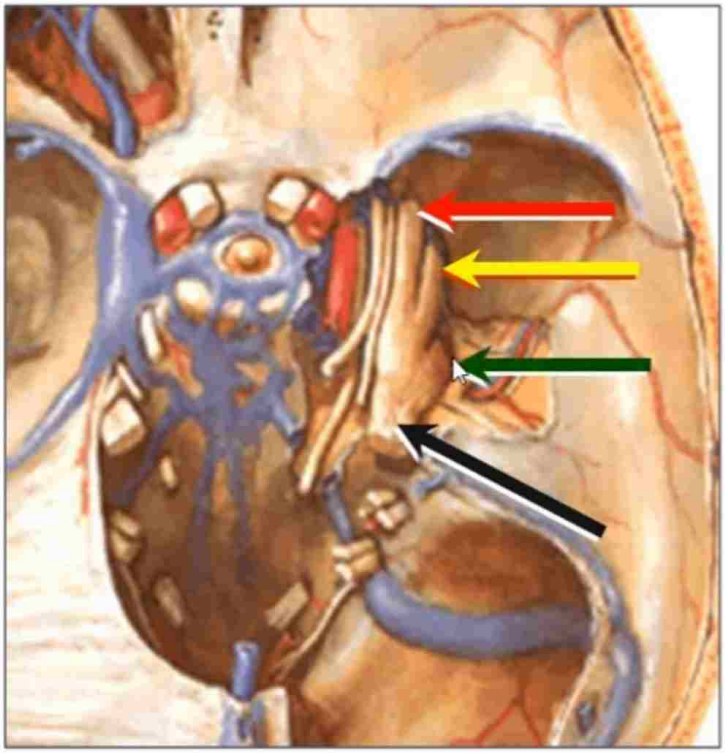


BRANCHES OF THE TRIGEMINAL NERVE

OHTHALMIC NERVE

MAXILLARY NERVE

MANDIBULAR NERVE



OPHTHALMIC NERVE

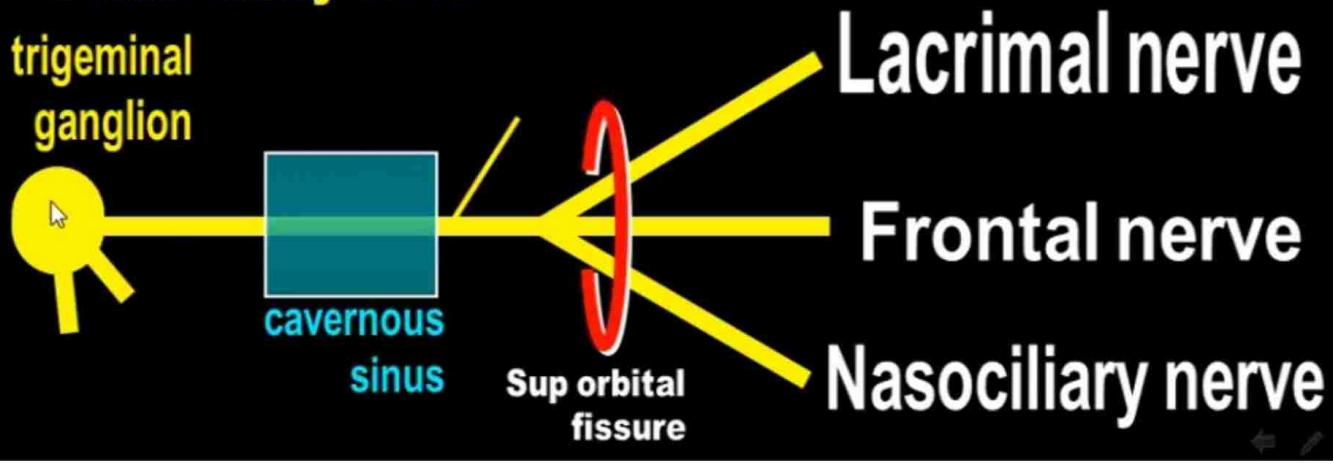
ORIGIN: trigeminal ganglion

COURSE:

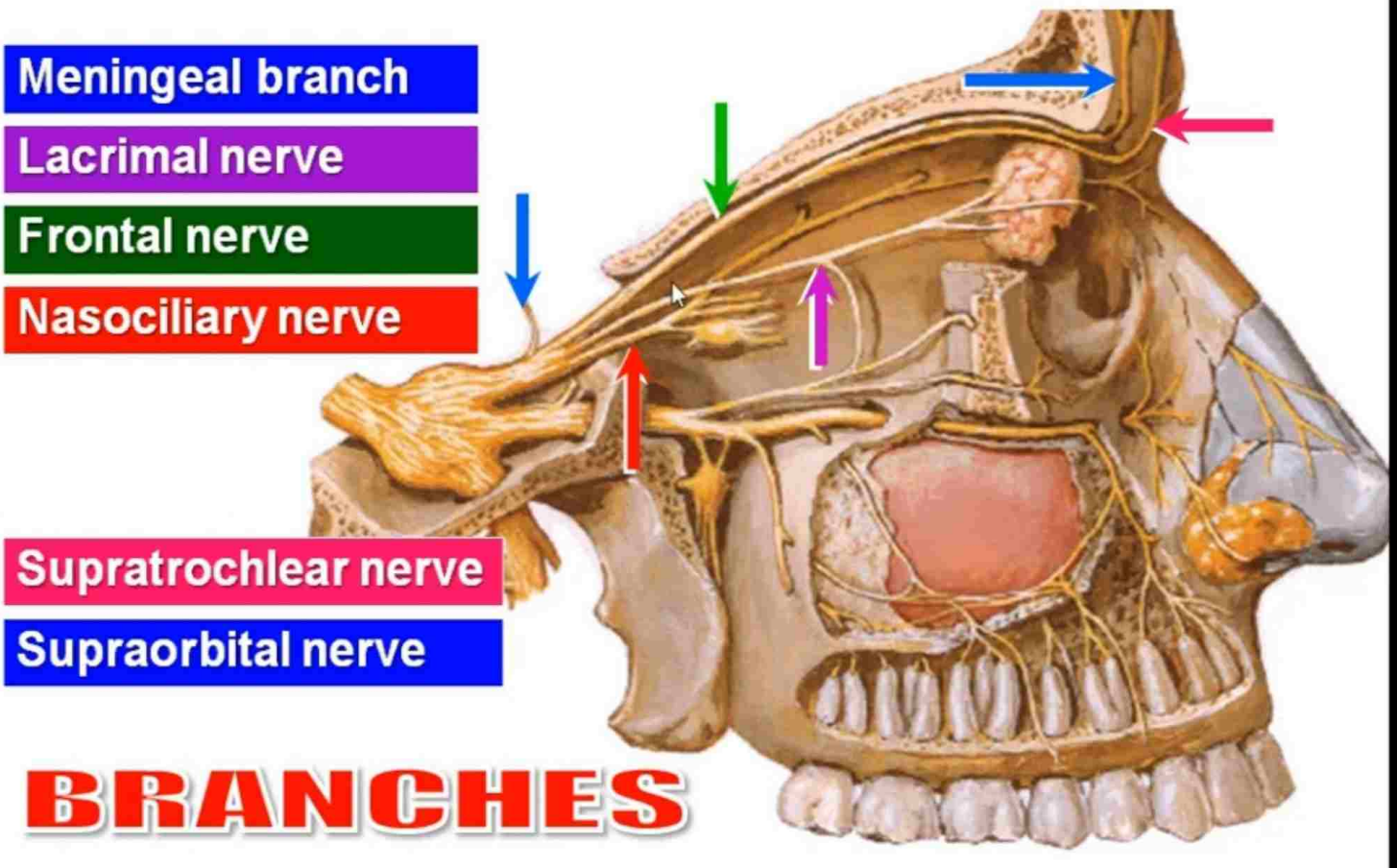
1. Lateral wall of the cavernous sinus
2. Divides into 3 branches which enter the sup orbital fissure

BRANCHES:

1. Meningeal branch: to the dura
2. Lacrimal nerve: to lacrimal gland
3. Frontal nerve: supratrochlear & supraorbital nerves: to the scalp & upper eyelid
4. Nasociliary nerve



OPHTHALMIC NERVE



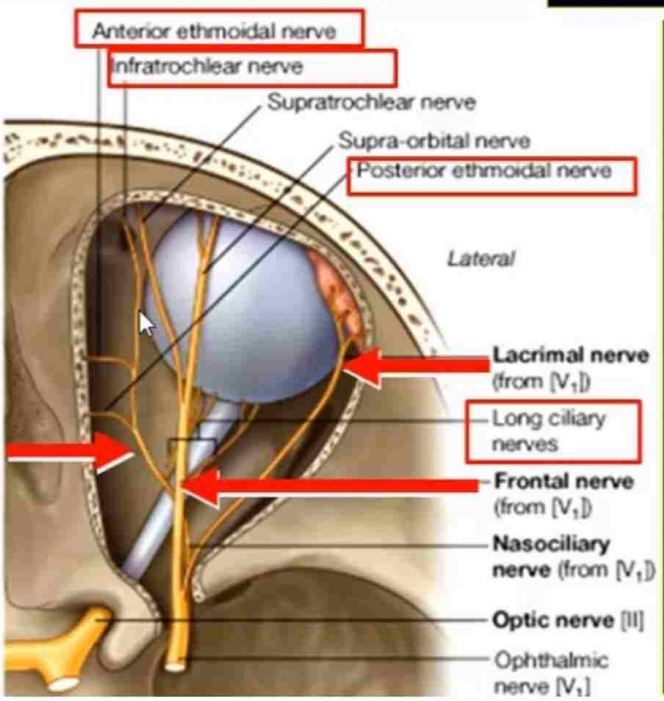
BRANCHES

OPHTHALMIC NERVE

LACRIMAL NERVE
1. Lacrimal gland
2. Upper eyelid

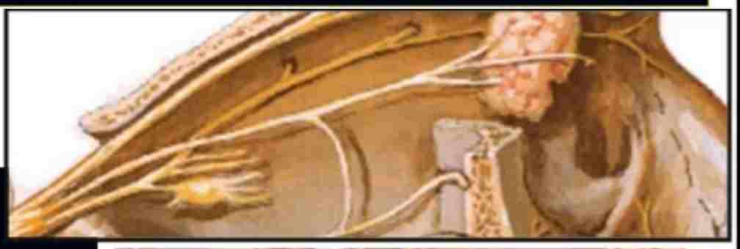
FRONTAL NERVE
1. supratrochlear nerve
2. supraorbital nerve

Both supply upper eyelid & scalp



NASOCILIARY NERVE
1. **Sensory root** to ciliary ganglion
2. **Long ciliary nerves:**
   a. **sympathetic** to dilator pupillae
   b. **sensory** to the cornea & iris
3. **Posterior ethmoidal nerve**: to sphenoid & ethmidal sinuses & dura
4. **Anterior ethmoidal nerve**: to the nasal cavity & the dura mater
5. **Infratrochlear nerve**

NASOCILIARY NERVE



1. **Sensory root:**
   to the ciliary ganglion
2. **Long ciliary nerves:**
   a. **sympathetic:**
      to the dilator pupillae
   b. **sensory:**
      to the cornea & iris
3. **Posterior ethmoidal nerve:**
   to sphenoid & ethmidal sinuses and dura mater
4. **Anterior ethmoidal nerve:**
   to nasal cavity and dura mater
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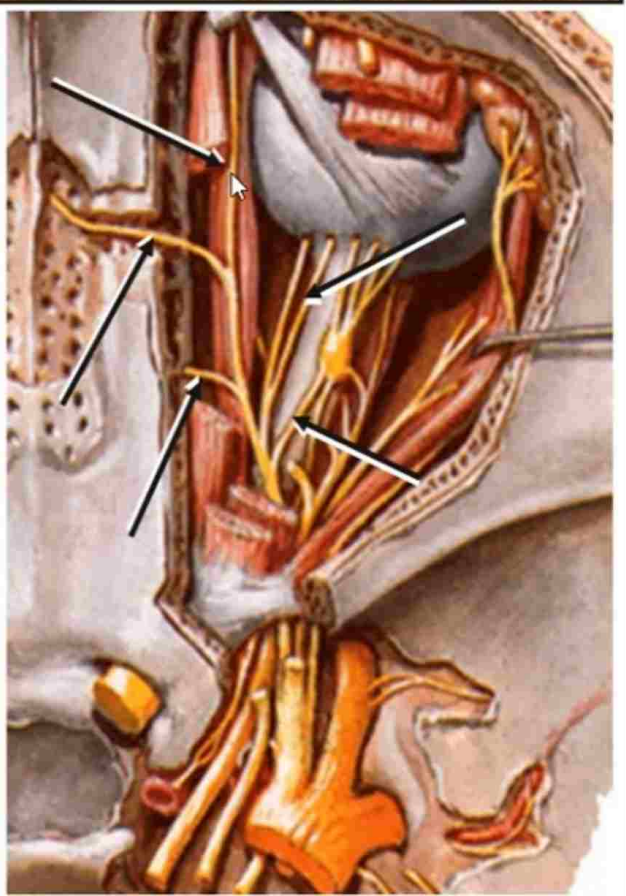
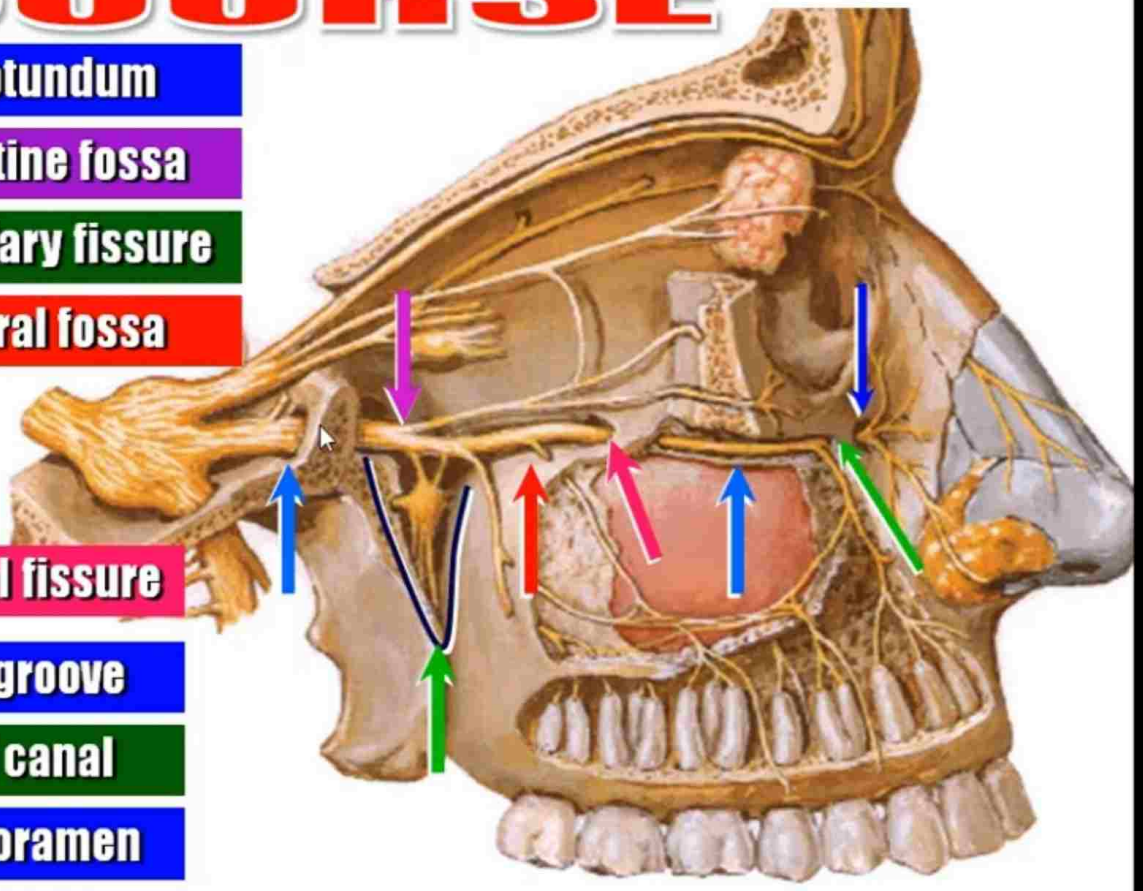


MAXILLARY NERVE

COURSE

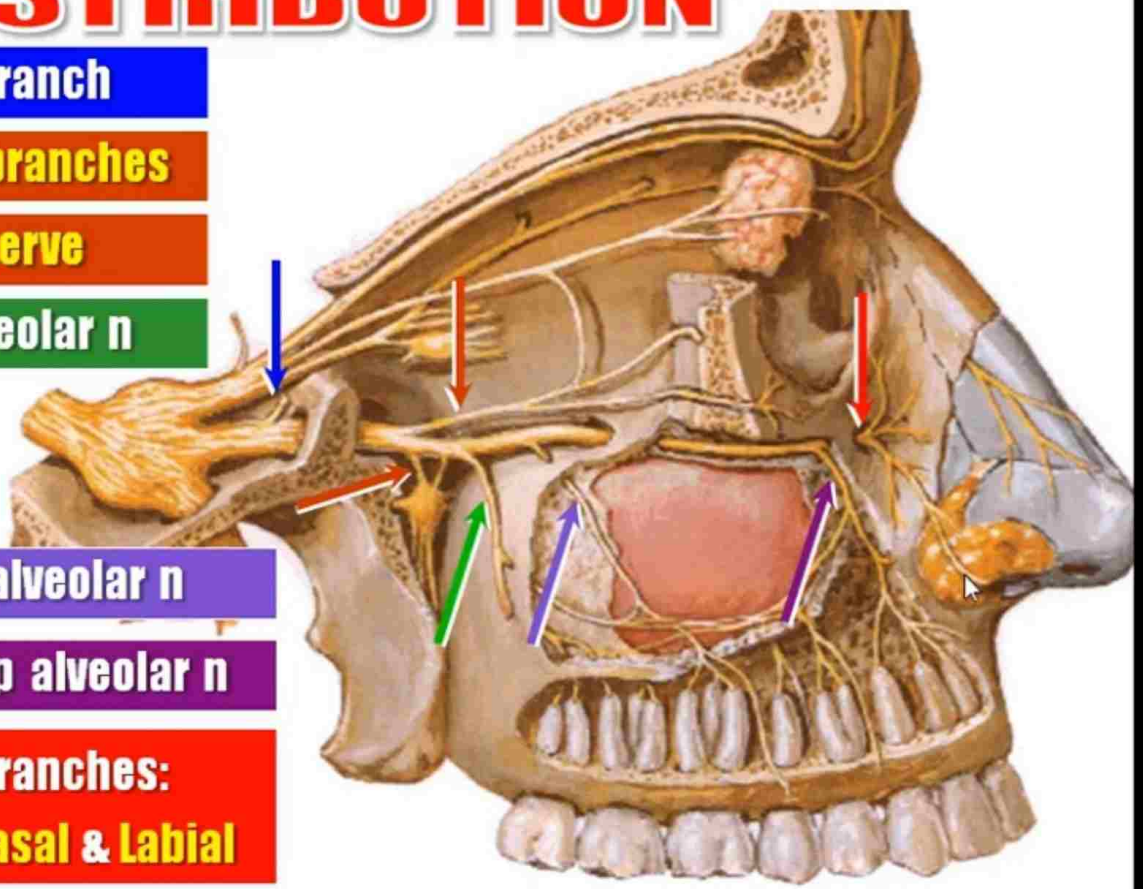
- Foramen rotundum
- Pterygopalatine fossa
- Pterygomaxillary fissure
- Infratemporal fossa
- Inferior orbital fissure
- Infraorbital groove
- Infraorbital canal
- Infraorbital foramen



MAXILLARY NERVE

DISTRIBUTION

1. Meningeal branch
2. Ganglionic branches
3. Zygomatic nerve
4. Post Sup alveolar n
5. Middle Sup alveolar n
6. Anterior Sup alveolar n
7. 3 Terminal branches: Palpebral, Nasal & Labial



MANDIBULAR NERVE

ORIGIN: by 2 ROOTS:

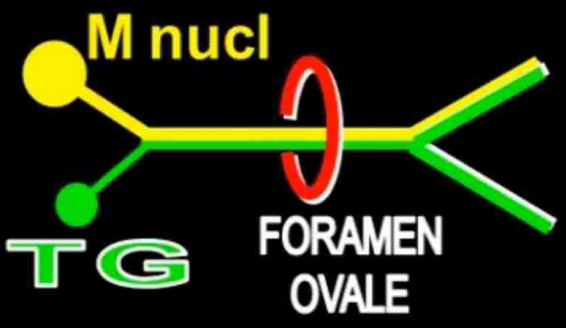
1. **Motor Root: from the Motor Nucleus**
2. **Sensory Root: from the Trigeminal Ganglion**

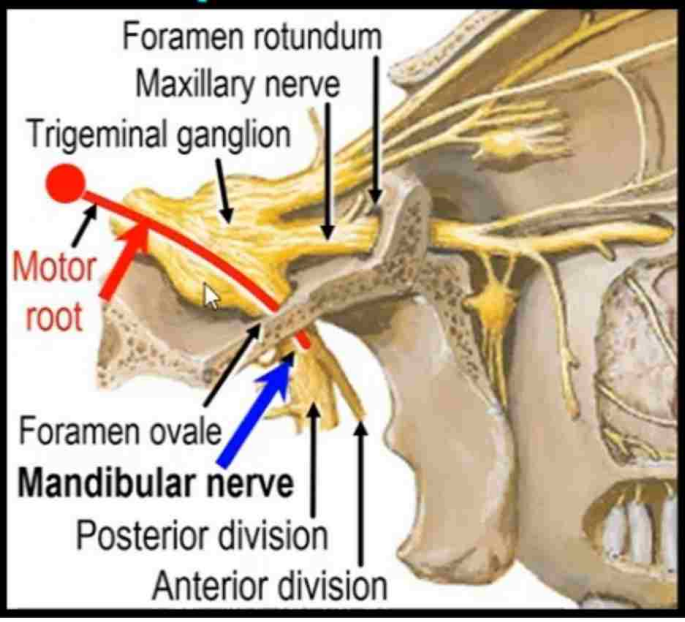
COURSE:

1. **Pass thru foramen ovale**
2. **Divides into 2 divisions: anterior and posterior**

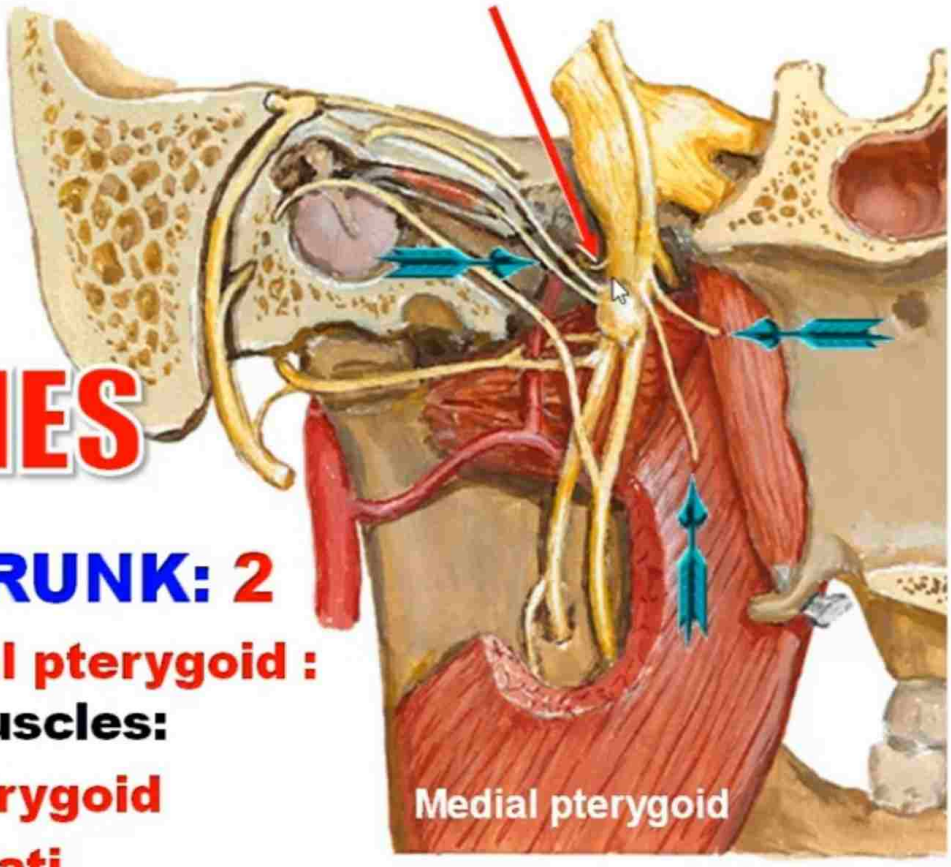
BRANCHES:

1. **From the trunk:**
2. **From the anterior division:**
3. **From the posterior division:**





BRANCHES



FROM THE TRUNK: 2

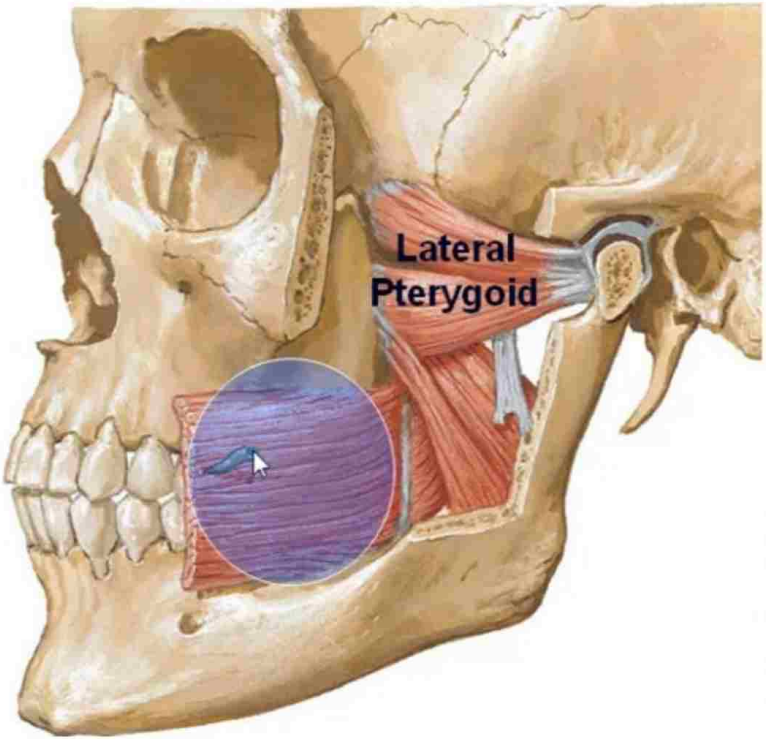
1. Nerve to Medial pterygoid :
it supplies 3 muscles:

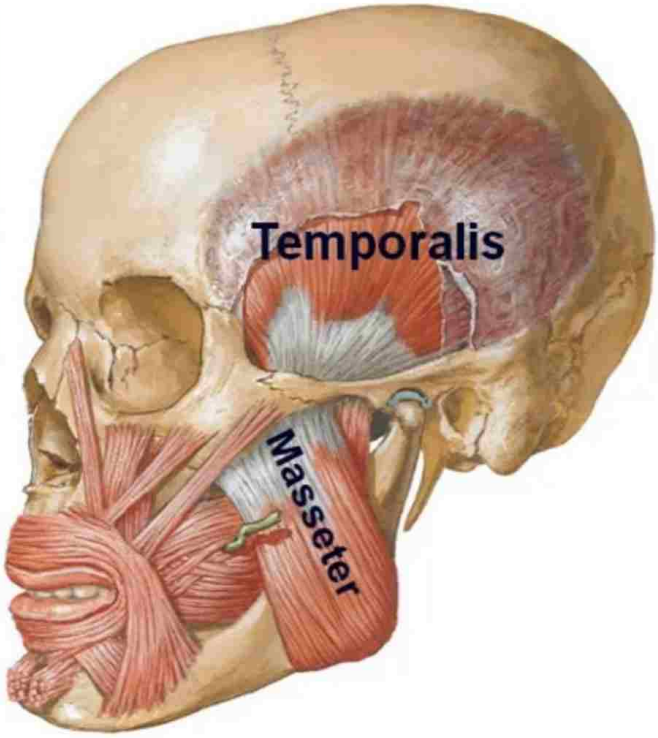
- **a. Medial pterygoid**
- **b. Tensor palati**
- **c. Tensor tympani**

2. Nervus spinosus: sensory to the dura

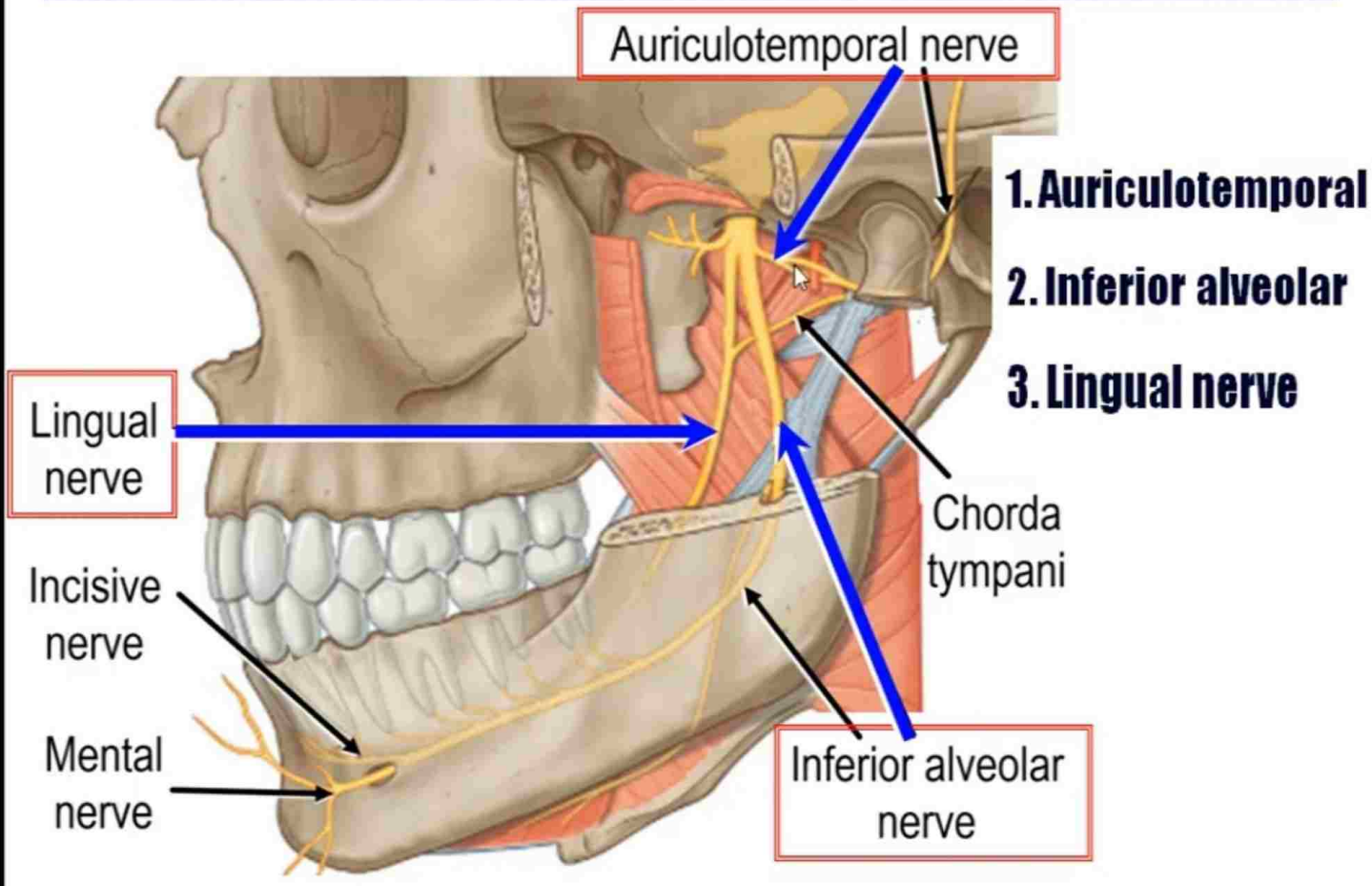
ANTERIOR DIVISION

1. **Muscular: all** muscles of mastication **except** medial pterygoid
2. **Buccal branch:** sensory to skin & mm over the buccinator





POSTERIOR DIVISION: 3



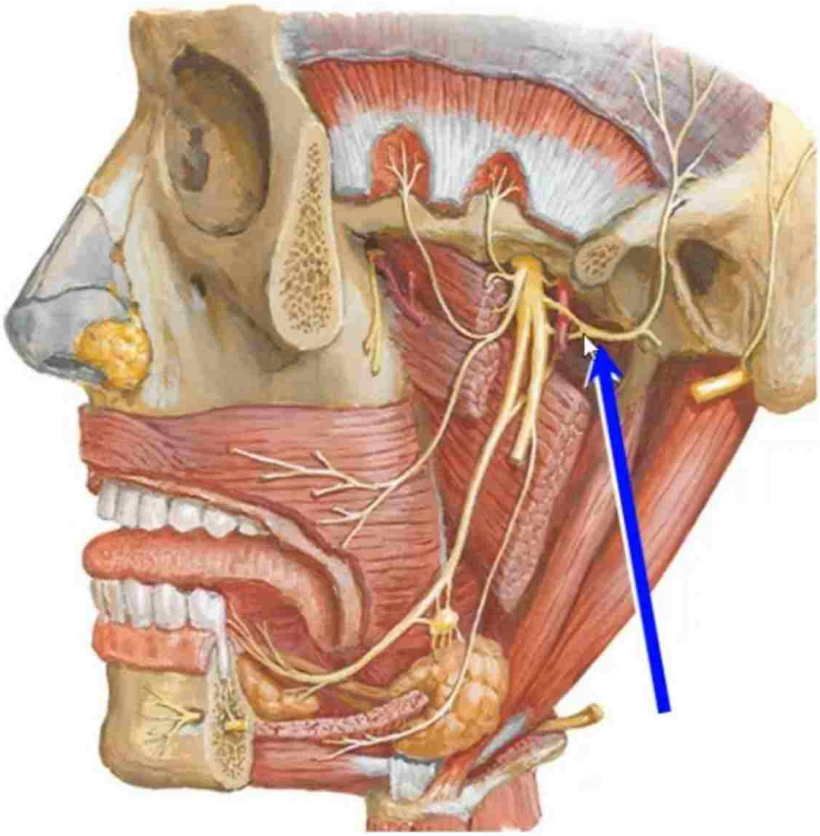
AURICULOTEMPORAL NERVE

ORIGIN:

By 2 roots surrounding the middle meningeal art

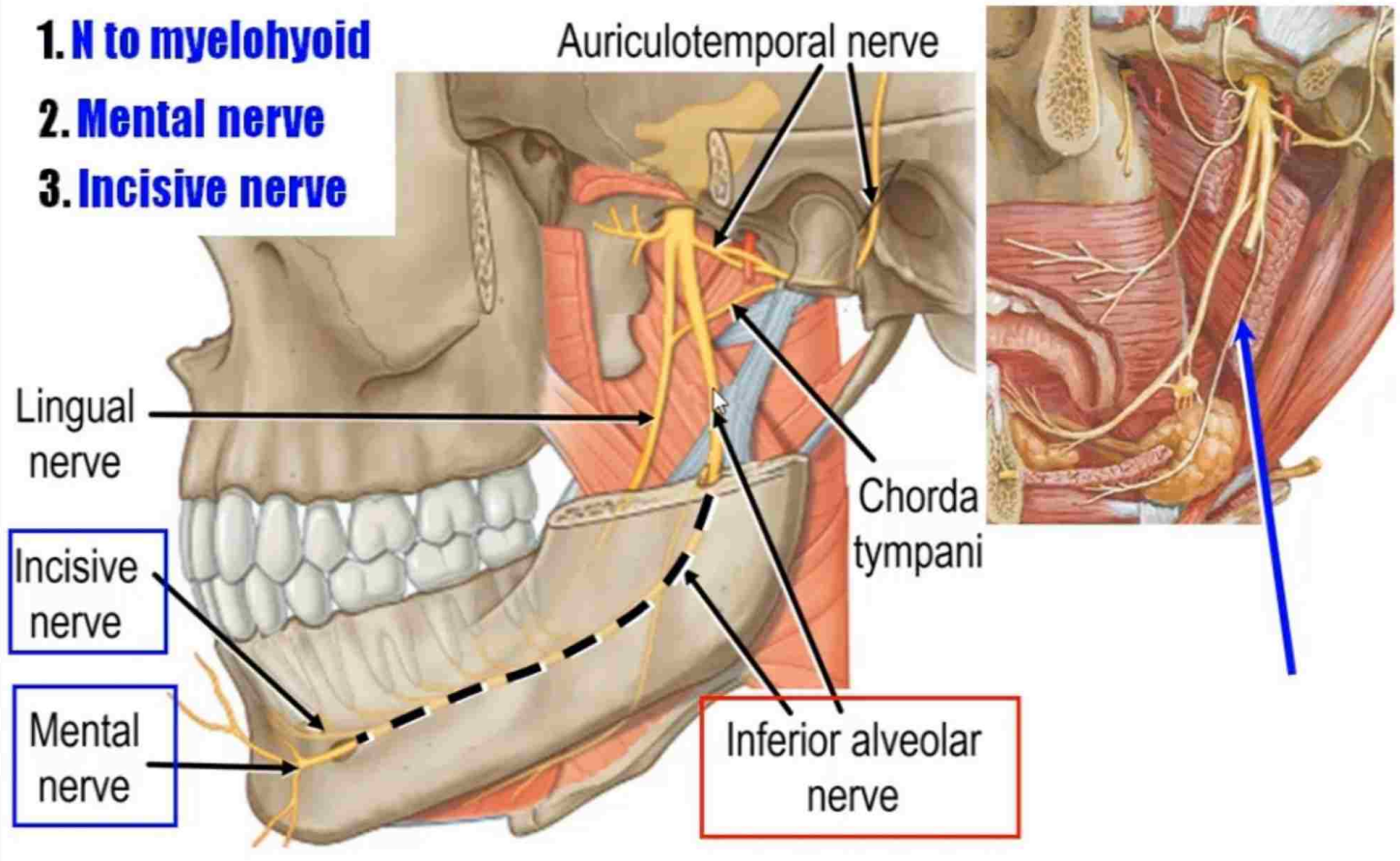
DISTRIBUTION:

1. **Sensory Fibers:** to
   - a. scalp
   - b. Auricle
   - c. external auditory m
   - d. tympanic membrane
   - e. parotid gland.
   - f. Temporomandibular J
2. **Parasymp Fibers:** to the parotid gland



INFERIOR ALVEOLAR NERVE

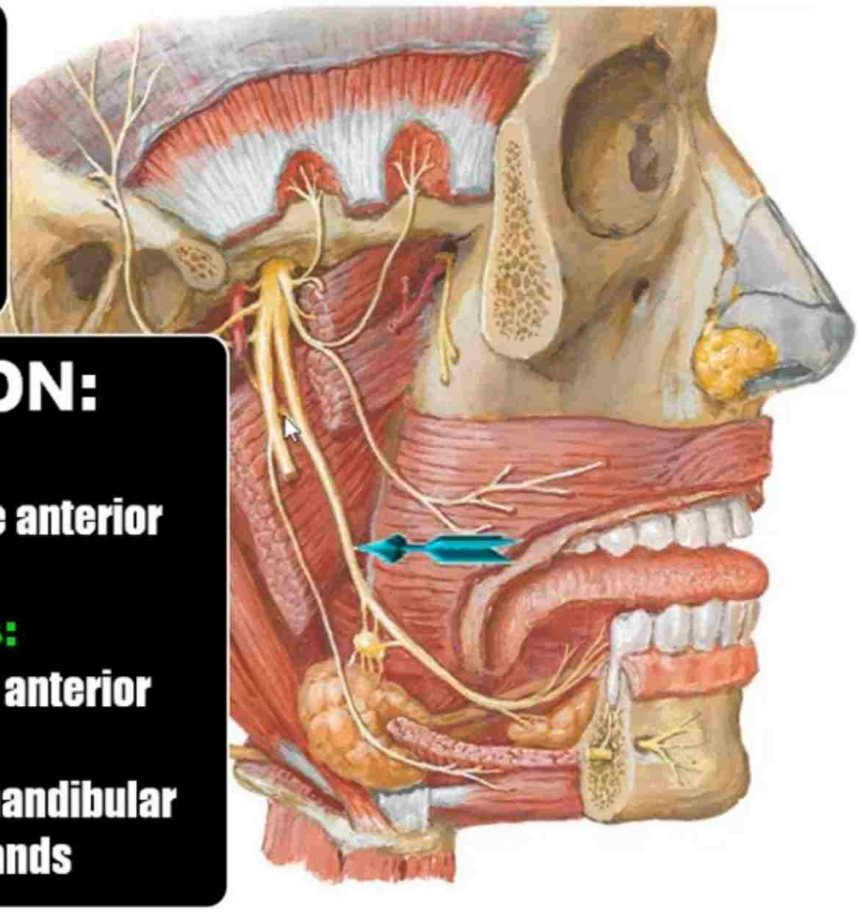
1. N to myelohyoid
2. Mental nerve
3. Incisive nerve



LINGUAL NERVE

IMPORTANT POINTS:

- Join the chorda tympani
- Run below the last molar



DISTRIBUTION:

Lingual Nerve Itself:

General sensation from the anterior 2/3 of the tongue

Chorda Tympani Fibers:

1. Taste sensation from the anterior 2/3 of the tongue
2. Parasymp fibers to submandibular & sublingual salivary glands

SUMMARY

FROM THE TRUNK:

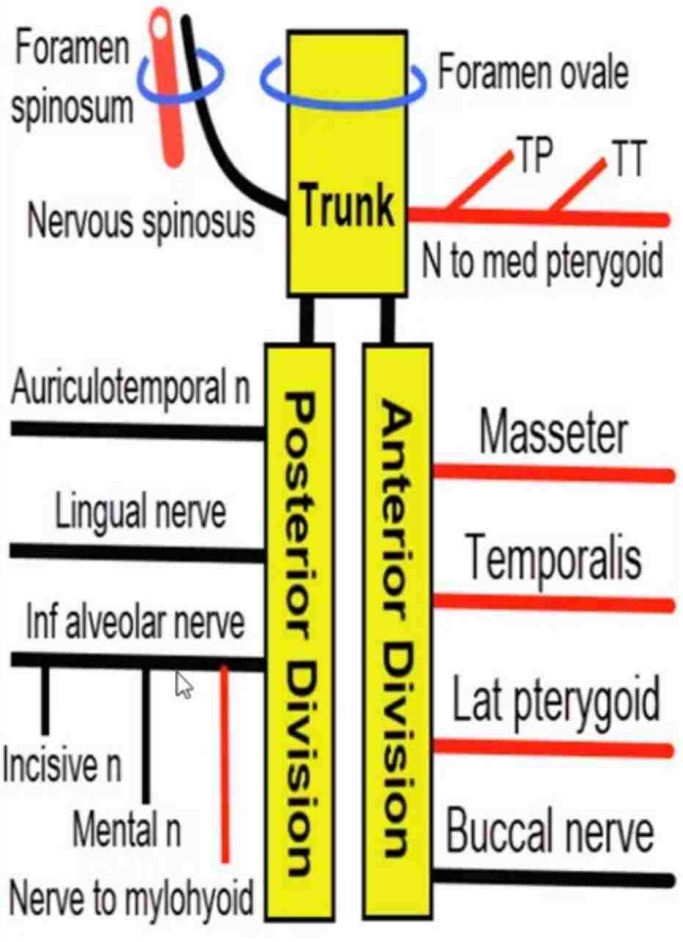
1. Nerve to Medial pterygoid
2. Nervus spinosus: sensory to dura

ANTERIOR DIVISION:

1. Nerve to Masseter
2. Deep temporal: temporalis
3. Pterygoid branches: to Lat ptery
4. Buccal branch: sensory

POSTERIOR DIVISION:

1. Auriculotemporal nerve
2. Lingual nerve
3. Inferior alveolar nerve



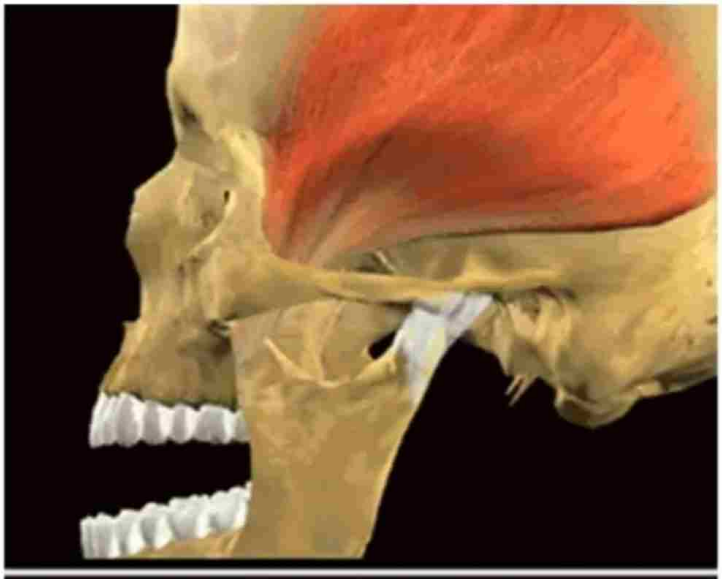
Trigeminal Nerve Lesion

Normal TMJ Closed Overview

Paralysis of muscles of mastication of the same side

Loss of all sensations on the same side of the face

Trigeminal Nerve Lesion

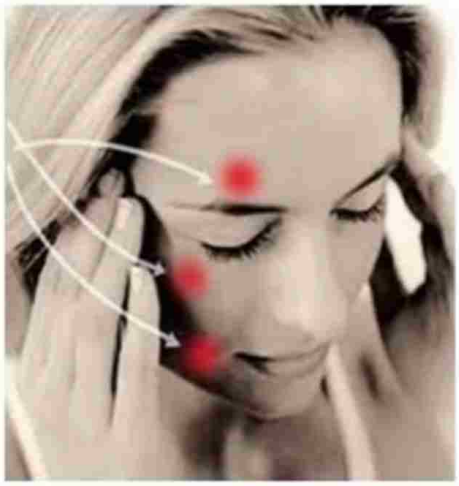


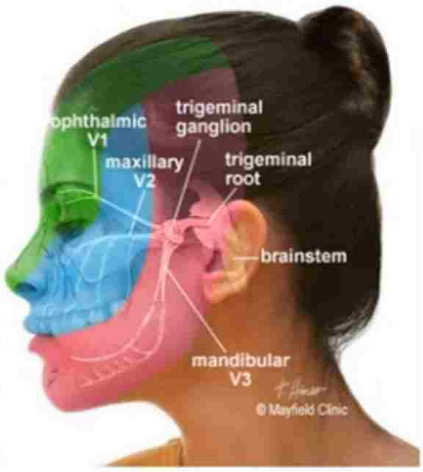
Problematic TMJ

Paralysis of muscles of mastication of the same side

Loss of all sensations on the same side of the face

Trigeminal Neuralgia





- Trigeminal neuralgia is a severe pain along the distribution of any branch of the trigeminal nerve
- It is due to compression or irritation of the trigeminal nerve by a tumor or cyst or blood vessel

FACIAL NERVE

DEEP ORIGIN

MOTOR NUCLEUS: ⇒ to muscles of facial expression

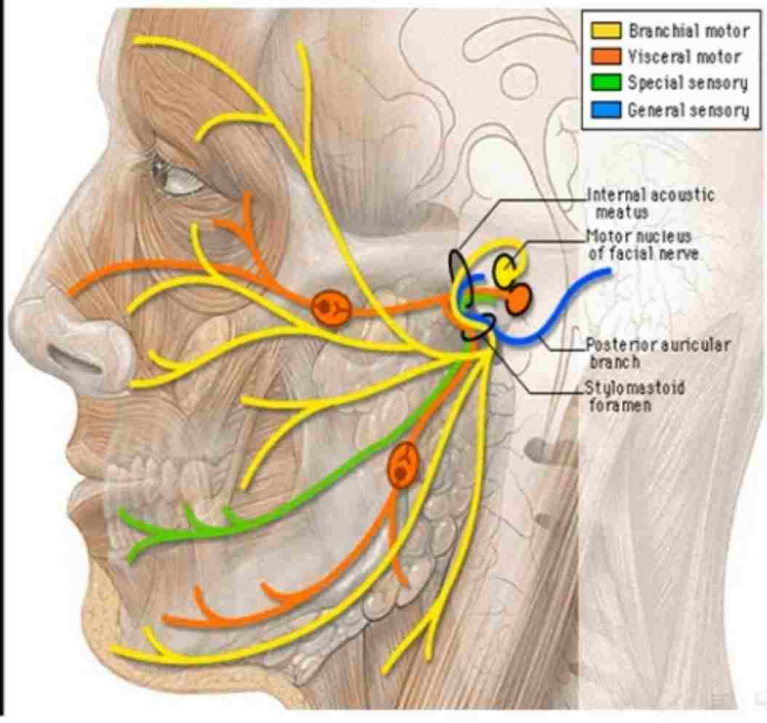
PARASYMPATHETIC NUCLEUS:

Superior salivary nucleus ⇒ to

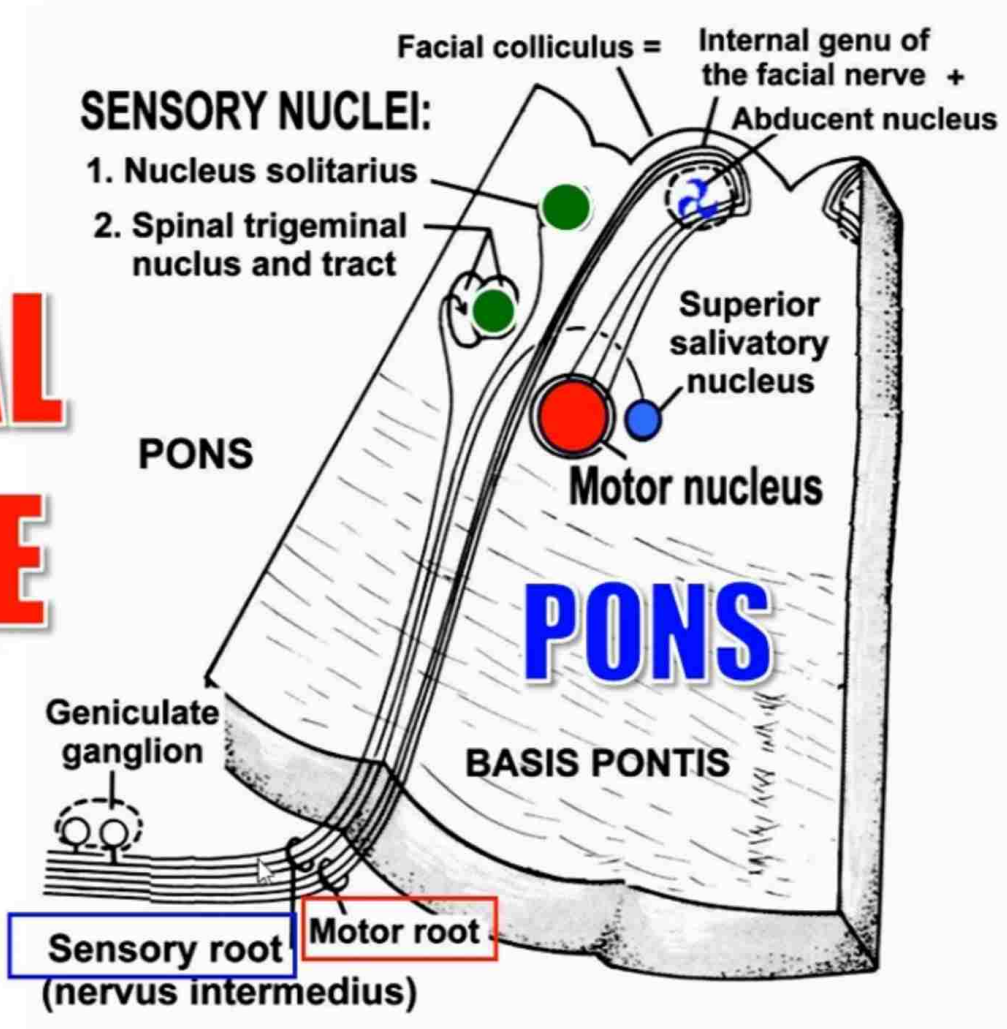
1. Submandibular & sublingual glands.
2. Lacrimal, nasal & palatine glands

2 SENSORY NUCLEI:

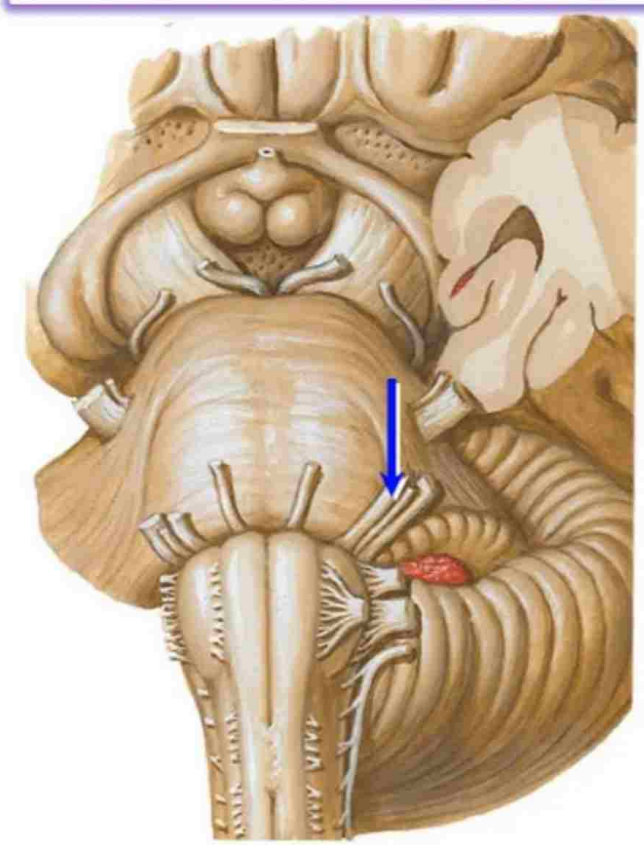
1. Solitary nucleus: taste
2. Spinal trigeminal nucleus



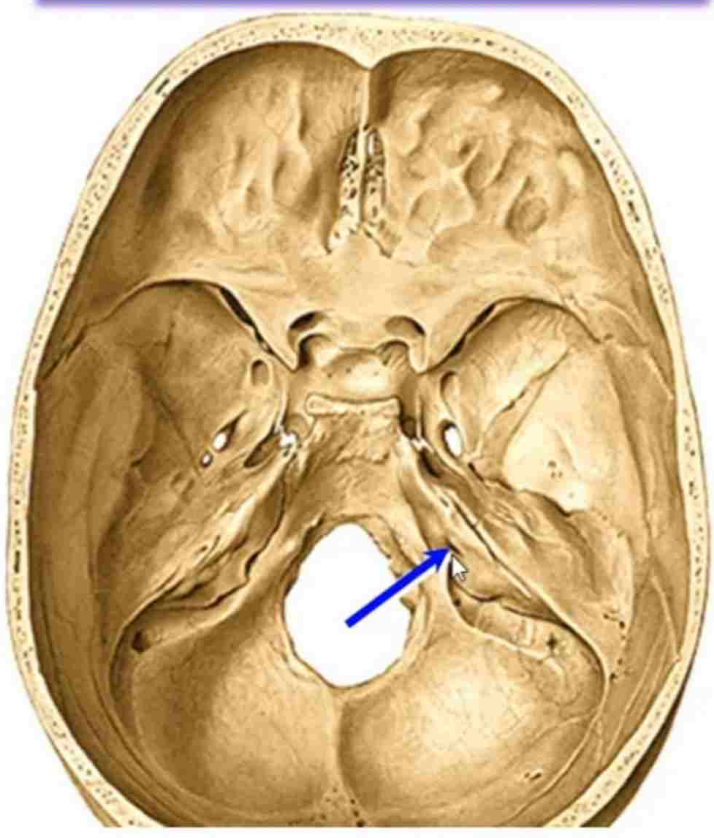
FACIAL NERVE



EXIT FROM THE BRAIN



EXIT FROM THE CRANIAL CAVITY



COURSE OF THE FACIAL NERVE

Cerebello-Pontine angle

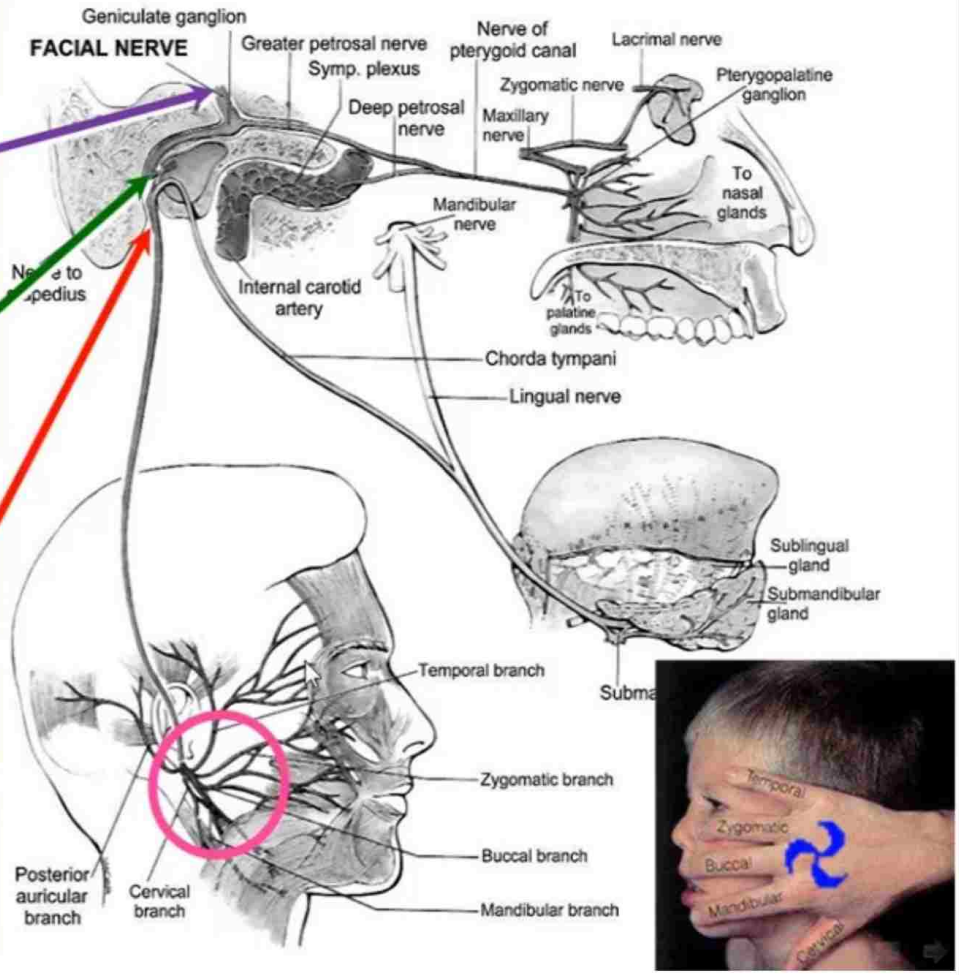
Internal auditory meatus

Facial canal: medial & posterior wall of middle ear

Exits from the stylomastoid foramen

Enters Parotid Gland

Divides into 5 terminal branches



BRANCHES OF THE FACIAL NERVE

In the Facial Canal

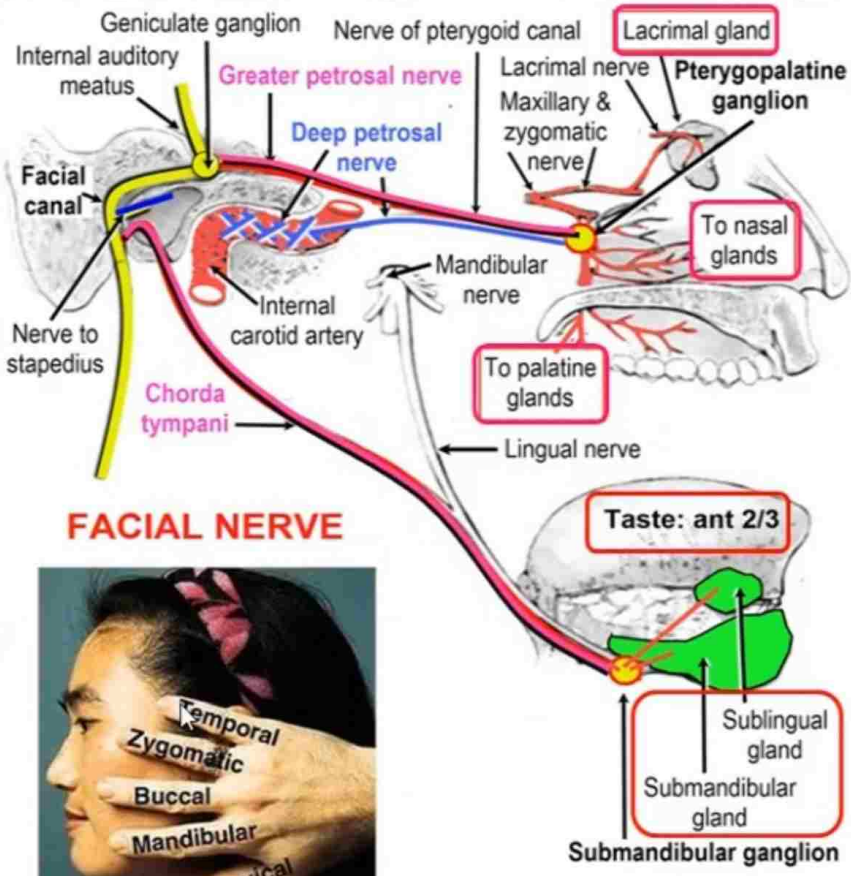
1. Greater Superficial petrosal nerve
2. Nerve to stapedius
3. Chorda tympani

At Stylomastoid Foramen

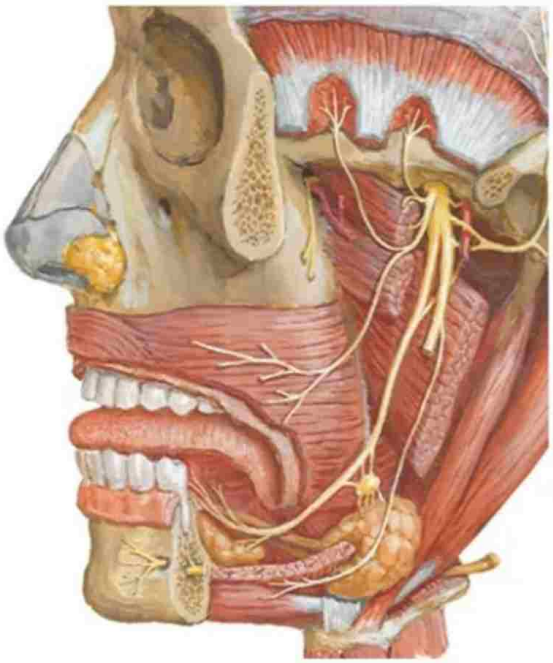
1. Post auricular nerve
2. Nerve to post belly of the digastric

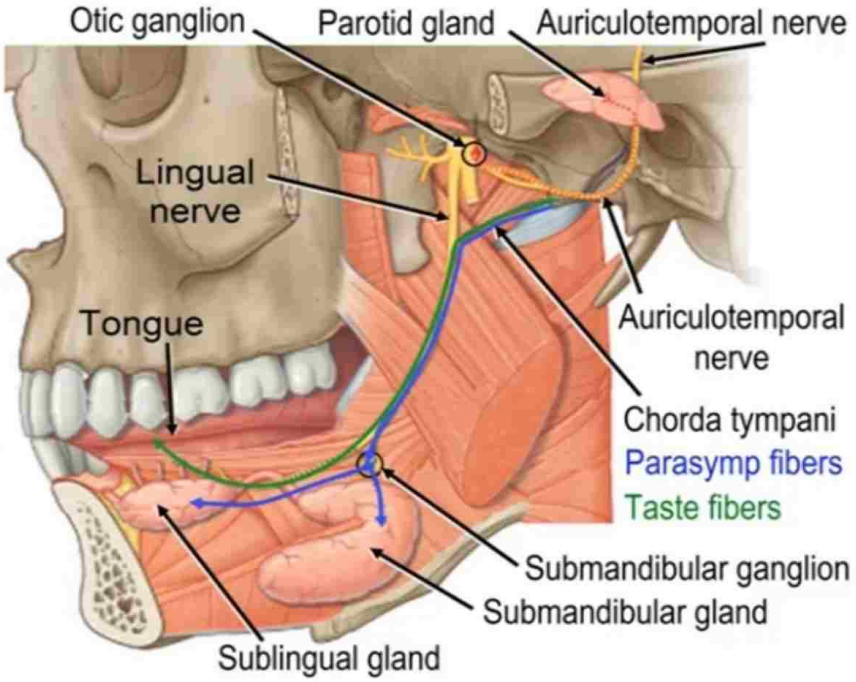
5 Terminal Branches In the Face

1. Temporal
2. Zygomatic
3. Buccal
4. Mandibular
5. Cervical



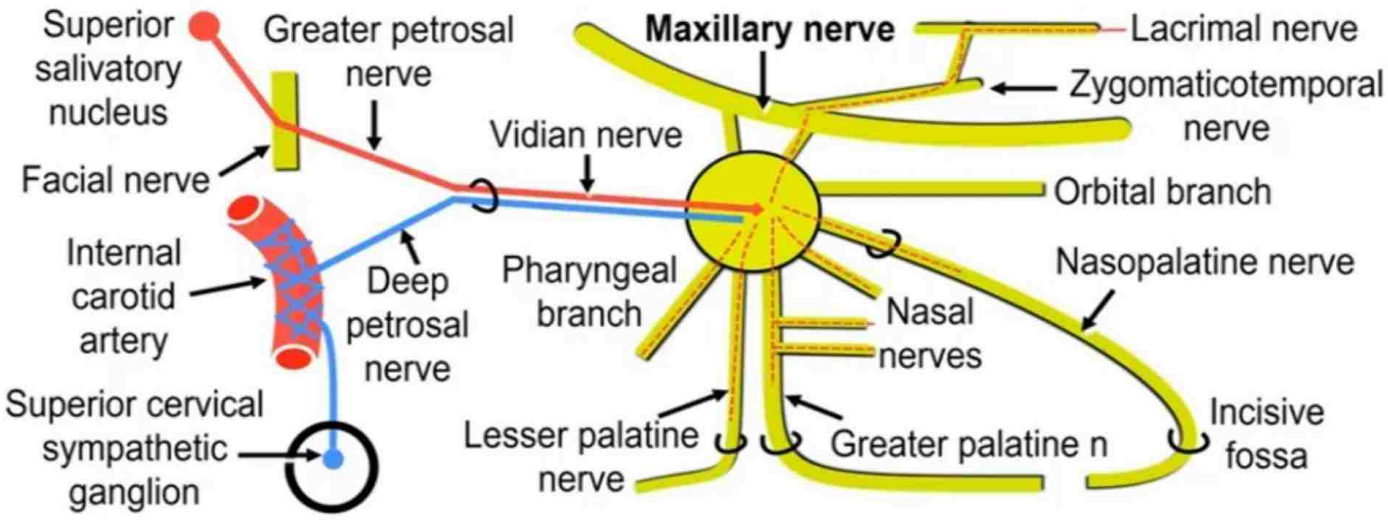
FACIAL NERVE





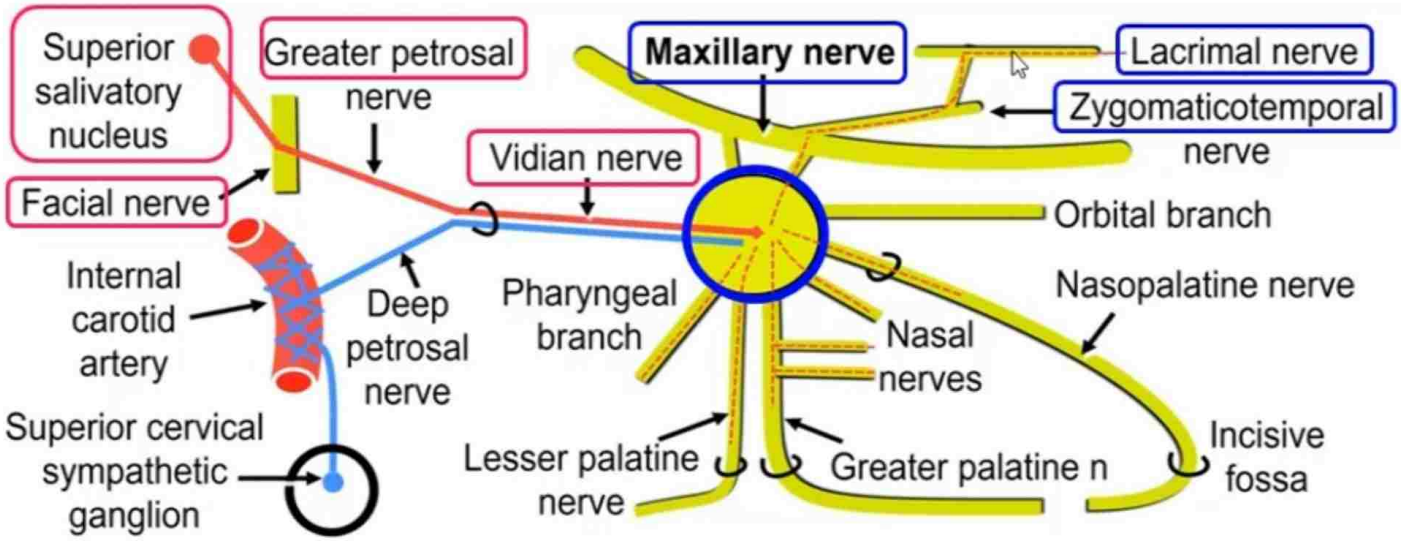
PARASYMPATHETIC fibers to SUBMANDIBULAR & SUBLINGUAL GLANDS

Superior salivatory nucleus ⇨ facial nerve ⇨ chorda tympani ⇨ lingual nerve ⇨ submandibular ganglion ⇨ submandibular and sublingual salivary glands.



Parasympathetic Fibers To Lacrimal Gland

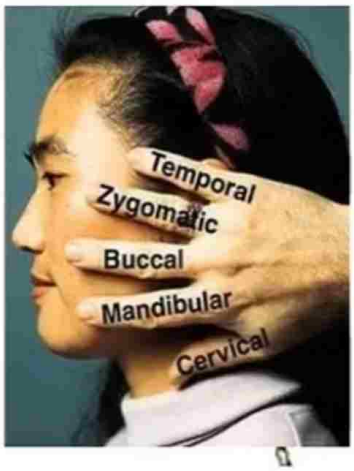
superior salivatory nucleus ⇨ facial nerve ⇨ greater superficial petrosal nerve ⇨ join the deep petrosal nerve ⇨ nerve of pterygoid canal ⇨ pterygopalatine (sphenopalatine) ganglion ⇨ maxillary nerve ⇨ zygomatic nerve ⇨ zygomaticotemporal nerve ⇨ lacrimal nerve ⇨ lacrimal gland

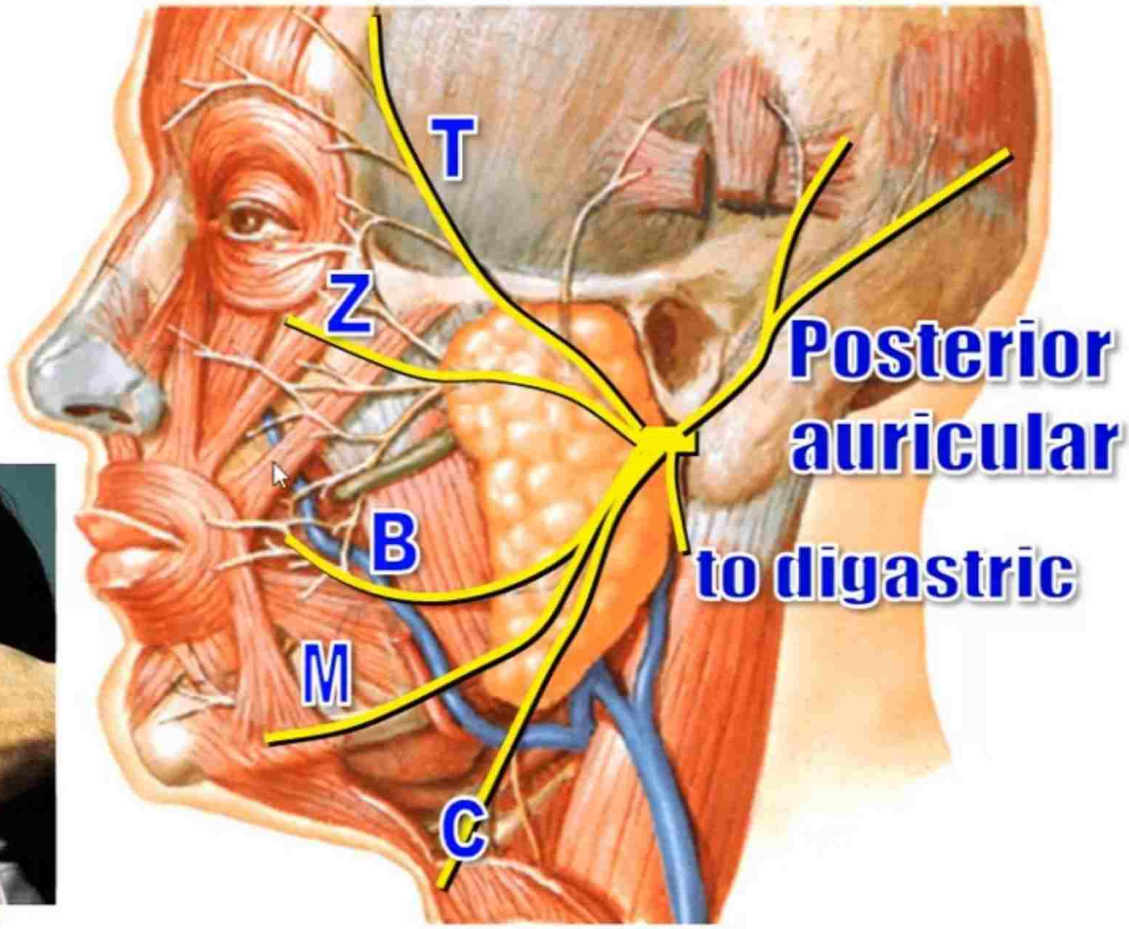


Parasympathetic Fibers To Lacrimal Gland

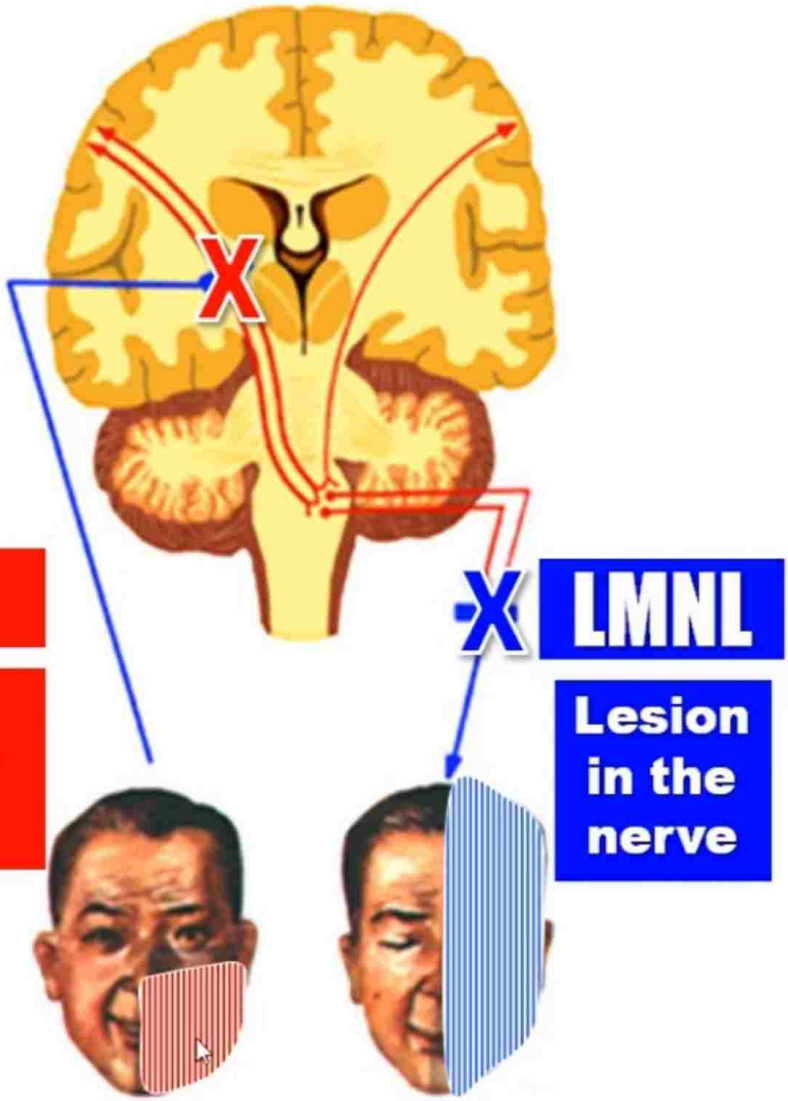
superior salivatory nucleus ⇨ facial nerve ⇨ greater superficial petrosal nerve ⇨ join the deep petrosal nerve ⇨ nerve of pterygoid canal ⇨ pterygopalatine (sphenopalatine) ganglion ⇨ maxillary nerve ⇨ zygomatic nerve ⇨ zygomaticotemporal nerve ⇨ lacrimal nerve ⇨ lacrimal gland

Extracranial Part

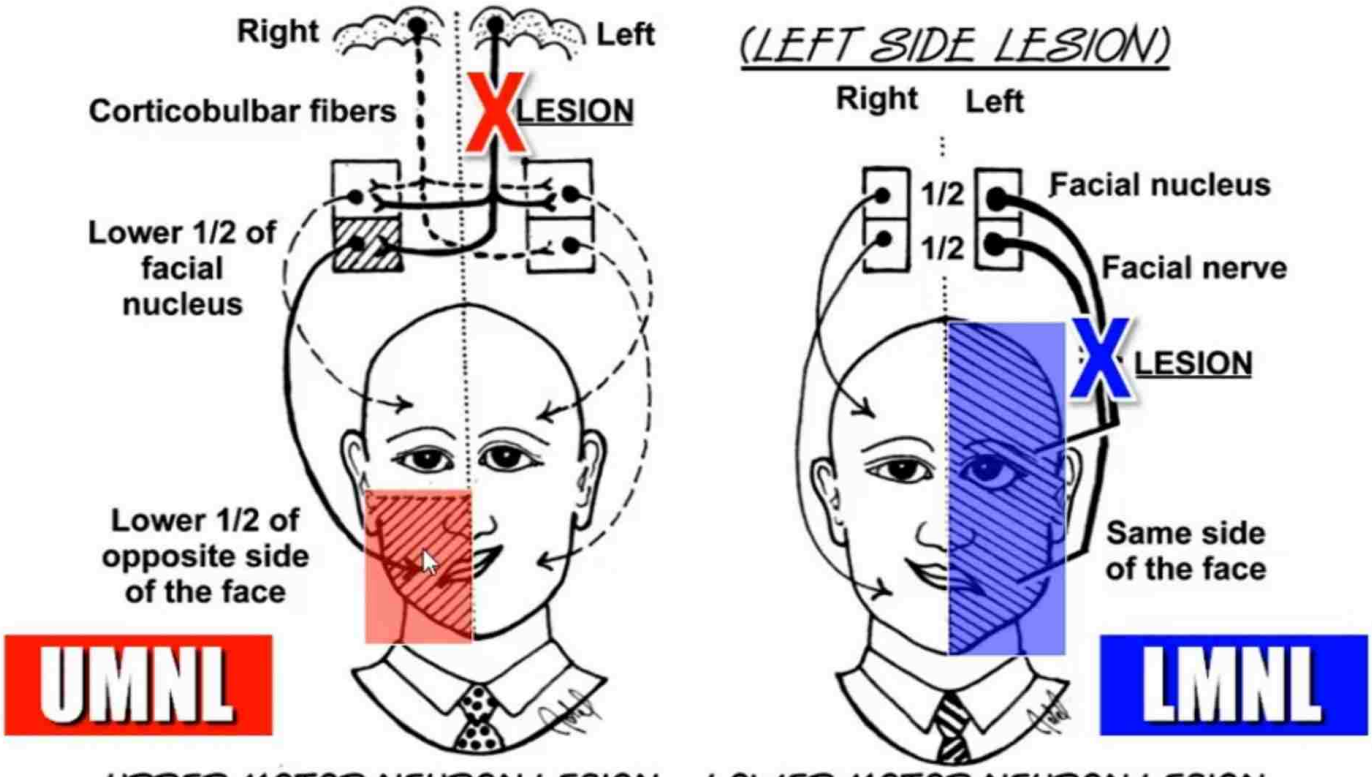




FACIAL NERVE LESIONS



FACIAL NERVE LESIONS

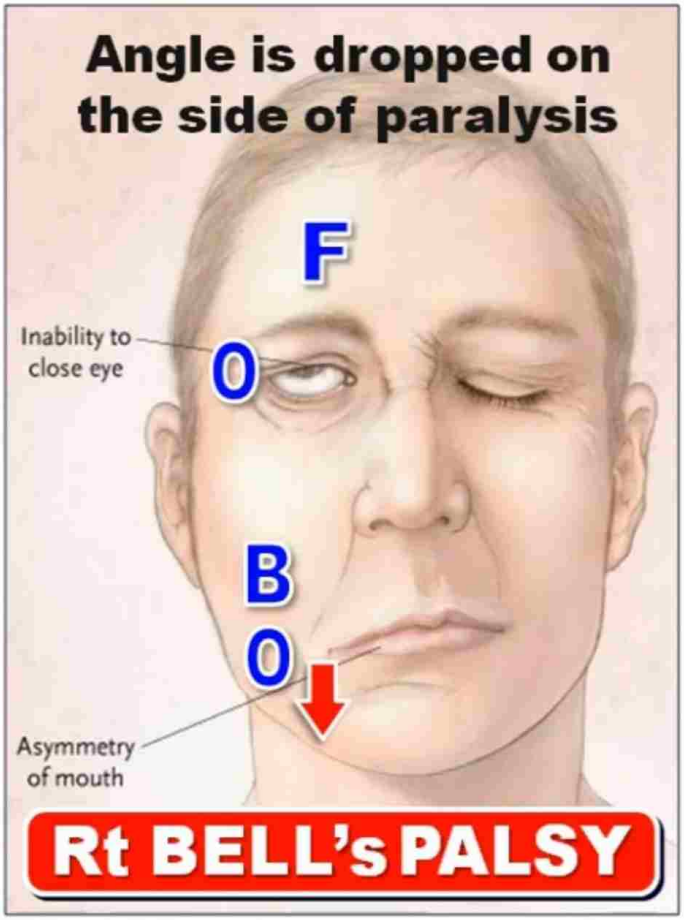


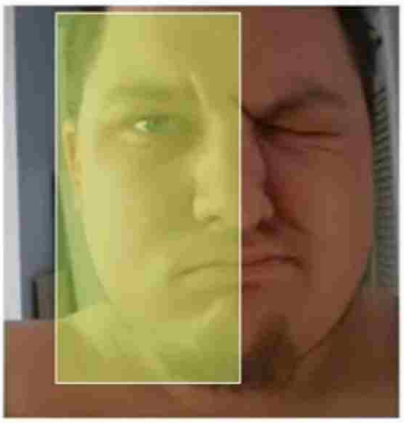
UPPER MOTOR NEURON LESION

LOWER MOTOR NEURON LESION

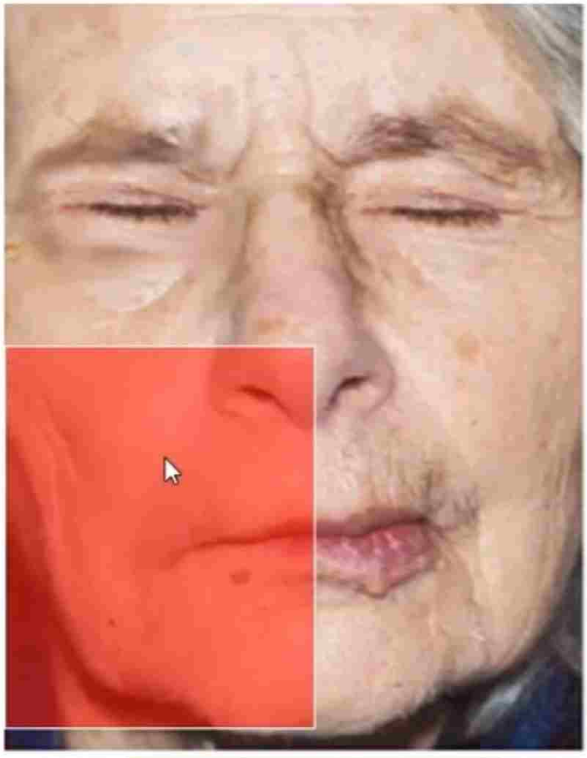
FACIAL NERVE LESIONS (UMNL and LMNL)

LMNL of FACIAL NERVE





UMNL & LMNL of the Facial Nerve



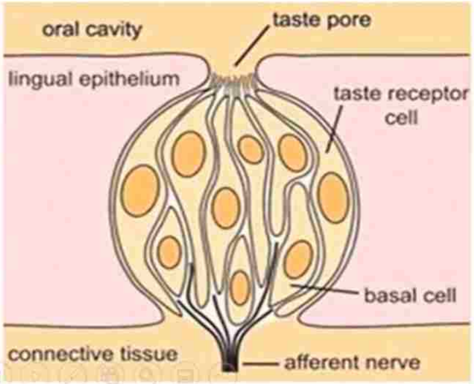
UMNL

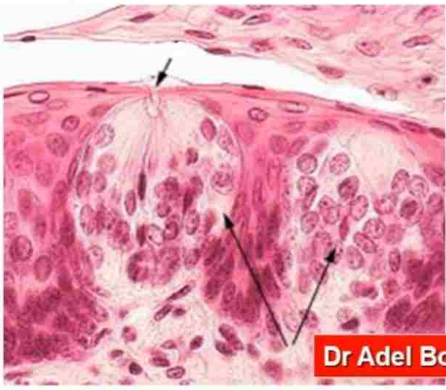
LMNL

Taste Pathway
Taste Receptors

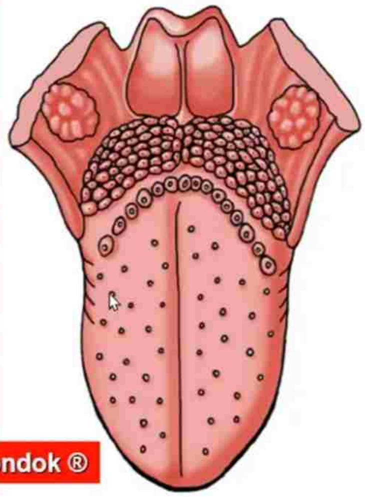
Taste buds in the tongue, epiglottis, soft palate & oropharynx

They are associated with lingual papillae: fungiform, circumvallate and foliate papillae





Dr Adel Bondok ®

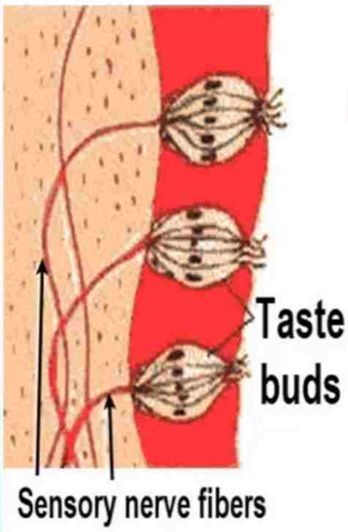


3 Cranial Nerves Containing Taste Fibers

Facial nerve (chorda tympani): sensation from the anterior 2/3 of the tongue

Glossopharyngeal nerve: sensation from the posterior 1/3 of the tongue

Vagus nerve: sensation from the most posterior part of the tongue & epiglottis



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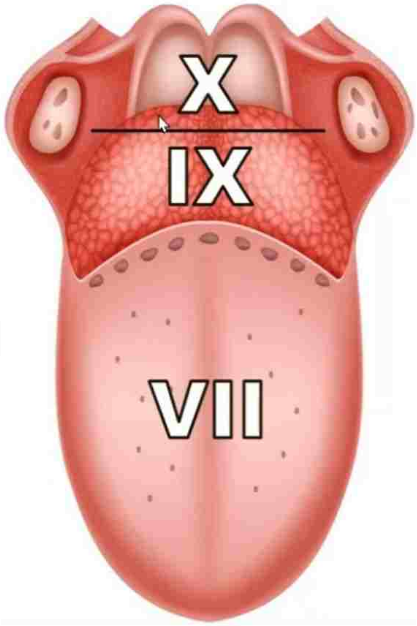

First Order Neuron

1. Geniculate ganglion of the facial nerve

2. Inferior ganglion of the glossopharyngeal nerve

3. Inferior ganglion of the vagus nerve

They contain pseudounipolar nerve cells

The peripheral branches terminate on taste buds

The central branches form the tract of nucleus solitarius which ends in the upper 1/3 of nucleus solitarius

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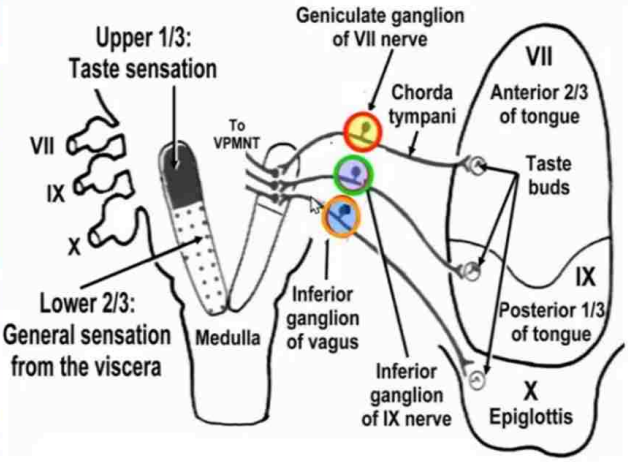


Second Order Neuron

Upper third of the nucleus solitarius in the medulla

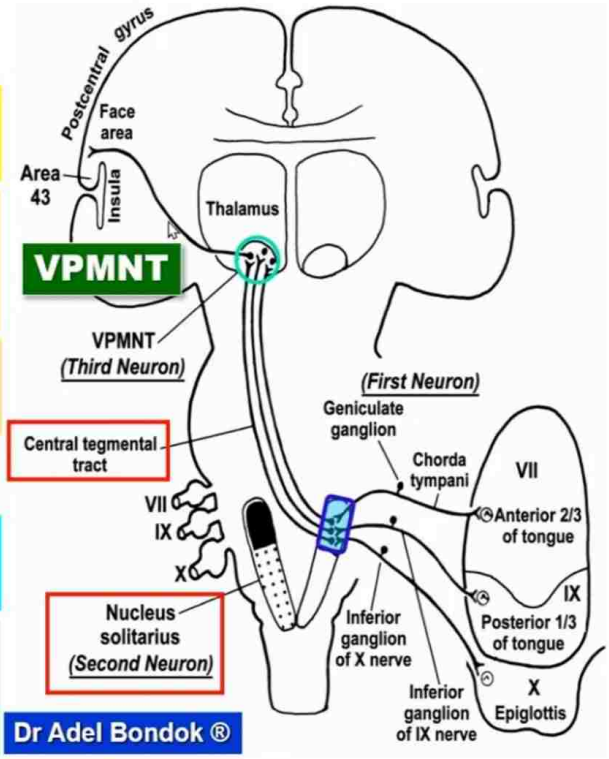
Axons cross to the opposite side and ascend in the central tegmental tract dorsal to the medial lemniscus

Axons terminate in the ventral posterior medial nucleus of the thalamus VPMNT

Third Order Neuron

VPMNT ventral posterior medial nucleus of the thalamus

Axons ascend in the posterior limb of the internal capsule to end in the gustatory area (area 43)



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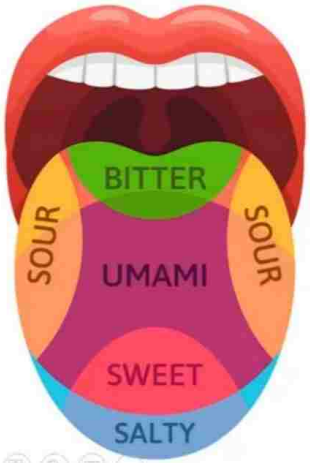
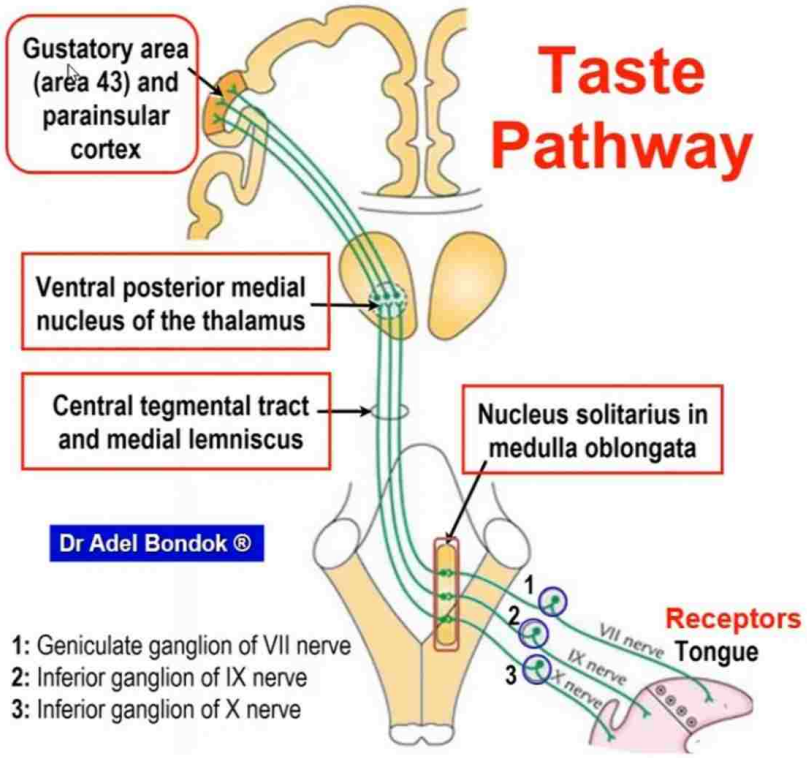
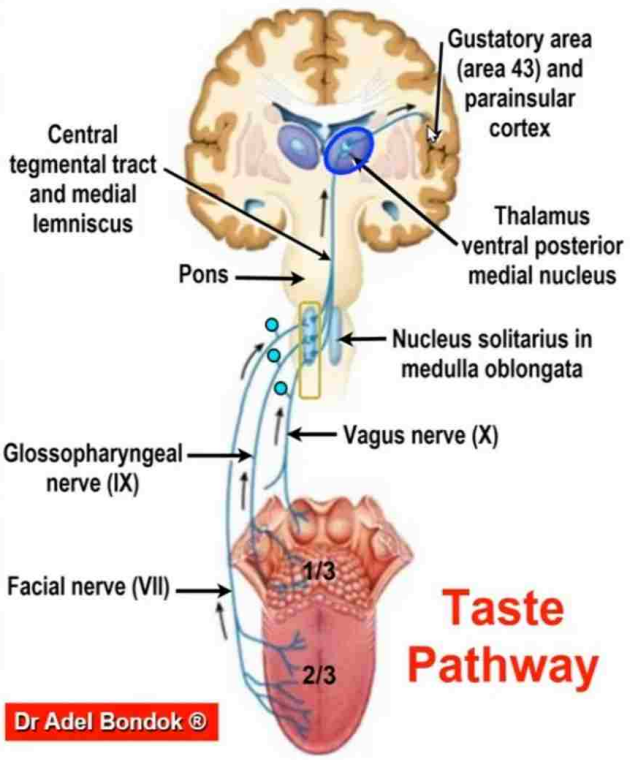
Taste Pathway





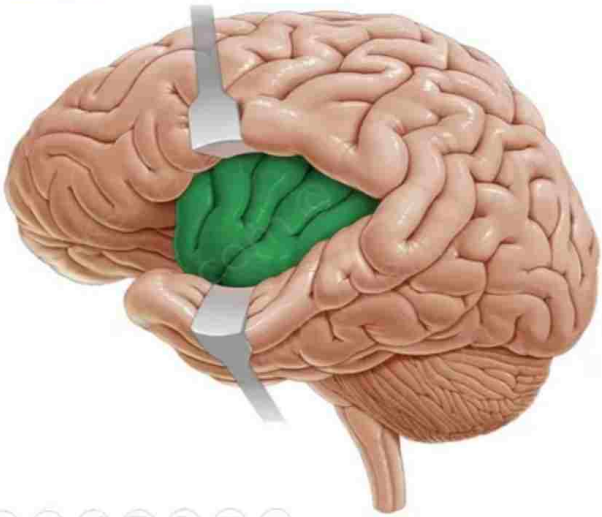
Summary of the Taste Pathway

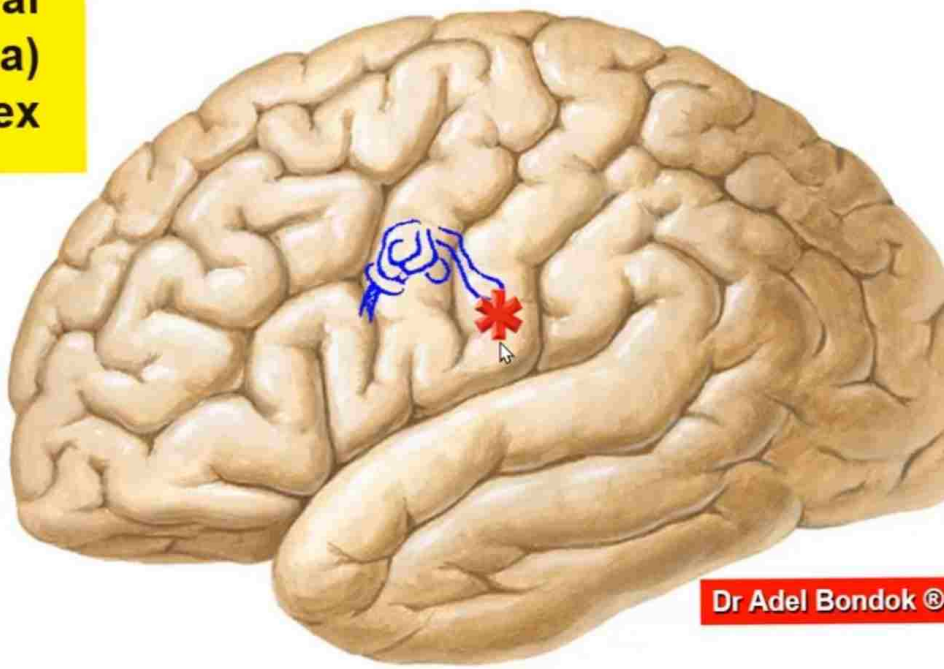
- Receptors: taste buds
- First order neuron: ganglia of the facial, glossopharyngeal and vagus nerves
- Tract of nucleus solitarius
- 2nd O.N: Upper third of nucleus solitarius
- Central tegmental tract
- 3rd ON:Ventral posterior medial thalamic nucleus
- Posterior limb of the internal capsule
- Gustatory area # 43



Gustatory (Taste) Area # 43

Lower end of the postcentral gyrus (general sensory area) and in the parainsular cortex





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Special Sensations

Special Senses

- Vision

- Hearing

- Taste

- Smell

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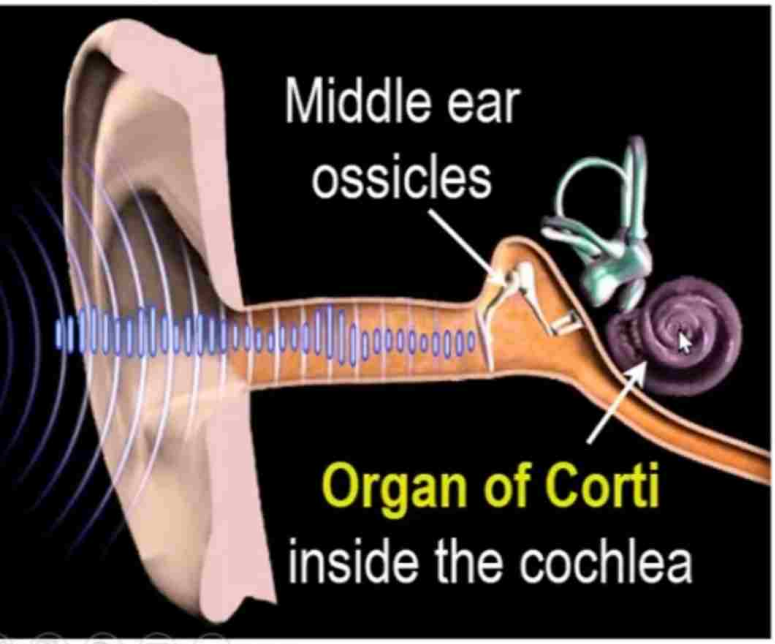
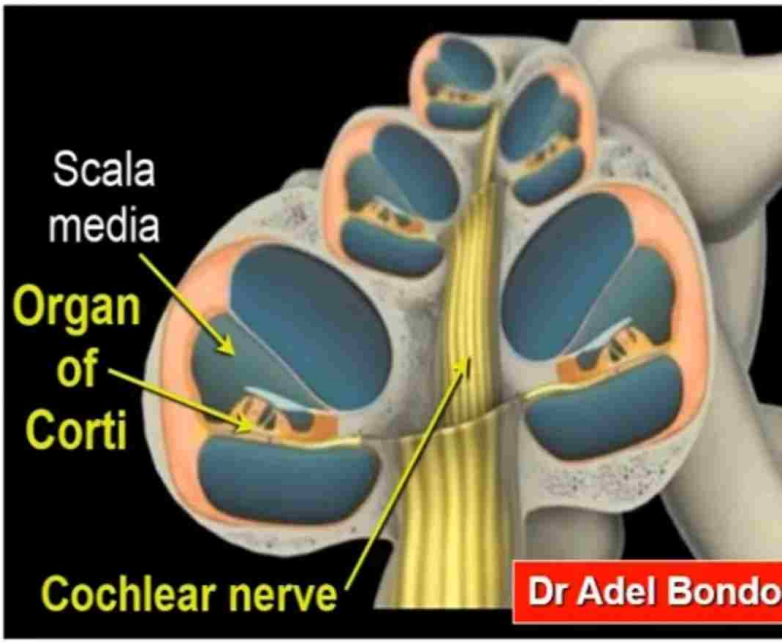
Auditory Pathway

Sensory Receptors

Hair nerve cells of the organ of Corti in the cochlea





First Order Neuron

Bipolar nerve cells in the spiral ganglion in the cochlea

The peripheral processes terminate on the hair cells

The central processes form the cochlear nerve

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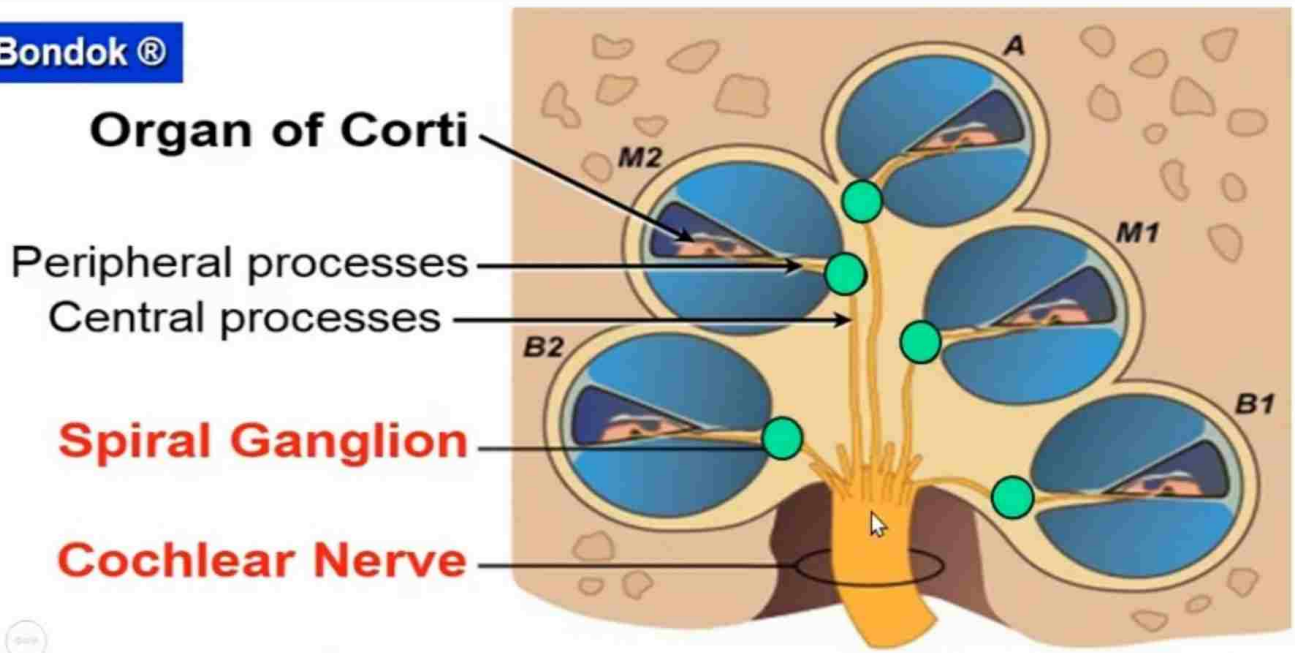
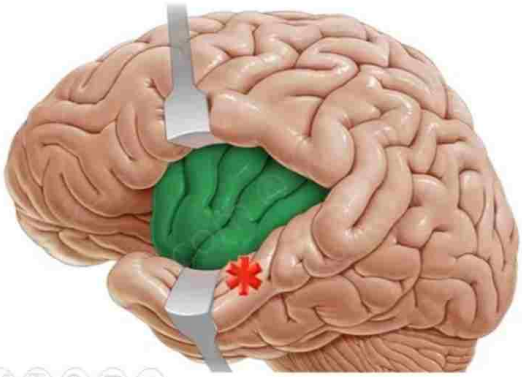


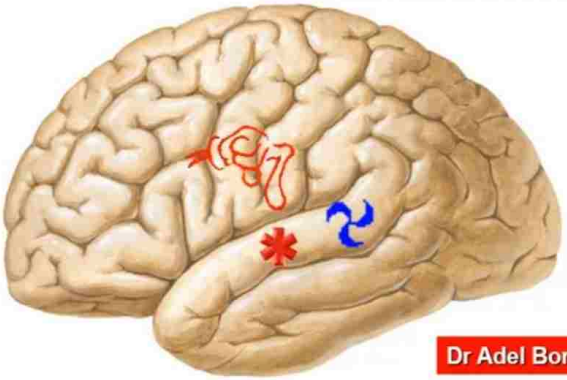
Primary Auditory Area # 41 & 42

In the middle of the upper surface of the superior temporal gyrus (transverse temporal gyri of Heschl) for perception of sounds

Auditory Association Area # 22

Posterior part of superior temporal gyrus for recognition of sounds





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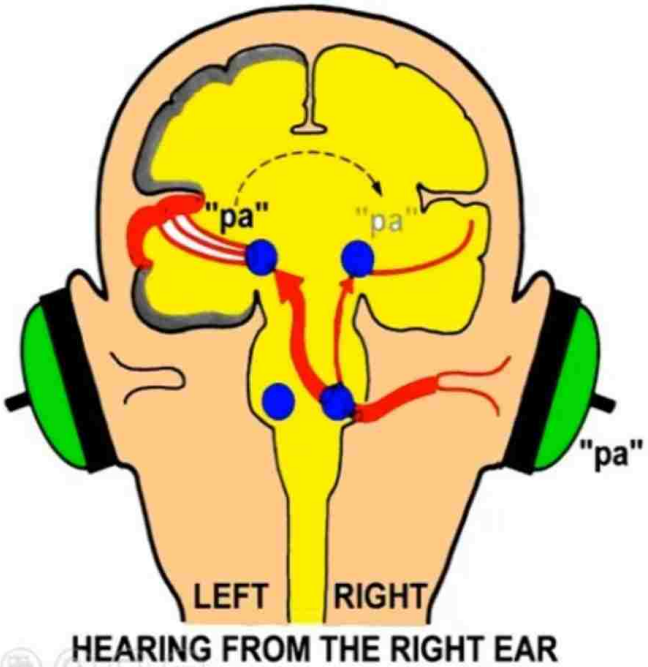
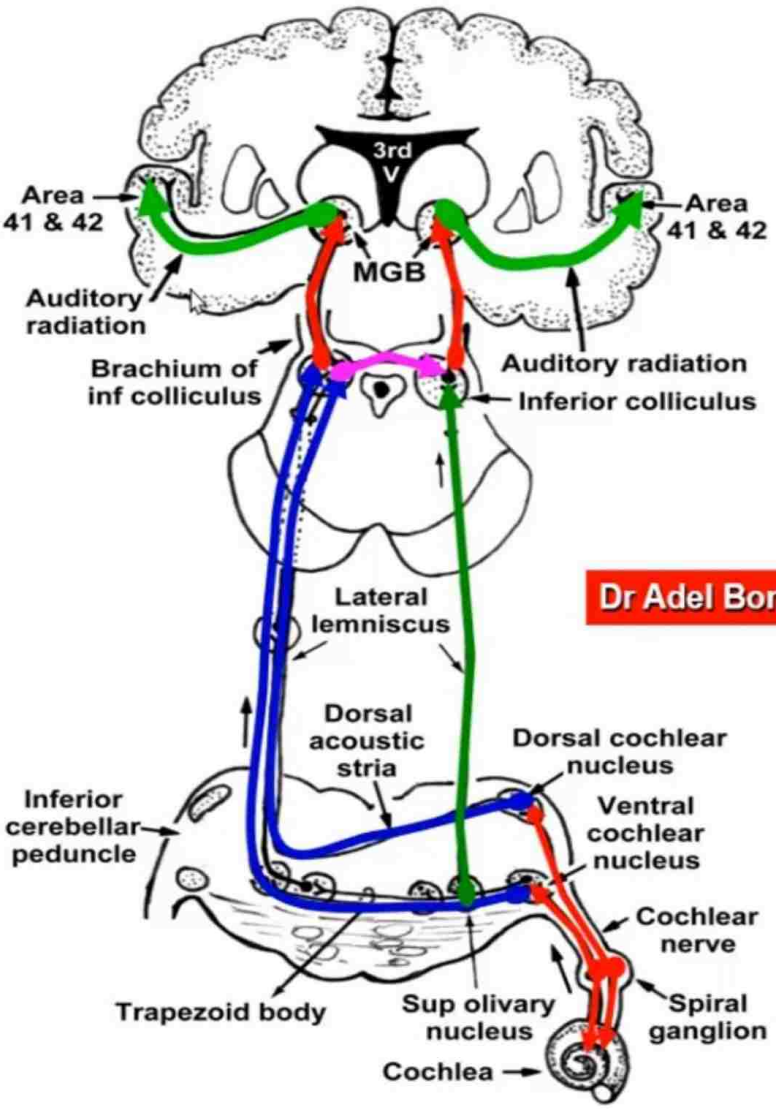
Auditory Pathway



HEARING FROM THE RIGHT EAR



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Summary of the Auditory Pathway

Receptors: organ of Corti in the cochlea

↓

First order neuron: spiral ganglion

↓

Cochlear nerve

↓

Dorsal & Ventral cochlear nuclei

↓

Trapezoid body & lateral lemniscus

↓

Inferior colliculus

↓

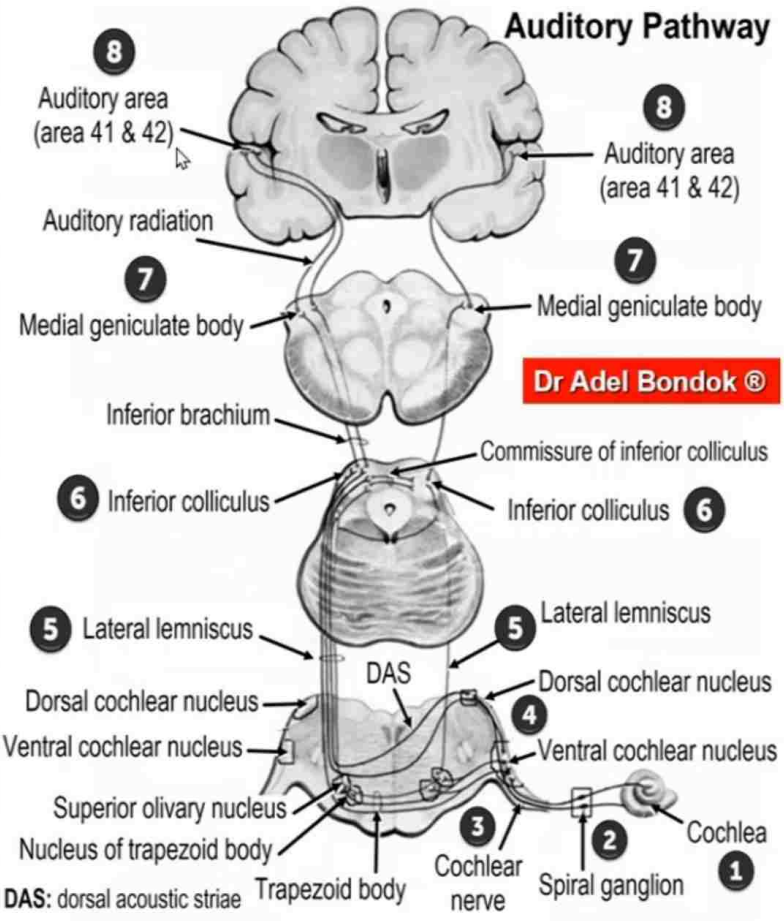
Medial geniculate body (MGB)

↓

Auditory radiation

↓

Primary auditory area (41 & 42) ➡ Area 22



Lesion in the Auditory Pathway

Lesion in the cochlea, cochlear nerve or cochlear nuclei:

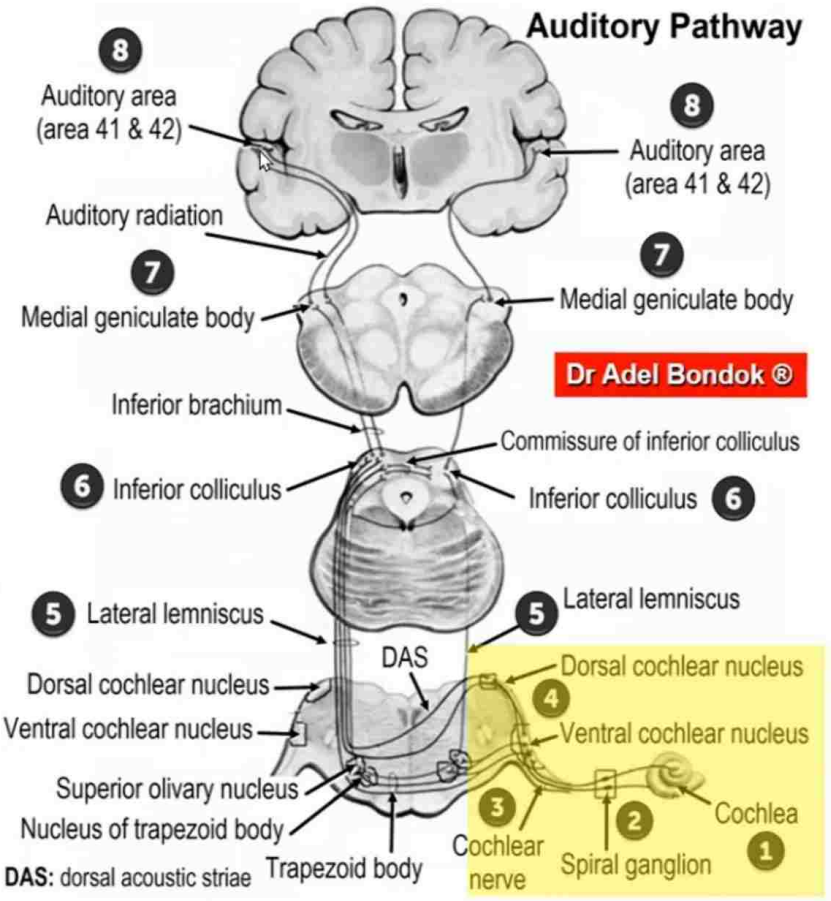
↓

Complete ipsilateral deafness

Lesion in the lateral lemniscus, MGB or the auditory are:

↓

Bilateral partial deafness mainly on the opposite side



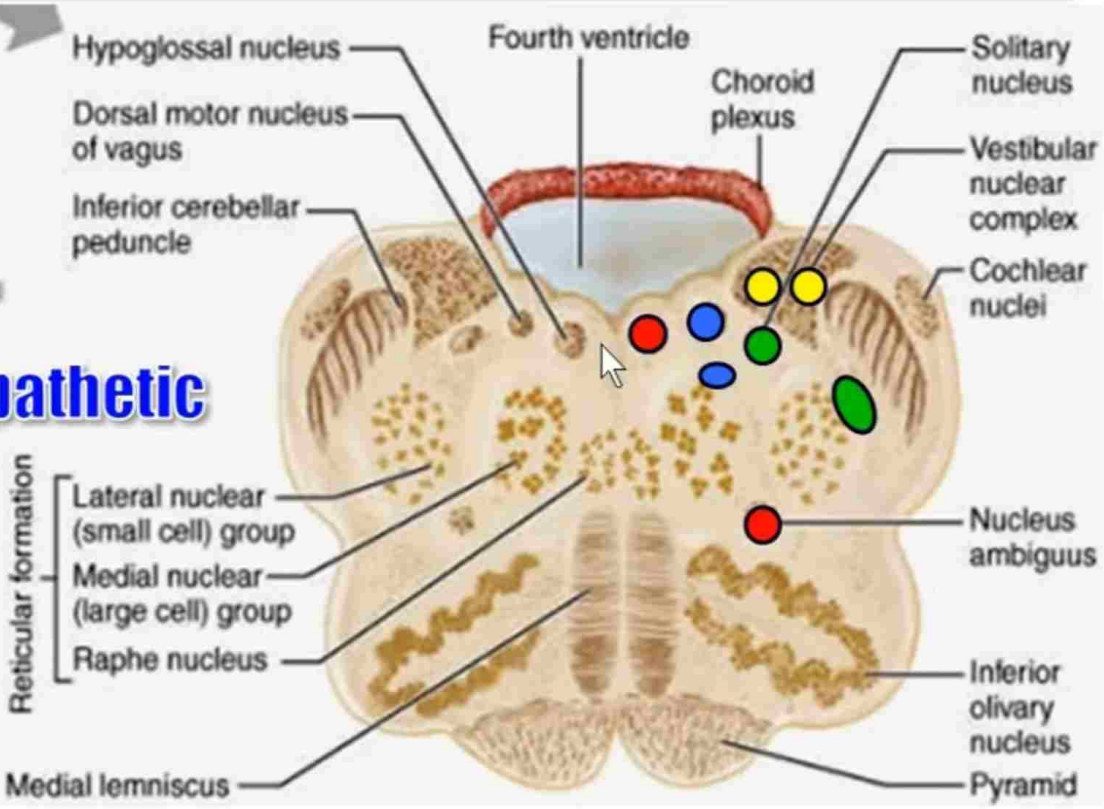
IX, X, XI & XII Nerve
Nuclei in the Medulla

2 motor

2 parasympathetic

2 sensory

2 vestibular



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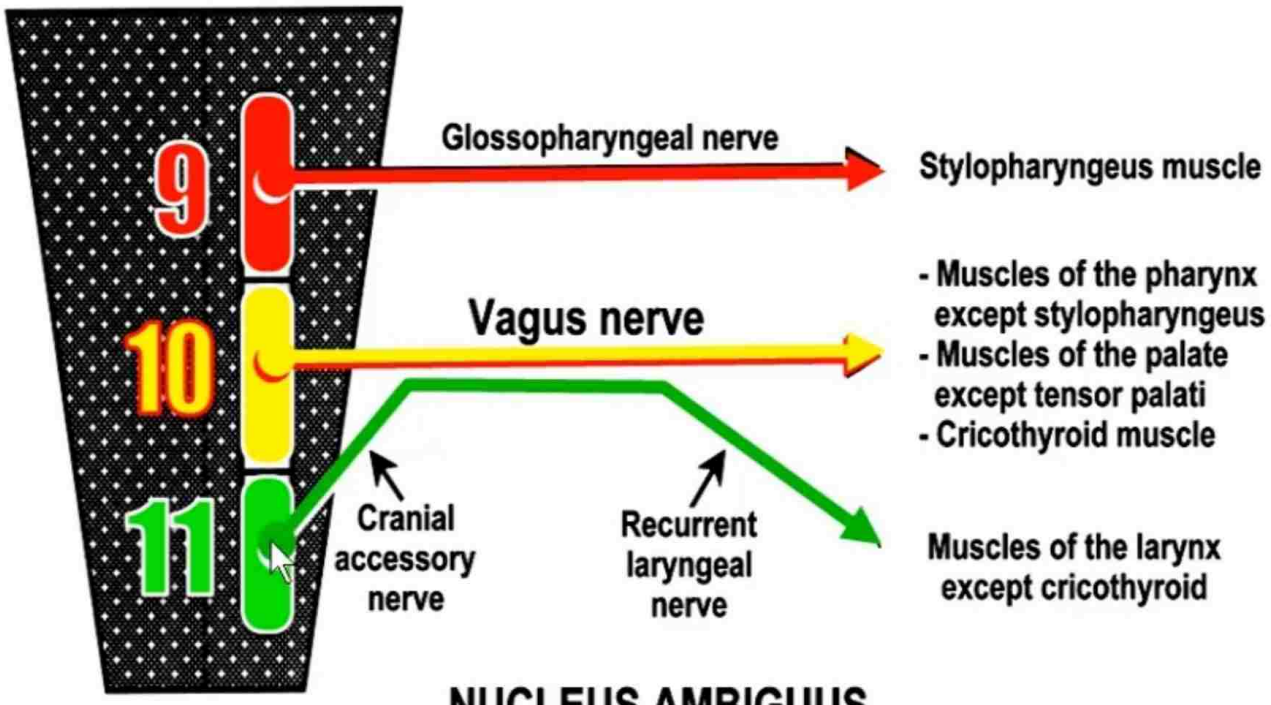
NUCLEUS AMBIGUUS



NUCLEUS AMBIGUUS

(motor to pharynx, larynx and palate)

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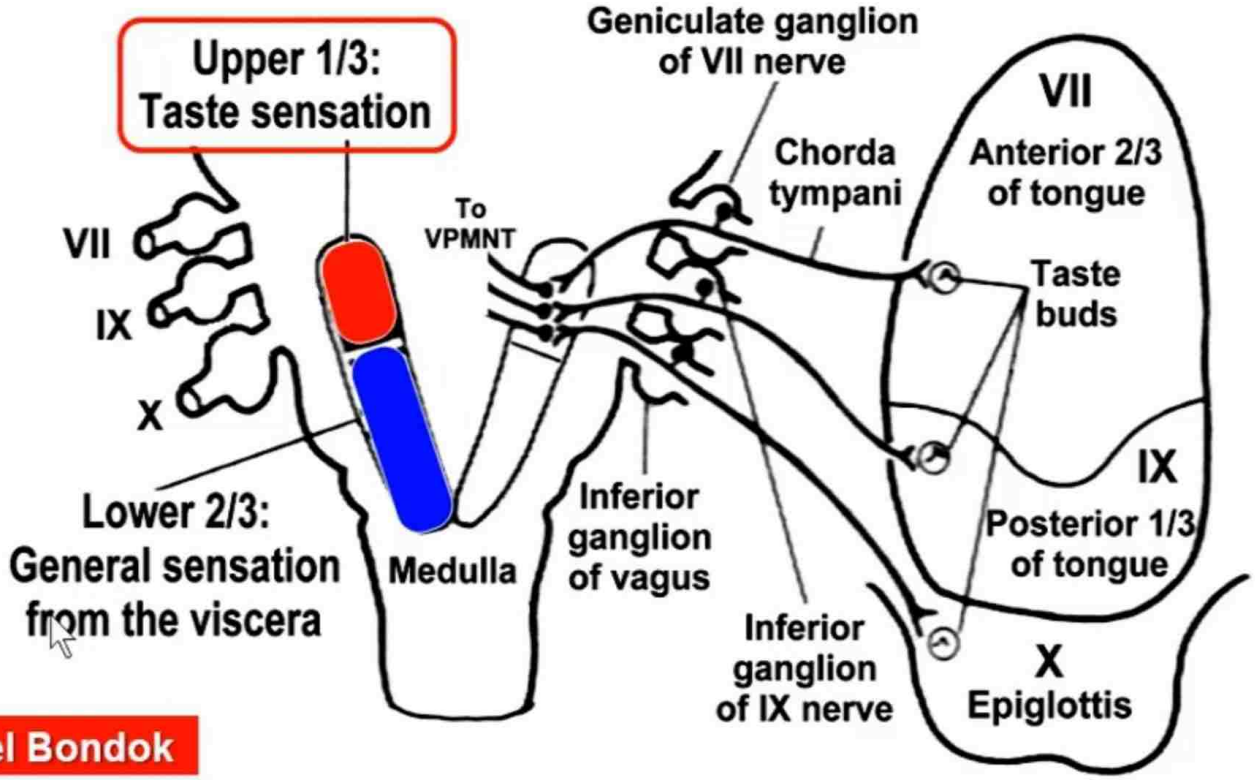
NUCLEUS SOLITARIUS



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NUCLEUS SOLITARIUS AND TASTE SENSATION

IX, X, XI & XII Nerves Exit from the Brain & Skull

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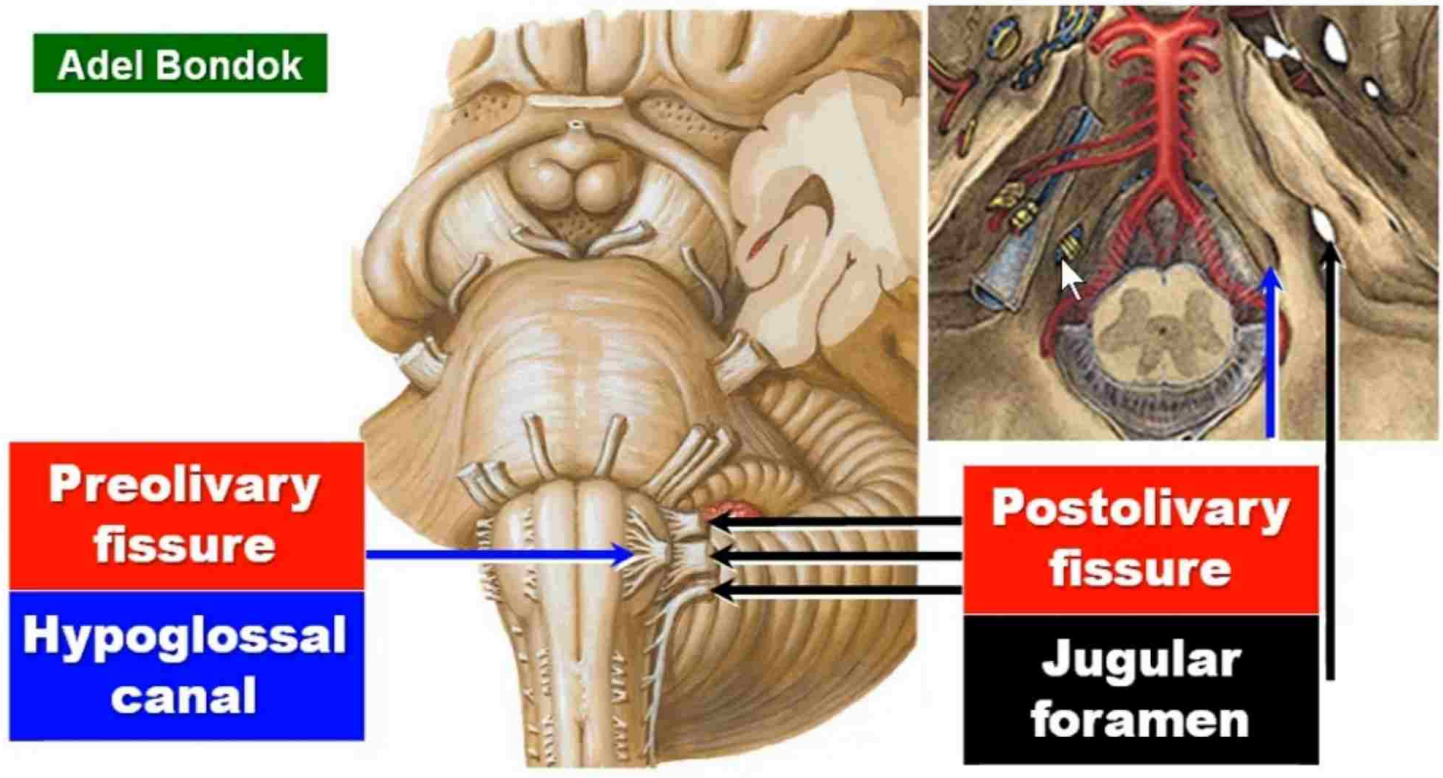

Glossopharyngeal Nerve

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1. Motor Nucleus:

Nucleus ambiguus ⇒ to stylopharyngeus

2. Parasympathetic Nucleus:

inferior salivary nucleus ⇒ parotid gland

3. Sensory Nucleus:

Nucleus solitarius: posterior 1/3 of tongue, middle ear, Eustachian tube, and palatine tonsil

The Glossopharyngeal Nerve

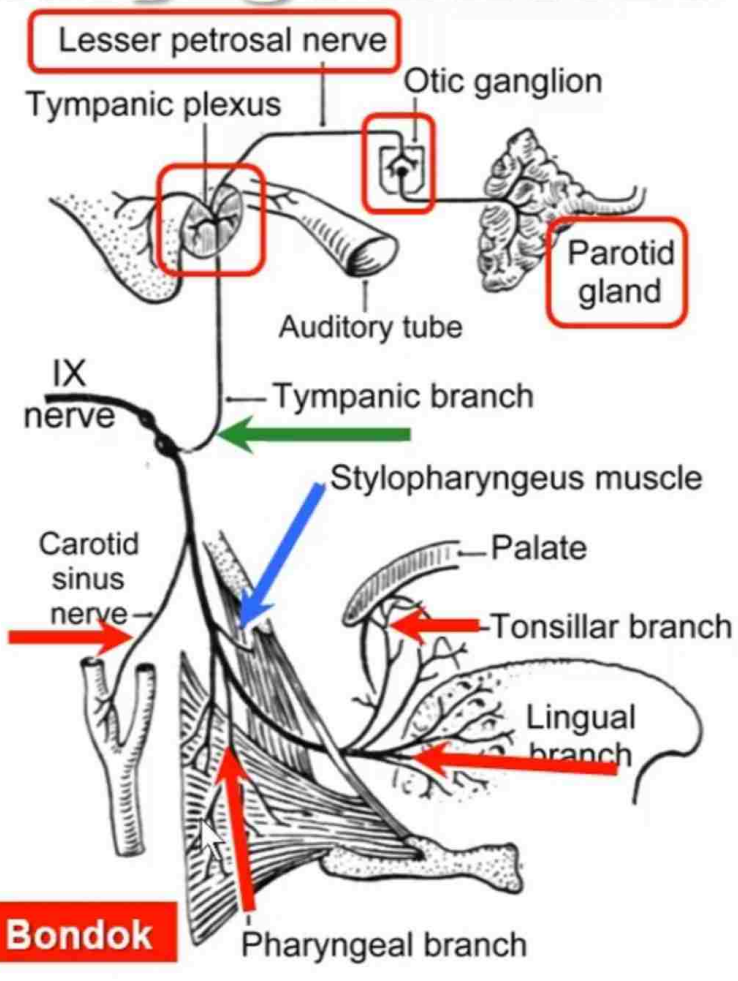
Postolivary fissure

Jugular foramen

Divide into 3 terminal branches

BRANCHES: 3+3

1. Tympanic Branch:
2. Nerve to stylopharyngeus
3. Carotid sinus nerve
4. 3 Terminal Branches:
   a. Tonsillar
   b. Lingual
   c. Pharyngeal



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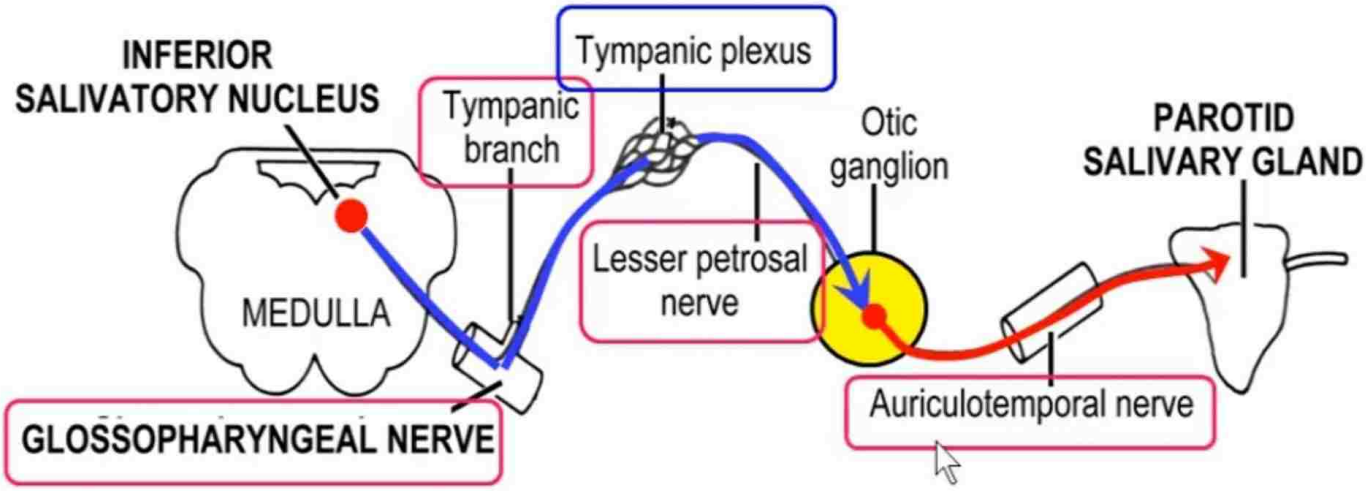
INFERIOR SALIVARY NUCLEUS: IX Nerve



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VAGUS NERVE

1. Motor Nucleus:

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Nucleus ambiguus ⇒ to

1. Muscles of the pharynx EXCEPT stylopharyngeus
2. Muscles of the palate EXCEPT tensor palati
3. Muscles of the larynx

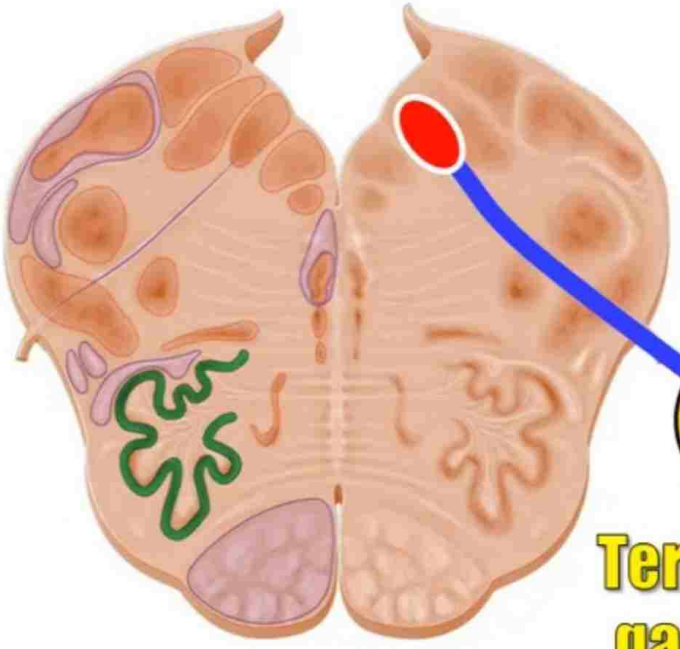
2. Parasympathetic Nucleus:

Dorsal motor nucleus ⇒ abdominal & thoracic viscera

3. Sensory Nuclei:

1. Nucleus solitarius: abdominal & thoracic viscera
2. Spinal trigeminal nucleus: external ear

DORSAL MOTOR NUCLEUS of the VAGUS



TO: Glands, Muscle Fibers and Blood Vessels of the:

- Heart
- Bronchial tree
- GI Tract till the left colic flexure

Terminal ganglia

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THE VAGUS NERVE

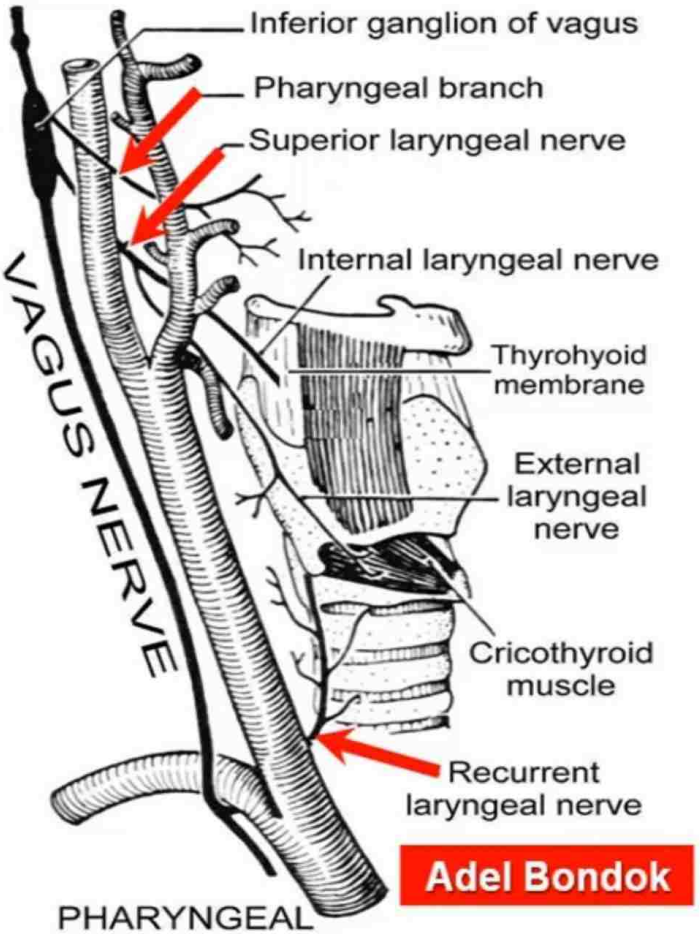
Postolivary fissure

Jugular foramen

Descends in the carotid sheath with IJV, CCA & ICA

BRANCHES:

1. Meningeal Branch
2. Auricular branch
3. Pharyngeal branch
4. Superior Laryngeal nerve
5. Recurrent Laryngeal nerve
6. Cardiac branches



PHARYNGEAL AND LARYNGEAL BRANCHES

Distribution of the Vagus Nerve

Auricular branch:

a. Auricle and External auditory meatus

b. Tympanic membrane

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Pharyngeal branch:

a. Muscles of the palate **EXCEPT** tensor palati

b. Muscles of the pharynx **EXCEPT** stylopharyngeus

Superior Laryngeal nerve: divides into:

a. **External laryngeal nerve:** to cricothyroid muscle

b. **Internal laryngeal nerve:** mm membrane **above** vocal cord

Recurrent Laryngeal nerve:

a. All muscles of the larynx **EXCEPT** cricothyroid.

b. Mucous membrane **below** vocal cord

LESION OF THE VAGUS NERVE

1. **Dysphagia:** paralysis of muscles of the pharynx
2. **Hoarsness of voice:** paralysis of muscles of the larynx
3. **Regurgitation of food from nose and deviation of the uvula to the normal side:** paralysis of muscles of the palate
4. **Loss of the** pharyngeal gag reflex.
5. **Loss of the** cough reflex.

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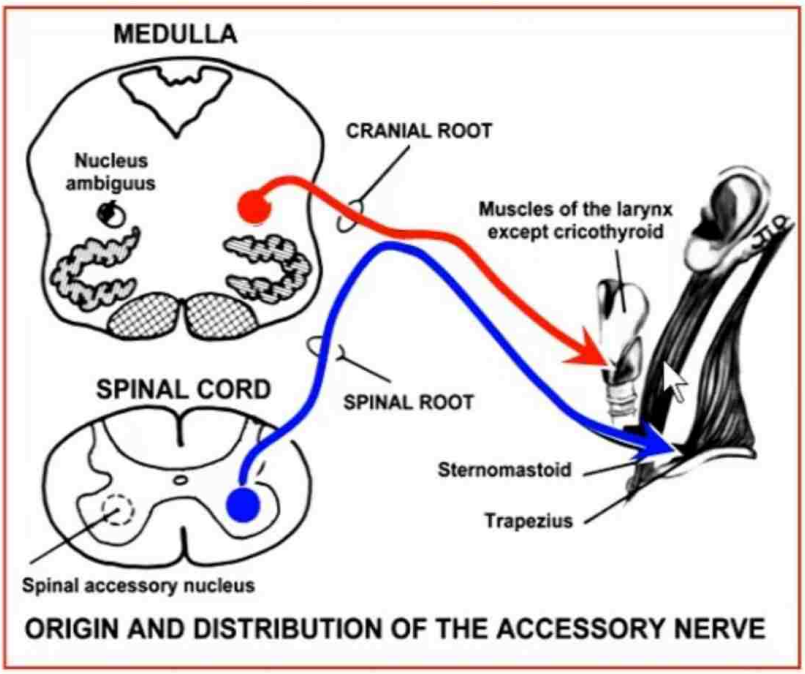
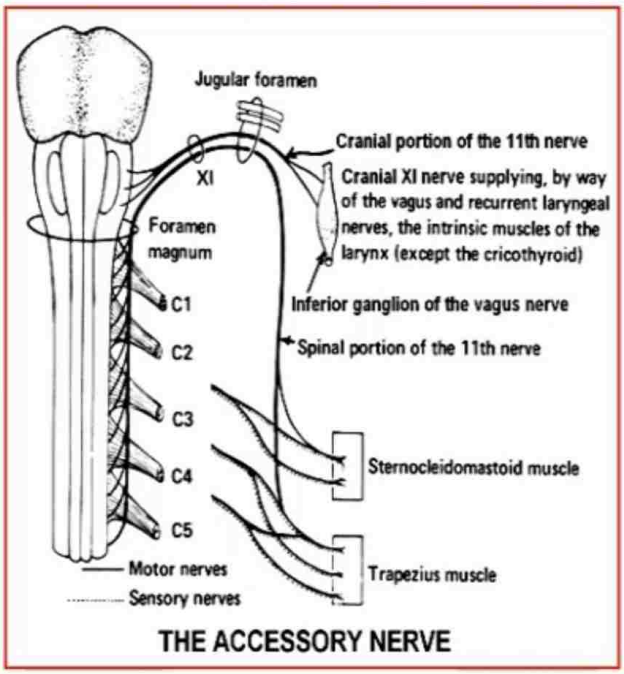
ACCESSORY NERVE



ORIGIN AND DISTRIBUTION OF THE ACCESSORY NERVE



THE ACCESSORY NERVE

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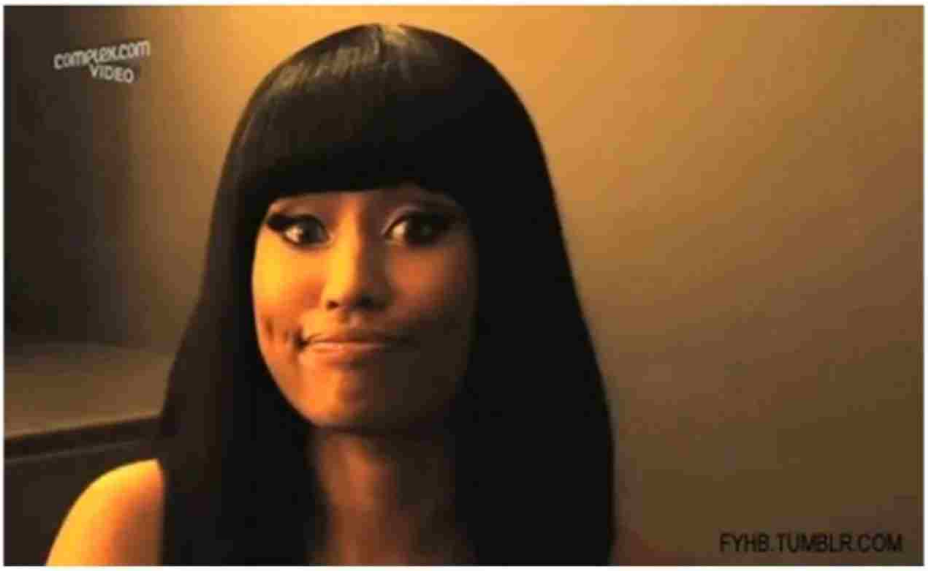
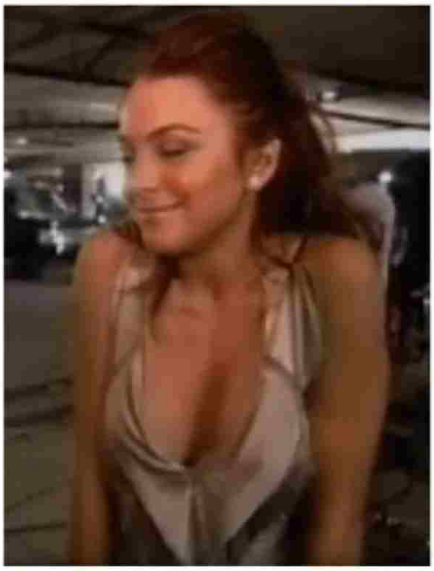
ACCESSORY NERVE LESION





Inability to shrug the shoulder

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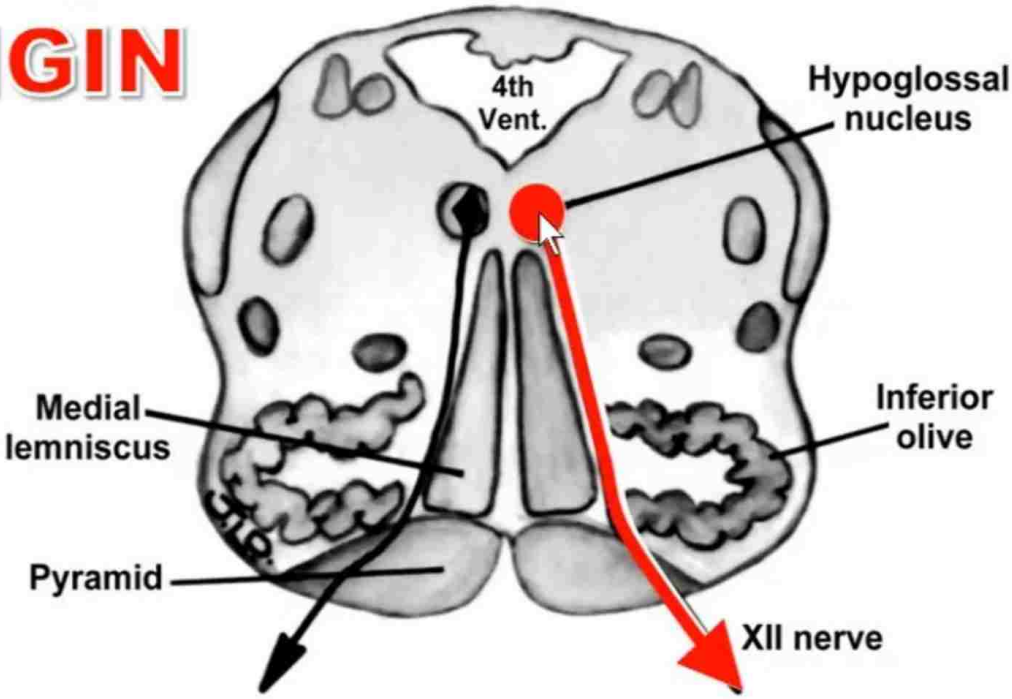
HYPOGLOSSAL NERVE

ORIGIN



ORIGIN OF THE HYPOGLOSSAL NERVE

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HYPOGLOSSAL NERVE

Exit from the BRAIN

Exit from the SKULL

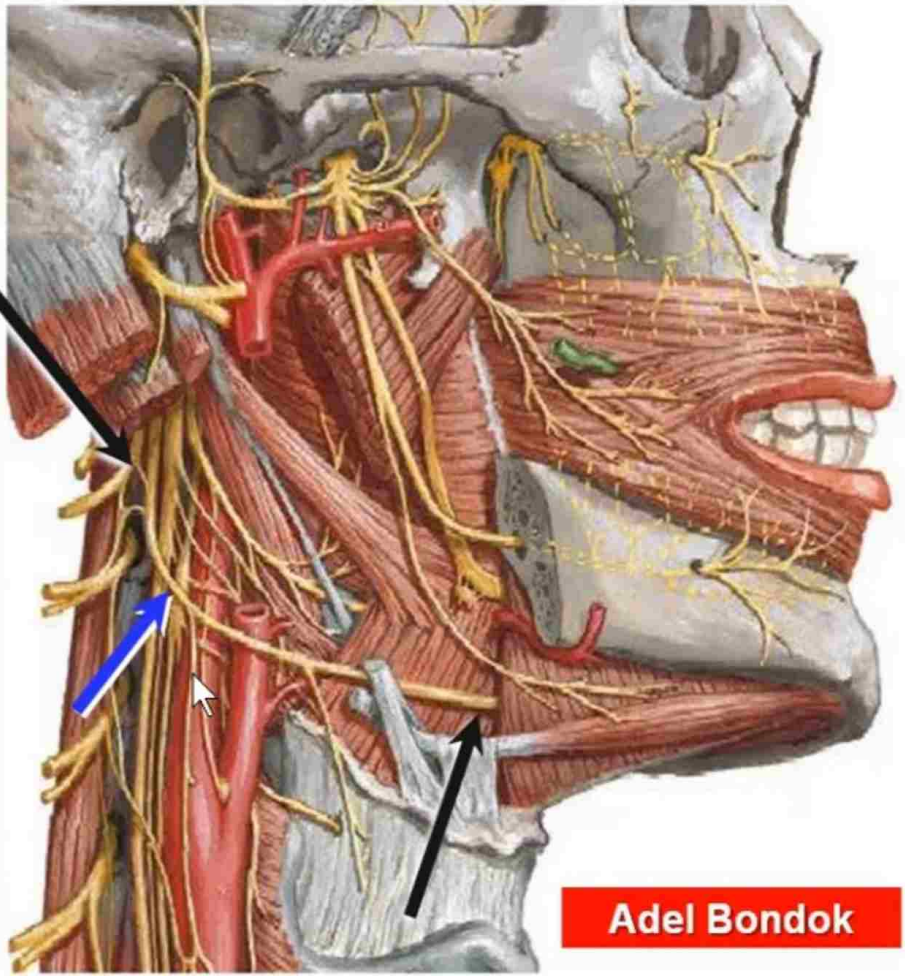
Joined by C1

Passes between hyoglossus and mylohyoid

BRANCHES:

1. XII nerve itself
2. C1

Lesion



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BRANCHES OF HYPOGLOSSAL NERVE

Branches of the XII Nerve Itself

All muscles of the tongue EXCEPT palatoglossus

Branches of C1

1. Meningeal Branch:
2. Superior root of ansa cervicalis
3. Nerve to thyrohyoid
4. Nerve to geniohyoid

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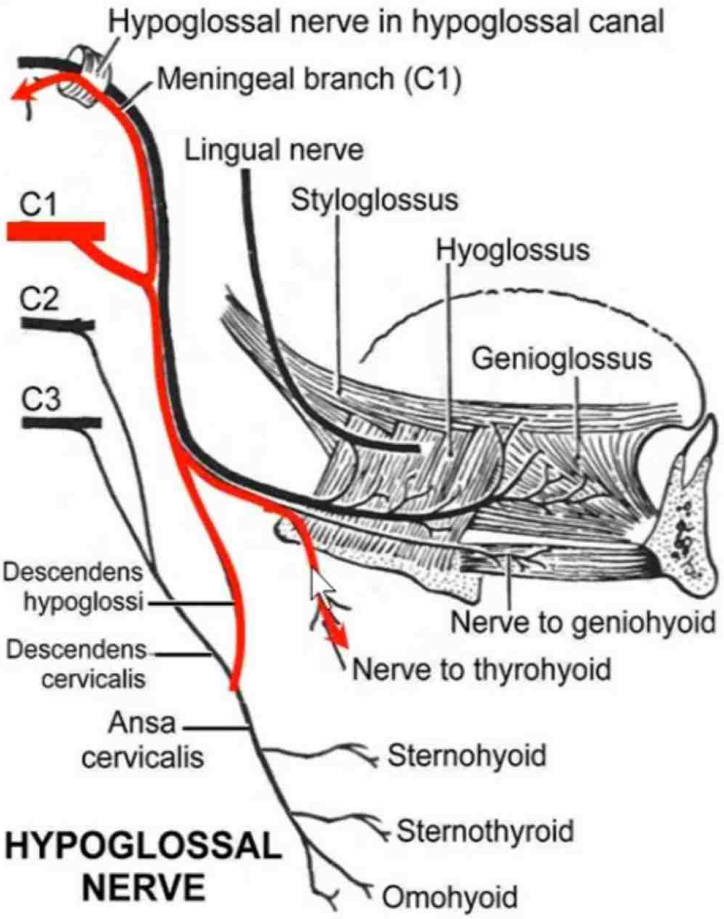
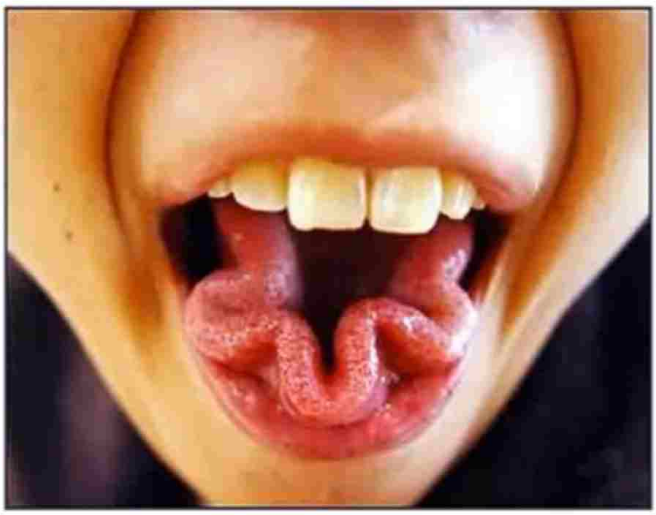


HYPOGLOSSAL NERVE



Supplies ALL the muscles of the tongue EXCEPT palatoglossus muscle

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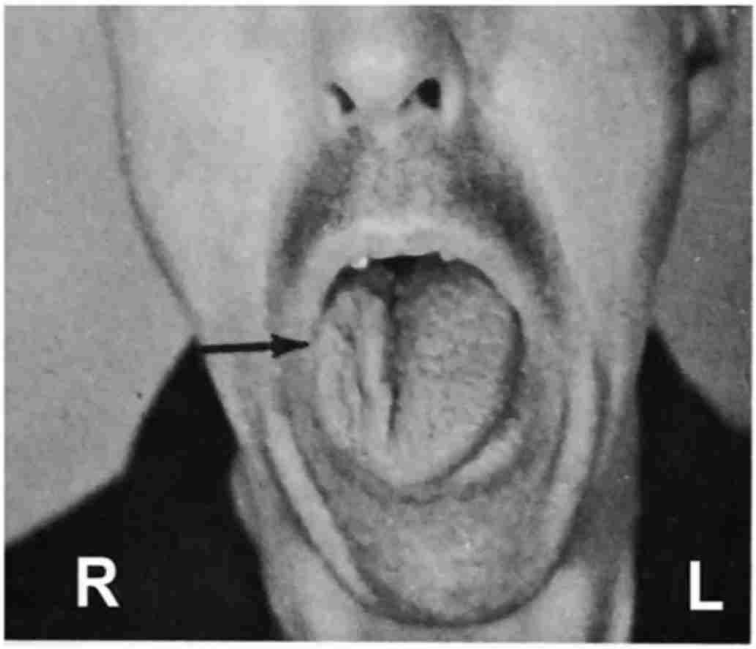
HYPOGLOSSAL NERVE LESION



Right Hypoglossal Nerve Paralysis

- Atrophy of the right side of the tongue
- Deviation of the tongue to the right

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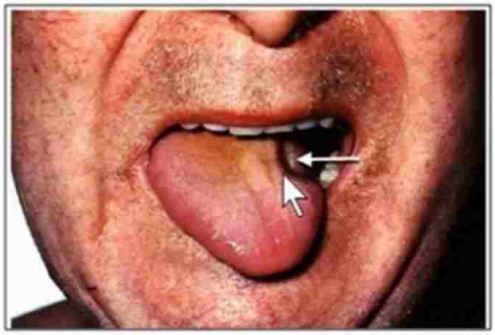
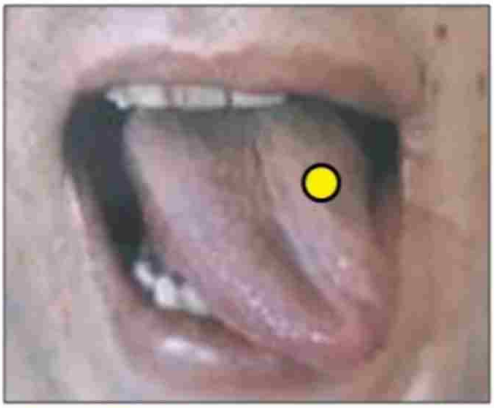


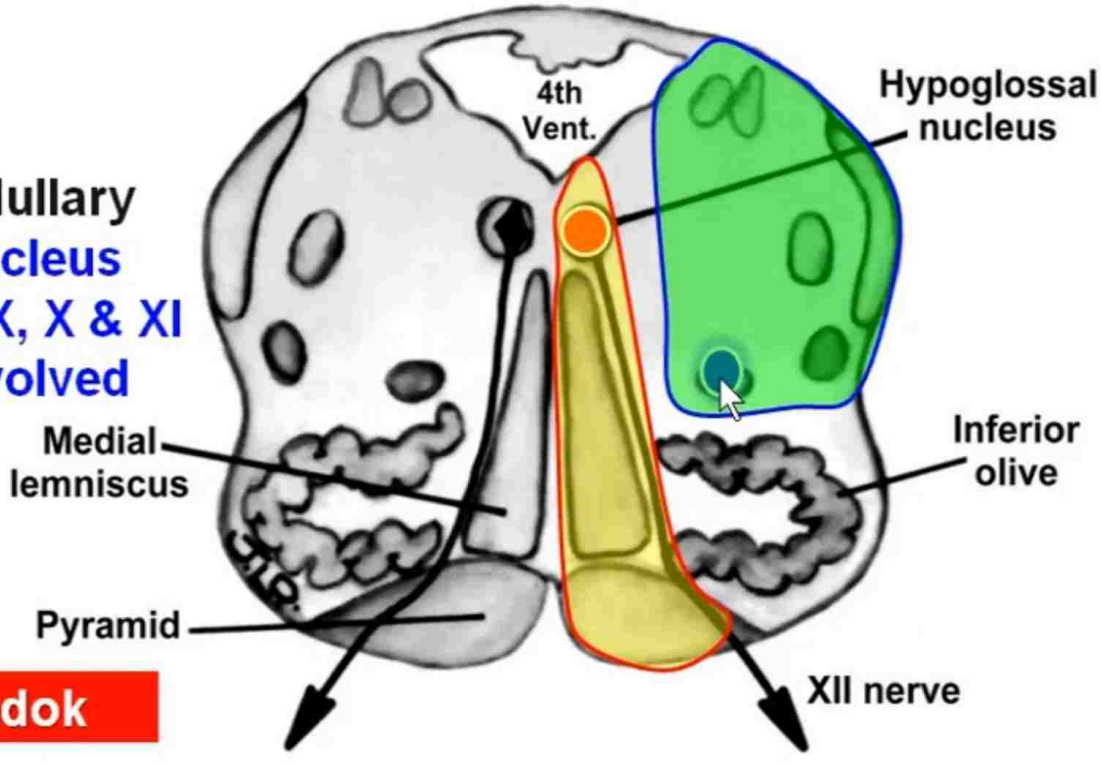


Left Hypoglossal Nerve Paralysis

Note to Neurologists

In Medial Medullary Syndrome, the XII nucleus & nerve are involved

In Lateral Medullary Syndrome, nucleus ambiguus & IX, X & XI nerves are involved



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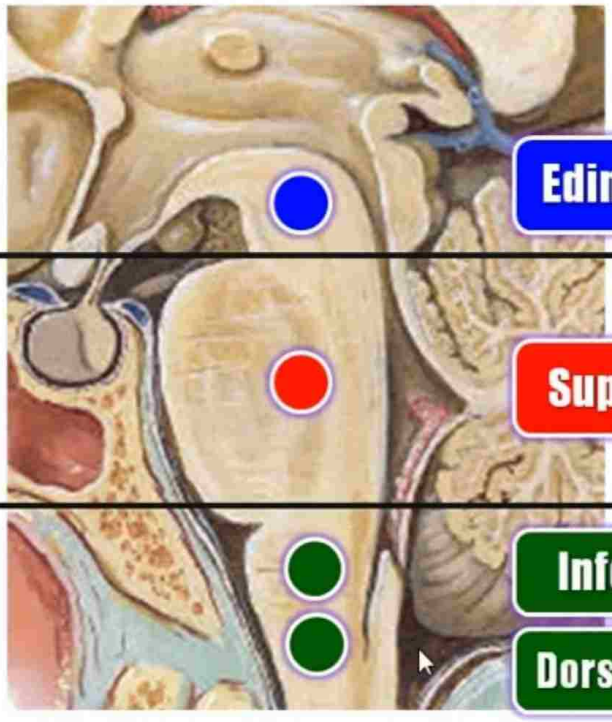

4 Parasympathetic Nuclei in the Brainstem

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4 Parasympatheic Nuclei in the Brainstem

1. Edinger-Westphal Nucleus:

- In the midbrain.
- Gives fibers to the oculomotor nerve.
- Supplies the sphincter pupillae and ciliary muscles

2. Superior Salivary Nucleus:

- In the pons.
- Gives fibers to the facial nerve.
- Supplies the lacrimal, nasal and palatine glands and the submandibular and sublingual salivary glands

3. Inferior Salivary Nucleus:

4. Dorsal Motor Nucleus of the Vagus:

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4 Parasympatheic Nuclei in the Brainstem

1. **Edinger-Westphal Nucleus:** midbrain
2. **Superior Salivary Nucleus:** pons
3. **Inferior Salivary Nucleus:**
   - ❑ In the medulla oblongata.
   - ❑ Gives fibers to the glossopharyngeal nerve.
   - ❑ Supplies the parotid gland
4. **Dorsal Motor Nucleus of the Vagus:**
   - ❑ In the medulla oblongata.
   - ❑ Gives fibers to the vagus nerve.
   - ❑ Supplies the thoracic and abdominal viscera till the left colic flexure.

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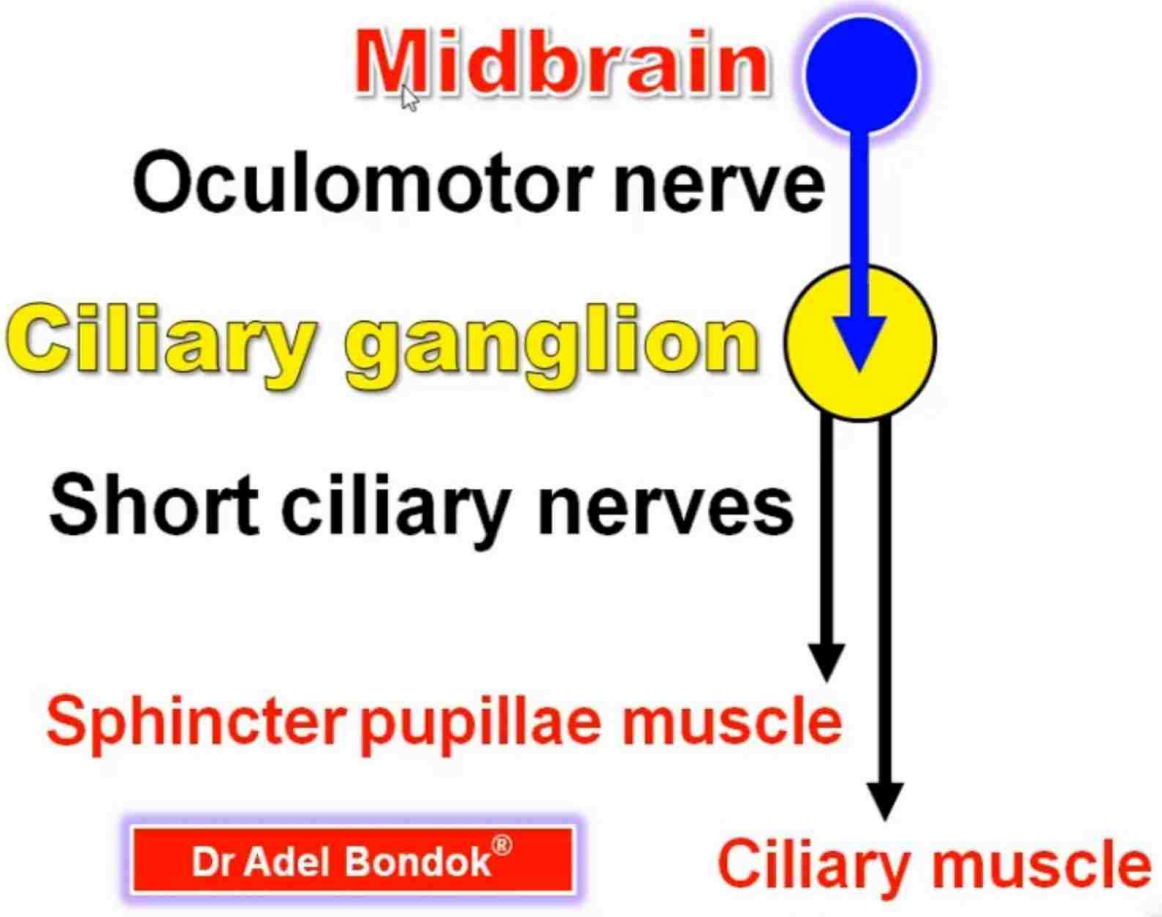
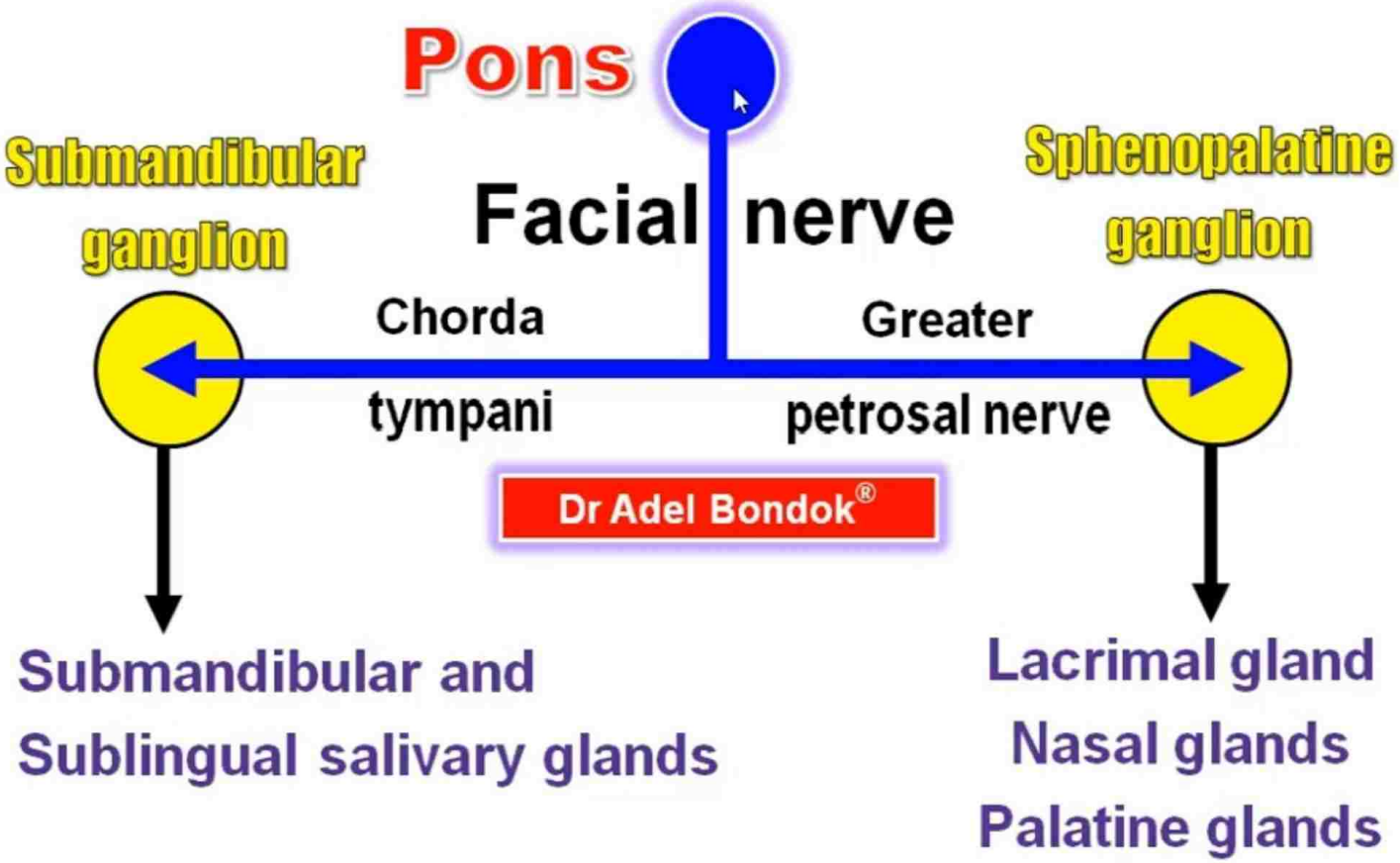
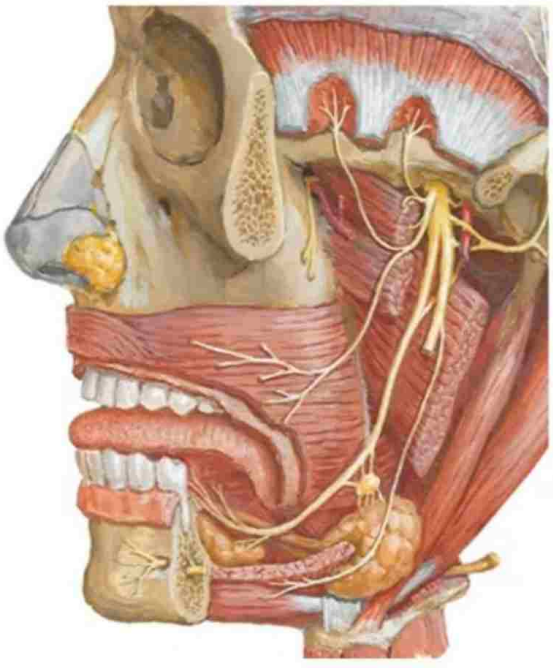
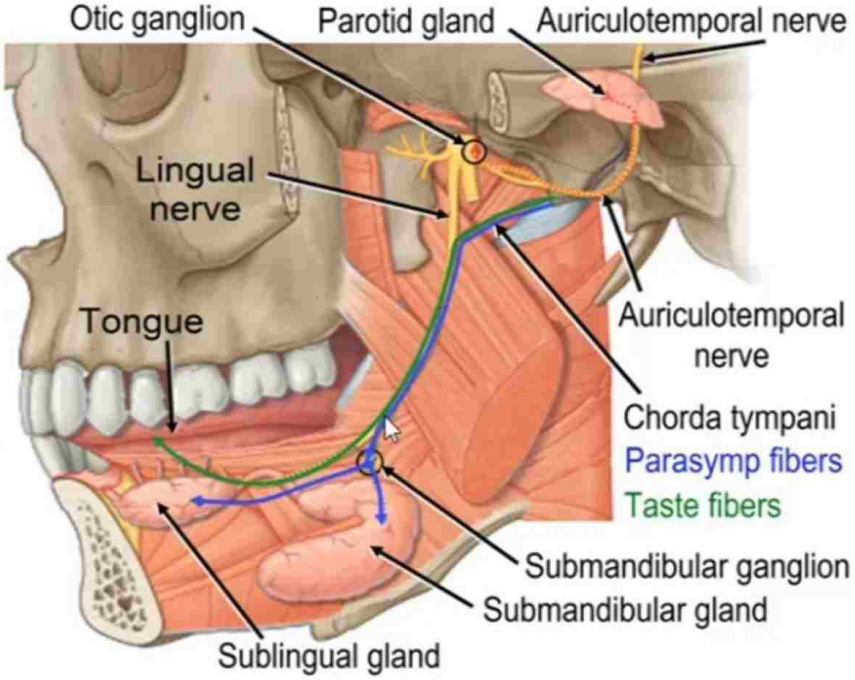
Edinger-Westphal Nucleus



Superior Salivary Nucleus

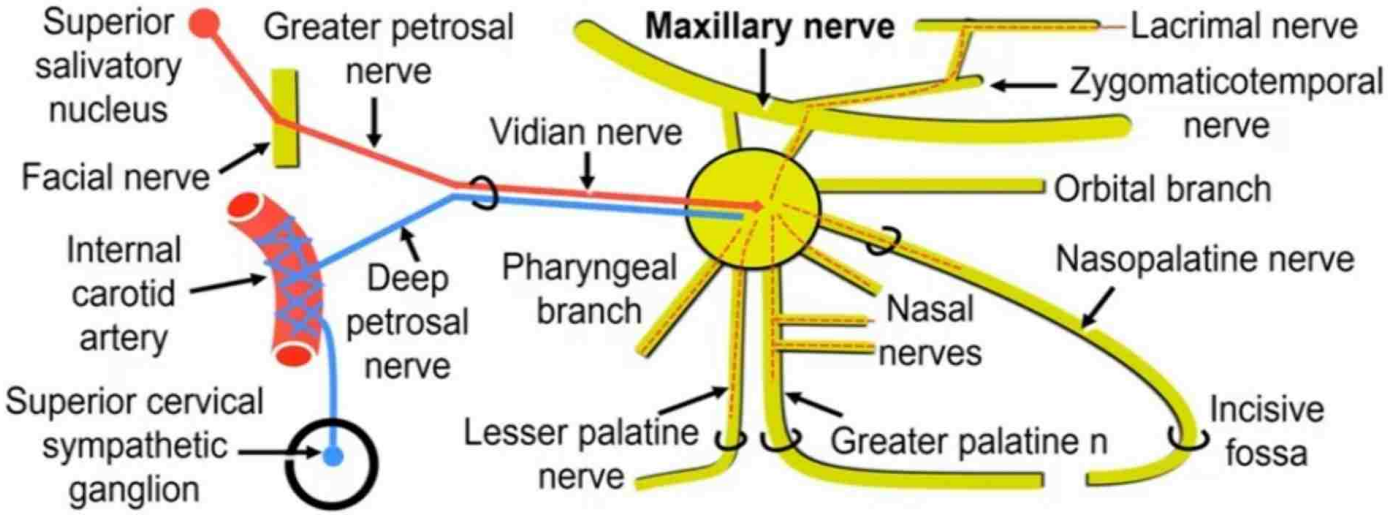






PARASYMPATHETIC fibers to SUBMANDIBULAR & SUBLINGUAL GLANDS

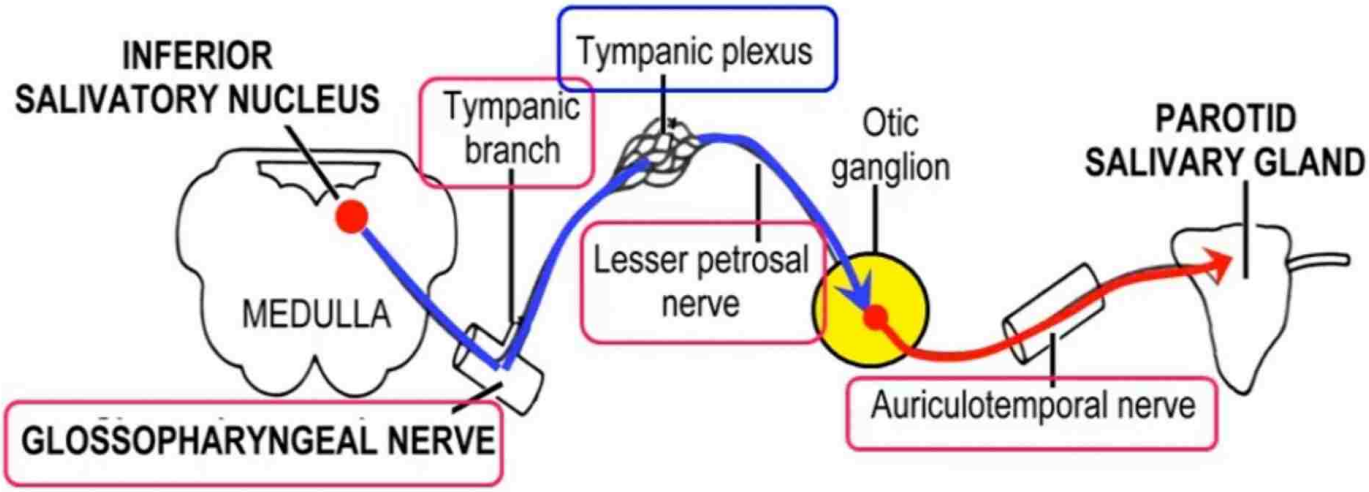
Superior salivatory nucleus ⇨ facial nerve ⇨ chorda tympani ⇨ lingual nerve ⇨ submandibular ganglion ⇨ submandibular and sublingual salivary glands.



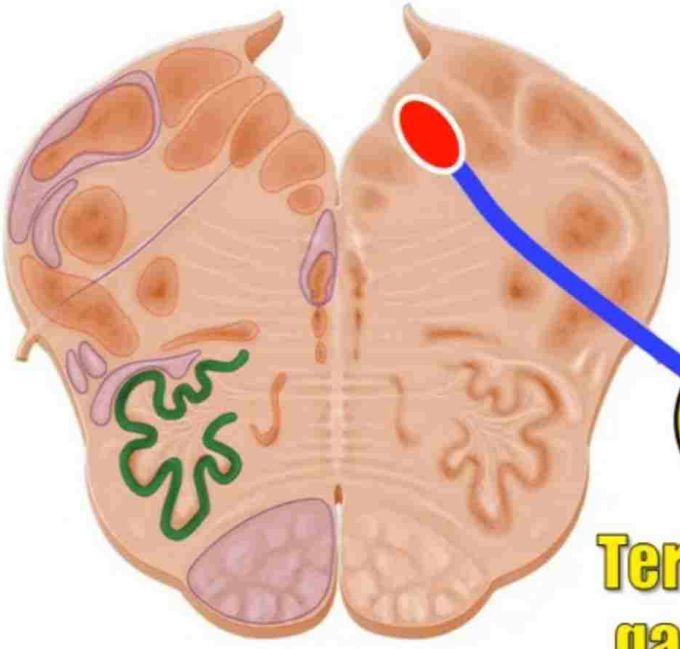
Parasympathetic Fibers To Lacrimal Gland

superior salivatory nucleus ⇨ facial nerve ⇨ greater superficial petrosal nerve ⇨ join the deep petrosal nerve ⇨ nerve of pterygoid canal ⇨ pterygopalatine (sphenopalatine) ganglion ⇨ maxillary nerve ⇨ zygomatic nerve ⇨ zygomaticotemporal nerve ⇨ lacrimal nerve ⇨ lacrimal gland

INFERIOR SALIVARY NUCLEUS: IX Nerve



DORSAL MOTOR NUCLEUS of the VAGUS



Medulla

TO: Glands, Muscle Fibers and Blood Vessels of the:

Heart

Bronchial tree

GI Tract till the left colic flexure

Terminal ganglia

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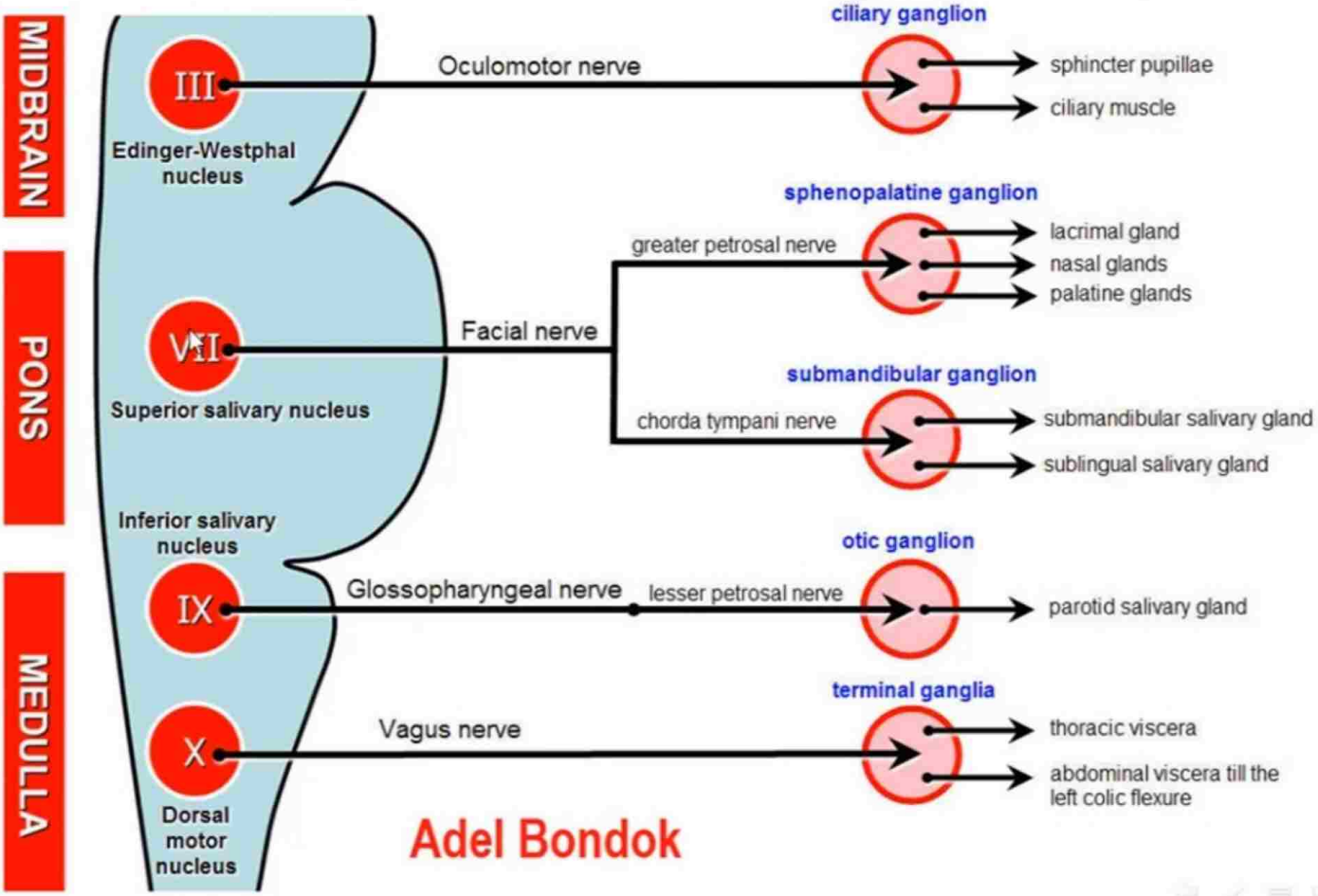
Parasympathetic Nuclei & Ganglia



Nucleus	Nerve	Ganglion	Attached to	Target
Edinger-Westphal	III	Ciliary	Nasociliary nerve	Sphincter pupil Ciliary muscle
Superior salivary	VII	Sphenopalatine	Maxillary nerve	Lacrimal, Nasal, Palatine Glands
Superior salivary	VII	Submandibular	Lingual nerve	Submandibular Sublingual Gl
Inferior salivary	IX	Otic	Mandibular nerve	Parotid Gland
DMN of the Vagus	X	Terminal	Wall of the viscera	Thoracic and abdominal visc

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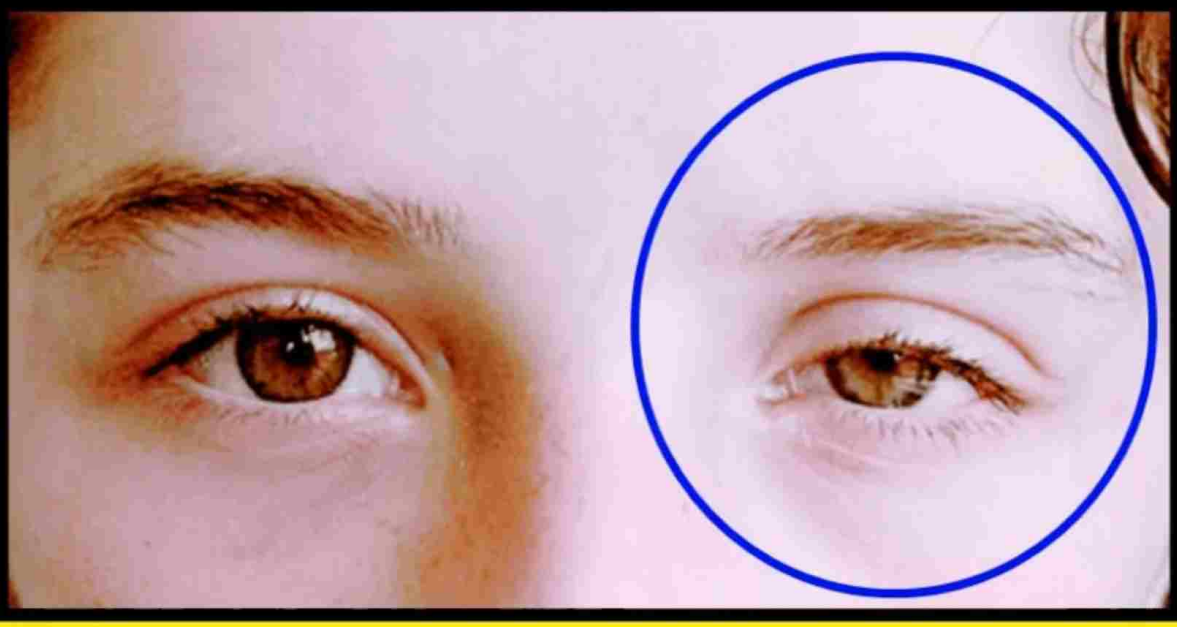
Horner's Syndrome



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Mansoura University, Egypt

Causes of Horner's Syndrome

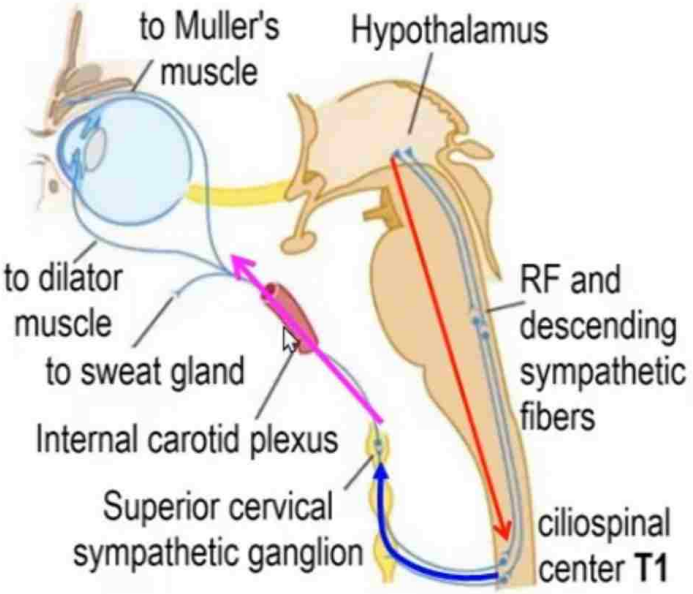
It is due to loss of the sympathetic innervation of the eye & face.

The lesion may be:

1. **Central: between** the hypothalamus and the ciliospinal center in T1 segment of the spinal cord in the descending autonomic fibers.

2. **Preganglionic: between** the ciliospinal center & the SCSG.

3. **Postganglionic: in the** branches of the SCSG.



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5 Signs of Horner's Syndrome

1. **Incomplete ptosis:** drooping of the upper eyelid
2. **Miosis:** constriction of the pupil
3. **Anhidrosis:** decreased sweating
4. **Enophthalmos:** sunken eyeball
5. **Flushing of the face**

Vasodilarion of blood vessels of face

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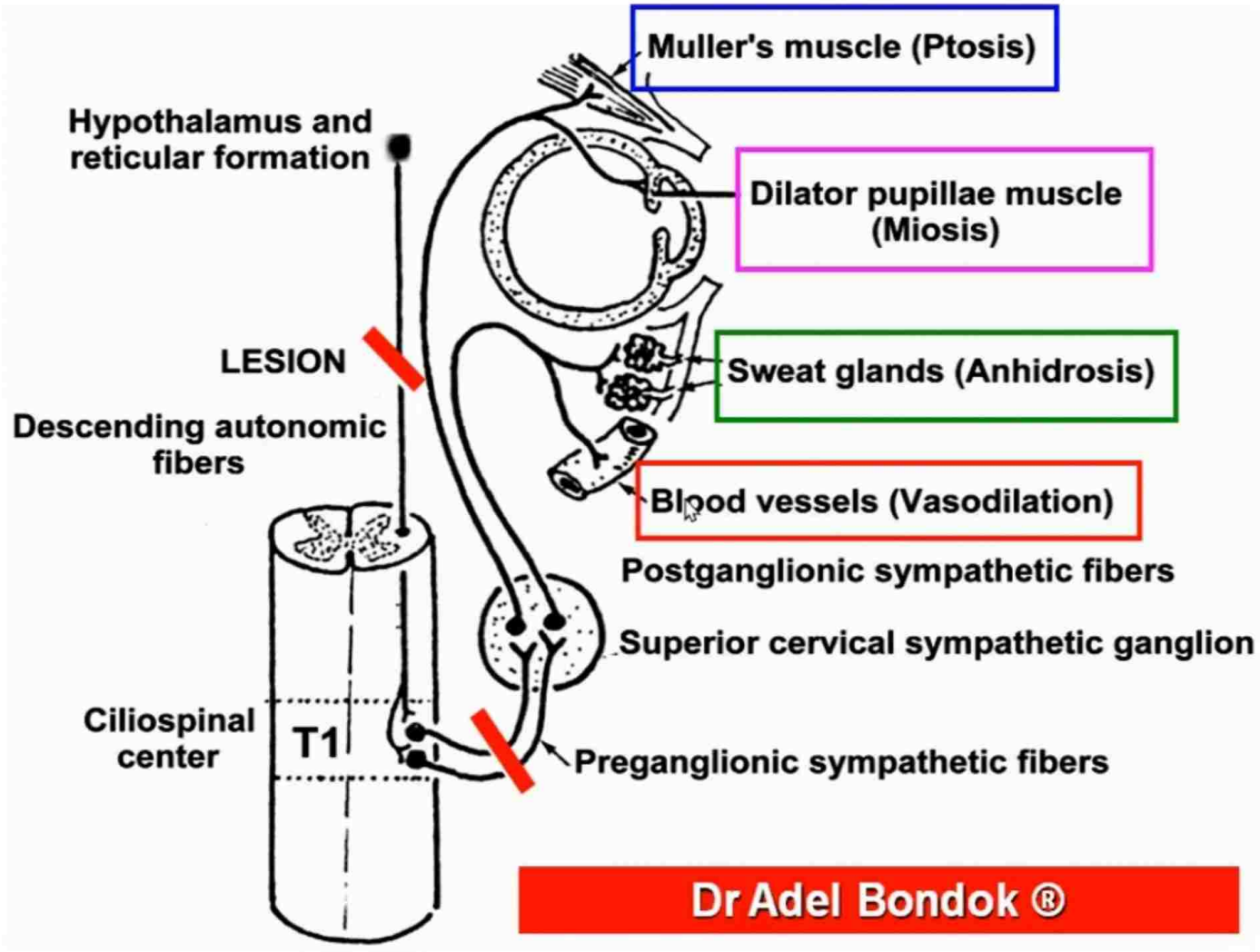
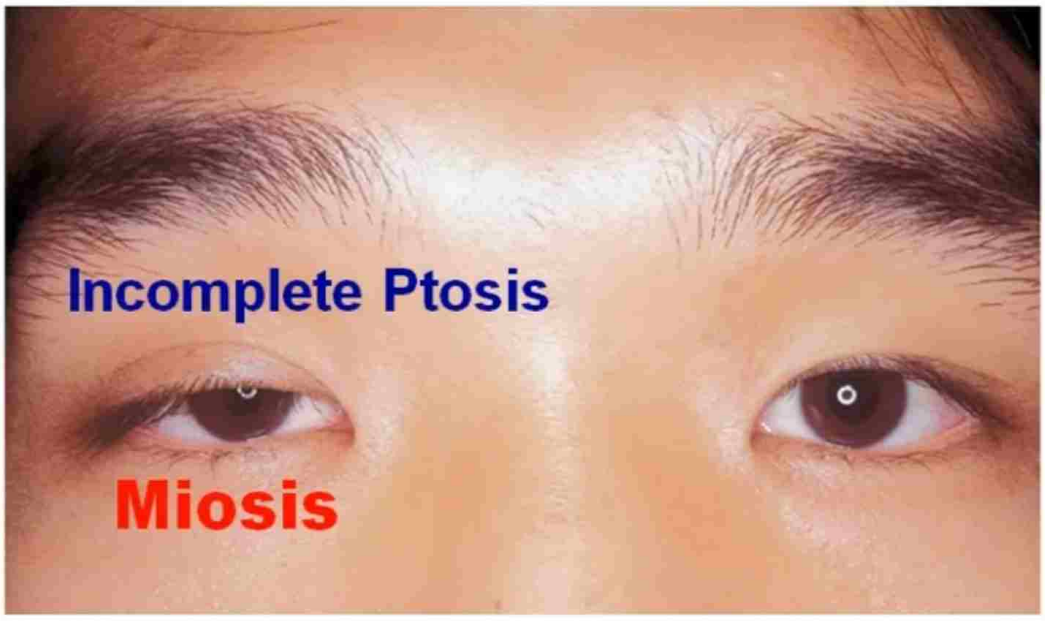
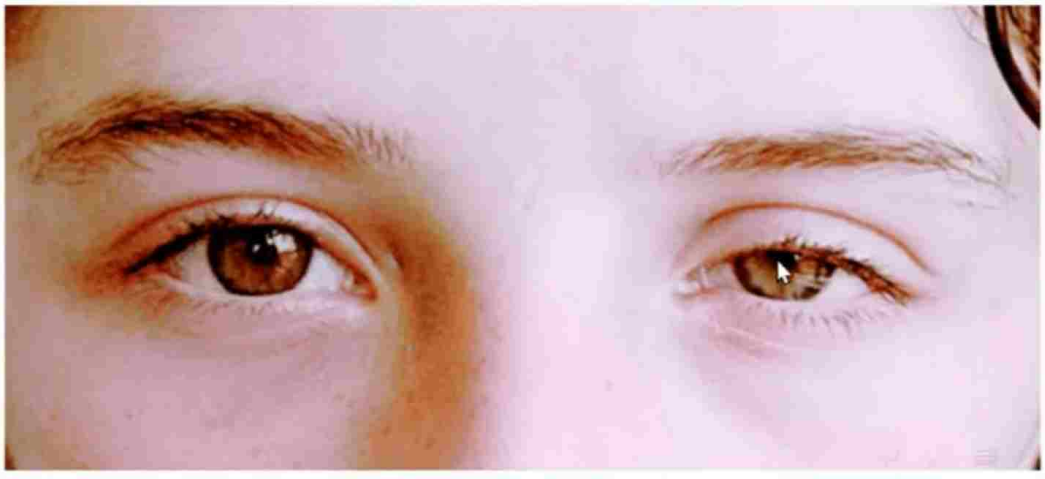


Rt Horner's Syndrome



Lt Horner's Syndrome



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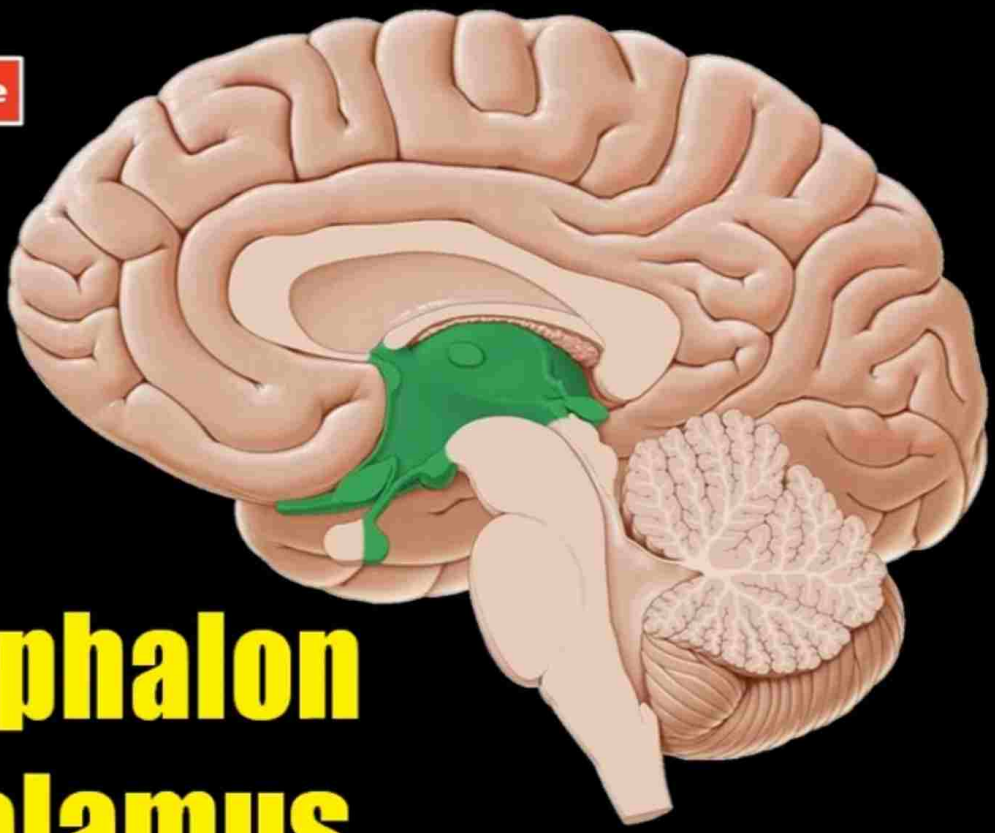

Diencephalon and Thalamus

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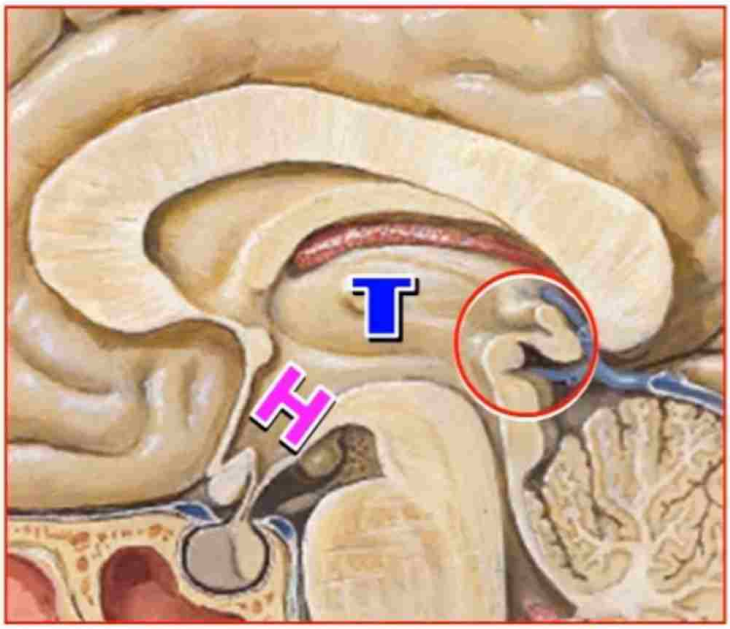
DIVISIONS OF THE DIENCEPHALON

1. Thalamus
2. Hypothalamus
3. Epithalamus
4. Subthalamus



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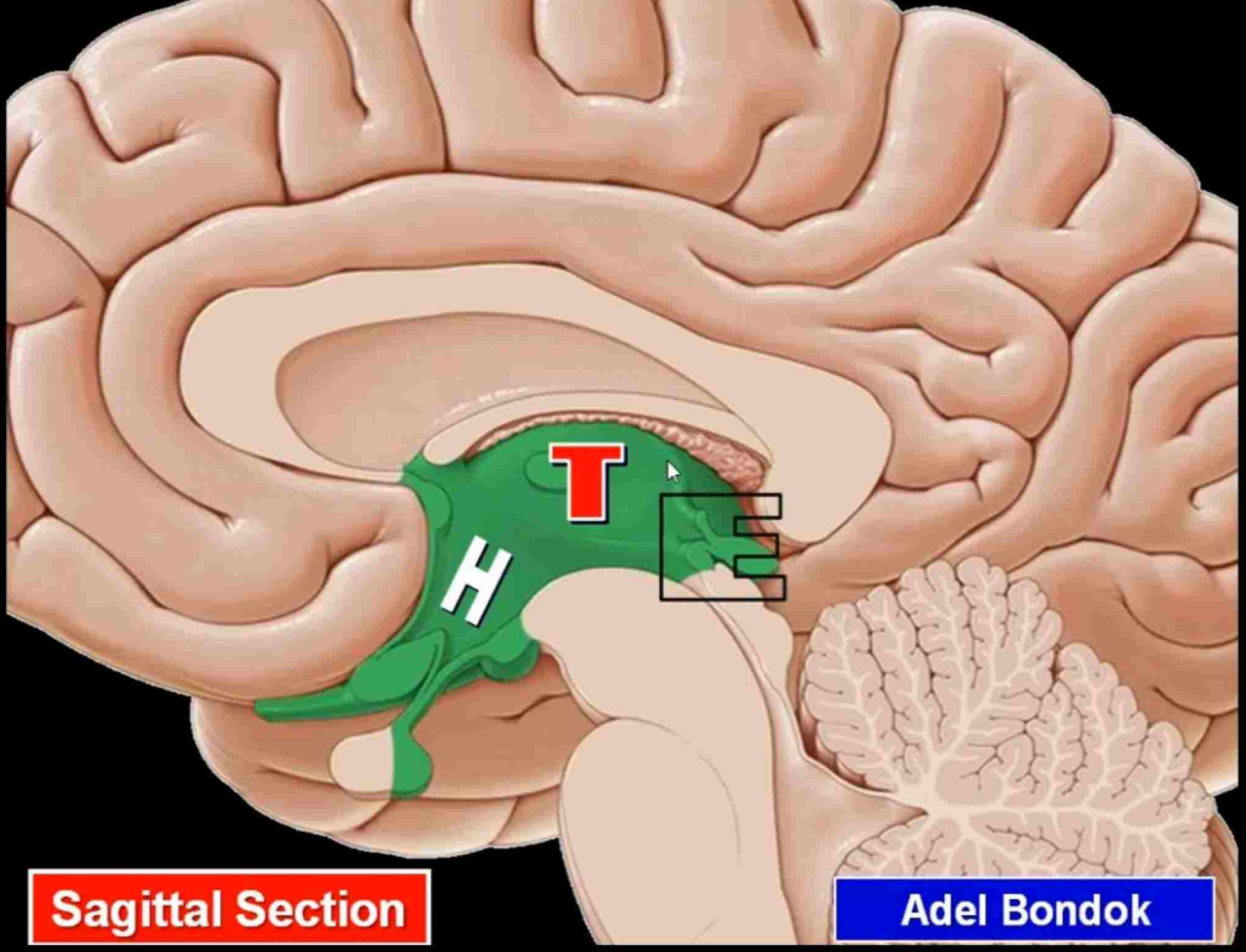
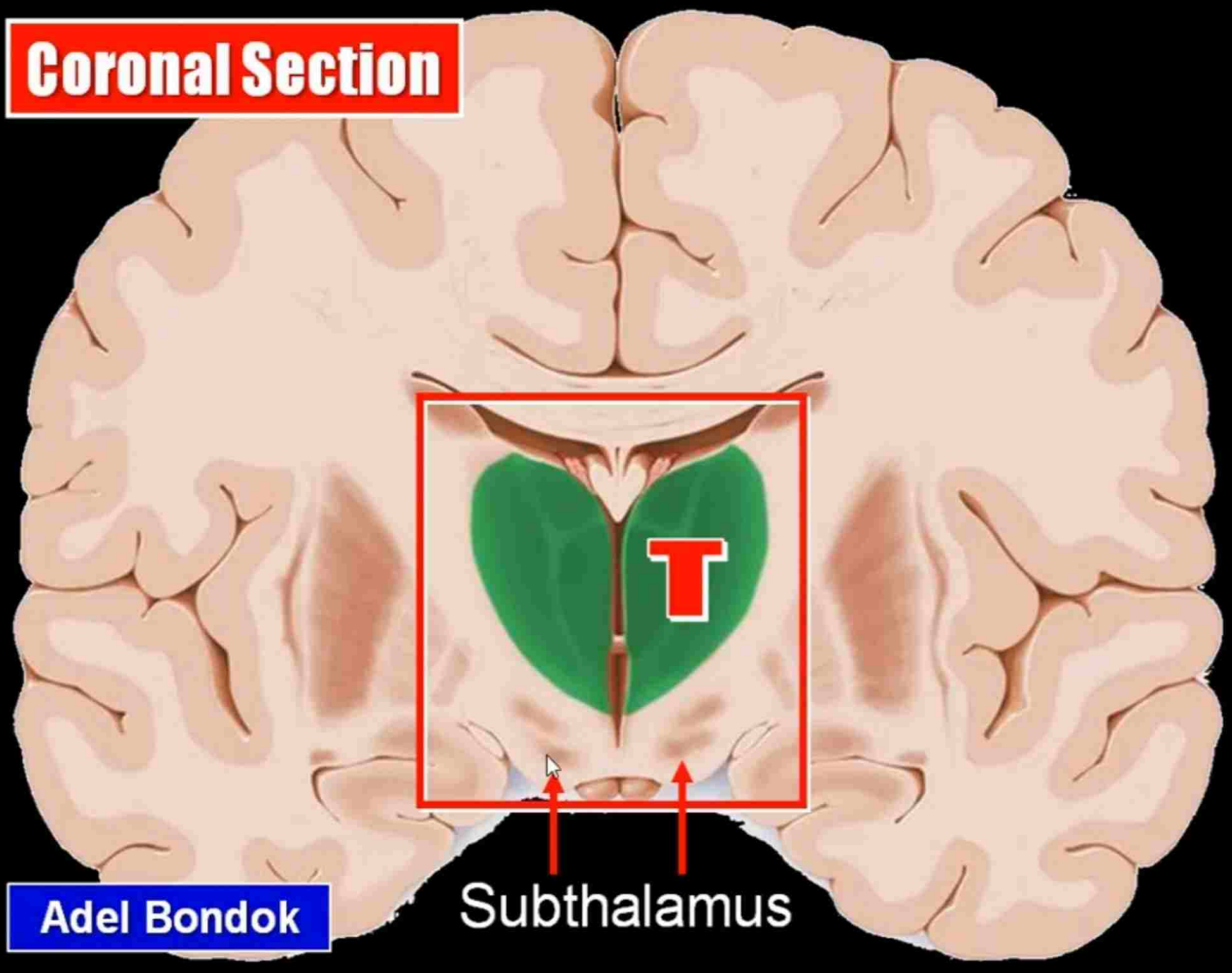
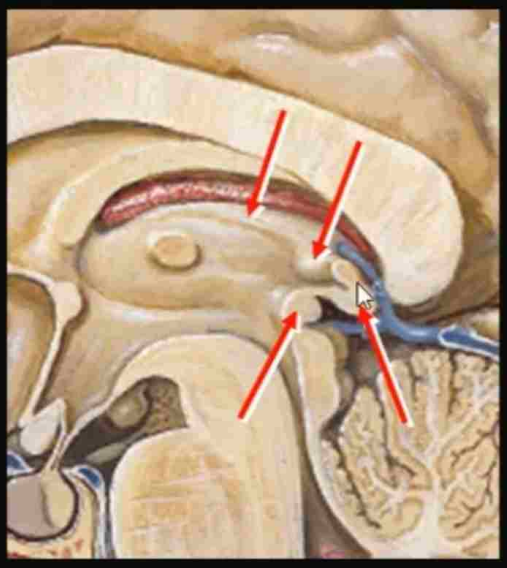

T
H
E
Sagittal Section
Adel Bondok


Coronal Section
T
Adel Bondok
Subthalamus

EPITHALAMUS

1. Posterior commissure
2. Pineal gland
3. Habenular nucleus
4. Stria medullaris thalami



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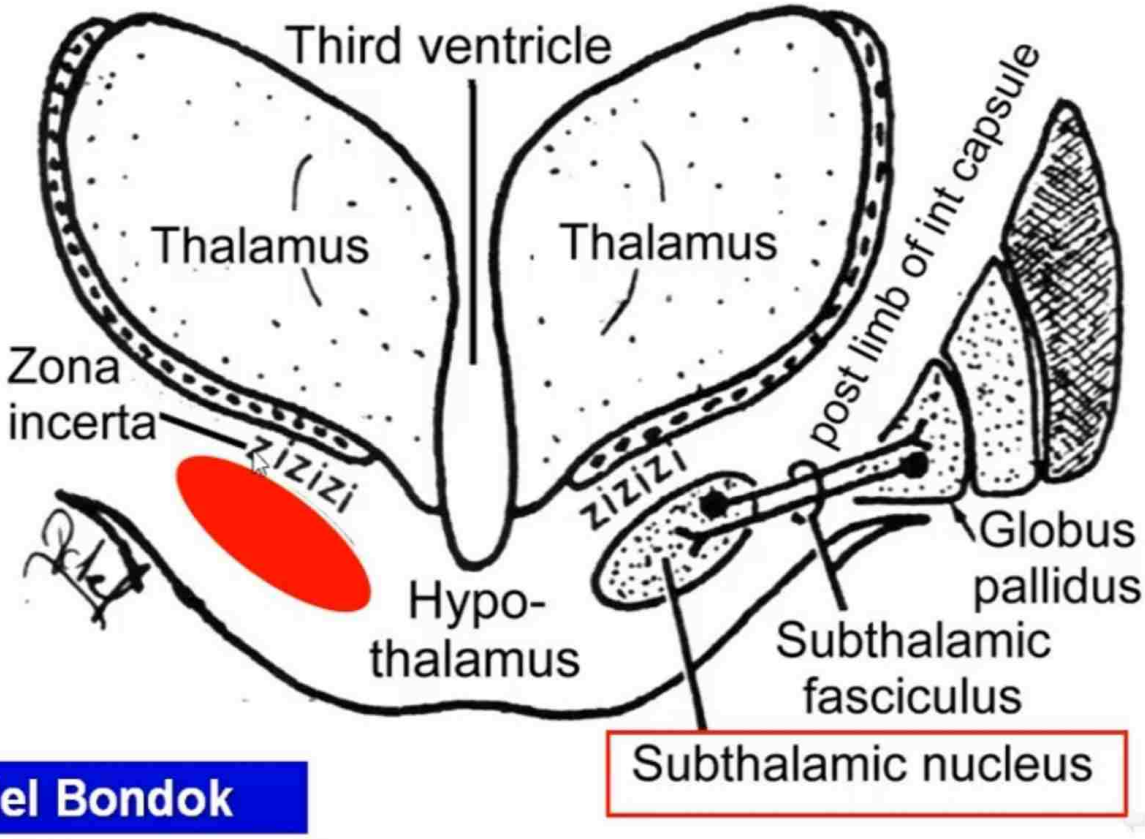
SUBTHALAMUS



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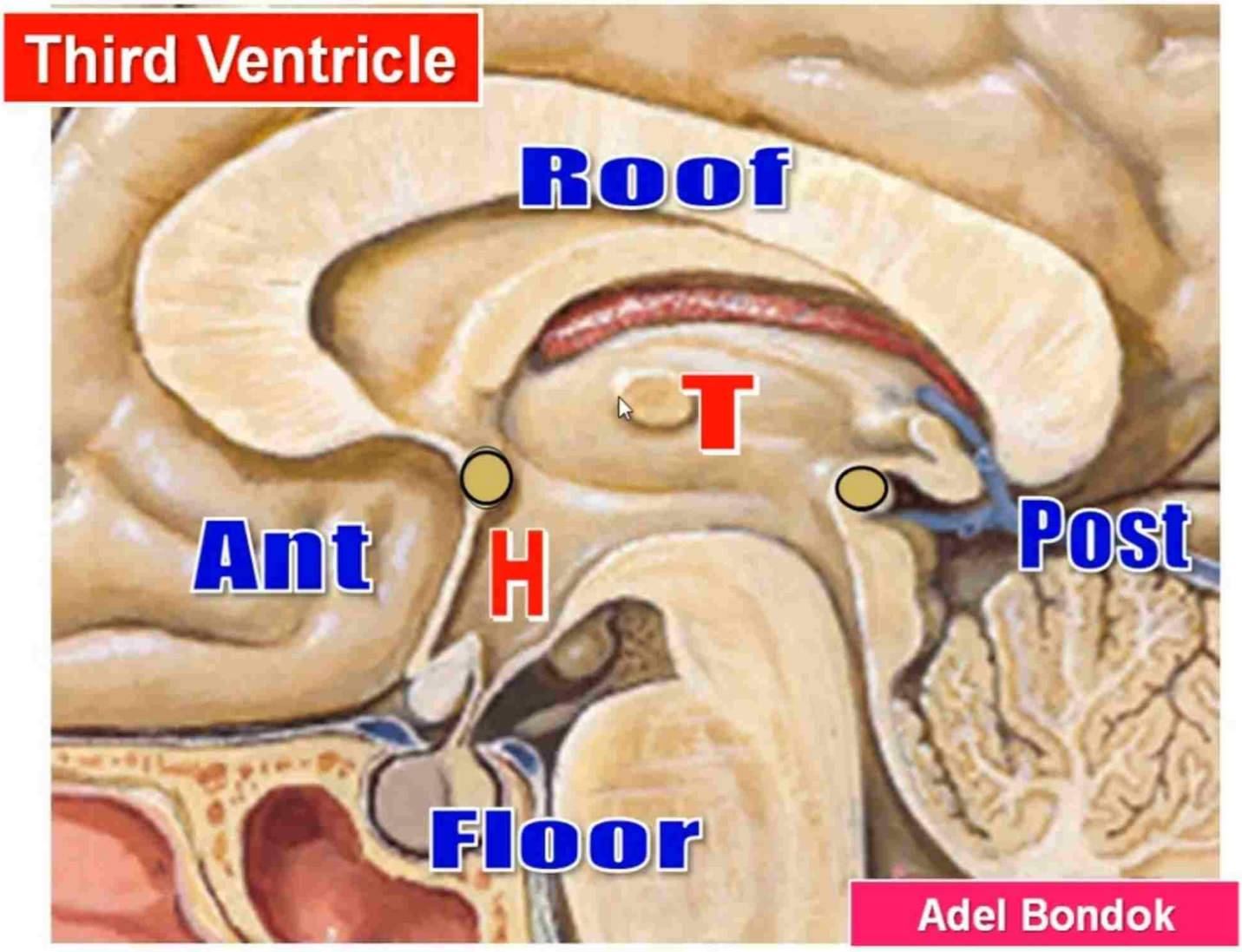
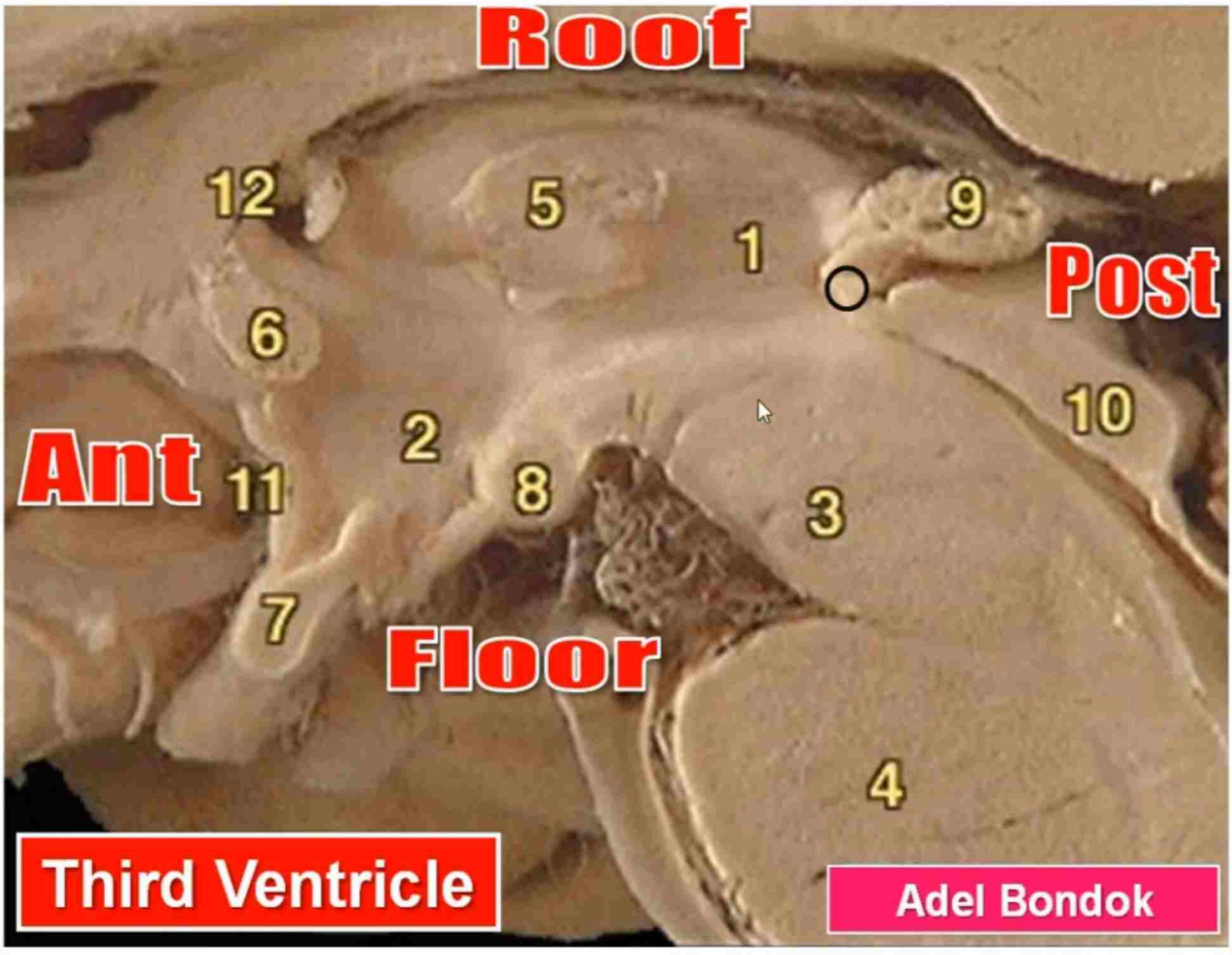

Third Ventricle
Roof
T
Ant
H
Post
Floor
Adel Bondok


Roof
12
5
1
9
Post
6
10
Ant
2
11
8
3
7
Floor
4
Third Ventricle
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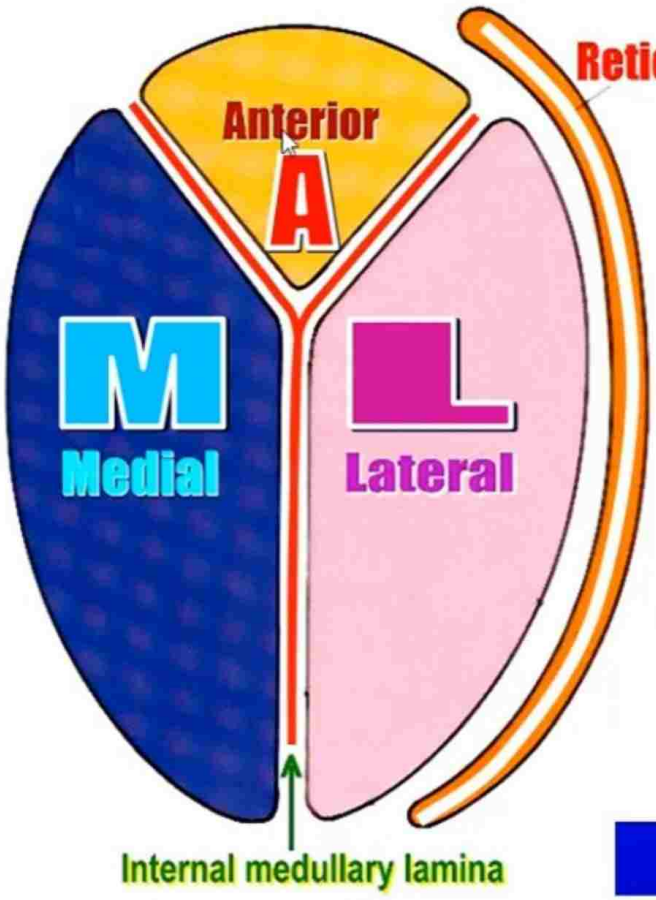
THALAMIC NUCLEI



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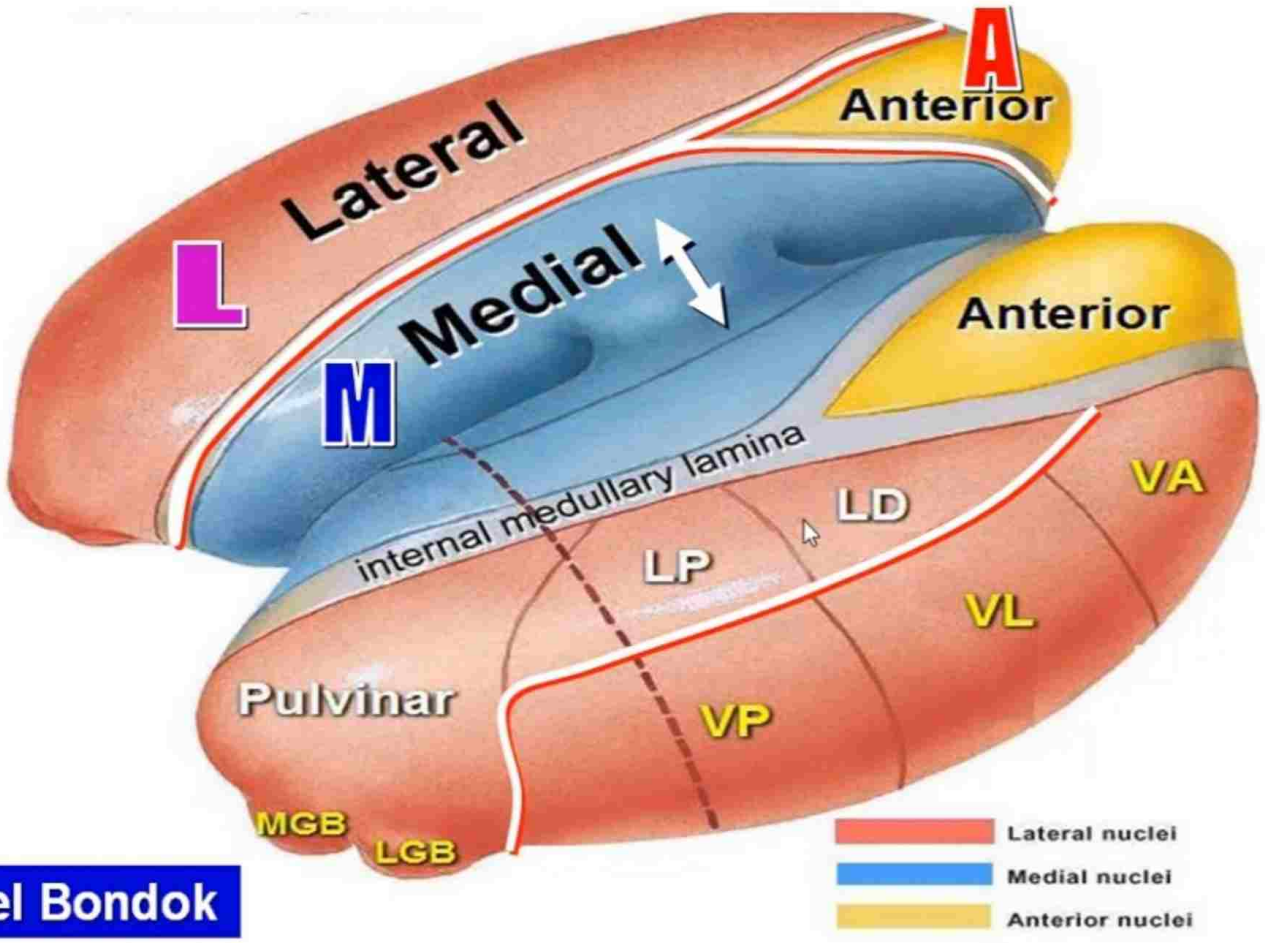
THALAMIC NUCLEI



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5 THALAMIC NUCLEI

- anterior
- LATERAL
  - dorsal
  - ventral
    - Ventral nucleus: VA, VL, VP: VPM + VPL
    - Metathalamus: MGB + LGB
- medial
- intralaminar
- reticular

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Anatomical Classification

- Anterior
- Medial
- Lateral
  - Dorsal Group
    1. Lateral dorsal
    2. Lateral posterior
    3. Pulvinar
  - Ventral Group
    - Ventral Nucleus
      1. Ventral anterior
      2. Ventral lateral
      3. Ventral posterior
    - Metathalamus
      1. MGB
      2. LGB
- Intralaminar
- Reticular

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THALAMIC NUCLEI

SPECIFIC

Connections:
Are:
1. Ventral nucleus
2. Metathalamus

NONSPECIFIC

Connections:
Are:
Other nuclei

BONDOK'S CLASSIFICATION

Http://www.Biology-online.Org/articles/Bondok-s-classification-thalamic-nuclei.Html

2 SENSORY NUCLEI: VP + Mtathalamus

2 MOTOR NUCLEI: VA + VL

2 LIMBIC NUCLEI: Ant + Med

2 RAS NUCLEI: Retic + Intralaminar

3 ASSOCIATION NUCLEI: LD + LP + Pulv

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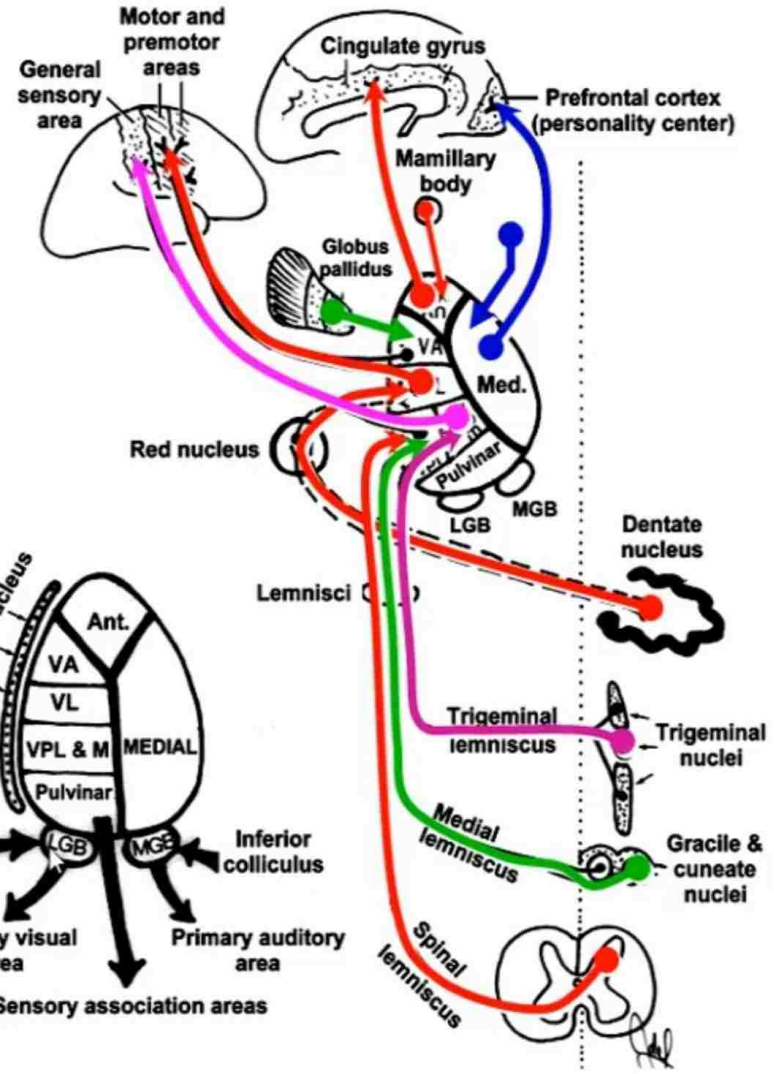
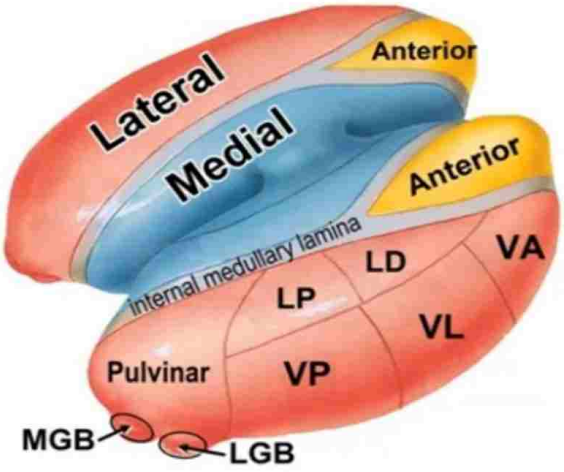
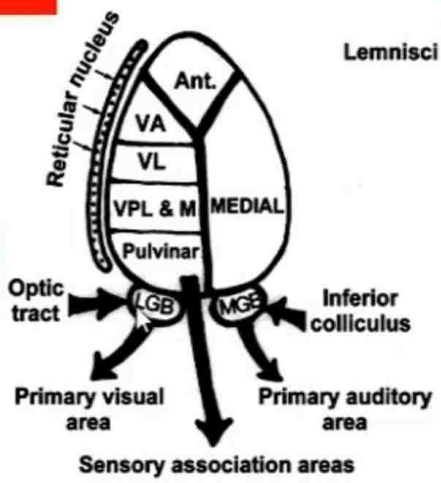
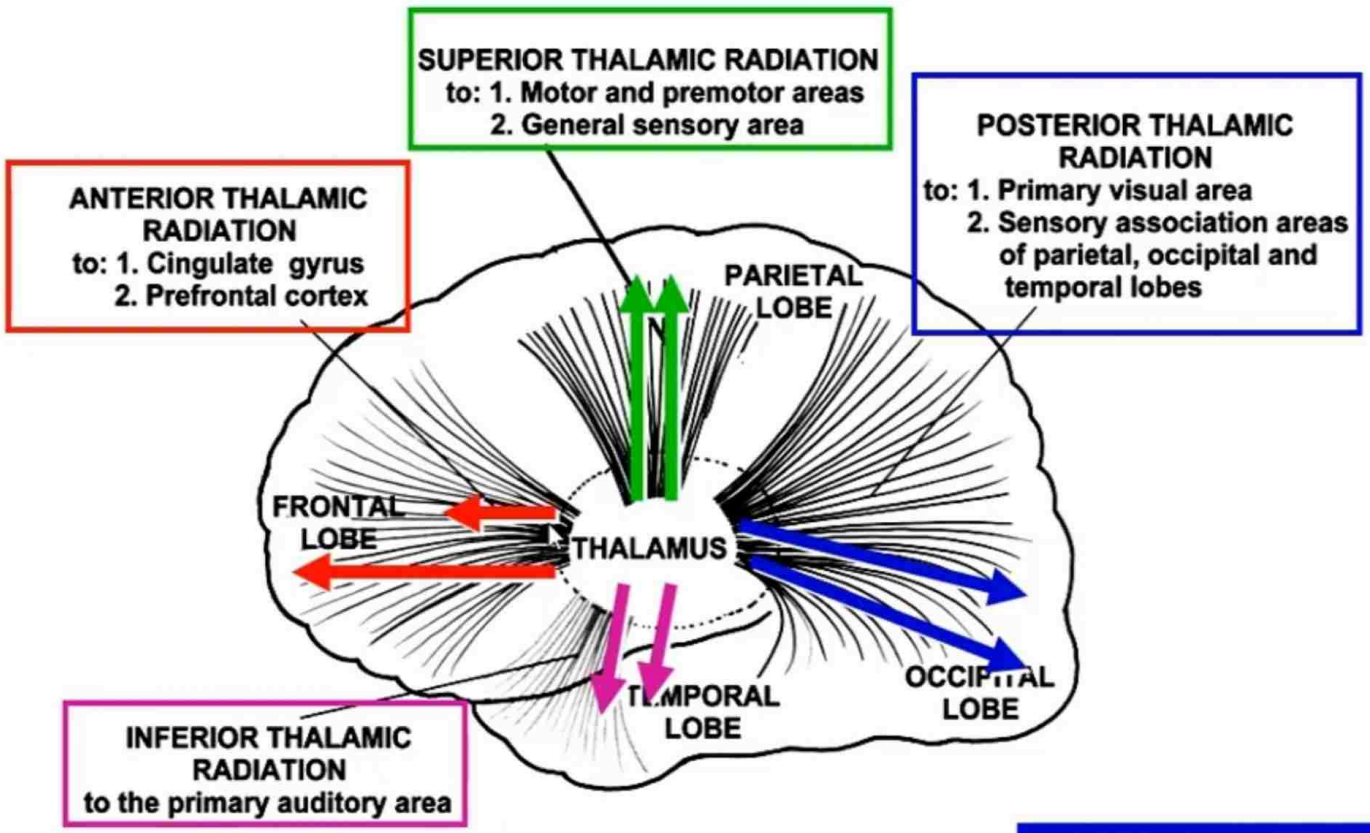
THALAMIC NUCLEI AND CONNECTIONS







4 THALAMIC RADIATIONS



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4 THALAMIC RADIATIONS

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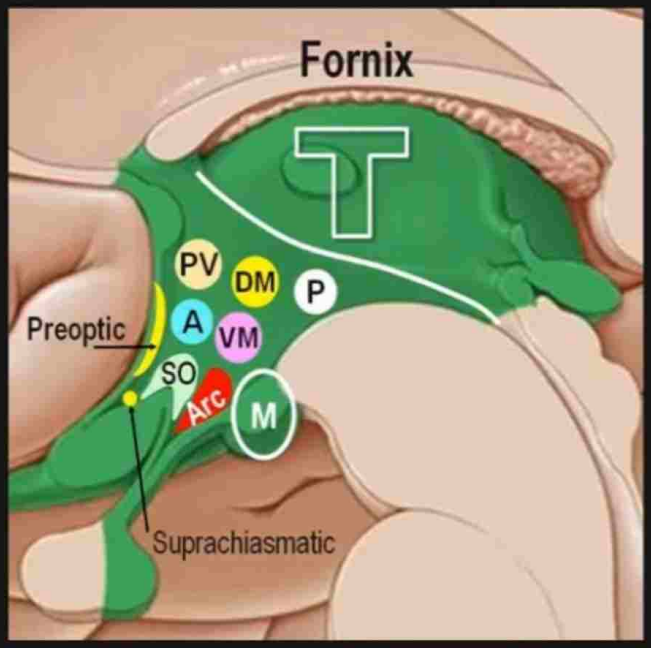
Radiation	Location	Origin	Termination	Function and Lesion
Anterior	Anterior limb	Anterior & medial nuclei	Cingulate gyrus Prefrontal cortex	Emotions, behavior, memory
Posterior	Retrolent-icular part	LGB: Lateral geniculate b	Primary visual area 17	Vision. Contralat hom hemianopia
Superior	Lenticulo thalamic p	VA and VL VP	Area 4 and 6 Area 3, 1, 2	Motor Sensory
Inferior	Sublentic part	MGB: Medial geniculate b	Primary audit area 41 & 42	Hearing. Bilat weakness of hearing

SUBSCRIBE

Hypothalamus Nuclei and Functions



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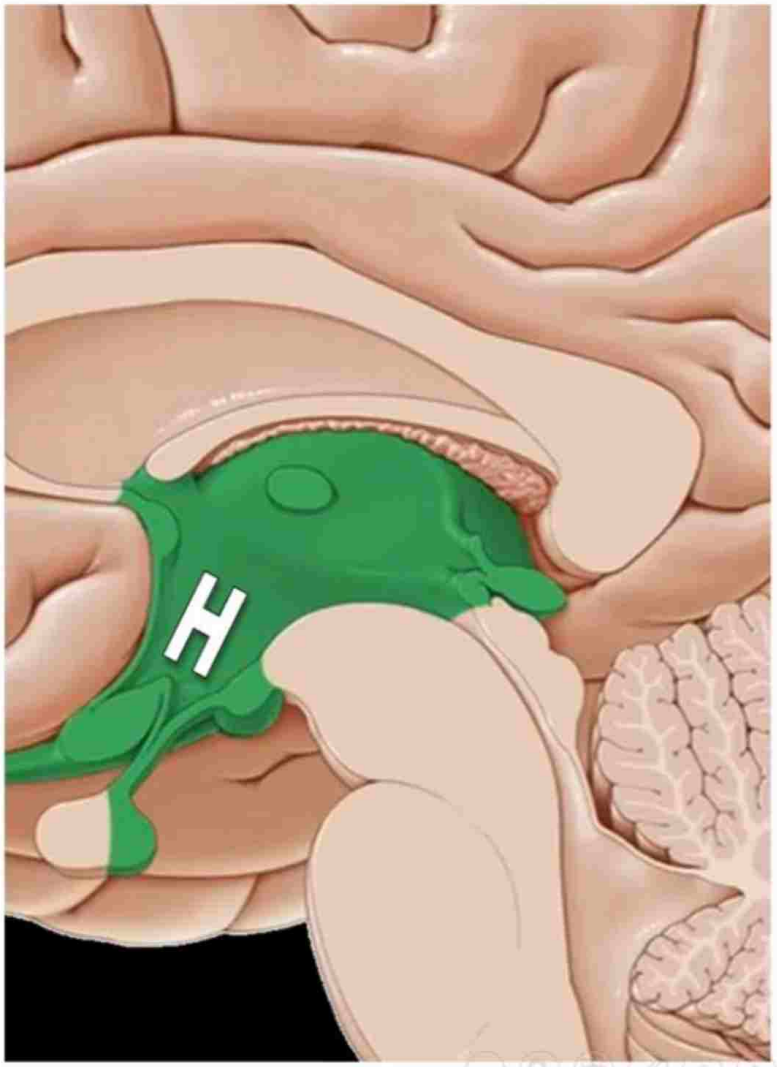
What is the Hypothalamus?

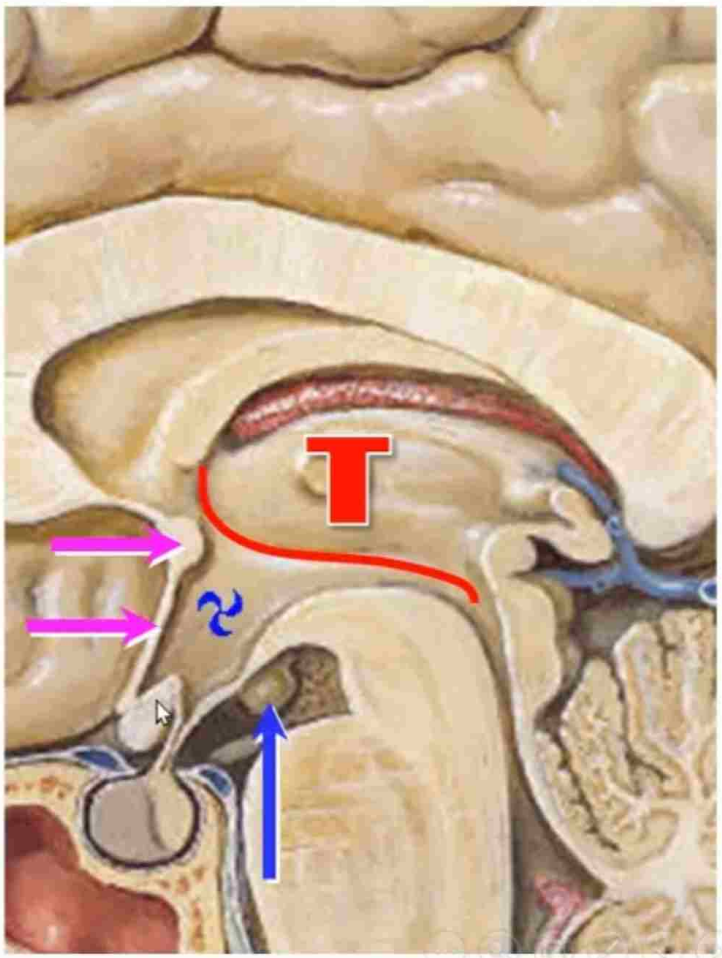
1. The hypothalamus is a part of the diencephalon.
2. It is the main autonomic center (the primary)
3. It is the main endocrine center



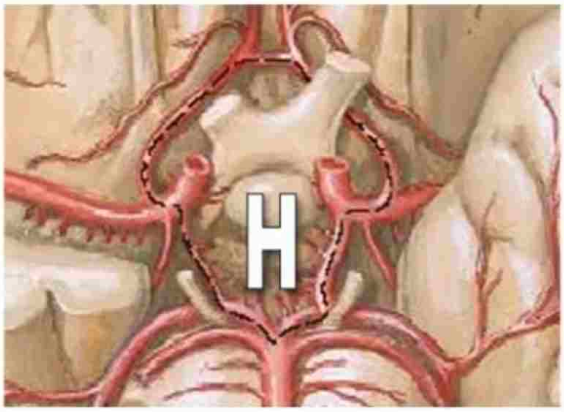
What is the location of the Hypothalamus?

It lies:

1. Below the thalamus and are separated by hypothalamic sulcus
2. Behind lamina terminalis & anterior commissure.
3. In the floor of the interpeduncular fossa above the optic chiasma, tuber cinereum, mamillary bodies and posteriotr perforated substance.

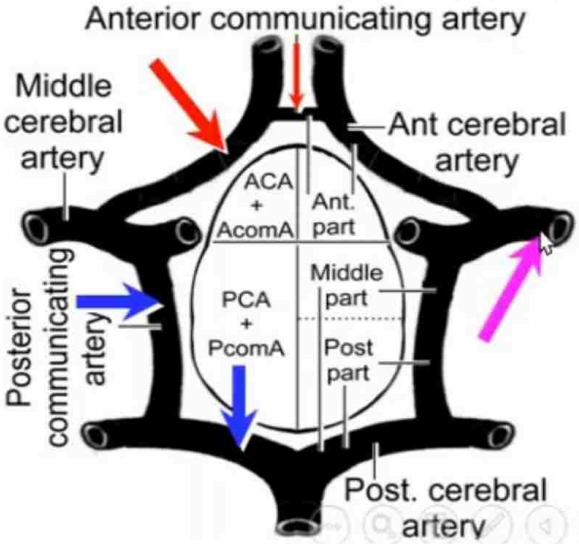


Arterial Supply of the Hypothalamus

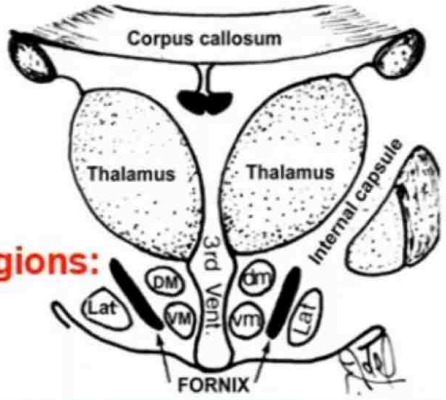


It is supplied by the 3 cerebral arteries:

1. **Anterior part: anterior cerebral** and anterior communicating arteries
2. **Posterior part: posterior cerebral** and posterior communicating arteries
3. **Lateral part: middle cerebral artery**



Organization of the Hypothalamic Nuclei

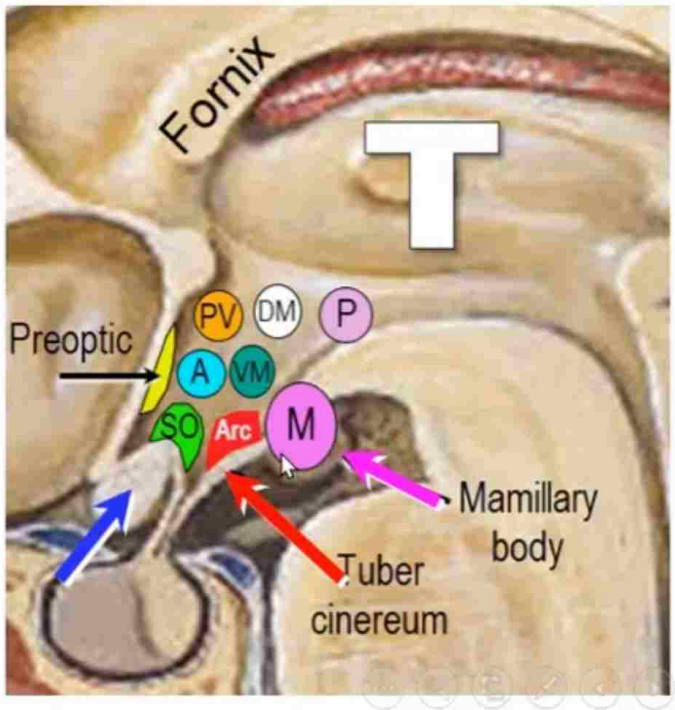


The fornix **divides** the hypothalamus into **medial & lateral regions:**

Medial Region: contains 4 groups:

- **Preoptic area:** behind lamina terminalis
- **Supraoptic group: anterior**, above optic chiasma. **Contains 3 nuclei:**
  1. Supraoptic nucleus
  2. Anterior nucleus.
  3. Paraventricular nucleus.
- **Tuberal group: middle**, above the tuber cinereum. **Contains 3 nuclei:**
  1. Arcuate nucleus.
  2. Ventromedial nucleus.
  3. Dorsomedial nucleus.
- **Mamillary group: posterior, contains** mamillary body & posterior nucleus.

Lateral Region: the **lateral nucleus**



Preoptic Nucleus
Parasympathetic Center

- **Site:** immediately behind the lamina terminalis.
- **Function:** **parasympathetic center**.
- **Stimulation produces** parasympathetic response vasodilation, ↓HR, ↓BP, salivation, increased peristalsis, constriction of the pupil, etc.

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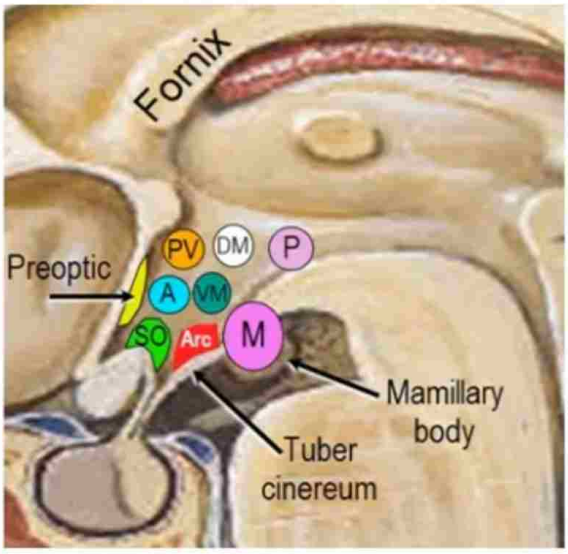
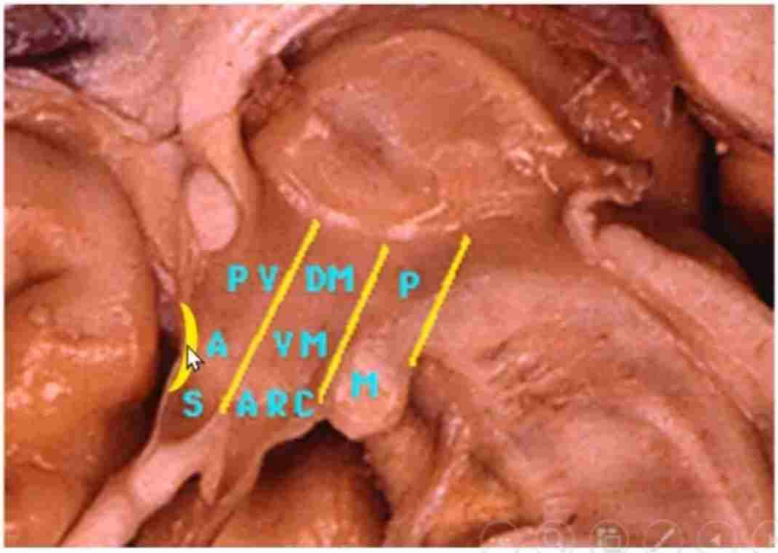




Anterior Nucleus

Site: behind preoptic area

Function: 2
1. Parasympathetic center
2. Heat dissipation center: heat loss in response to heat

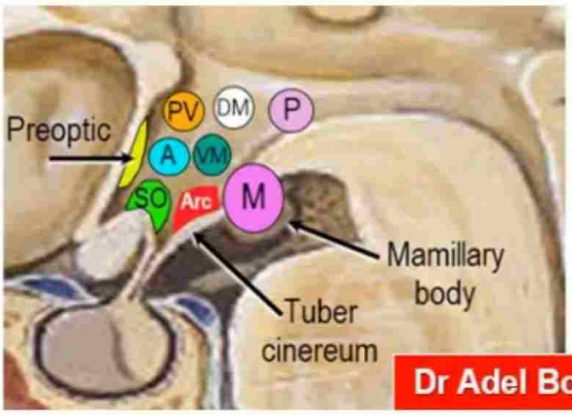
Lesion: Hyperthermia
No heat loss

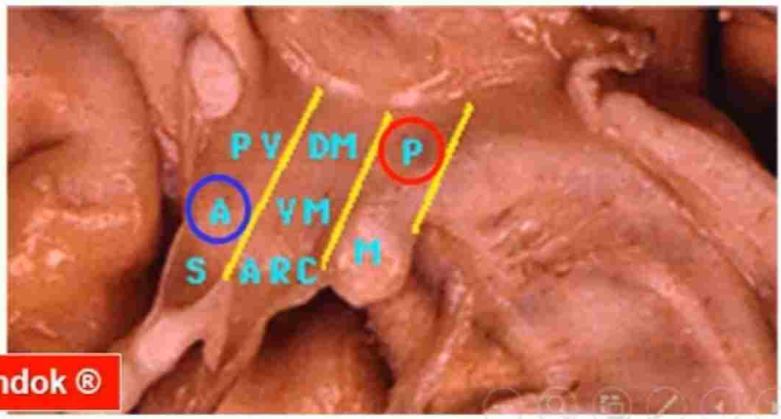
Posterior Nucleus

Site: above mamillary body

Function: 2
1. Sympathetic center
2. Heat production center: heat ↑ in response to cold

Lesion: Hypothermia
No Heat production





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Supraoptic Nucleus

Site: above optic chiasma

Function: secretes ADH

ADH increases reabsorption of water from the DCT and causes vasoconstriction (called vasopressin)

Lesion: polyuria: diabetes insipidus

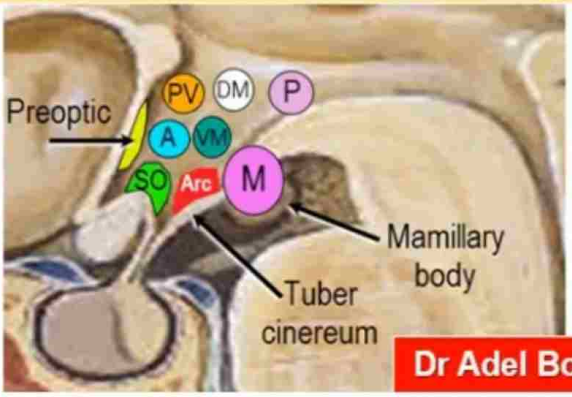
Paraventricular Nucleus

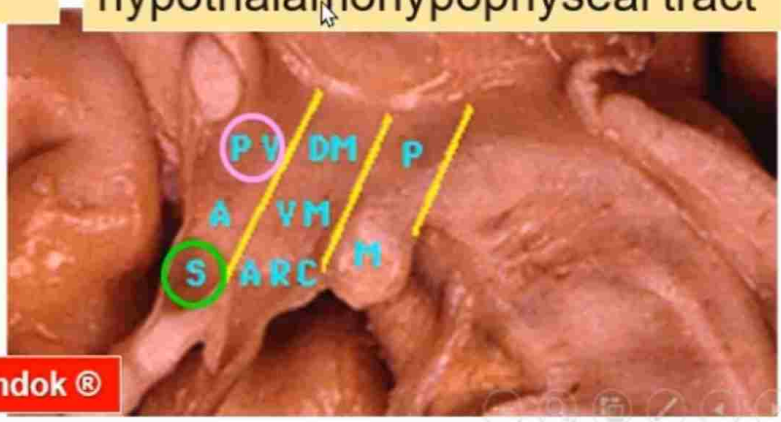
Site: above supraoptic nucl

Function: secretes oxytocin

Oxytocin acts on the breast and uterus. Milk ejection and contraction of the uterus

ADH & Oxytocin reach the posterior pituitary trhough the hypothalamohypophyseal tract





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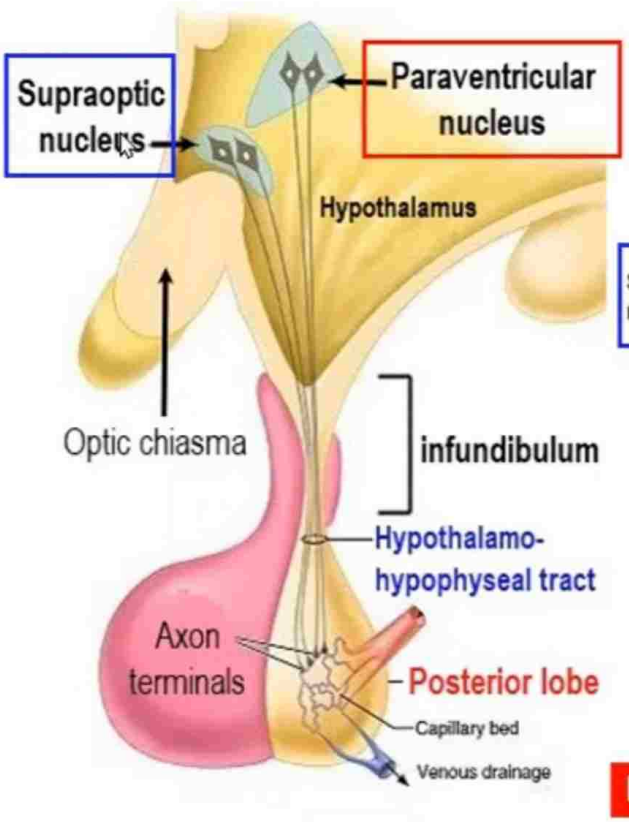
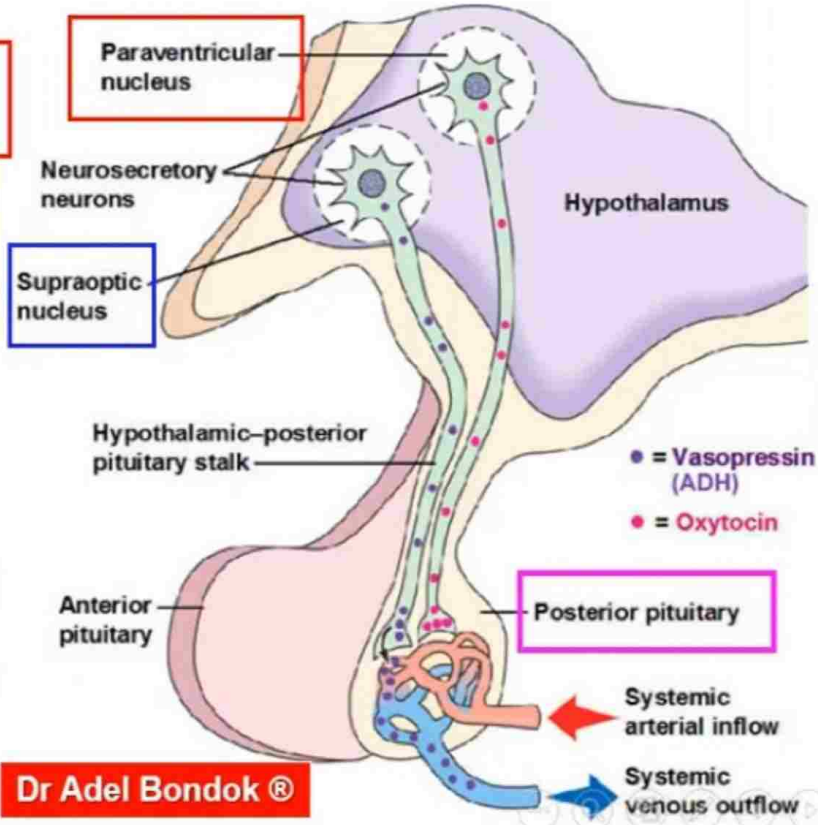
Hypothalamo-hypophyseal Tract

- **Formed by** axons of the supraoptic & paraventricular nuclei.
- **Transport ADH & Oxytocin** to the posterior lobe of PG.





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Tuberal Nuclei: Arcuate, VM & DM

- **Site:** above tuber cinereum.
- **Function:** control the anterior pituitary secretion by secreting:

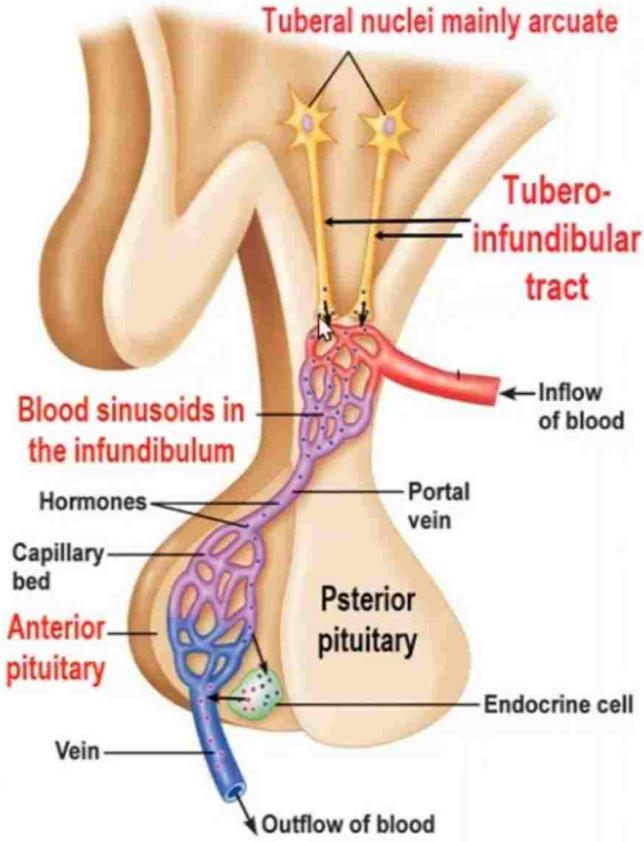
6 releasing hormones:

TRH, CRH, GHRH, FSHRH, LHRH, PRH

2 inhibiting hormones:

GHIH & PIH

The hormones are **carried by** the **tubero-infundibular tract** to the **blood sinusoids** in **infundibulum**, then **carried by** the **portal vessels** to be released in the anterior lobe.



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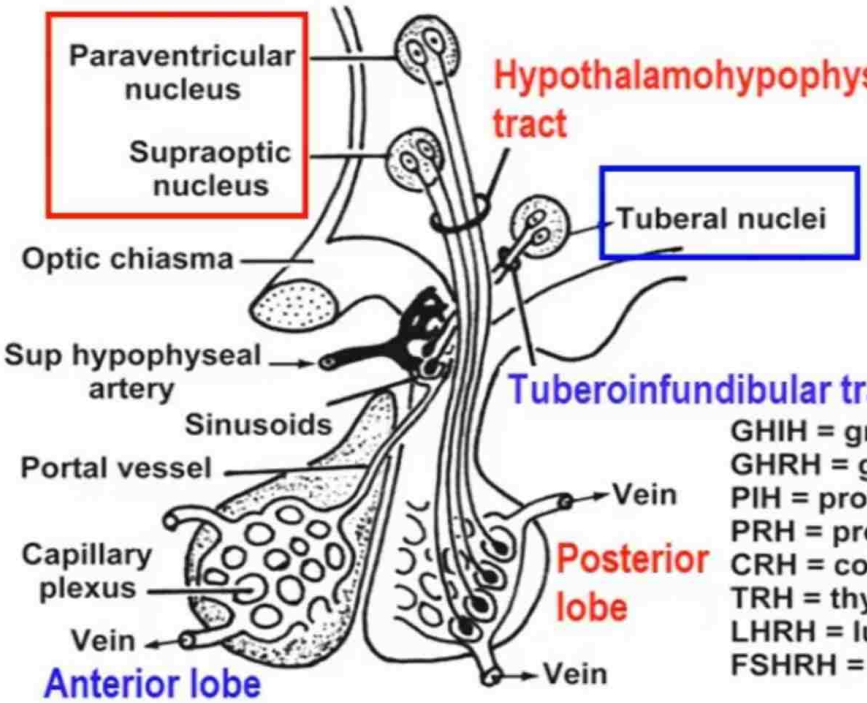
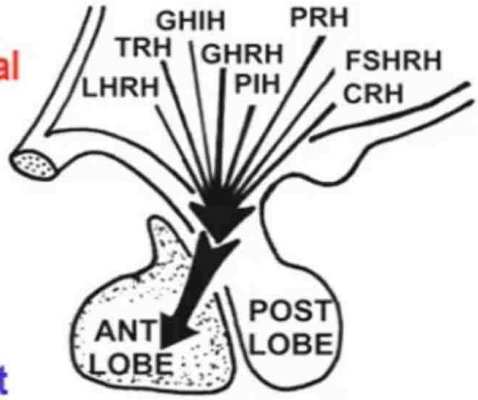
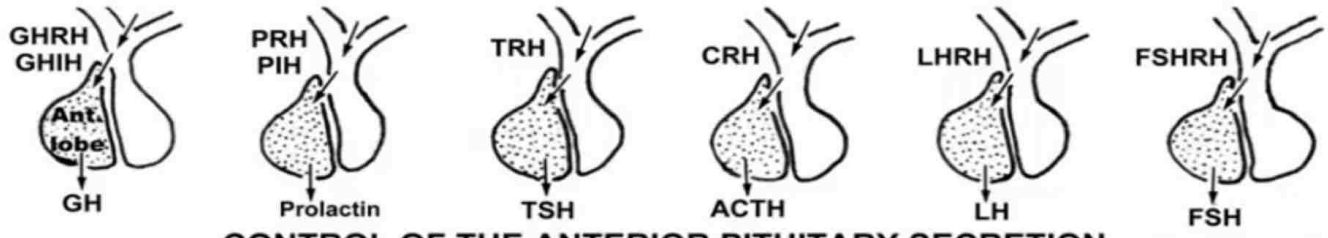




GHIH = growth hormone inhibiting hormone
GHRH = growth hormone releasing hormone
PIH = prolactin inhibiting hormone
PRH = prolactin releasing hormone
CRH = corticotropin releasing hormone
TRH = thyrotropin realesing hormone
LHRH = luteininzing hormone releasing h.
FSHRH = follicle stimulating h. releasing h.

Releasing & inhibiting hormones are secreted mainly by the arcuate nucleus



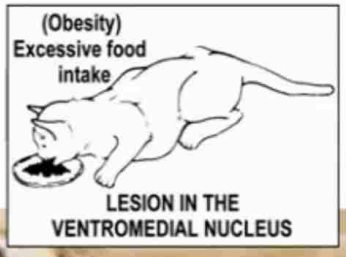
CONTROL OF THE ANTERIOR PITUITARY SECRETION

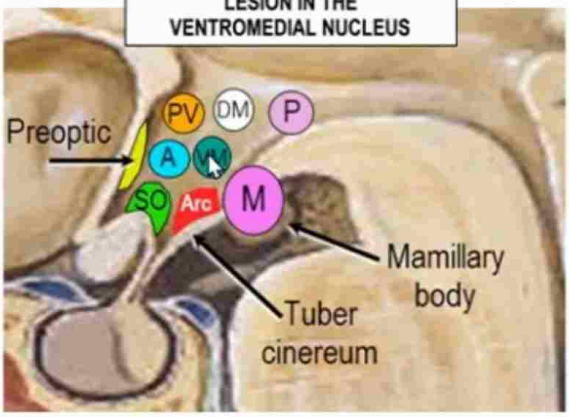
Ventromedial Nucleus

Site: above arcuate nucleus

Function: satiety center (inhibits food intake)

Lesion: Obesity



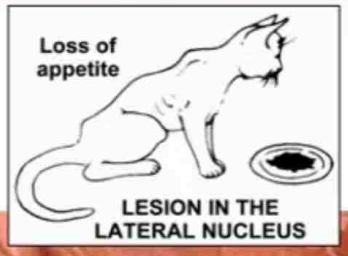


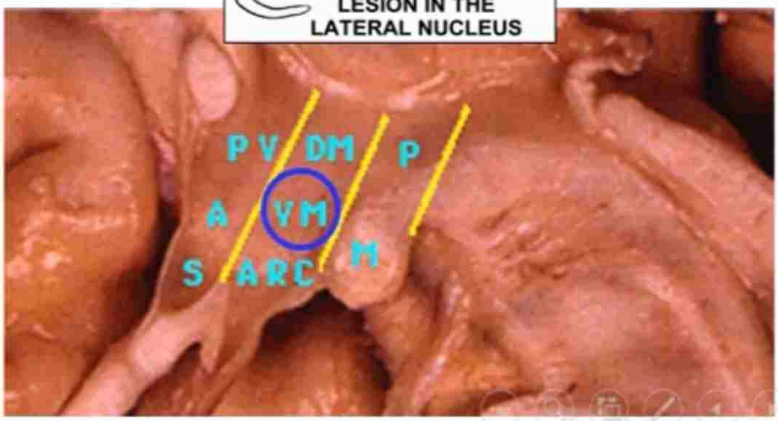
Lateral Nucleus

Site: lateral to the fornix

Function: hunger & thirst center: stimulate food intake

Lesion: Anorexia





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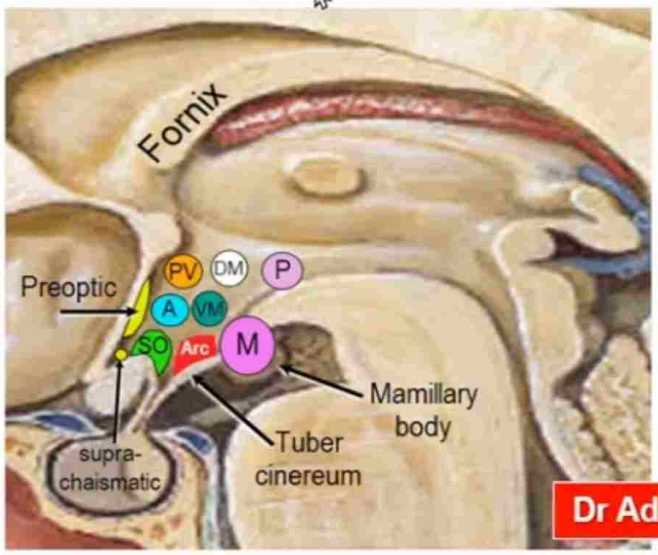
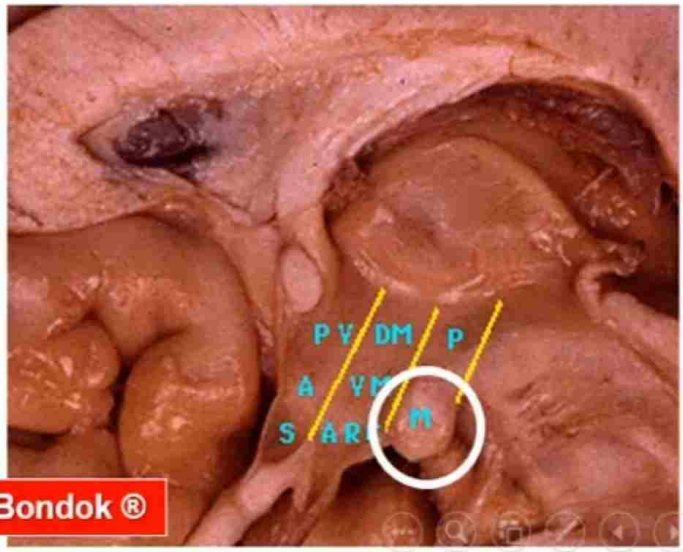
Mamillary Body

- **Input:** from the hippocampus through the **fornix**.
- **Output:** to the anterior thalamic nucleus through the **mamillothalamic tract**.
- **Function:** it is part of the **limbic system** and plays a role in **memory** and **emotions**.





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Connections of the Hypothalamus

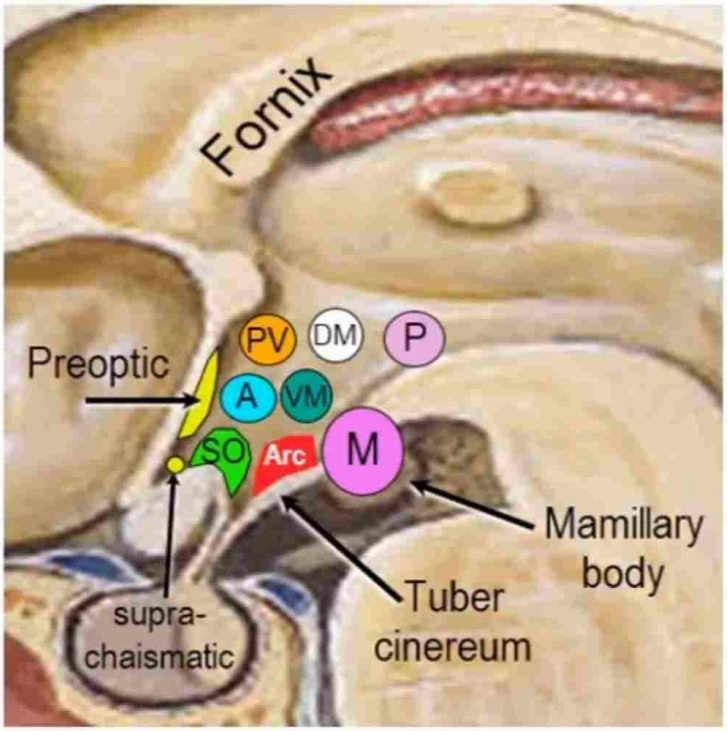
Input from 3 Systems Sensory, Limbic and Olfactory

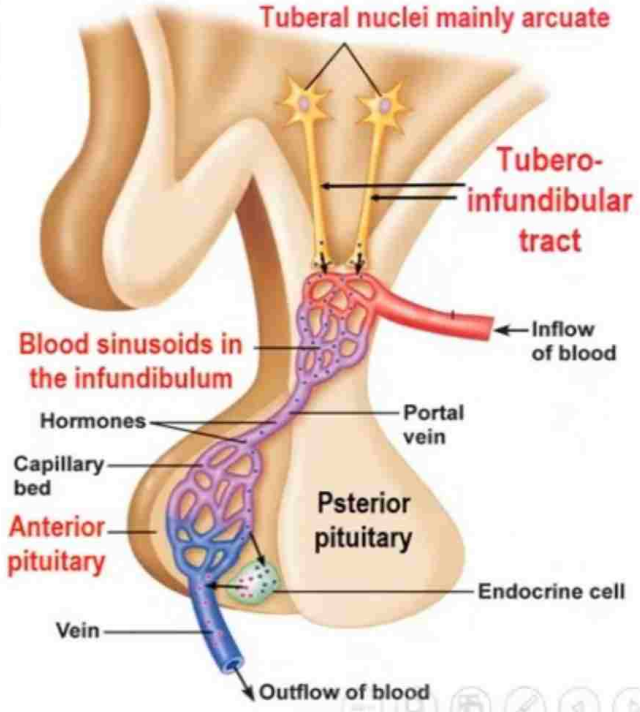
- **Sensory System:** mostly taste fibers & touch fibers from the nipple & genitalia
- **Limbic System:** fornix from the hippocampus & stria terminalis from the amygdaloid nucleus
- **Olfactory System:** from the medial & lateral olfactory areas

Output to 2 main areas: Reticular Formation & Pituitary Gland

- **Reticular Formation:** to parasymp nuclei in the brainstem (III, VII, IX & X) and to symp and parasymp nuclei in the spinal cord
- **Pituitary Gland:**
  1. Hypothalamohypophyseal tract: ADH & oxytocin
  2. Tuberoinfundibular tract releasing & inhibiting horm

Summary of the Functions of the Hypothalamus





Functions of the Hypothalamus

Endocrine Function: control the posterior pituitary

- **Supraoptic nucleus:** secretes **ADH**
- **Paraventricular nucleus:** secretes **oxytocin**

Endocrine Function: tuberal nuclei control anterior pituitary

- **6 Releasing hormones:** GHRH, PRH, TRH, CRH, LHRH, FSHRH
- **2 Inhibiting hormones:** GHIH and PIH.

Autonomic Function

- **Parasympathetic center:** anterior part (ant & preoptic nucl.)
- **Sympathetic center:** posterior part (posterior & lateral nucl.)

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Temperature regulation

- **Heat dissipation center:** anterior nucleus (sensitive to heat)
- **Heat production center:** posterior nucleus (sensitive to cold)

Functions of the Hypothalamus

Regulation of Food Intake: 2 centers

- **Satiety center:** ventromedial nucleus (inhibits food intake)
- **Hunger / feeding center:** lateral nucleus (stimulate feeding)

Regulation of Water Intake and Excretion

- **Lateral nucleus:** thirst center (stimulates water intake)
- **ADH:** increases reabsorption of water by DCT of the kidney

Relation to Emotions

- **Part of the limbic system:** for autonomic and endocrine manifestations of emotions

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Controls the circadian Rhythms

- **Suprachiasmatic nucleus:** **below the preoptic nucleus**. It controls the circadian rhythms through input from the retina

Overall Hypothalamic Functions

1	• Endocrine function
2	• Autonomic function
3	• Temperature regulation
4	• Regulation of food intake
5	• Regulation of water intake
6	• Manifestations of emotions
7	• Controls circadian rhythms

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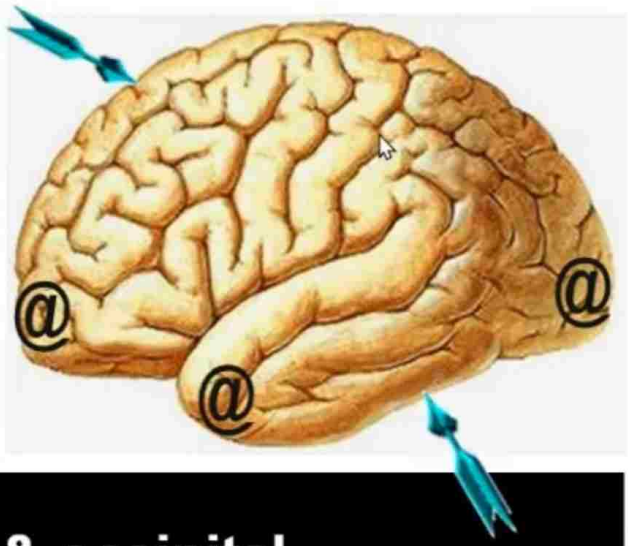
Cerebral Cortex Functional Cortical Areas

Dr. Adel Bondok

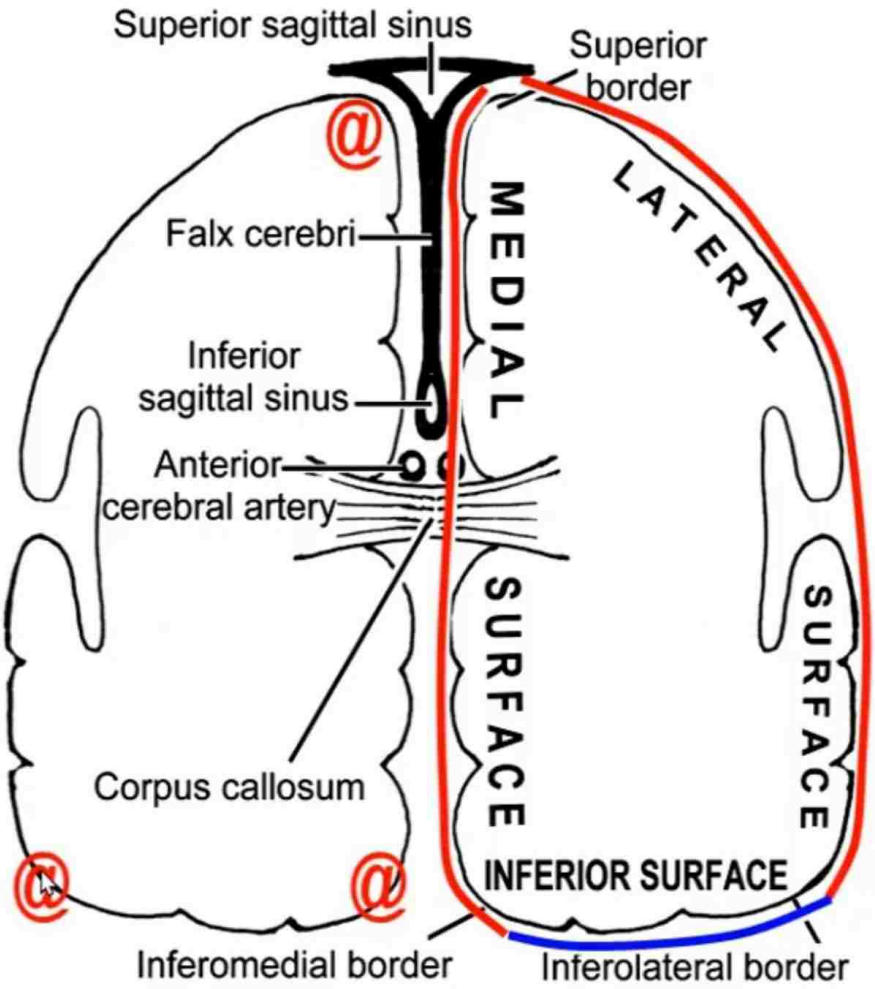
Mansoura University – Egypt

CEREBRAL HEMISPHERE
External Features

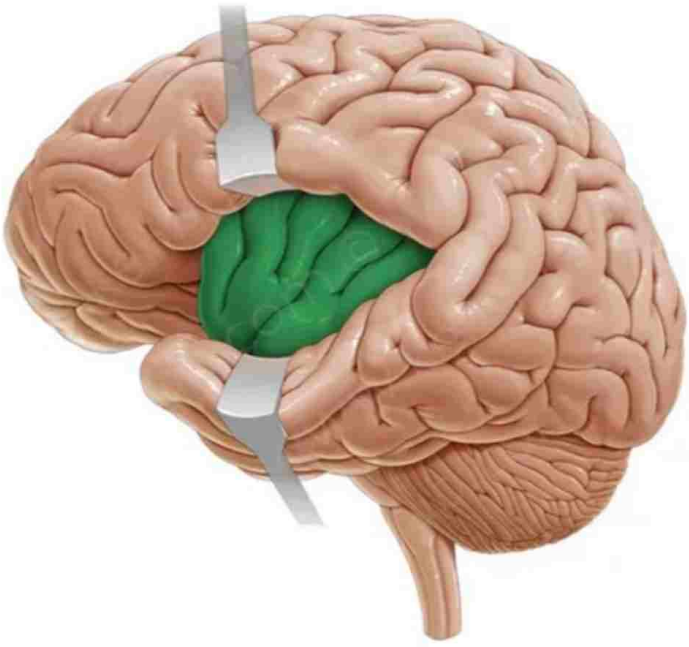


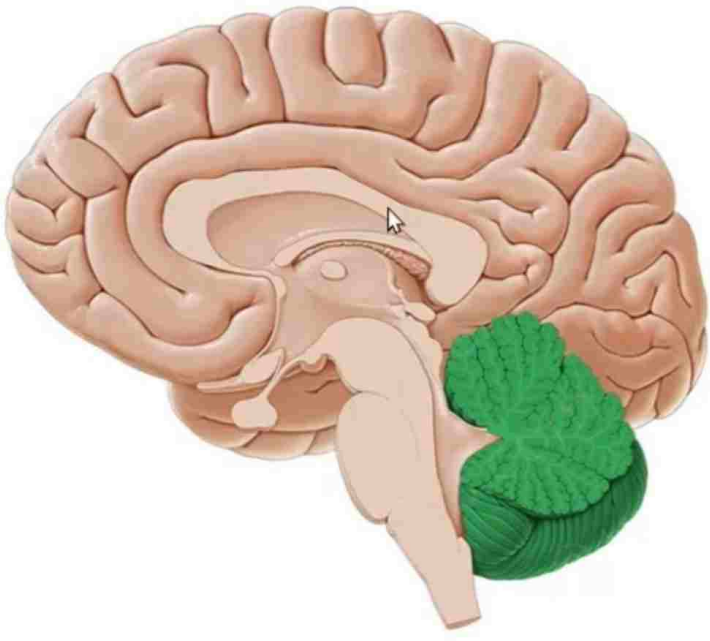
- **3 Poles:** frontal, temporal & occipital
- **3 Borders:** superior, inferomedial & inferolateral
- **3 Surfaces:** lateral, medial & inferior
- **4 Major sulci:** central, lateral, calcarine & P.O.
- **4 Lobes:** frontal, parietal, temporal & occipital

SURFACES AND BORDERS



BORDERS AND SURFACES OF THE CEREBRAL HEMISPHERE





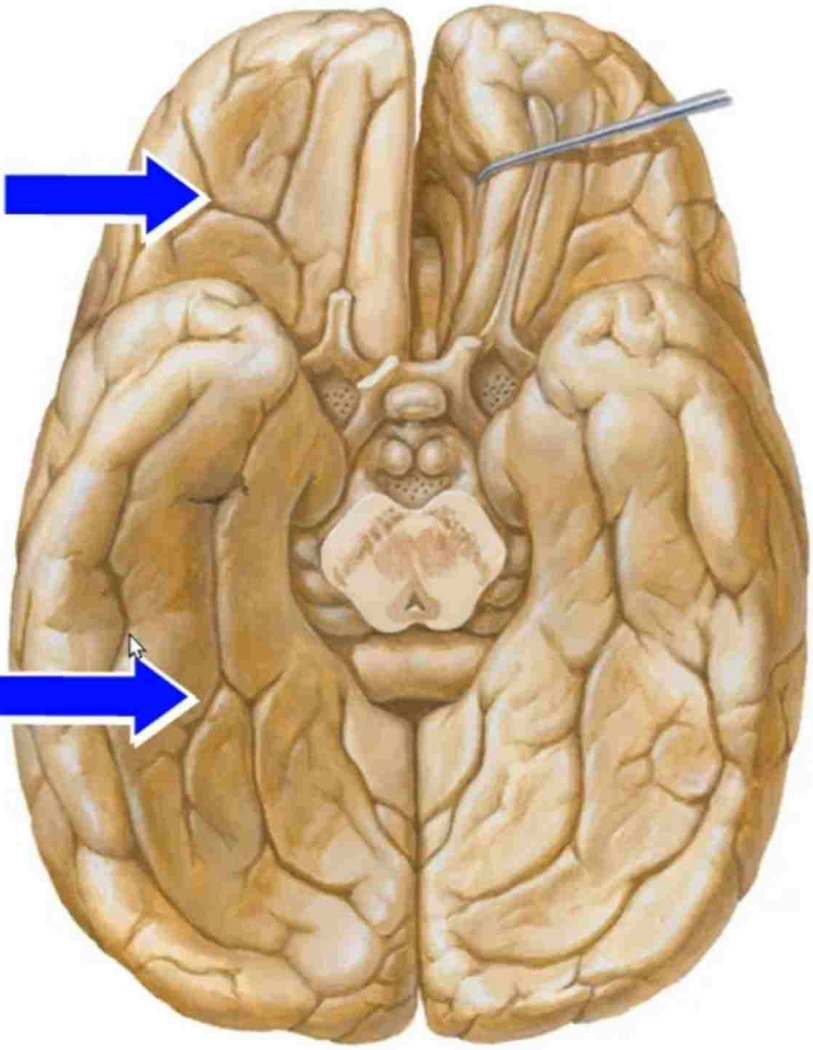
The lateral surface is identified by the presence of the lateral sulcus and the insula

The medial surface is identified by the presence of the corpus callosum

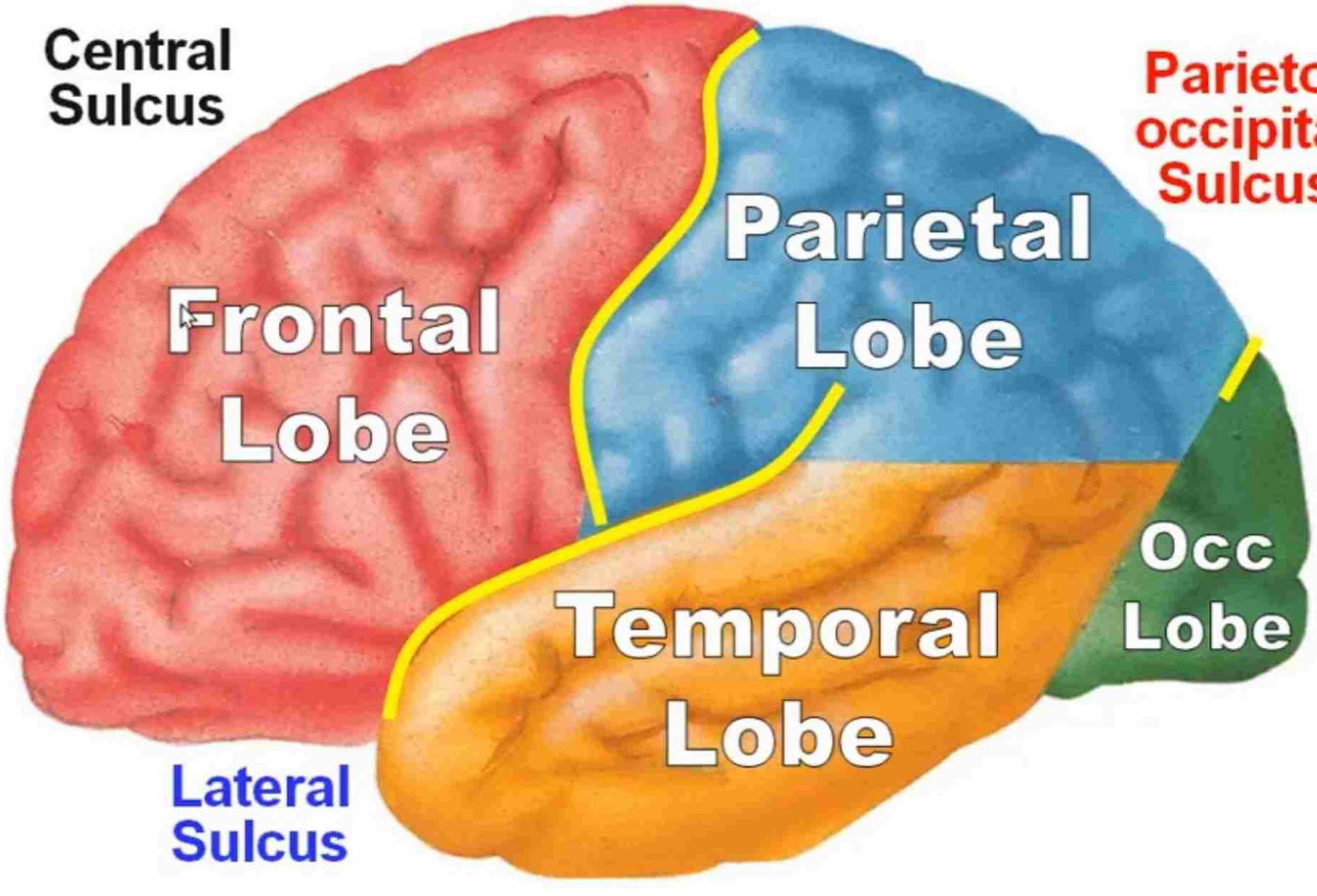
Orbital Surface

INFERIOR SURFACE

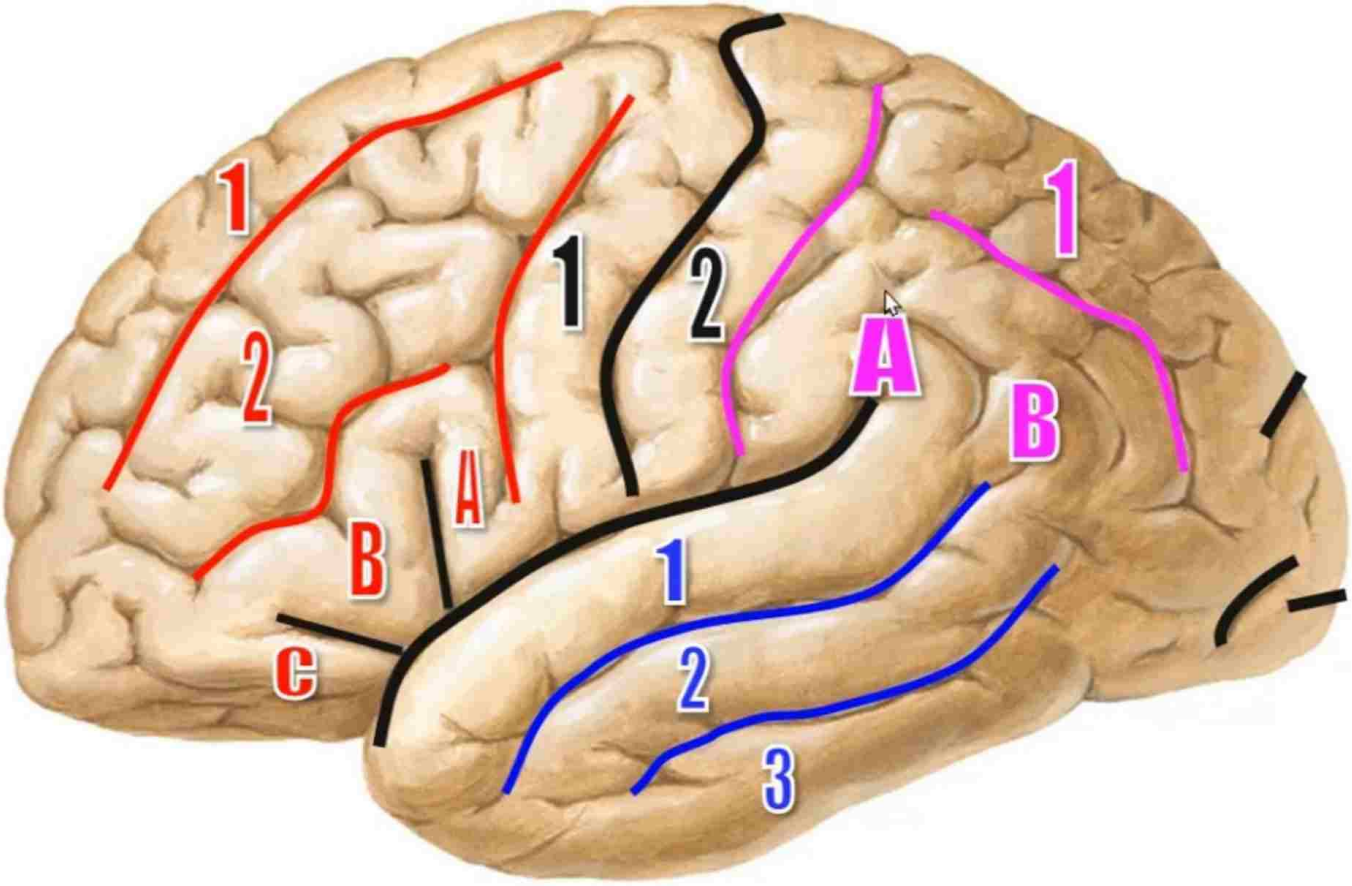
Tentorial Surface



Lobes of the Cerebral Hemisphere



Sulci & Gyri on the Lateral Surface



Cortical Areas on the Lateral Surface

Frontal Lobe:

All motor areas: 4, 6, 8, 44 & 45

Personality center: 9, 10, 11, 12

Other 3 Lobes: P + T + O

All sensory areas: 3, 1, 2 + 5, 7, 40 + 41, 42 + 22 + 39, 40 + part of 17

MOTOR AREAS

1. Primary motor area (# 4)
2. Premotor area (# 6)
3. Motor eye field area (# 8)
4. Broca's area (# 44 & 45)

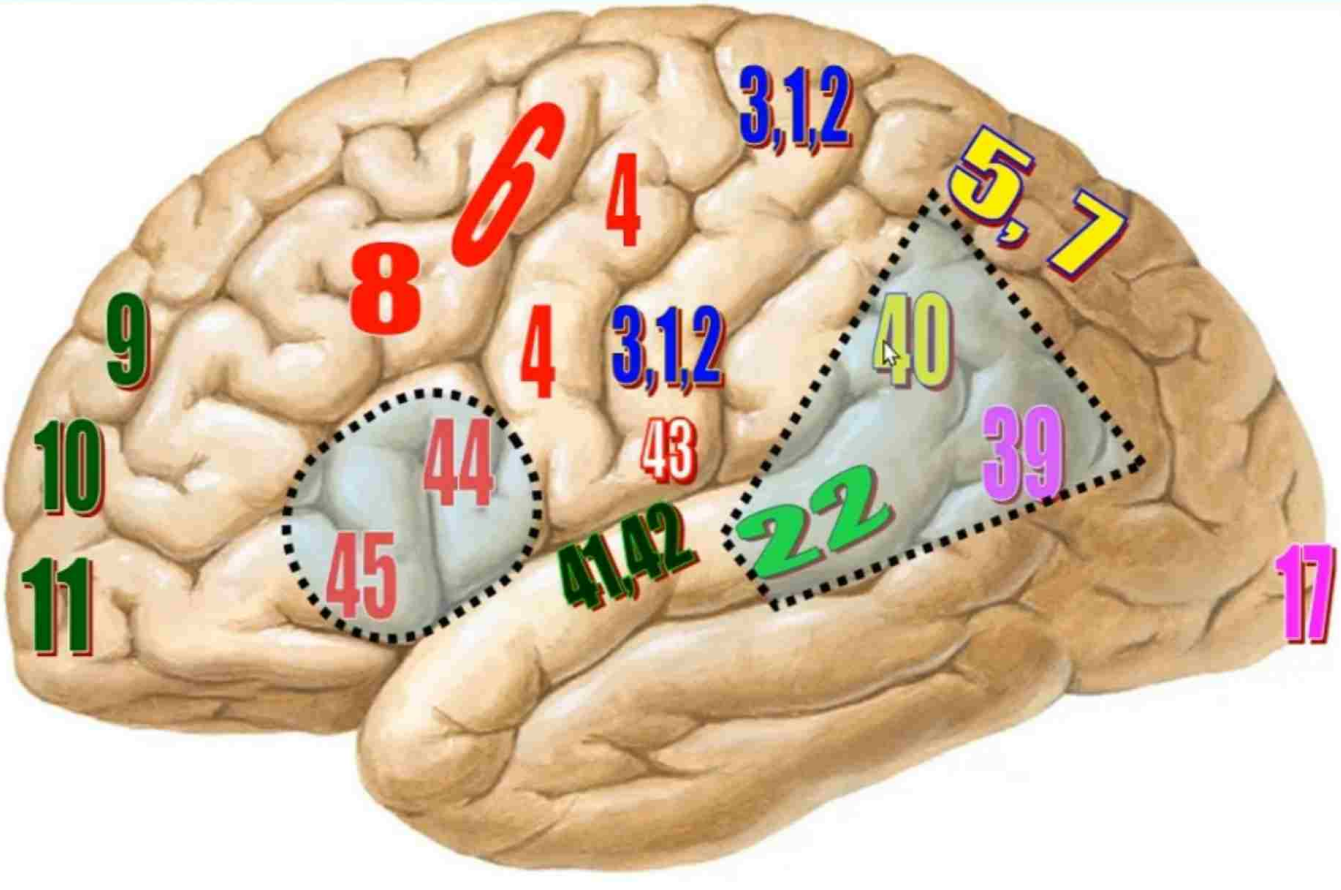
SENSORY AREAS

1. General sensory area (3, 1, 2)
2. Sensory association area (5, 7)
3. Primary auditory area (41, 42)
4. Auditory association area (22)
5. Primary visual area (17)
6. Visual association area (18, 19)
7. Others: taste, olfactory & vestibular

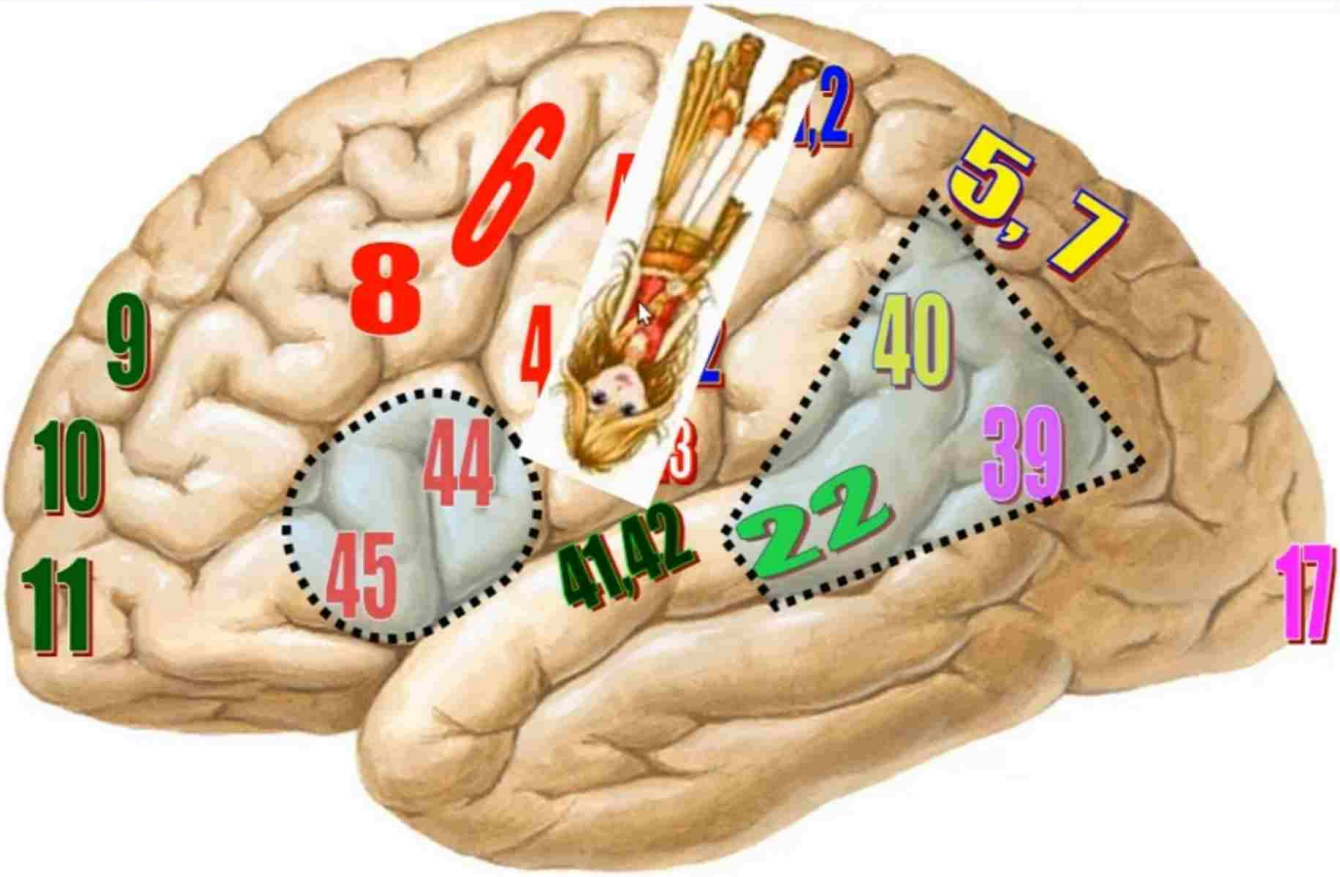
SPEECH AREAS

1. **Motor speech area:**
   Broca's area: 44 & 45
2. **Sensory speech areas:**
   a. Wernicke's area (# 22)
   b. Angular gyrus (# 39)
   c. Supramarginal gyrus (# 40)

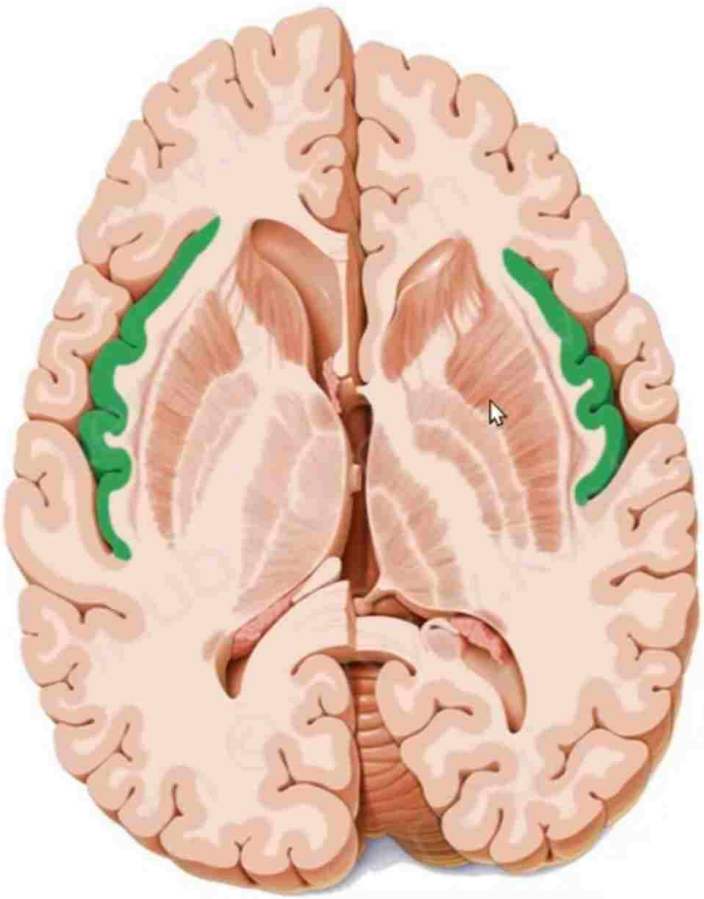
Location of the Cortical Areas

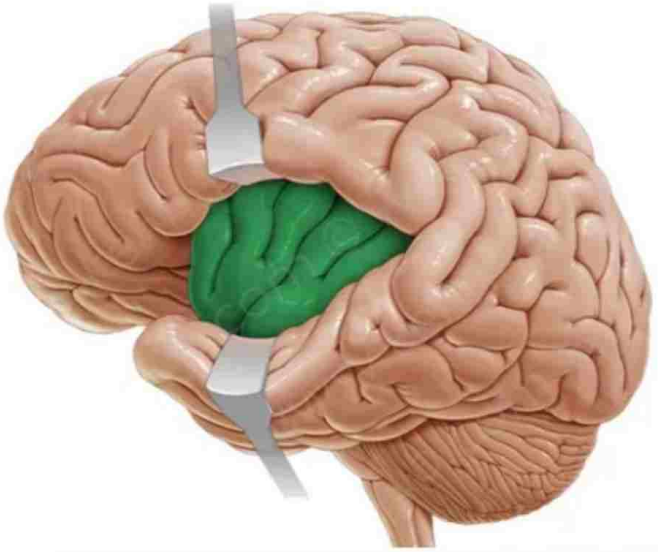


Location of the Cortical Areas



INSULA

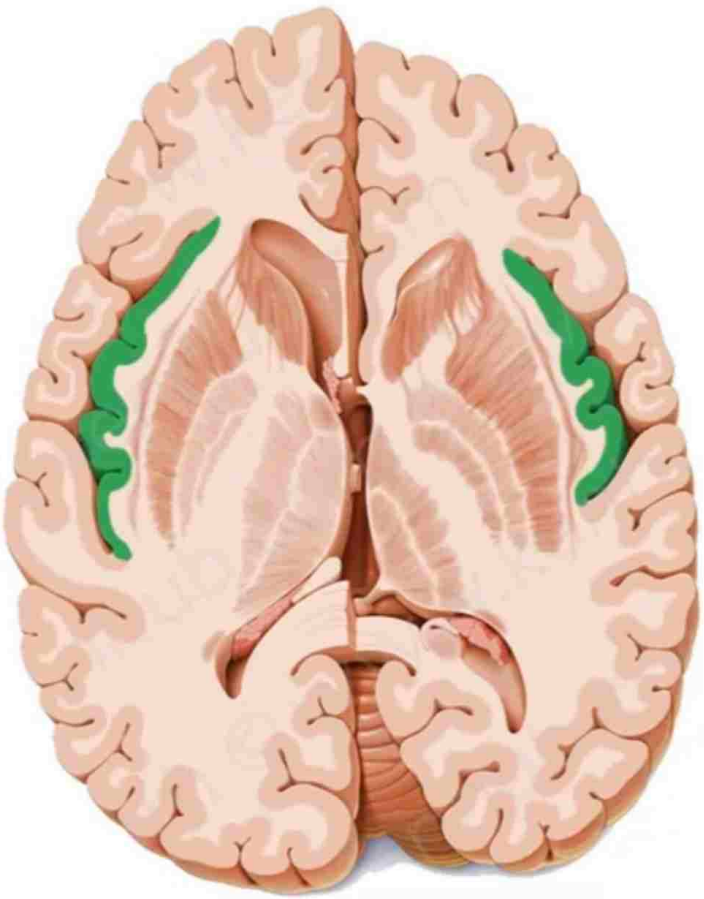


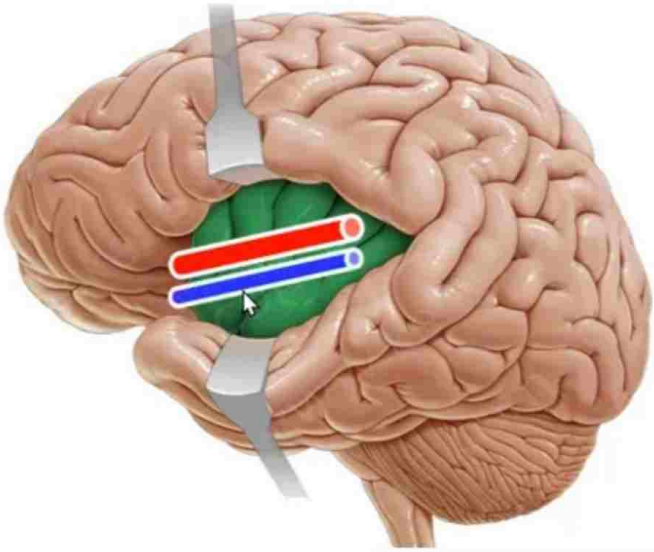


Medial Relation:

1. Extreme capsule
2. Claustrum
3. External capsule
4. Lentiform nucleus

INSULA





Medial Relation:

1. Extreme capsule
2. Claustrum
3. External capsule
4. Lentiform nucleus

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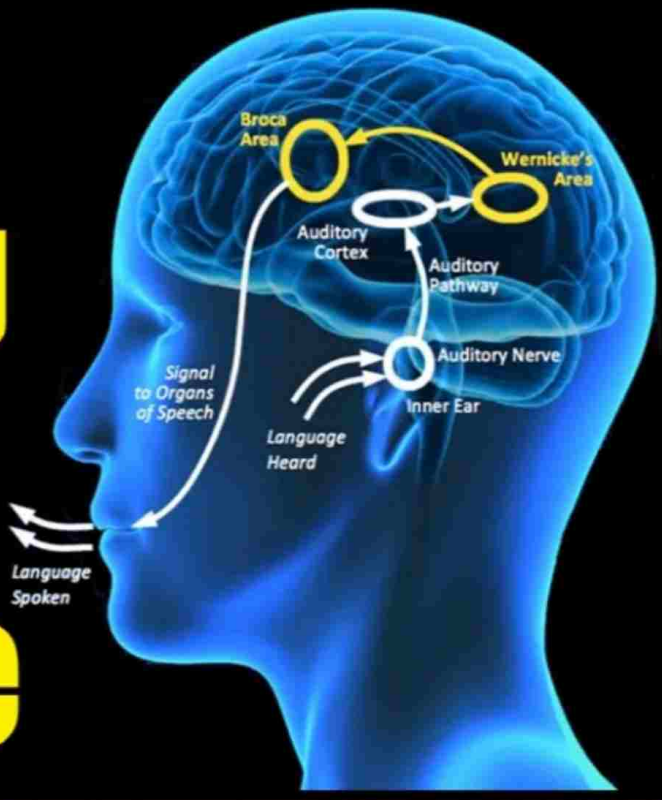
Processing of Language



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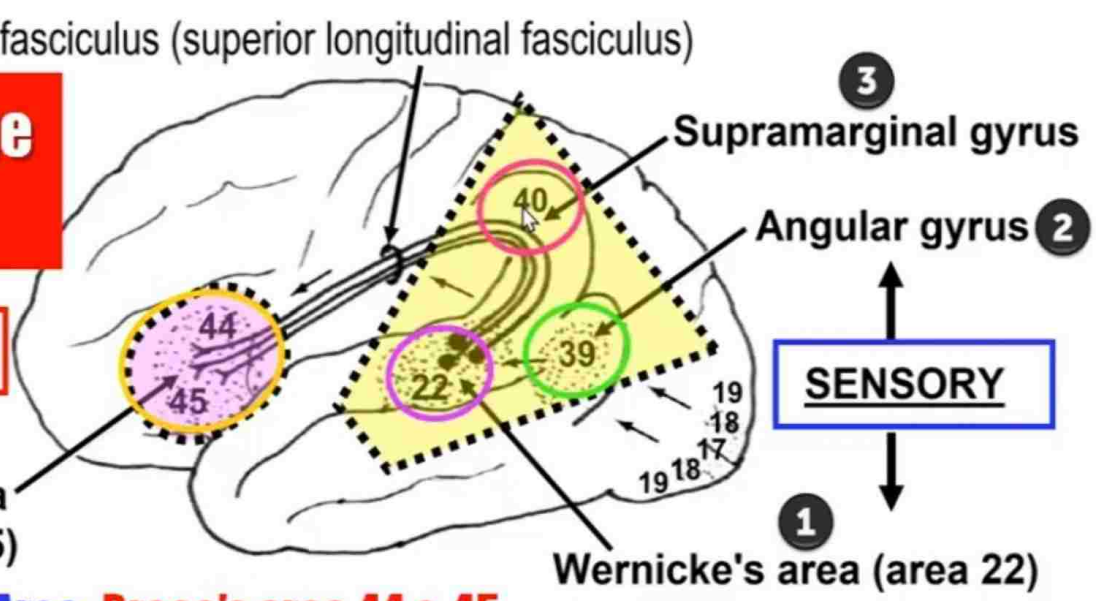
4 Language AREAS



Motor Speech Area: Broca's area 44 & 45

Lesion: expressive (motor) aphasia

Are present in the dominant hemisphere

3 Sensory Speech Areas: Areas 22, 39 & 40

@ Wernicke's area 22: understands the spoken language

Lesion: sensory aphasia, inability to understand spoken / written language

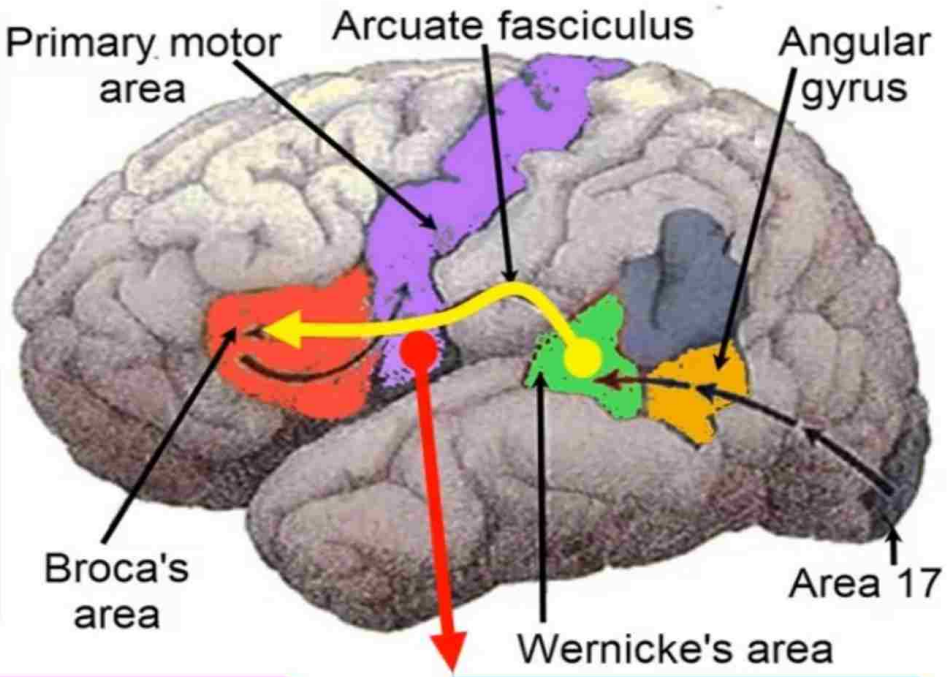
@ Angular gyrus: area 39: understands the written language

Lesion: alexia and agraphia

@ Supramargial gyrus: #40: understands sizes, shapes & texture and recognition of the body parts and left side from right side

Processing of Written Language

Reading from a book



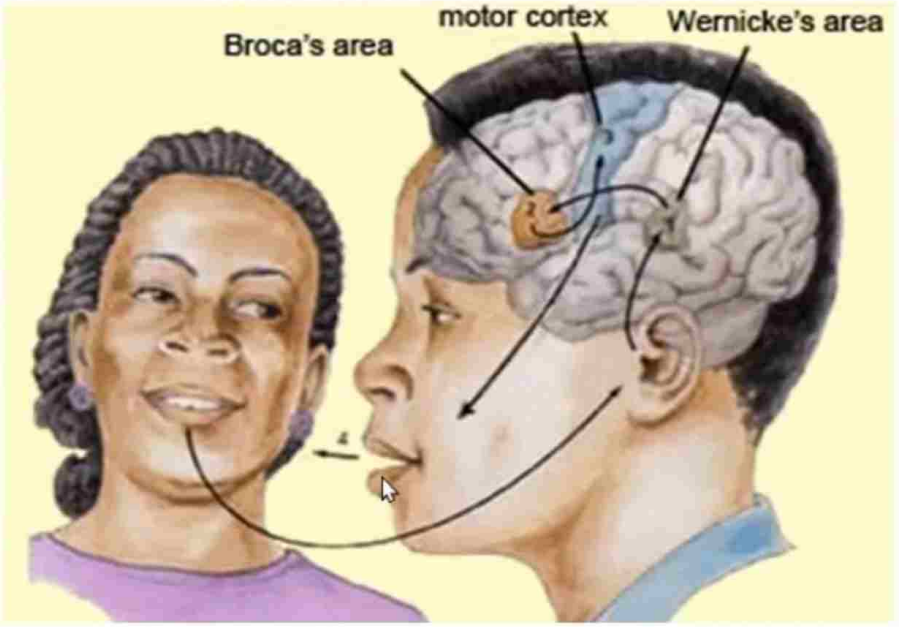
Retina → Primary visual area → #18 &19 for recognition

Angular gyrus to comprehend the written form → Wernicke's area to comprehend the auditory form → Broca's area via arcuate fasciculus to formulate the words

Area 4 → Coticobulbar tract → VII, X, XII to lips, larynx and tongue

Processing of Spoken Language

Answering a Question



Ear → Primary auditory area 41, 42 → Wernicke's area to comprehend the spoken words

Broca's area via arcuate fasciculus to formulate the words → Primary motor Area 4 → Corticobulbar tract

VII, X & XII nerves → Muscles of lips, larynx and tongue

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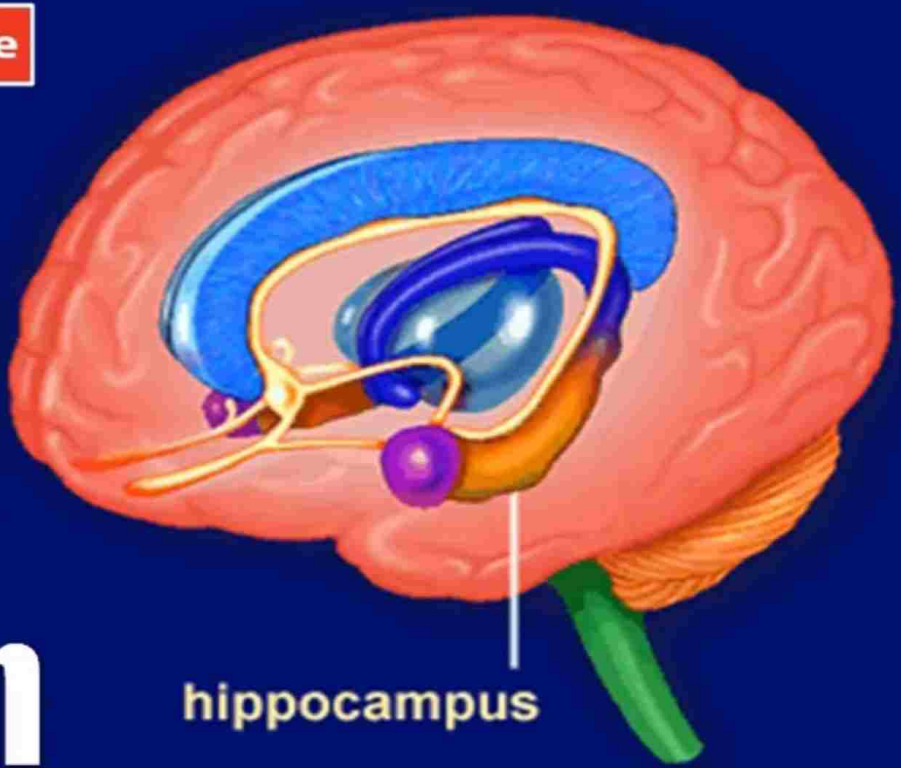
The Limbic system



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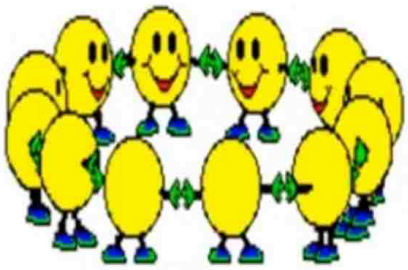
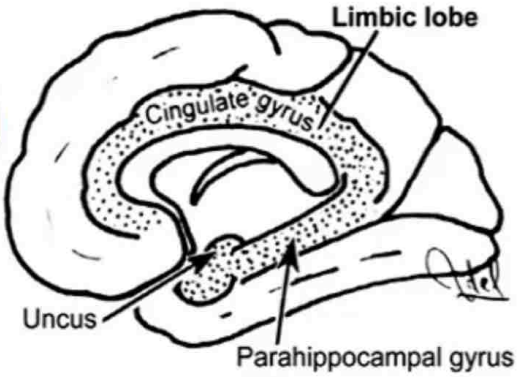
LIMBIC SYSTEM

Components:

1. Nuclei
2. Fiber bundles



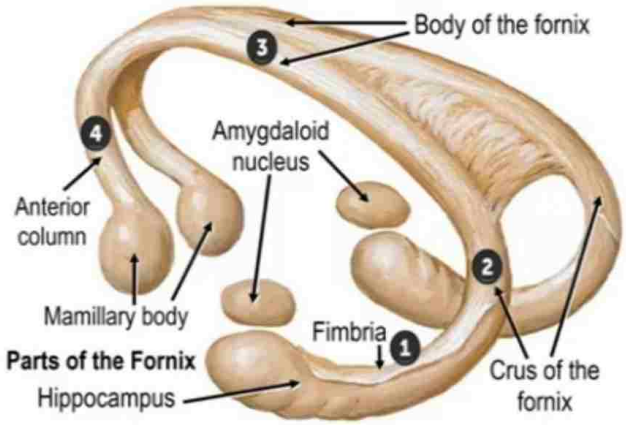


Functions:

1. Recent memory
2. Emotional behavior
3. Olfaction

Lesions:

1. Loss of memory
2. Alzheimer's disease
3. Abnormal behavior



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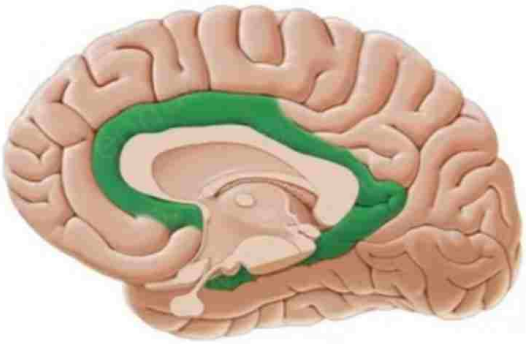
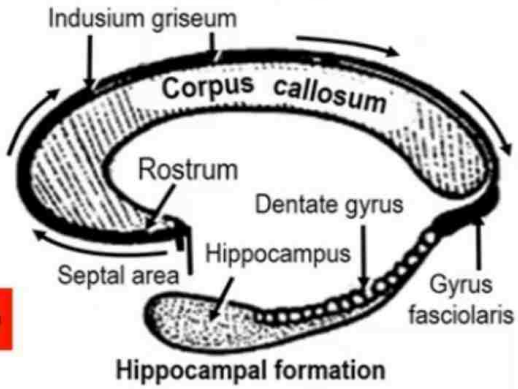
NUCLEI



1. **Limbic lobe: 3 parts**
   a. Cingulate gyrus
   b. Parahippocampal gyrus
   c. Uncus
2. **Hippocampal formation:**
   hippocampus & dentate gyrus
3. **Mamillary boby** (hypothalamus)
4. **Thalamus:**
   a. Anterior nucleus
   b. Medial nucleus
5. **Prefrontal cortex**
6. **Amygdaloid nucleus**
7. **Septal area**
8. **Habenular nucleus**



Hippocampal formation

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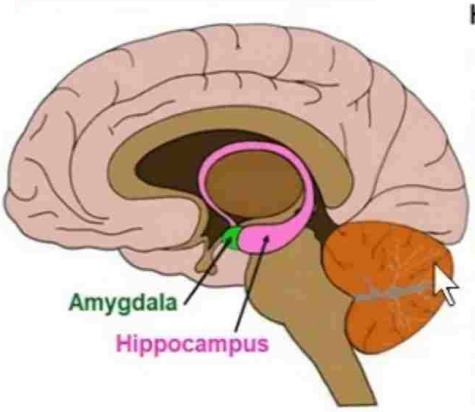

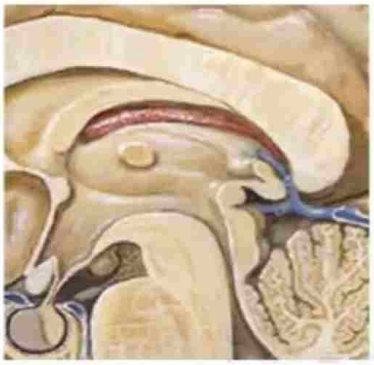

LIMBIC SYSTEM

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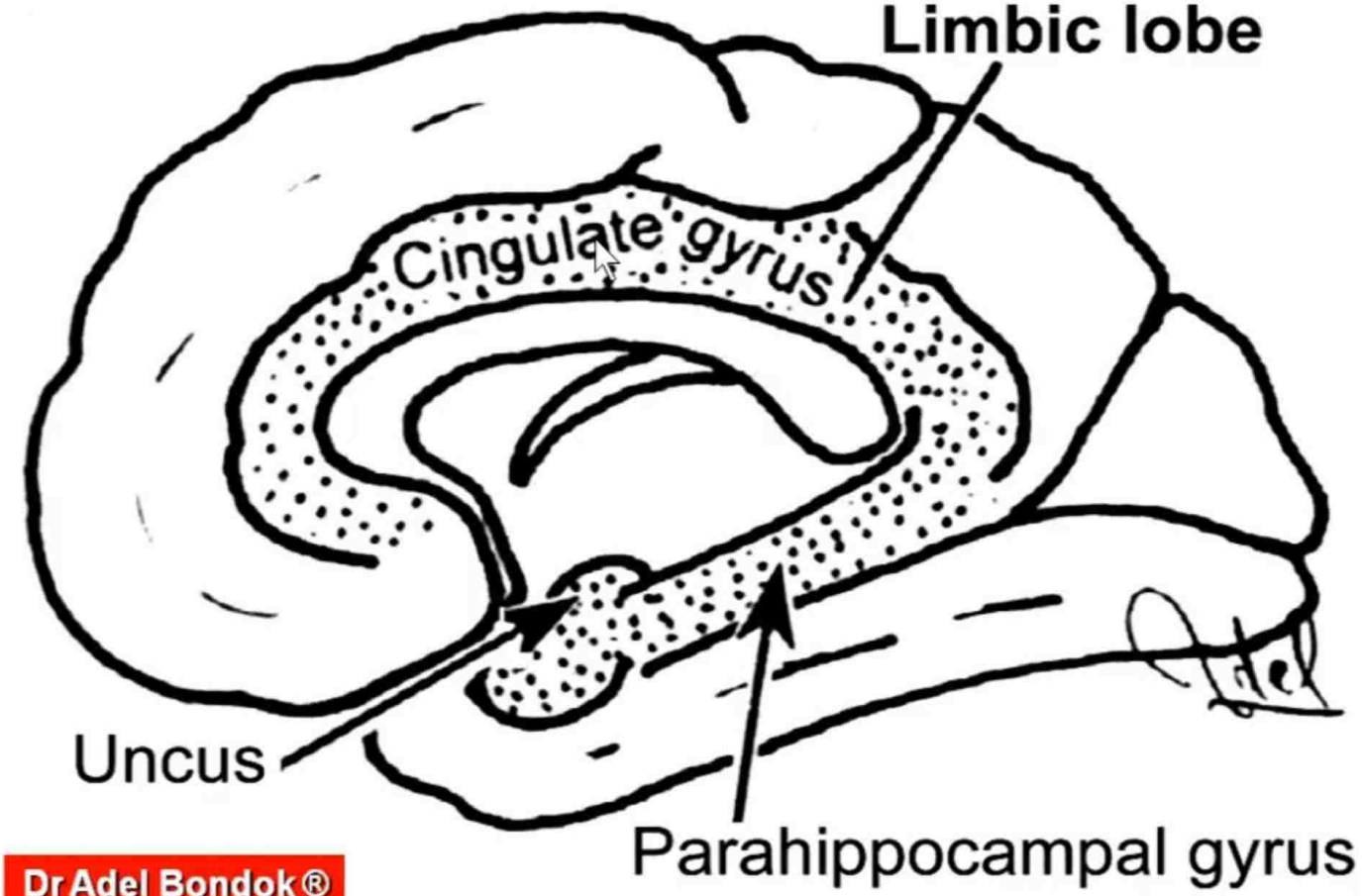
- Limbic lobe
- Hippocampus
- Mamillary body
- Anterior thalamic nucleus
- Medial thalamic nucleus
- Prefrontal cortex
- Amygdaloid nucleus
- Septal area
- Habenular nucleus

- Cingulum
- Fornix
- Mamillothalamic tract
- Ant thalamic radiation
- Stria terminalis
- Stria medullaris thalami

Limbic lobe



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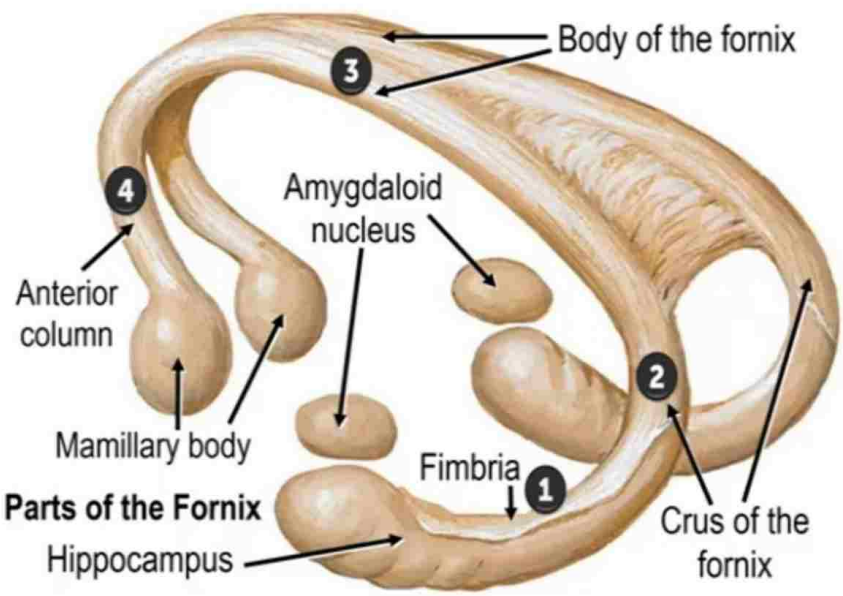

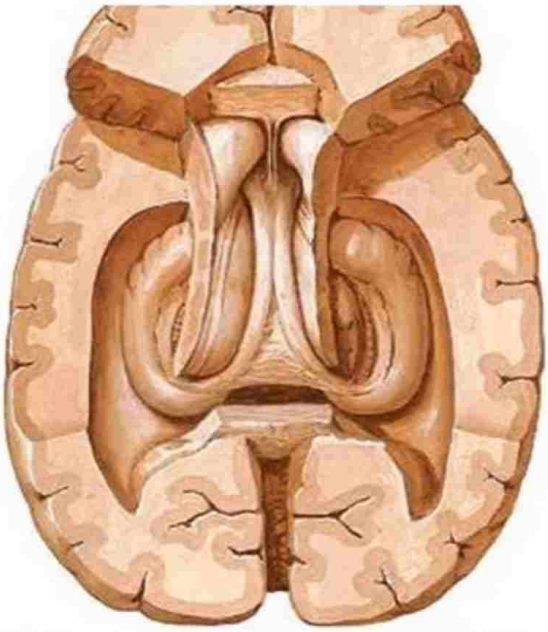

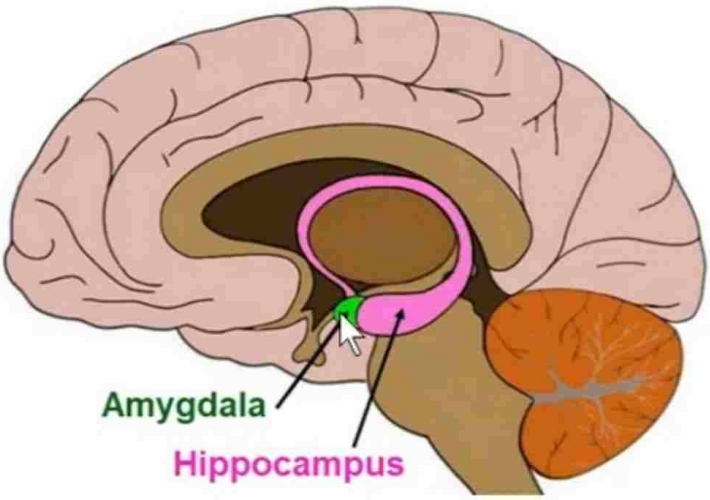

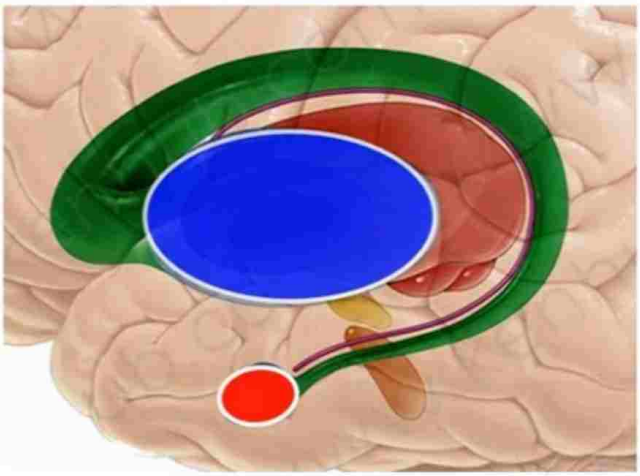

FUNCTIONS

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1. Recent memory:

hippocampus plays a role in short-term memory

2. Emotional behavior:

a. Emotions: all types of feelings and expressions

b. Emotional reactions (behavior) to situations

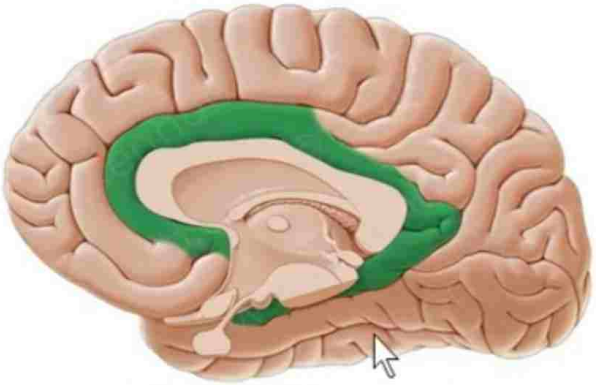
c. Anger, fear, sadness, and aggression (amygdala)

d. Sexual behavior and sex drive (amygdala)

e. Social behavior and individual's personality

3. Olfaction: uncus and amygdaloid nucleus

Papez Circuit for Emotions



Hippocampus

Cingulum

Cingulate gyrus

Fornix

Anterior thalamic radiation

Mamillary body

Mamillothalamic tract

Anterior thalamic nucleus

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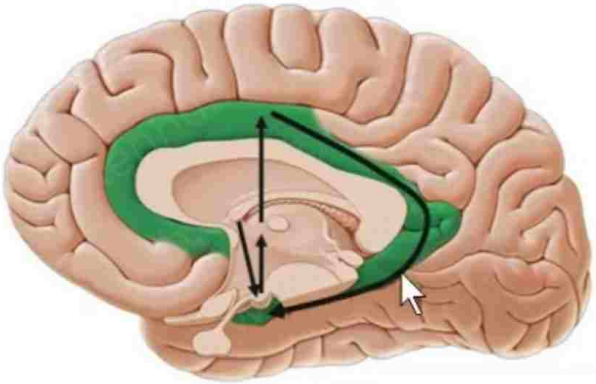
Papez Circuit for Emotions



Hippocampus

Cingulum

Cingulate gyrus

Fornix

Anterior thalamic radiation

Mamillary body

Mamillothalamic tract

Anterior thalamic nucleus

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Lesions of the Limbic System

1. **Lesion** in the **hippocampus** causes **loss of memory**
2. **Alzheimer's disease:** there is extensive **degeneration** in the **hippocampus**
3. **Lesion** In the **amygdaloid nucleus** causes **loss of** aggressive behavior, fear and anger.
4. Bilateral lesion of the **amygdaloid** and **hippocampus** causes increased appetite and abnormal **hypersexual behavior**

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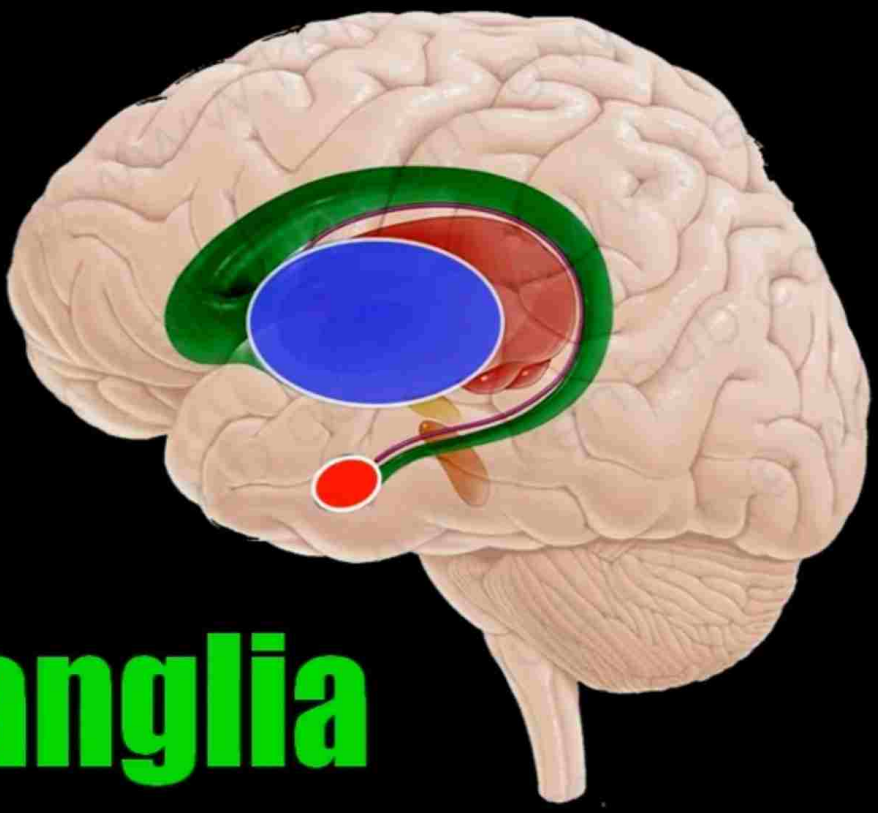
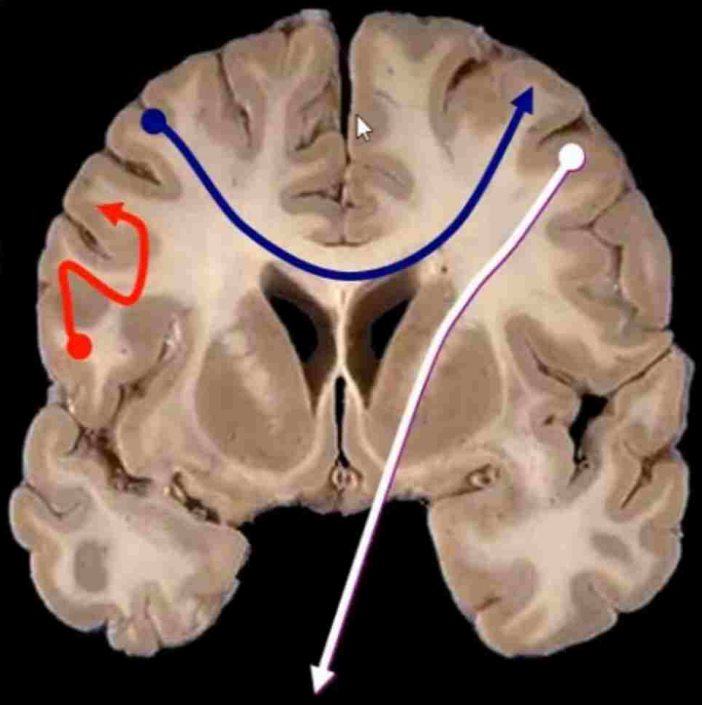


Anatomy of the Basal Ganglia

Dr Adel Bondok
Mansoura University, Egypt

Internal Structure of the Cerebrum

- ❑ Lateral Ventricle
- ❑ Basal Ganglia
- ❑ 3 Types of Nerve Fibers:
  1. Commissural fibers
  2. Association fibers
  3. Projection fibers



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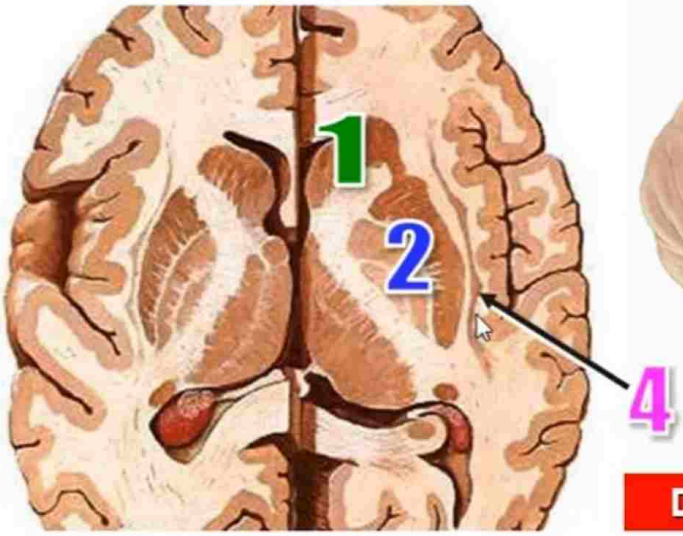
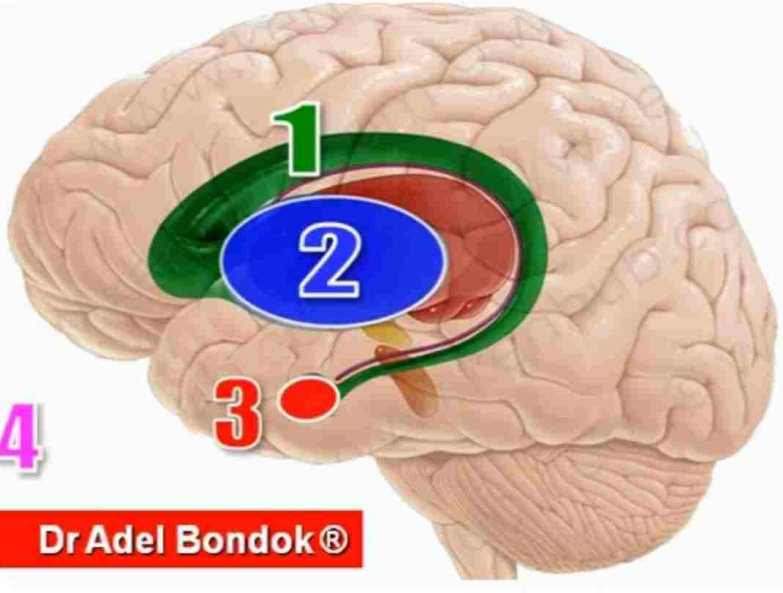
BASAL GANGLIA

4 ANATOMICAL COMPONENTS:

1. Caudate nucleus
2. Lentiform nucleus
3. Amygdaloid nucleus
4. Claustrum

Anatomically, they are the subcortical nuclei in the cerebral hemisphere





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CLINICAL COMPONENTS

They are the extrapyramidal motor nuclei

1. **Corpus striatum:**
   - a. Caudate nucleus
   - b. Lentiform nucleus
   - c. Nucleus Accumbens (pleasure center)
2. **Subthalamic nucleus**
3. **Red nucleus & substantia nigra**
4. **VA & VL thalamic nuclei**

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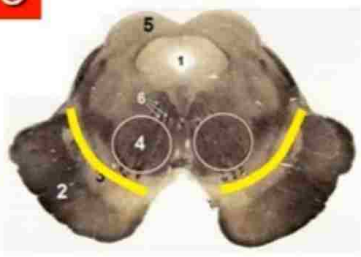
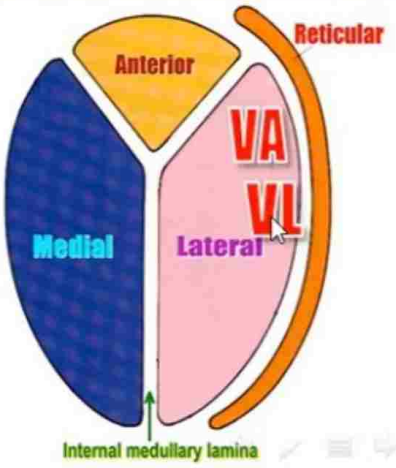
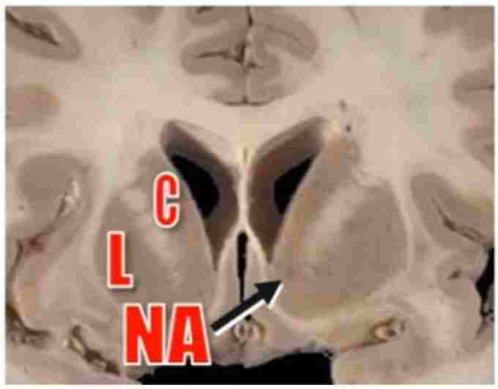
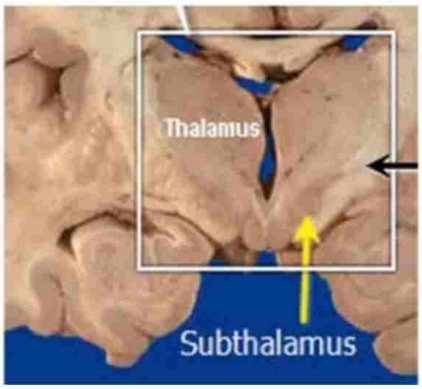
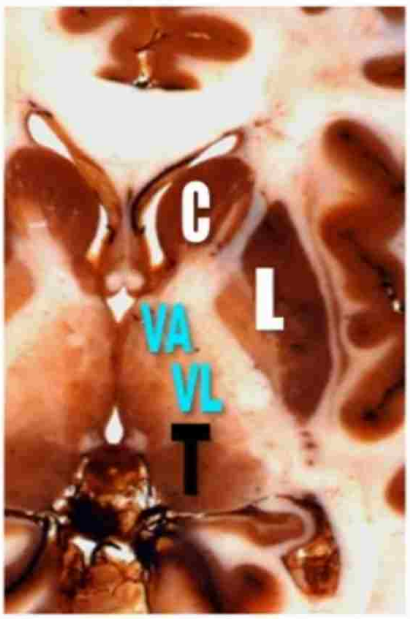


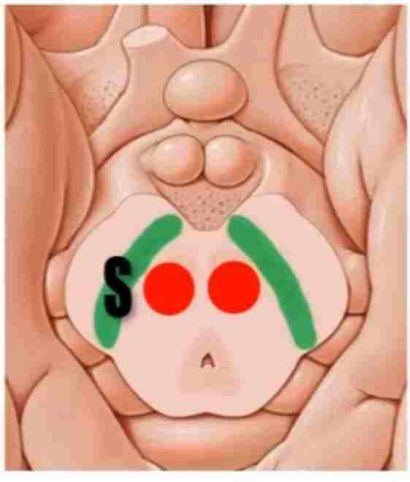
THALAMIC NUCLEI



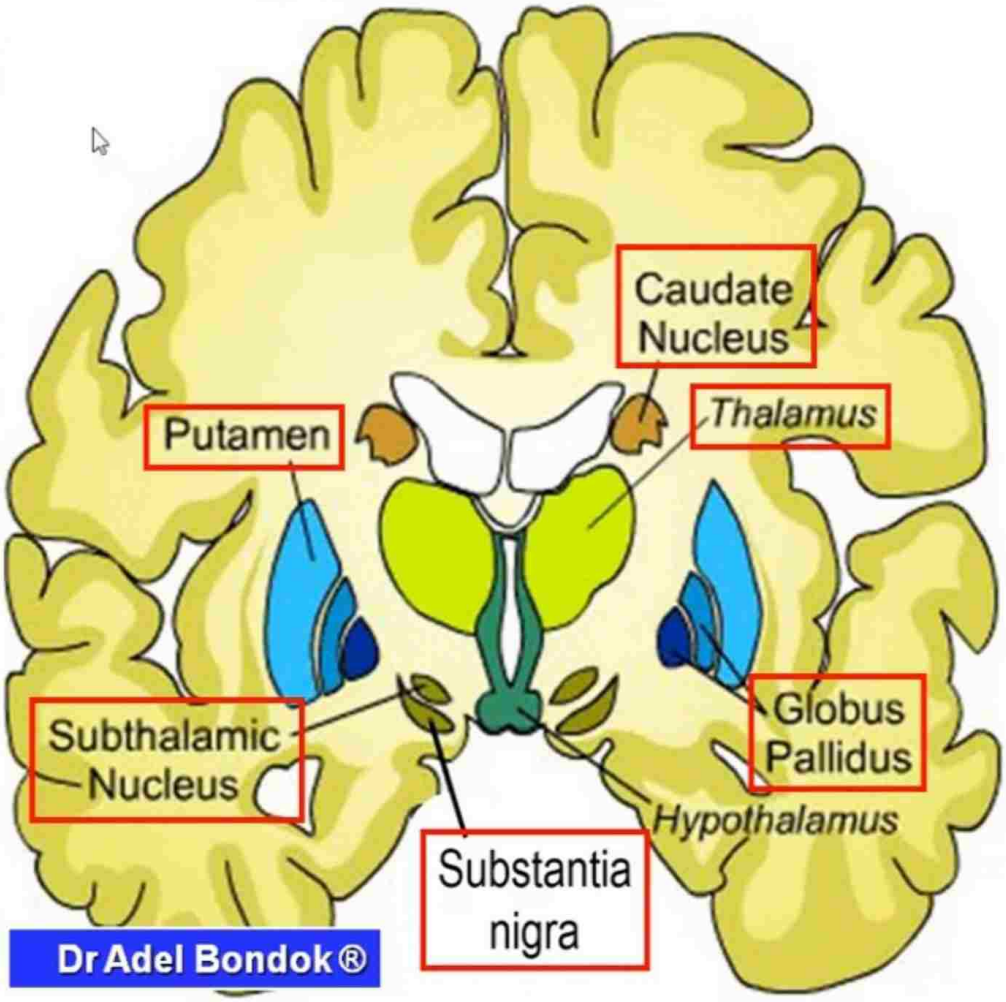








Components of BG



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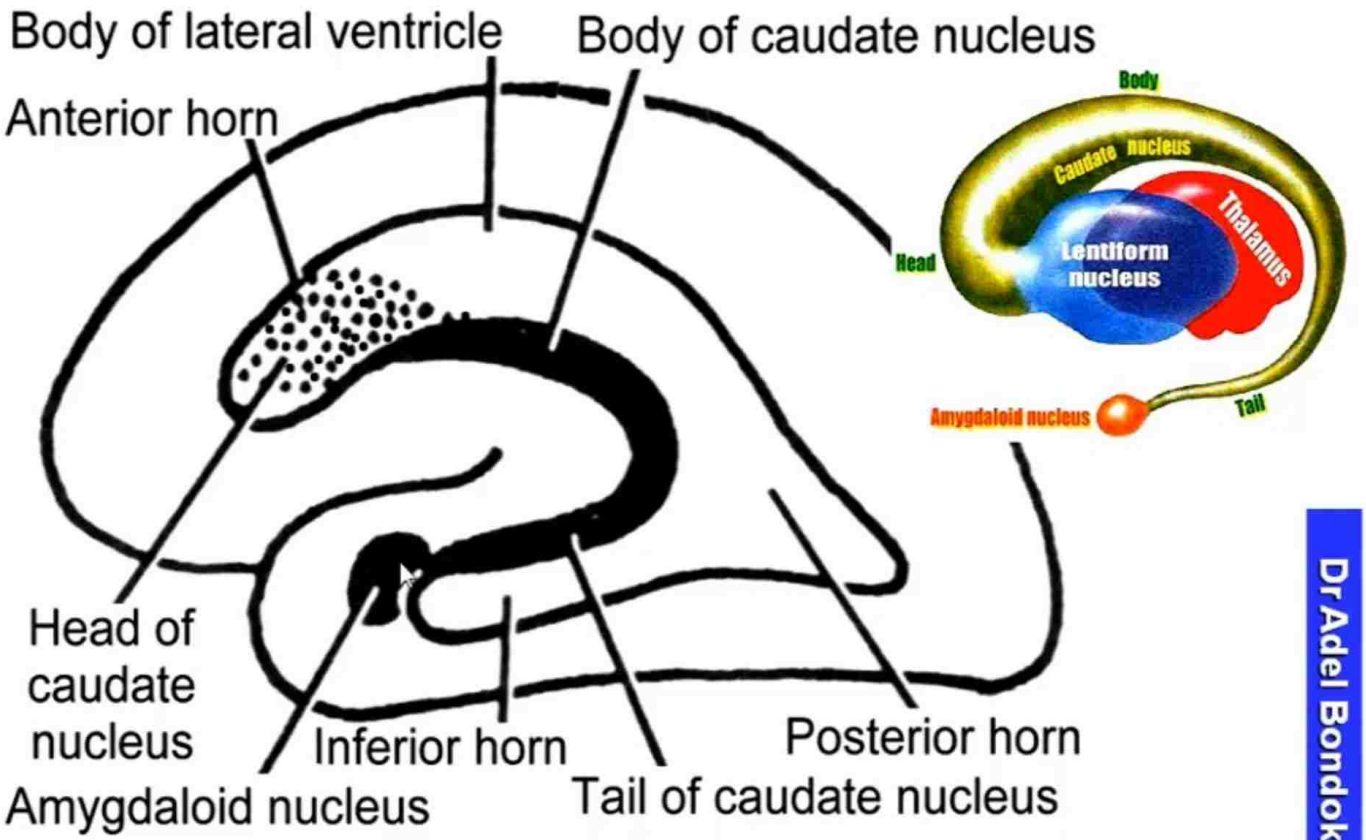
CAUDATE NUCLEUS



RELATION TO THE CAUDATE NUCLEUS

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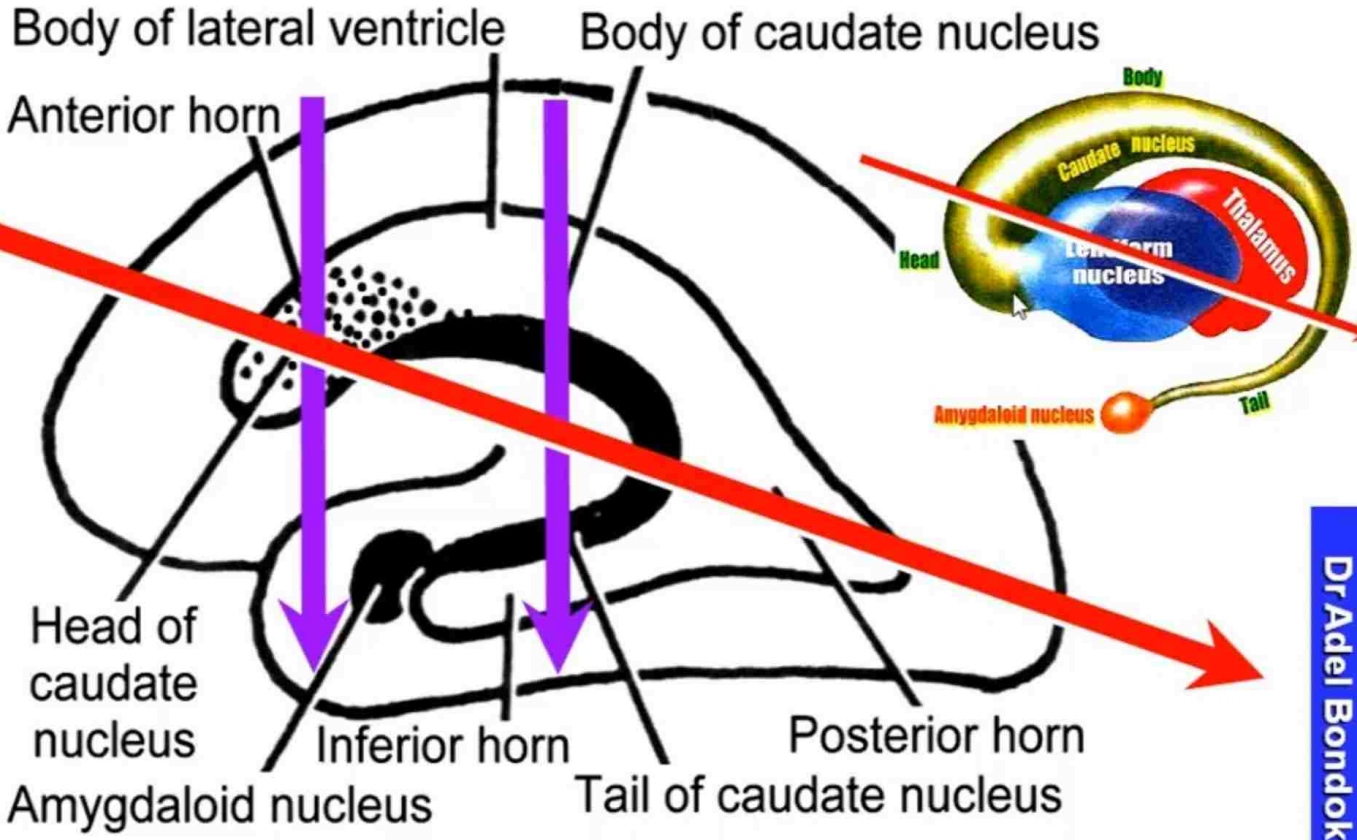
CAUDATE NUCLEUS



RELATION TO THE CAUDATE NUCLEUS

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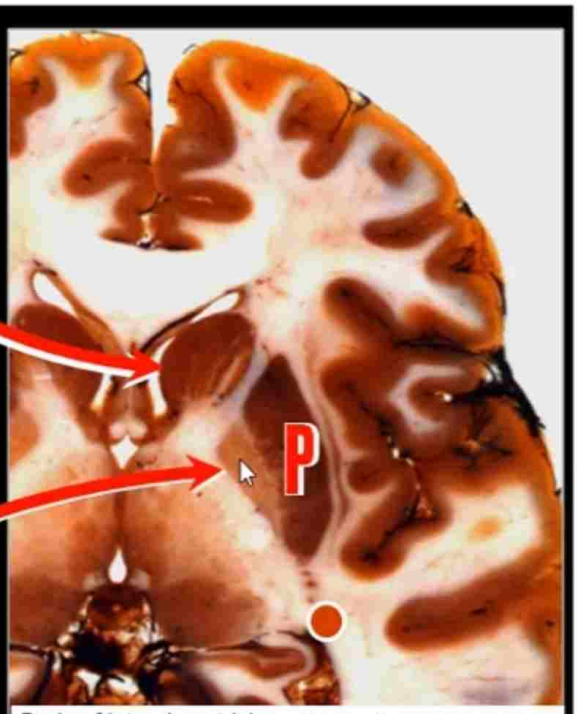
CAUDATE NUCLEUS:

1. Head: to ant horn
2. Body: to body of LV
3. Tail: to inf horn of LV



LENTIFORM NUCLEUS:

1. Putamen
2. Globus Pallidus

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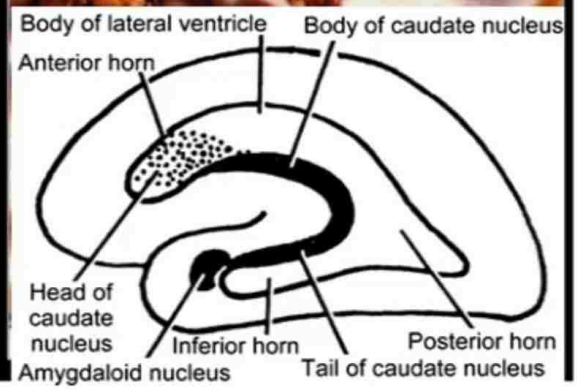
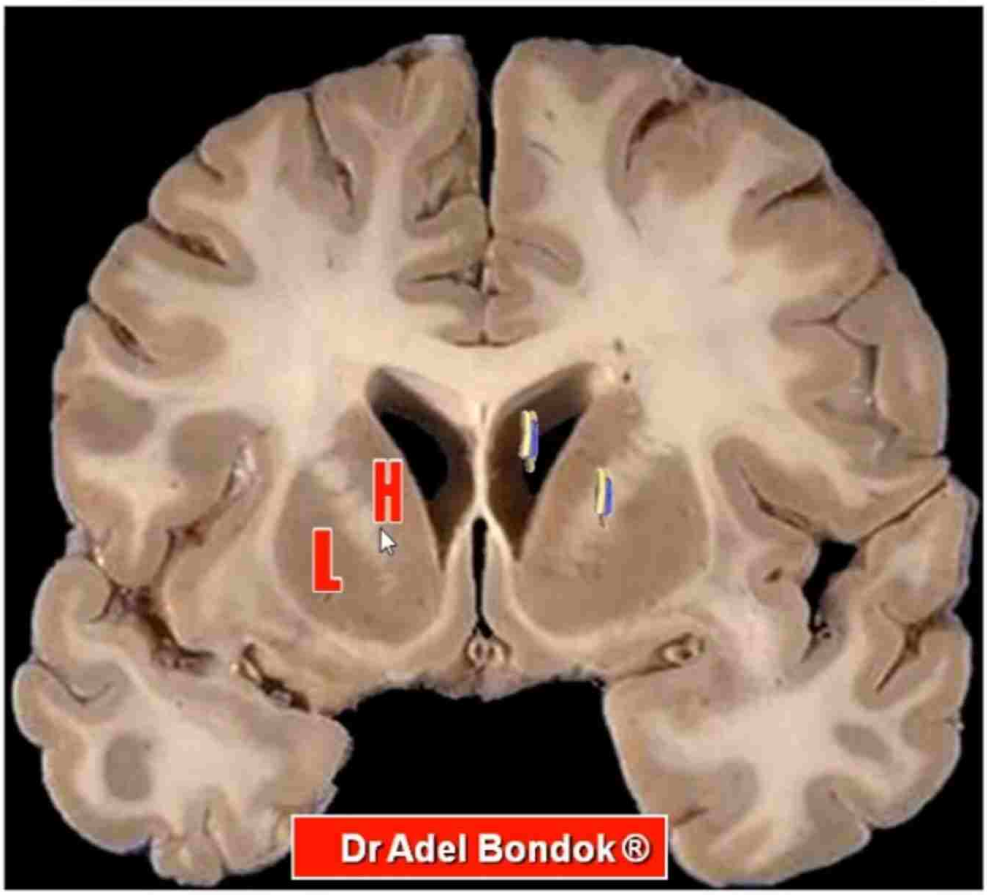


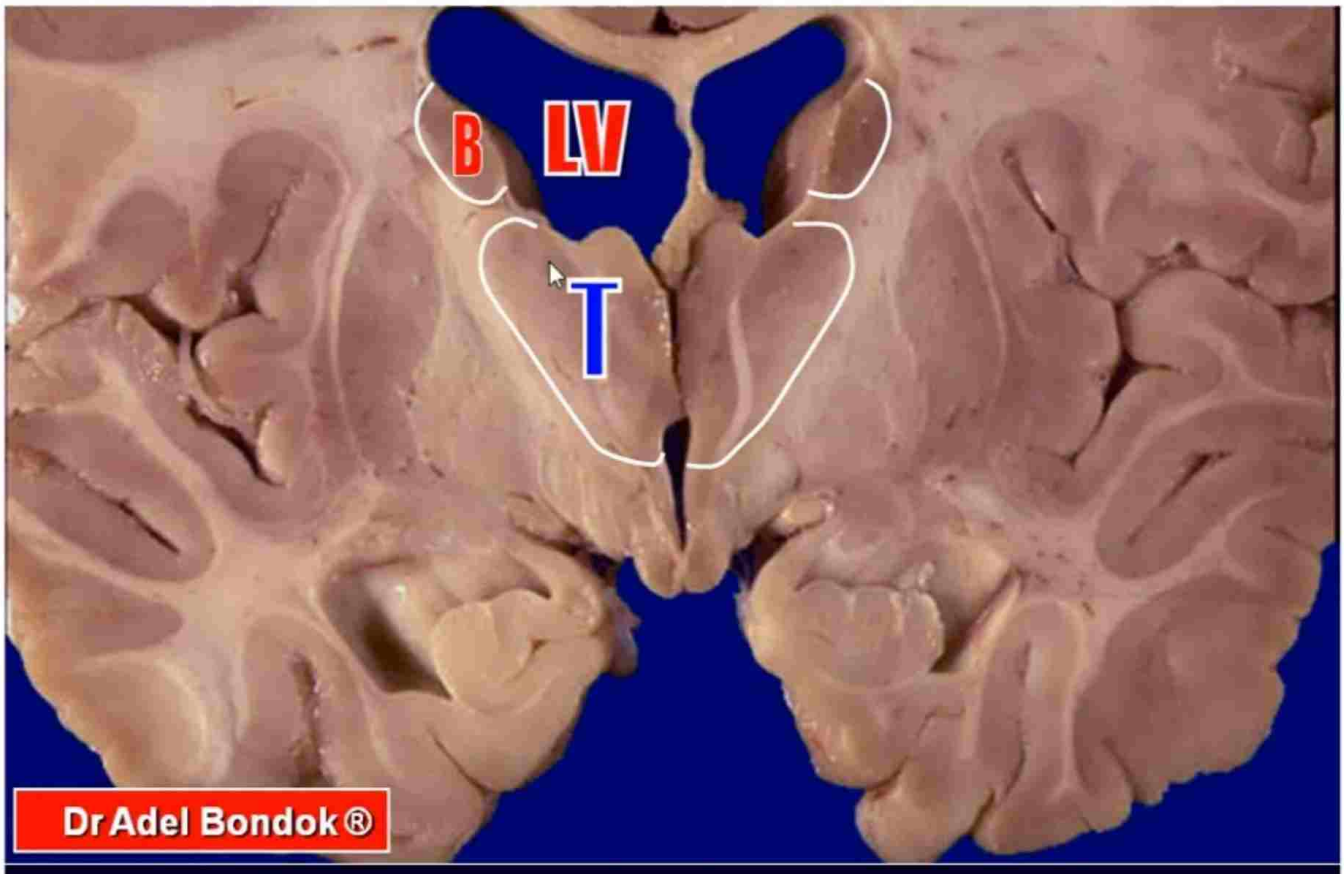
Head of Caudate Nucleus

CORONAL SECTION
Level of the Rostrum

Related to 2 Anterior:

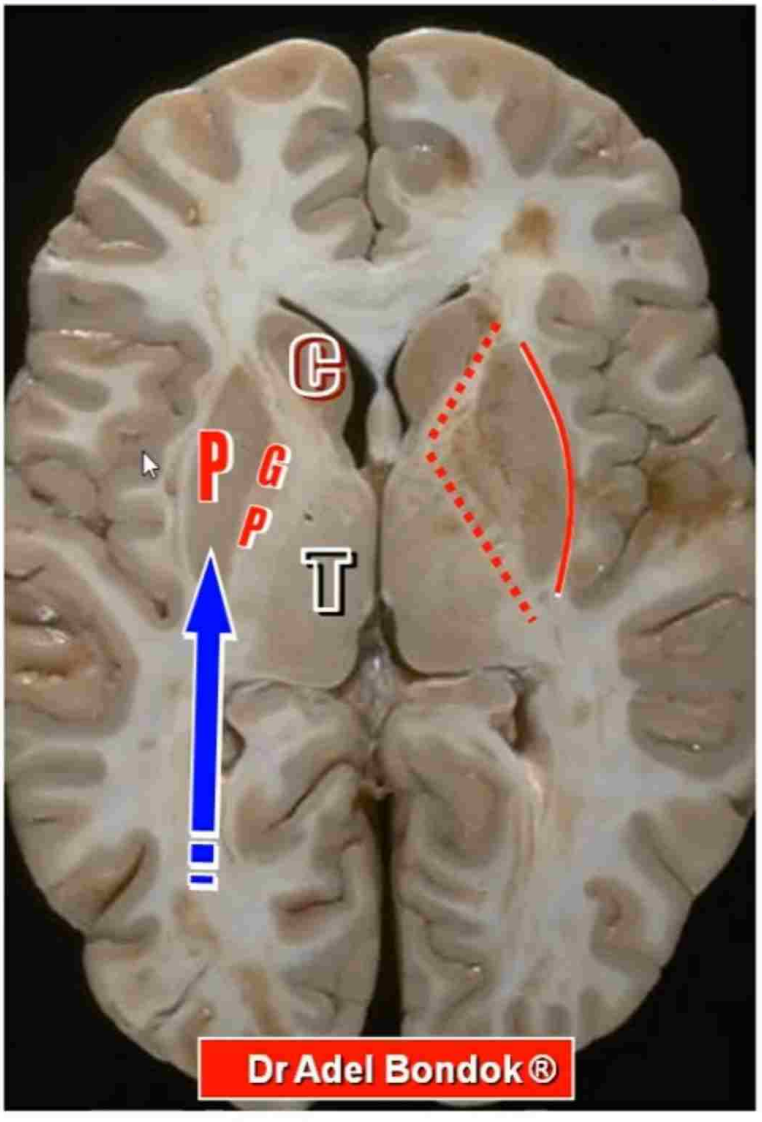
1. Ant horn of lat vent
2. Ant limb of internal Capsule





Body of caudate nucleus: Related to the
Thalamus & central part of the lat ventricle
@@ Lentiform Nucleus: Putamen & Globus Pallidus

LENTIFORM NUCLEUS



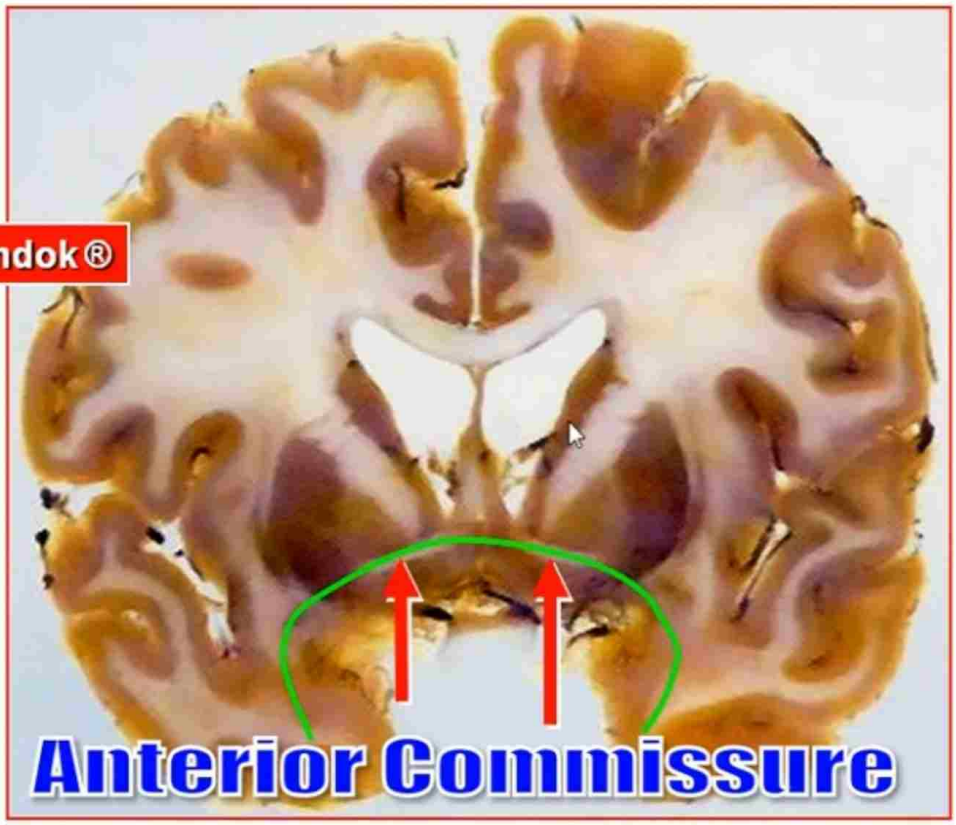
PARTS:

1. Putamen
2. Globus Pallidus

RELATIONS:

1. Medial: Int Cap
2. Lateral: Ext Cap
3. Inferior: Ant Com

INFERIOR RELATION OF THE LENTIFORM NUCLEUS



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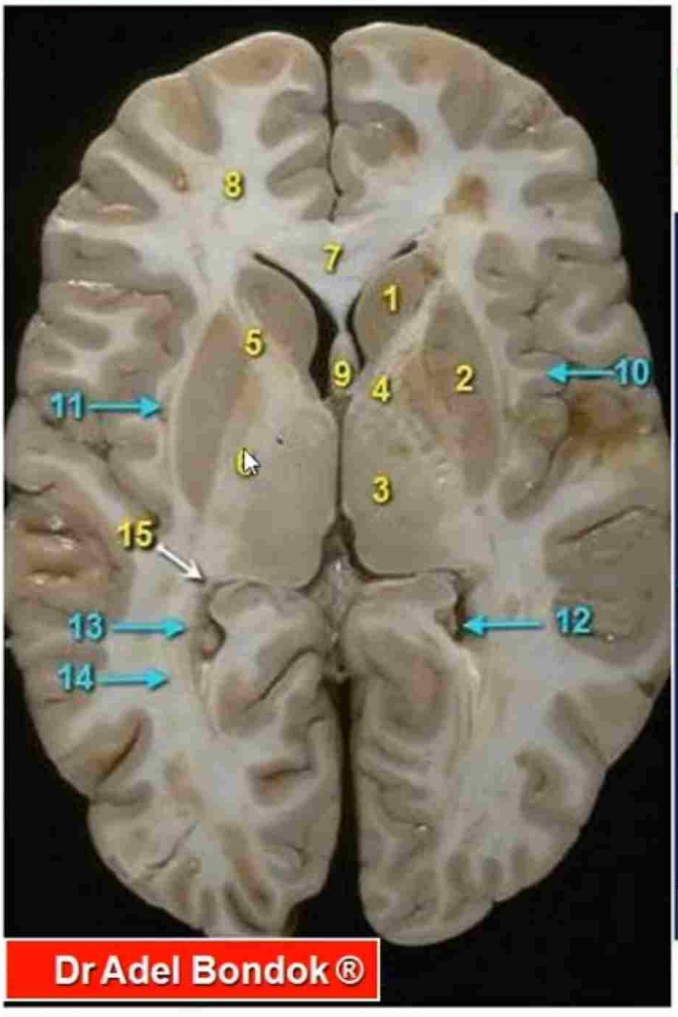
HORIZONTAL SECTION



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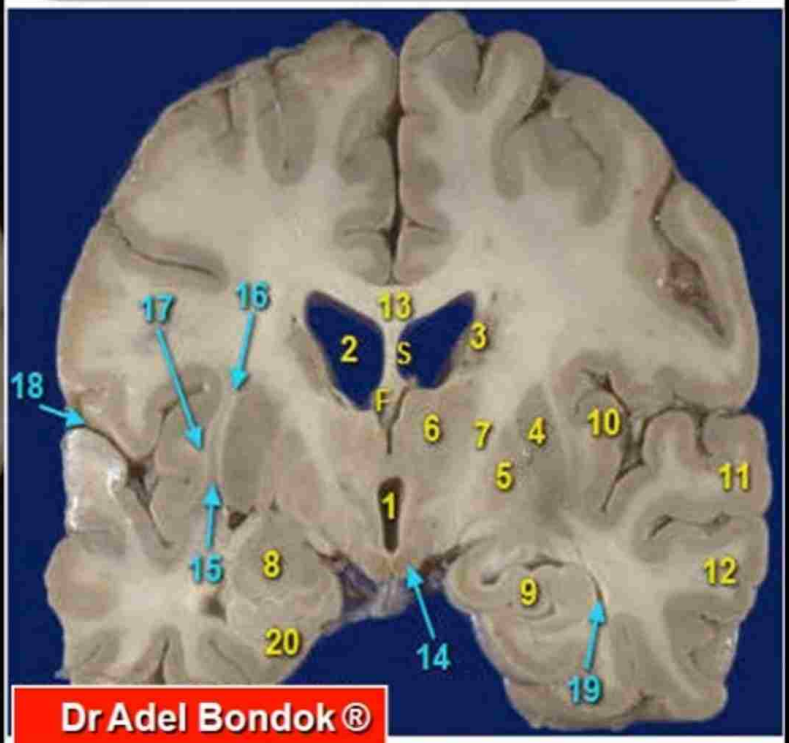
CORONAL SECTION
Level of the Mamillary Body



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Dopamine from the VTA in the midbrain

Amygdaloid Nucleus

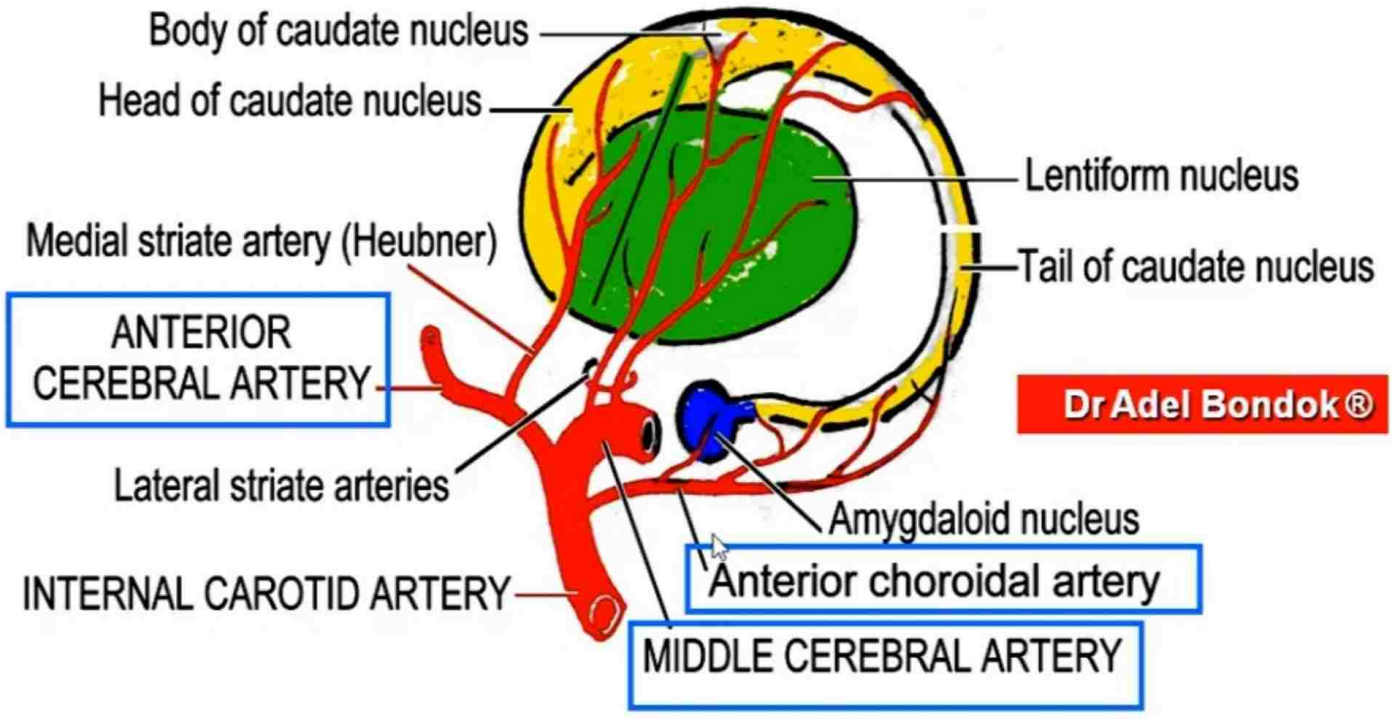
Nucleus Accumbens

Dr Adel Bondok®

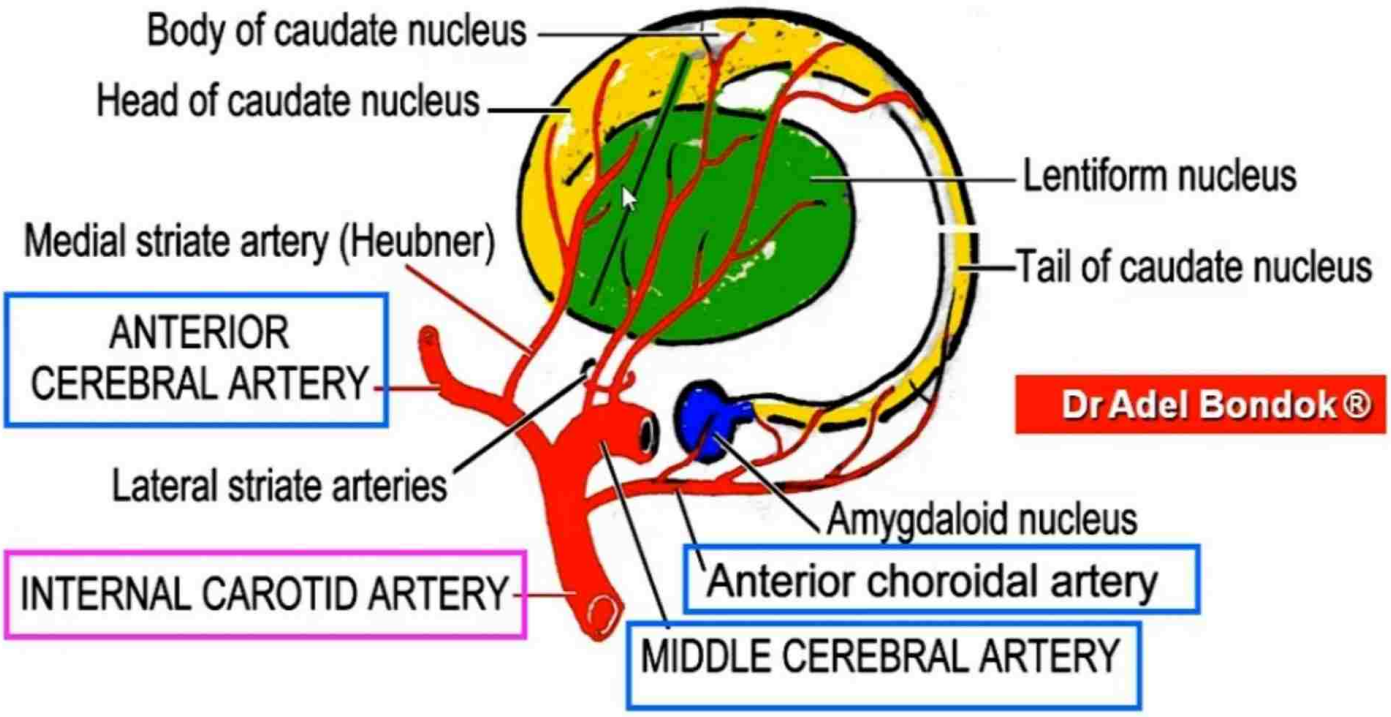
Globus pallidus → Medial thalamic nucleus → Prefrontal cortex → Affect the mood

1. It is a pleasure center
2. Involved in motivation
3. Involved in drug & alcohol addiction

ARTERIAL SUPPLY OF THE BASAL GANGLIA 3



ARTERIAL SUPPLY OF THE BASAL GANGLIA 3



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FUNCTIONS OF THE BASAL GANGLIA

1. Regulate the stereotyped gross movement (as walking, running & swimming)
2. Maintain stability of the muscles of the trunk

Dr Adel Bondok®

Motor & Limbic Activity of BG

Dr Adel Bondok®

Motor Circuit
Cerebral Cortex

Striatum:
Caudate & Putamen

Globus Pallidus

Glu &
GABA

Subthalamus

D

Substantia Nigra
Pars Compacta

Substantia Nigra
Pars Reticularis

Thalamus: VA & VL

+
-

Limbic Circuit
Prefrontal Cortex

Amygdaloid

MB VTA

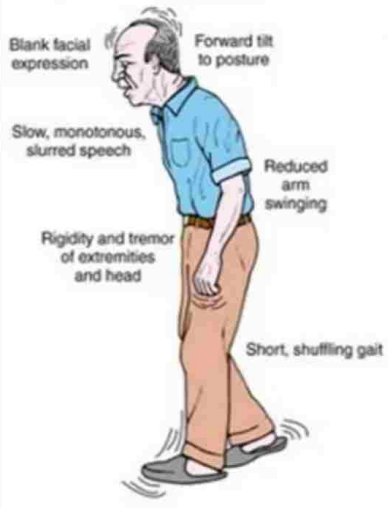
Nucleus
Accumbens

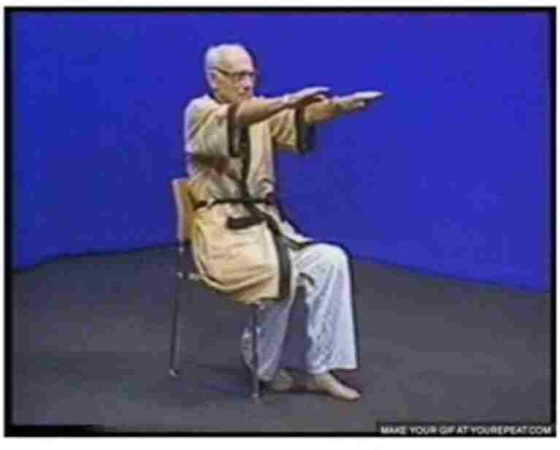
Globus
Pallidus

Thalamus: Medial nucl

LESIONS OF THE BASAL GANGLIA

1. **Parkinsons disease:** degeneration of **substantia nigra** and depletion of dopamine
2. **Hemiballismus:** degeneration of the **substhalamic** nucleus
3. **Chorea:** degeneration of the GABA-secreting neurons of the **striatum** (**caudate** & **putamen**)





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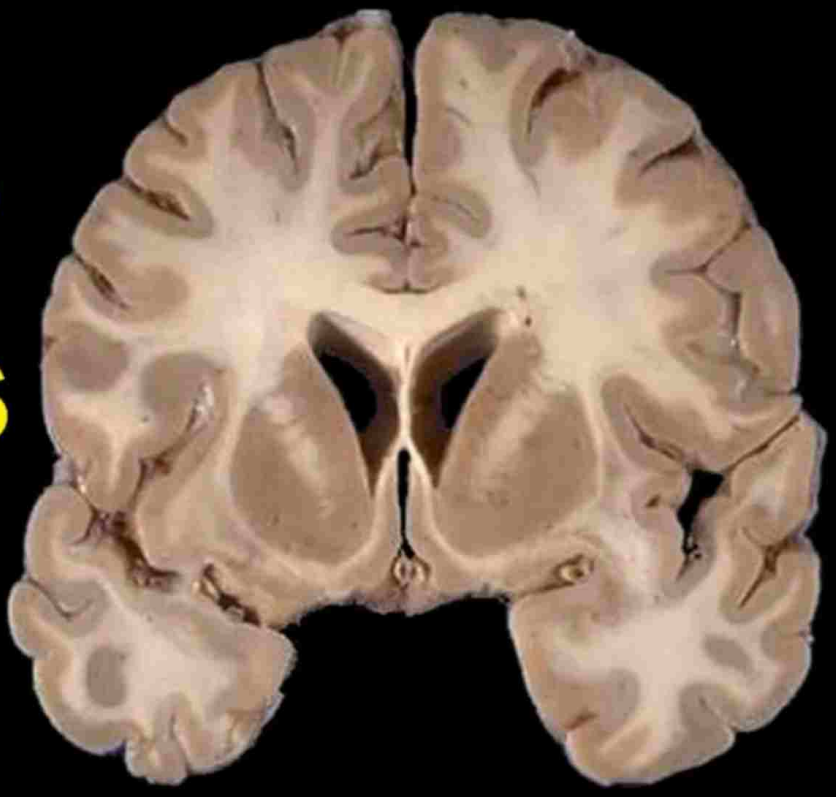
Nerve Fibers in the Brain



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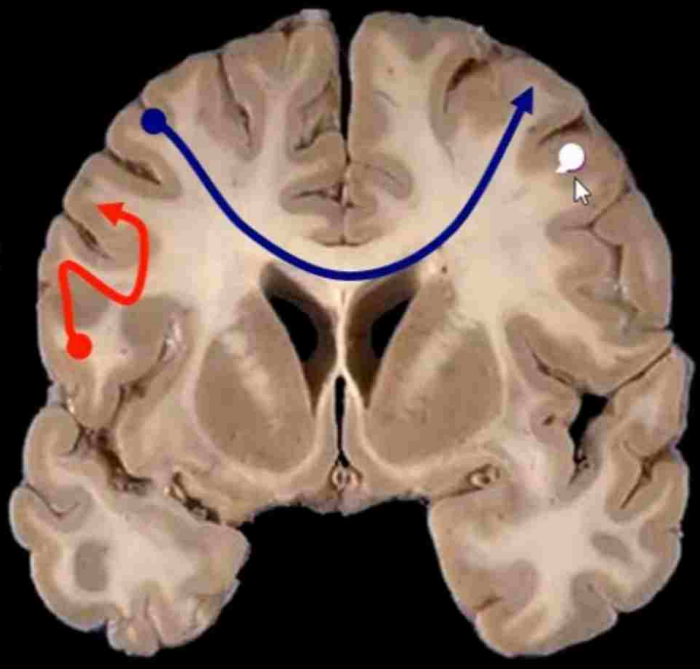
Internal Structure of the Cerebrum

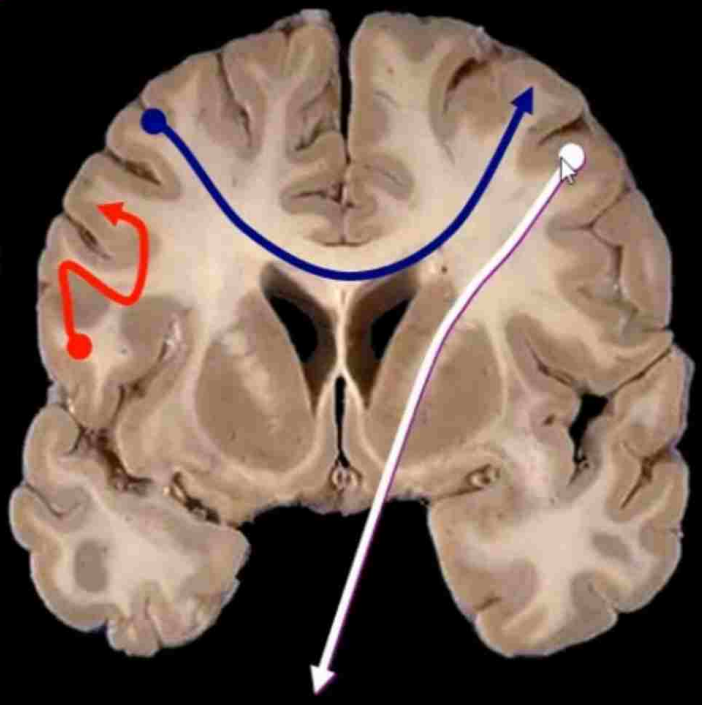
- Lateral Ventricle
- Basal Ganglia
- 3 Types of Nerve Fibers:



1. Commissural fibers
2. Association fibers
3. Projection fibers

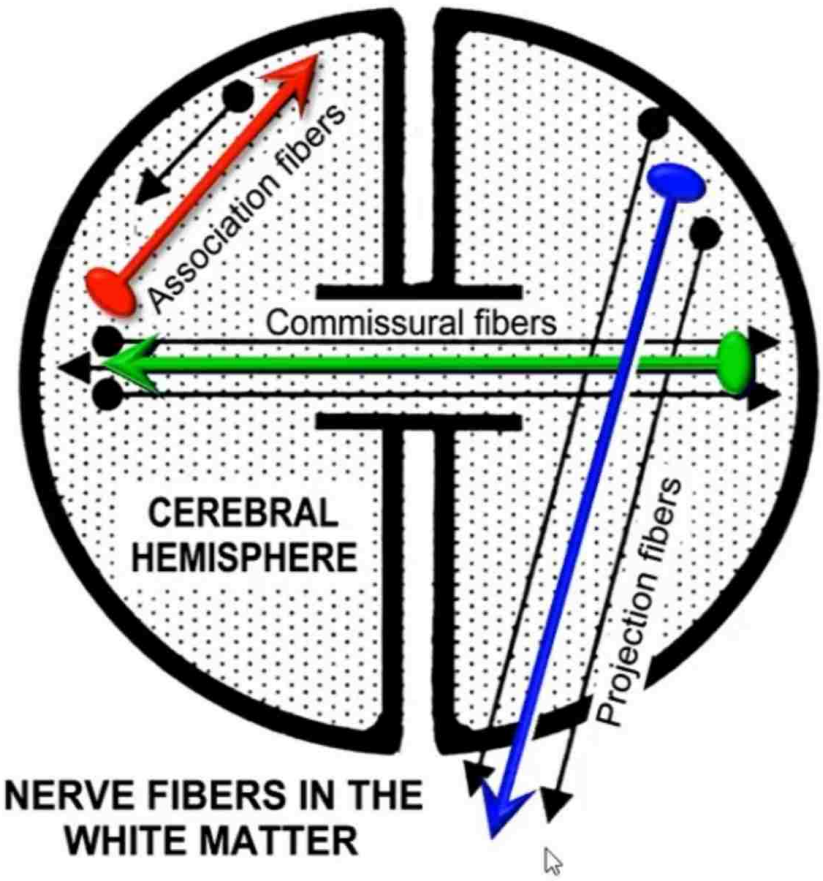
Internal Structure of the Cerebrum

- ❑ Lateral Ventricle
- ❑ Basal Ganglia
- ❑ 3 Types of Nerve Fibers:
  1. Commissural fibers
  2. Association fibers
  3. Projection fibers



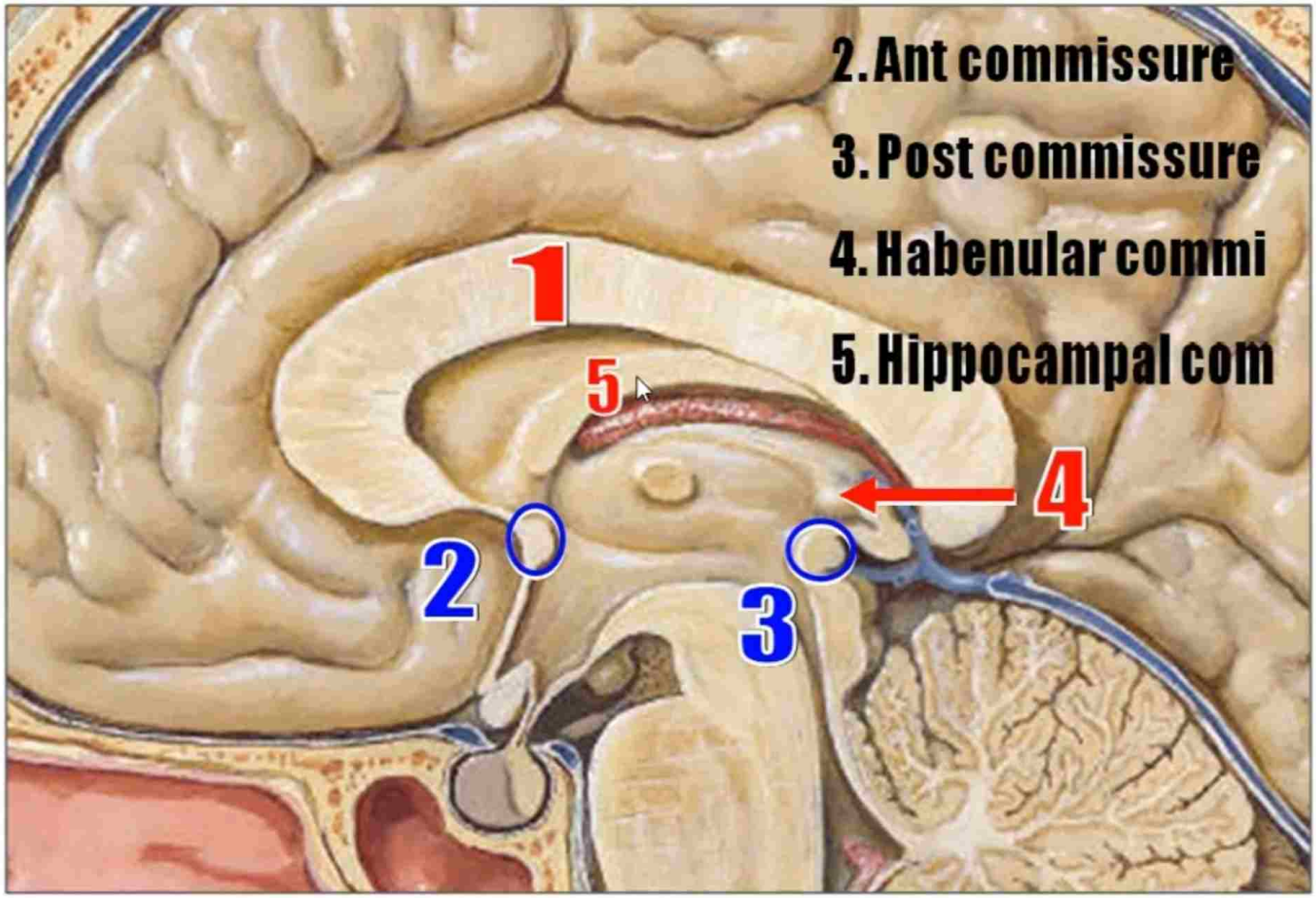
Nerve Fibers in the Cerebral Hemisphere

1. Commissural
2. Association
3. Projection

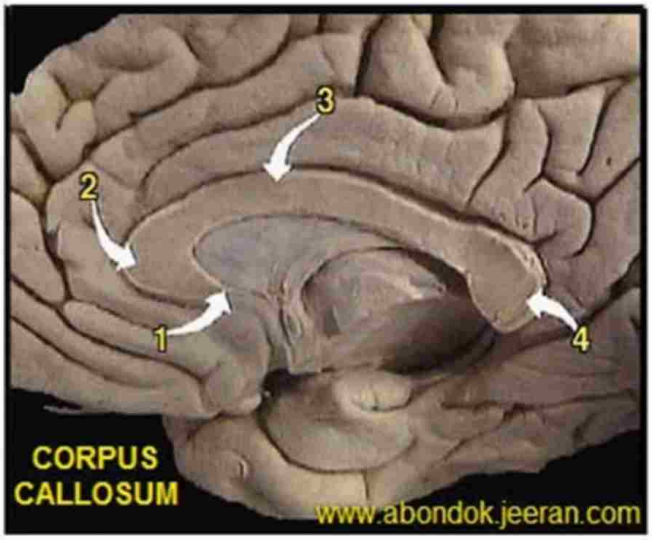


5 COMMISSURAL FIBERS:

1. Corpus callosum
2. Ant commissure
3. Post commissure
4. Habenular commi
5. Hippocampal com



CORPUS CALLOSUM



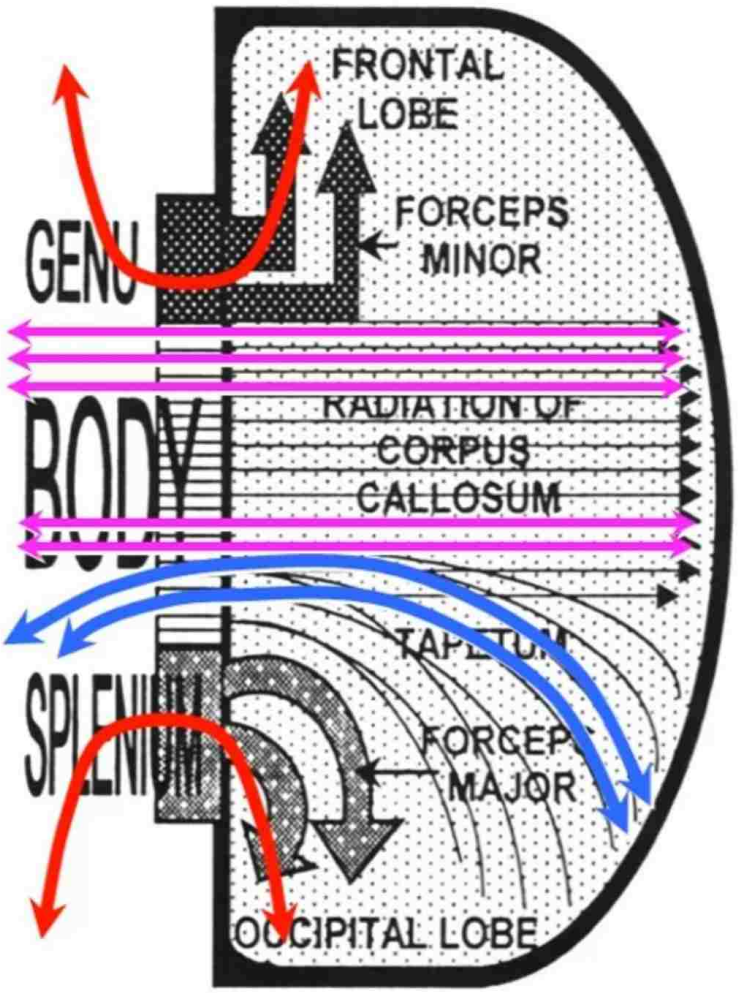
1: Rostrum **2:** Genu **3:** Body **4:** Splenium

PARTS: 4 parts

Arterial Supply: ACA

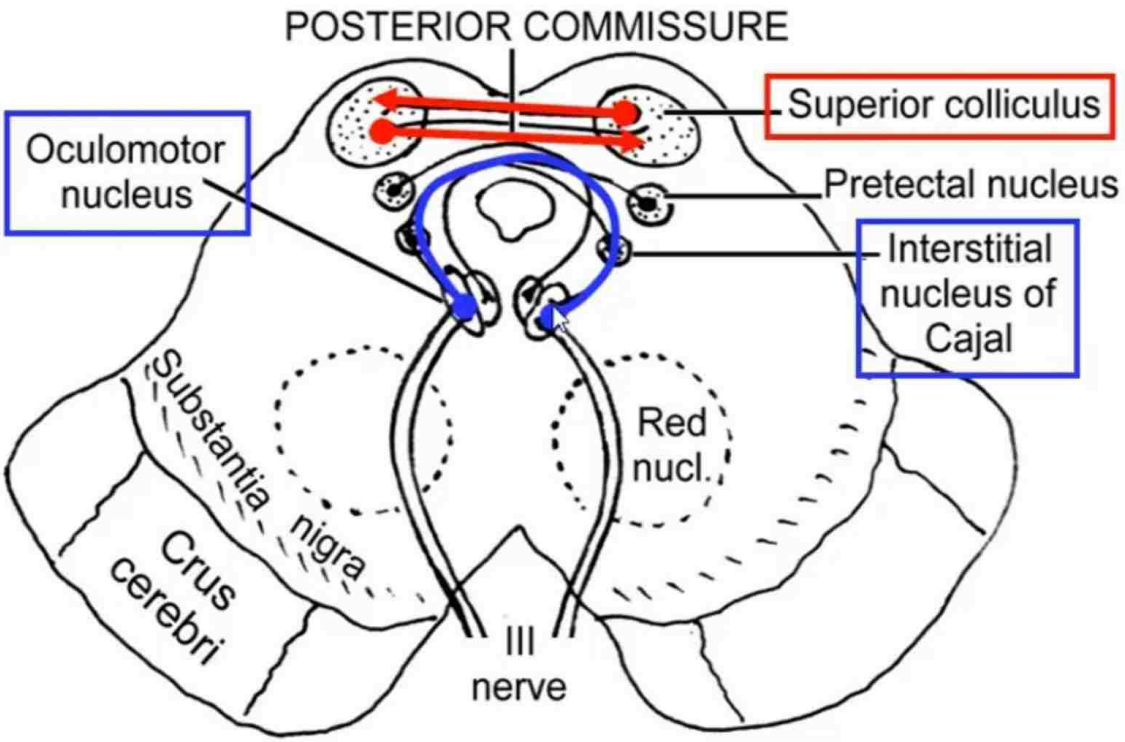
Function:

Lesion: callosal apraxia



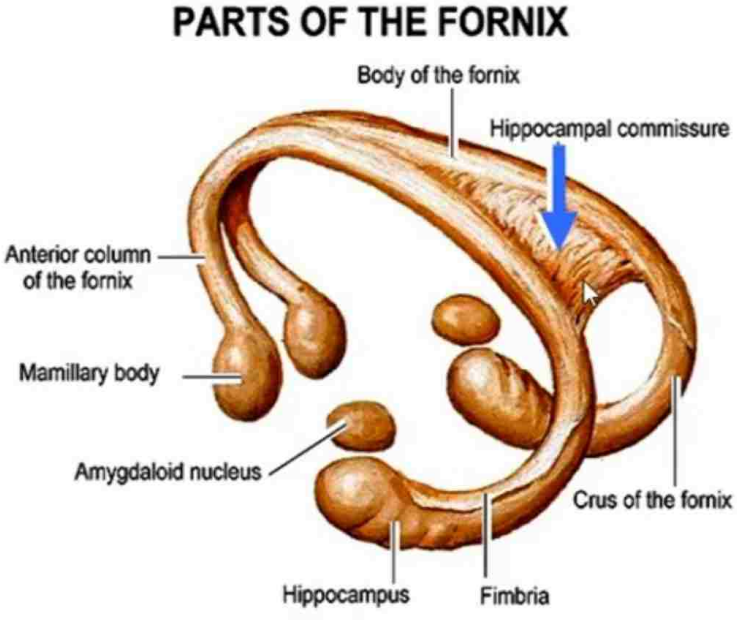
FIBERS OF CORPUS CALLOSUM

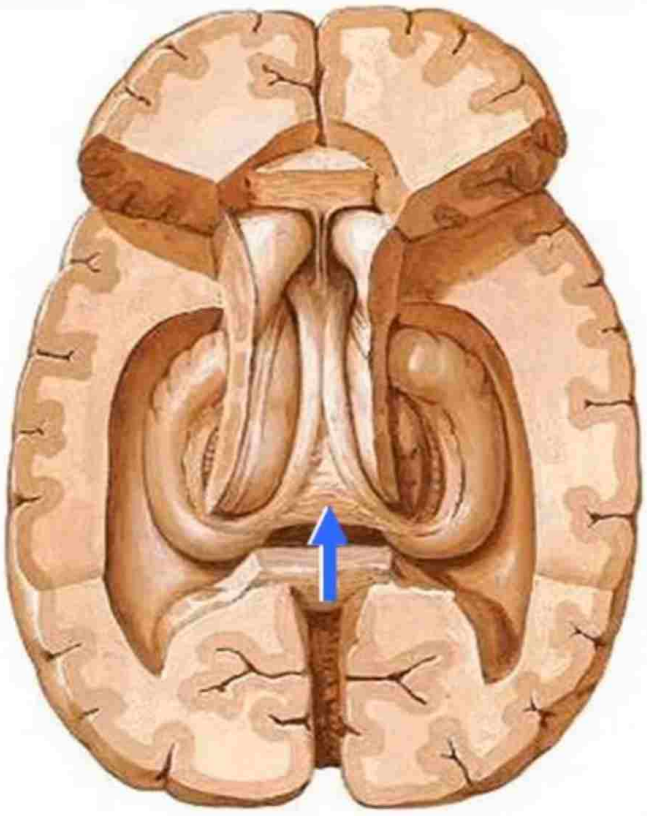
POSTERIOR COMMISSURE



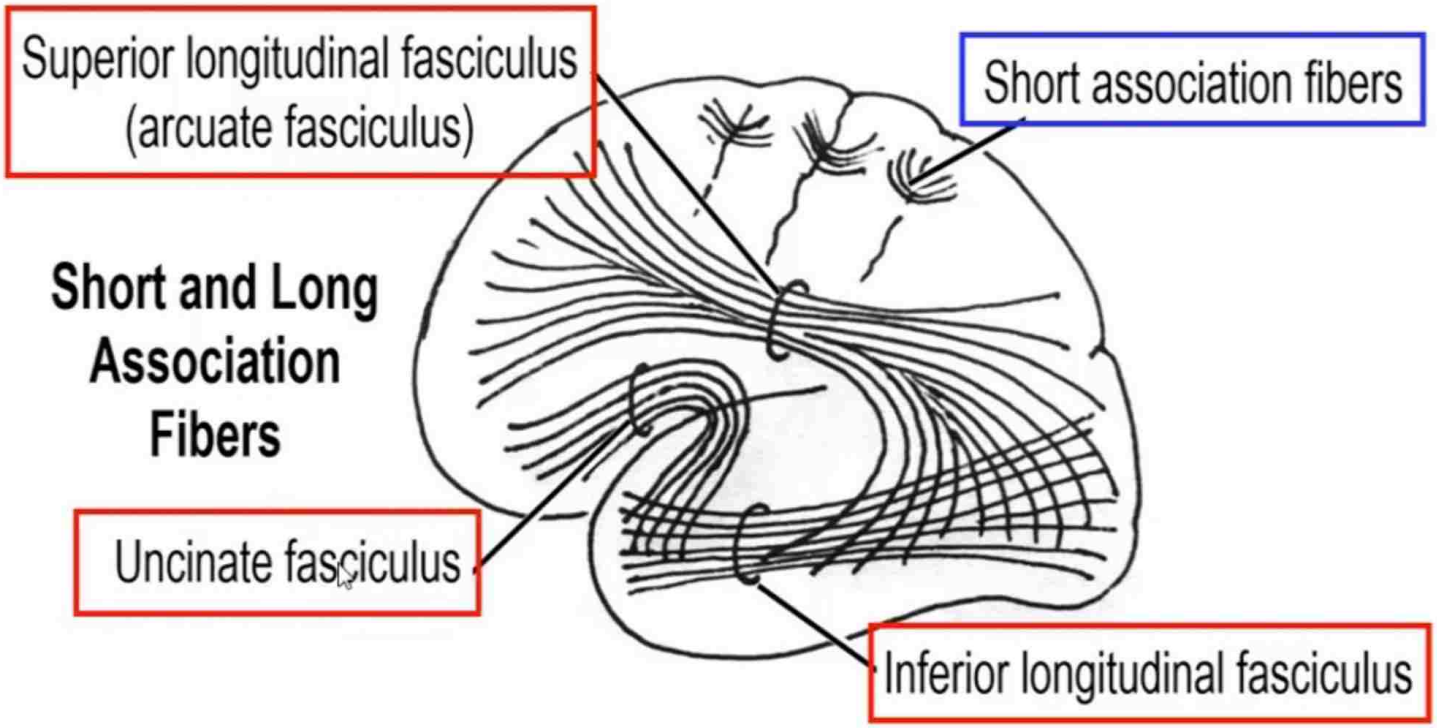
FIBERS IN THE POSTERIOR COMMISSURE

HIPPOCAMPAL COMMISSURE





ASSOCIATION FIBERS



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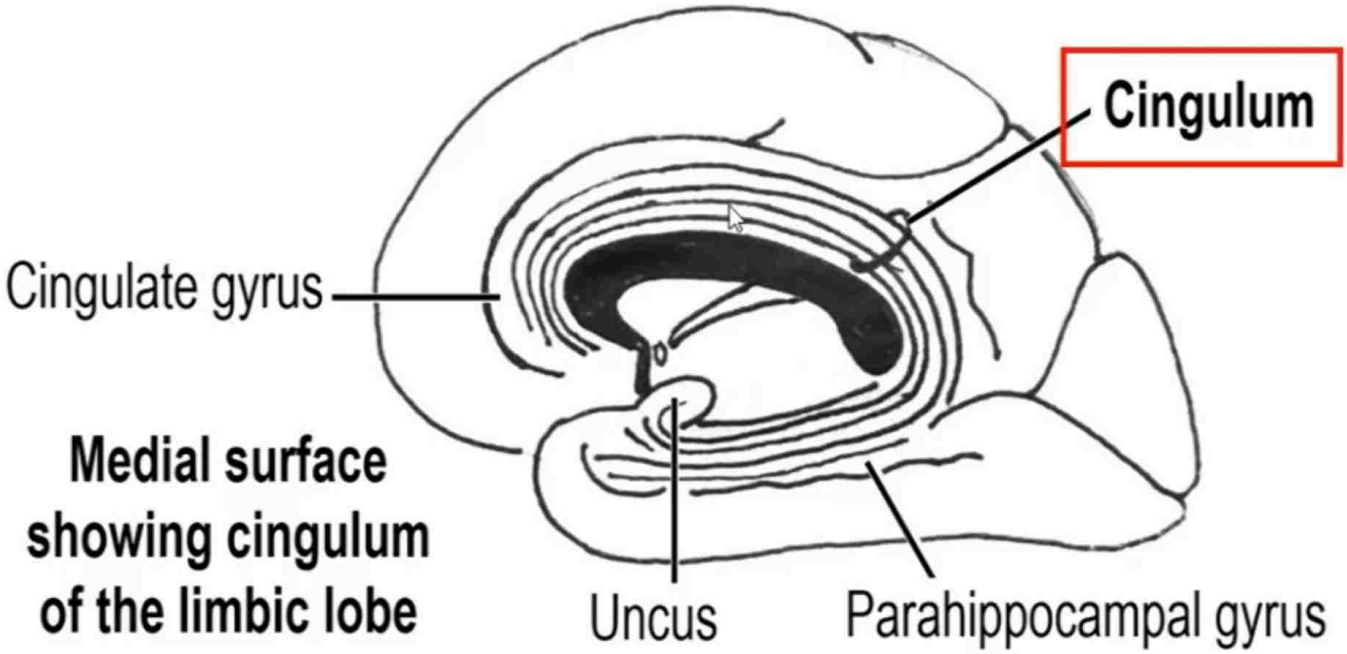
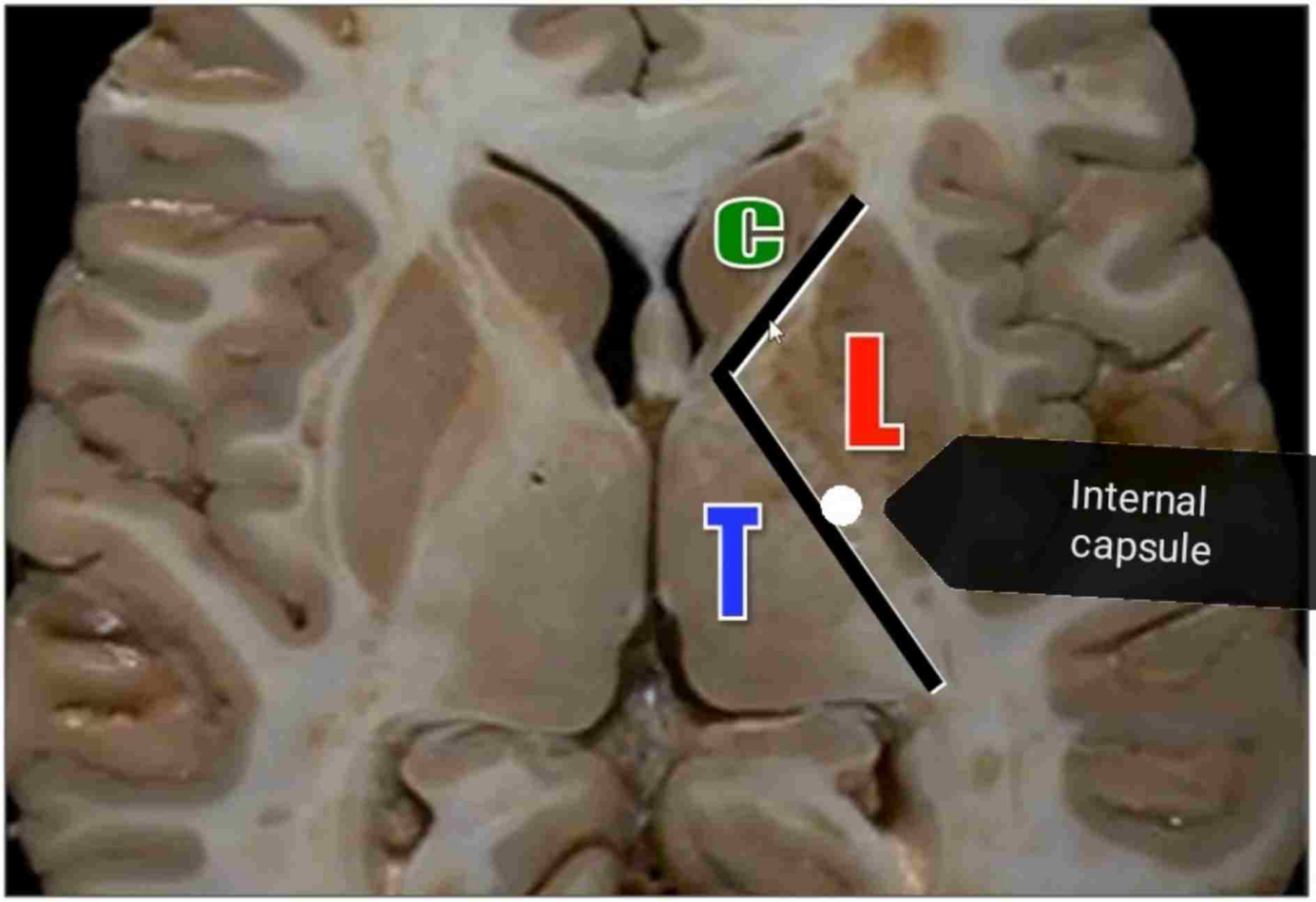
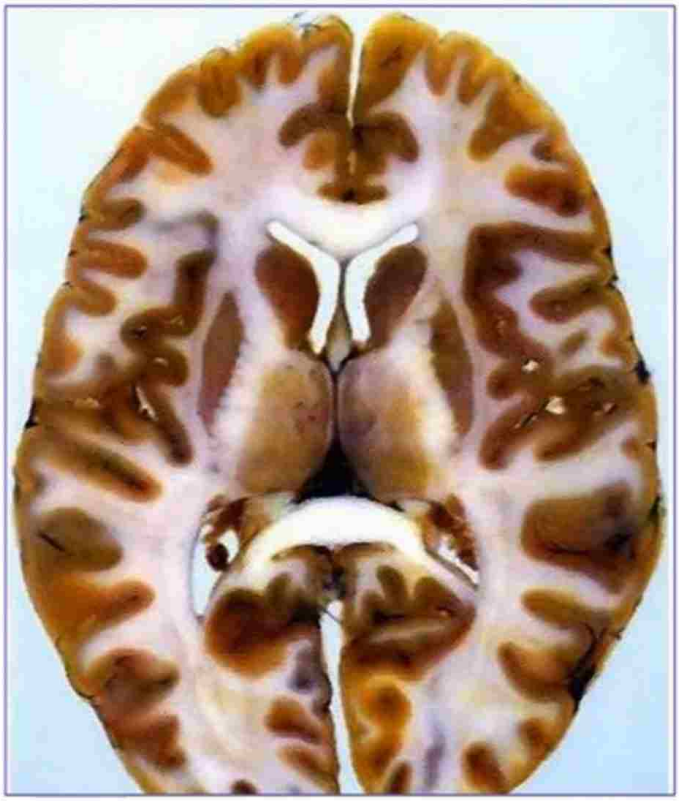
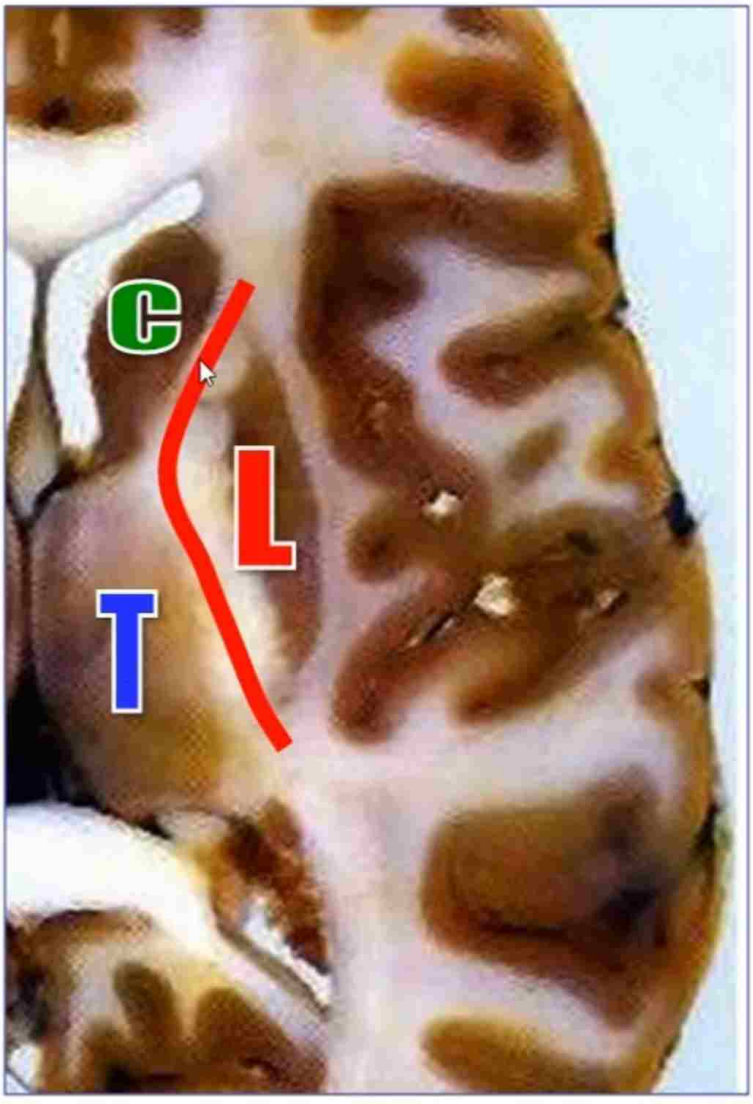


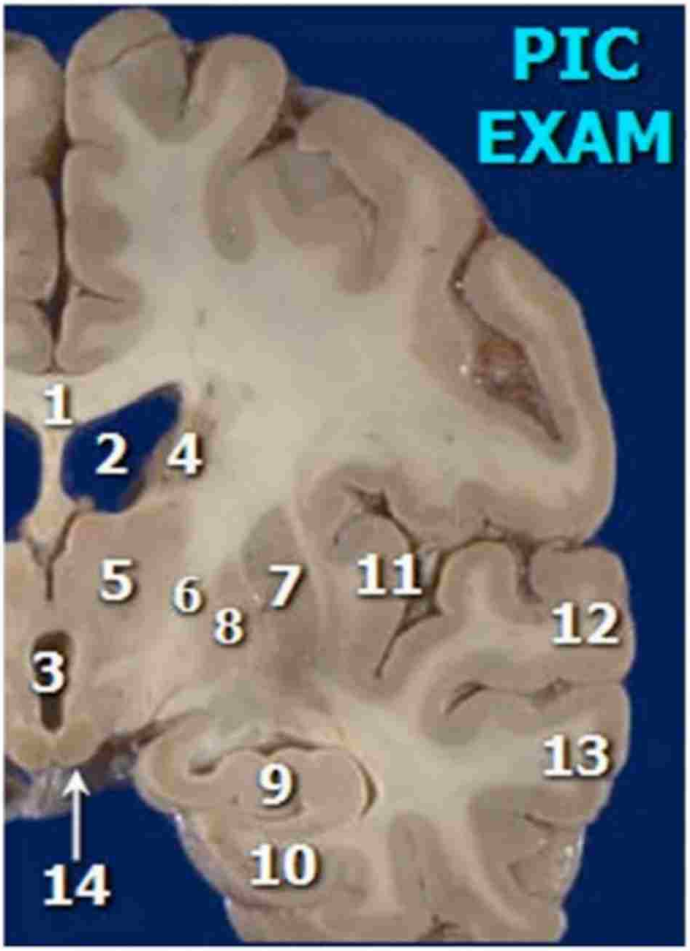
PROJECTION FIBERS

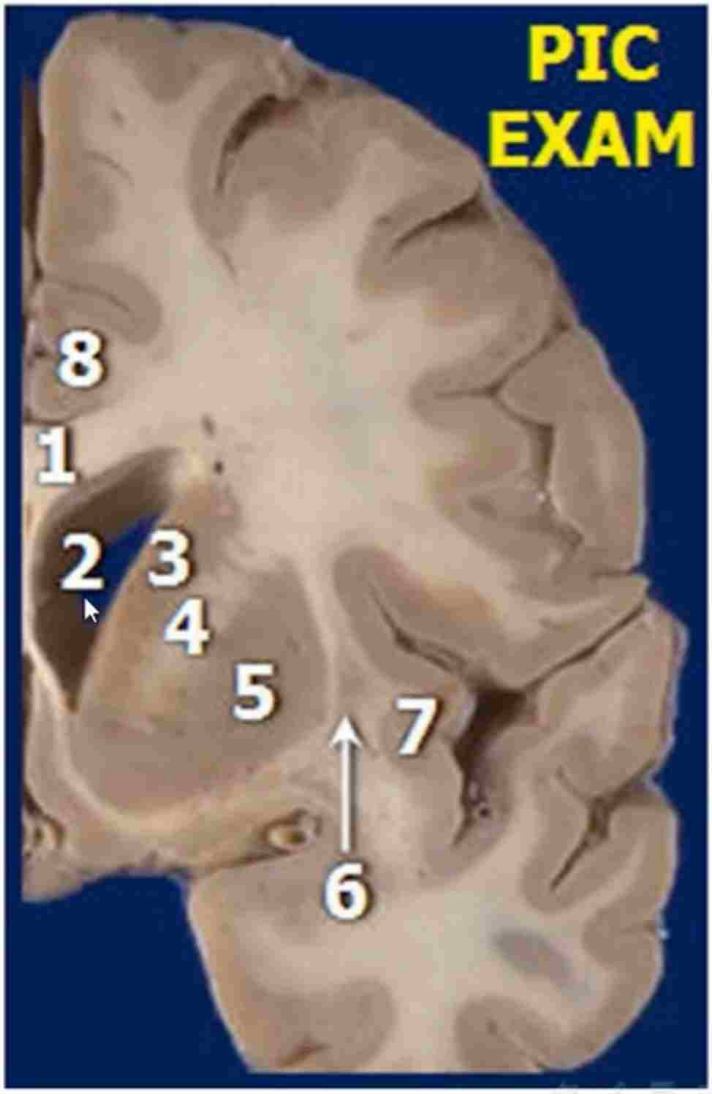


POSITION & DIVISIONS





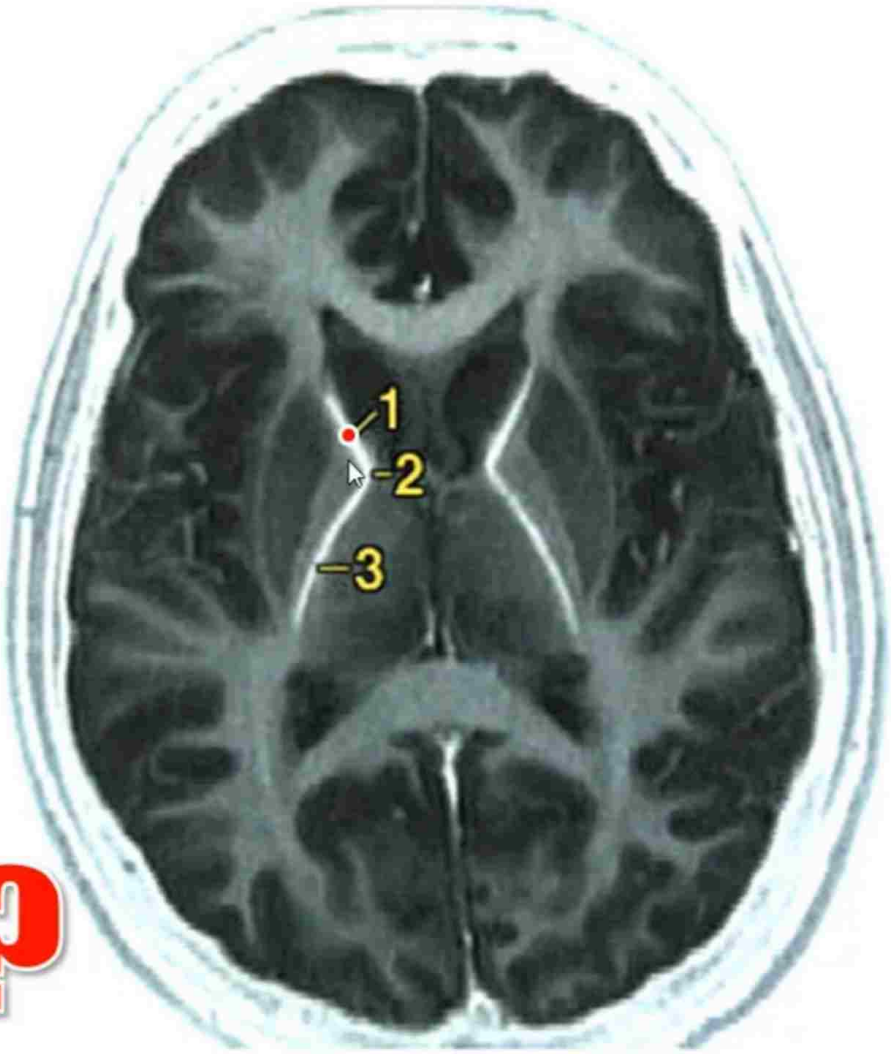




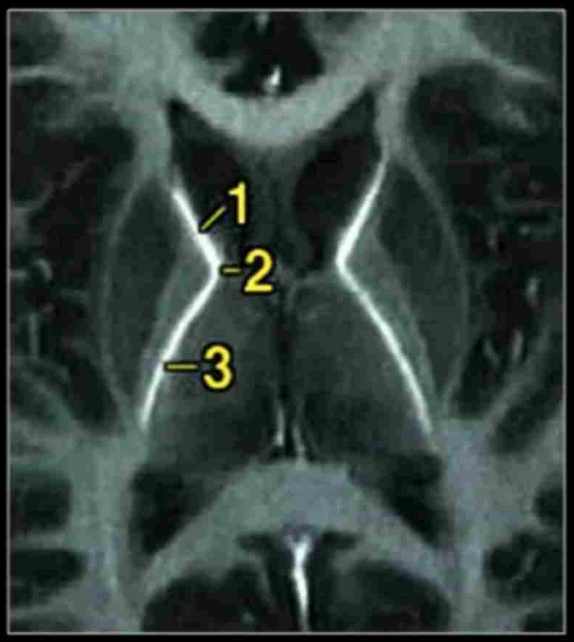
QUIZ ?

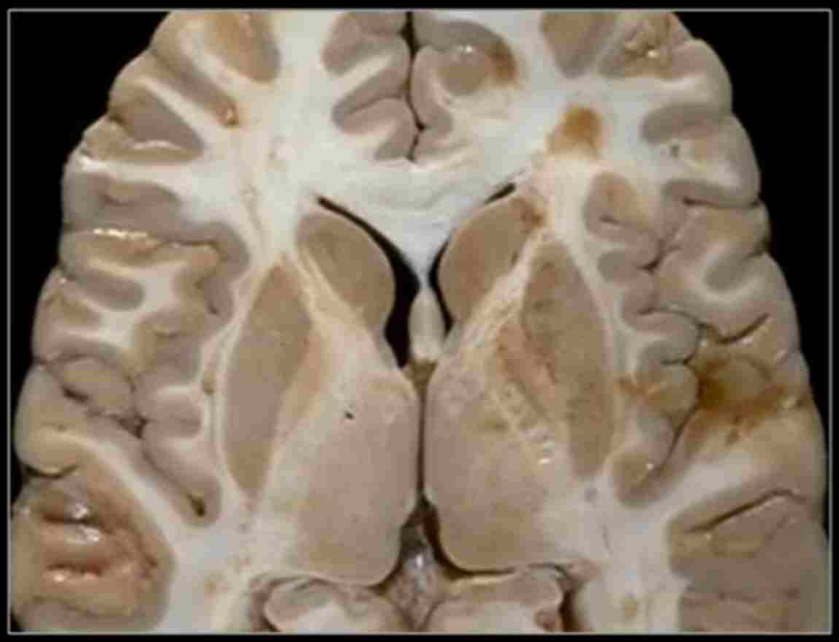
MRI OF THE INTERNAL CAPSULE

1: Anterior limb
2: Genu
3: Posterior limb



QUIZ ?





Internal Capsule

Dr Adel Bondok

INTERNAL CAPSULE

POSITION: between

1. Lentiform nucleus
2. Head of caudate n
3. Thalamus

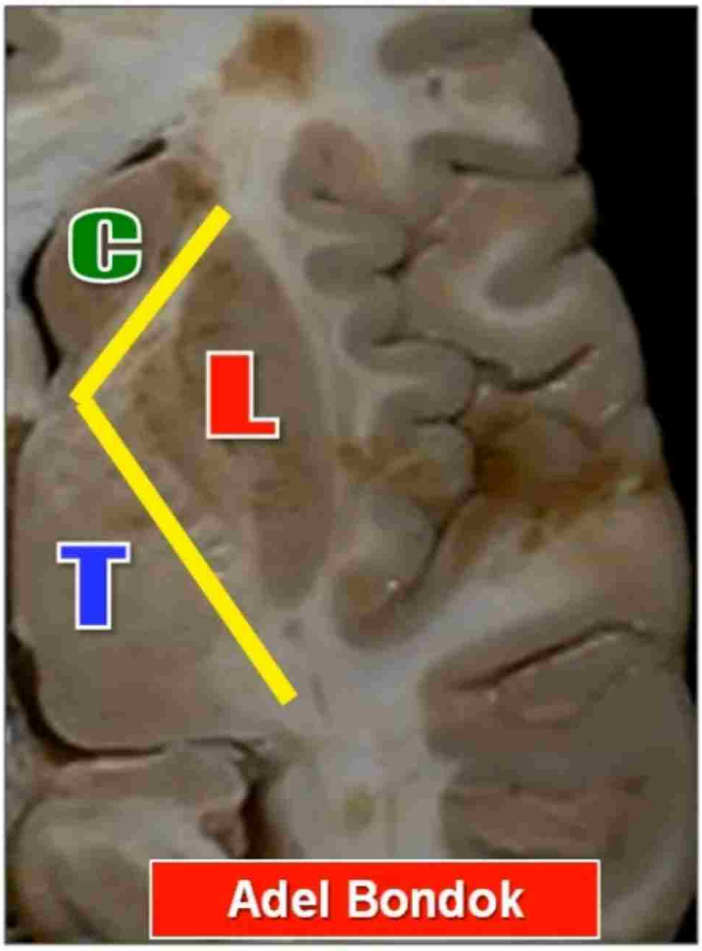
DIVISIONS: 3 parts

1. Anterior limb
2. Genu
3. Posterior limb

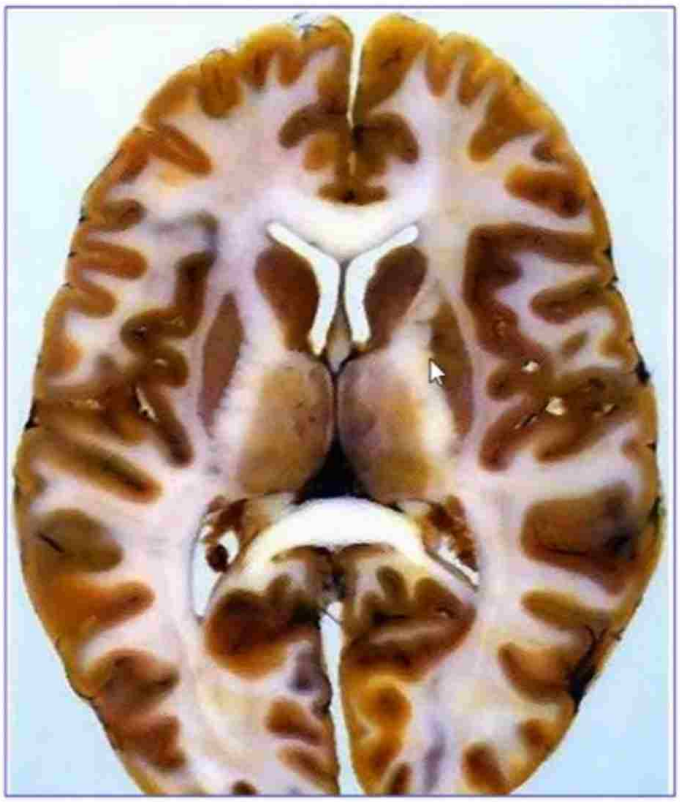
FIBER CONTENT:

ARTERIAL SUPPLY:

LESION in POST LIMB:



POSITION & DIVISIONS



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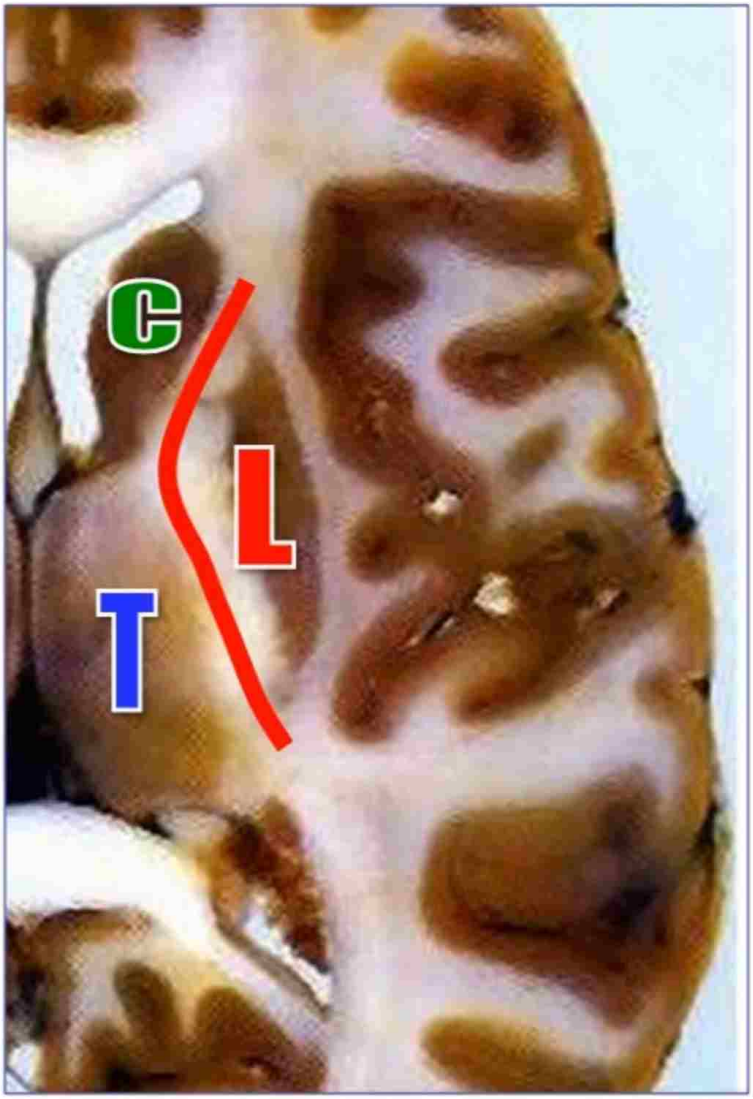
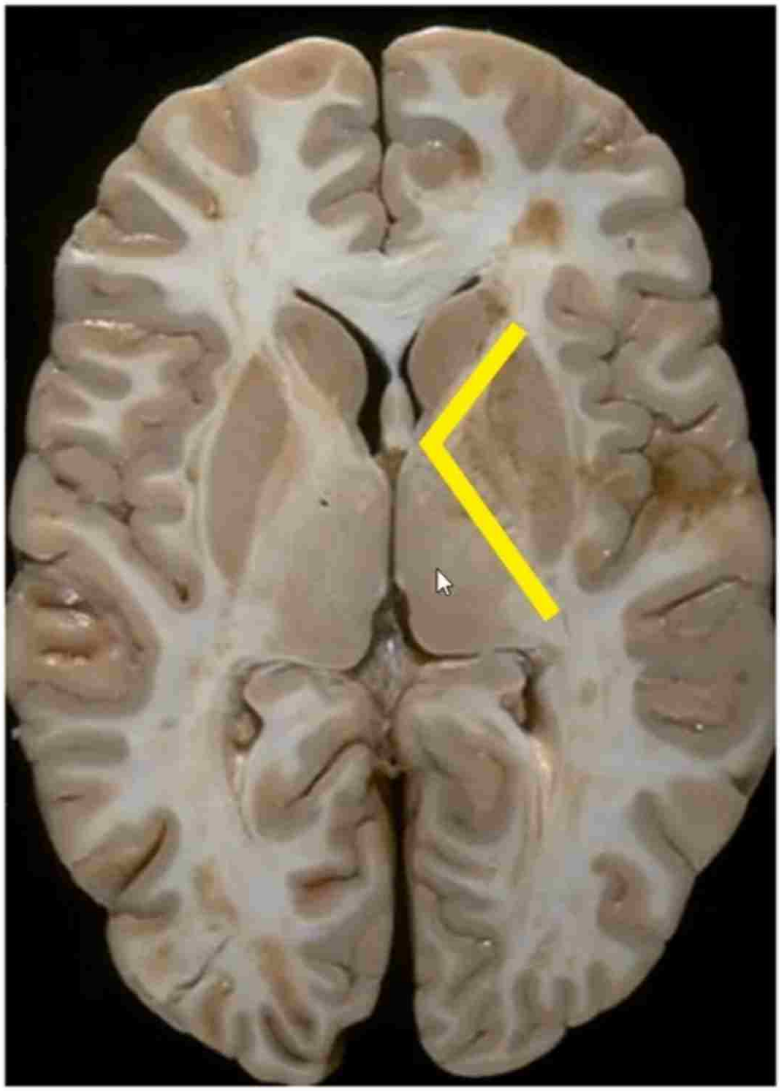
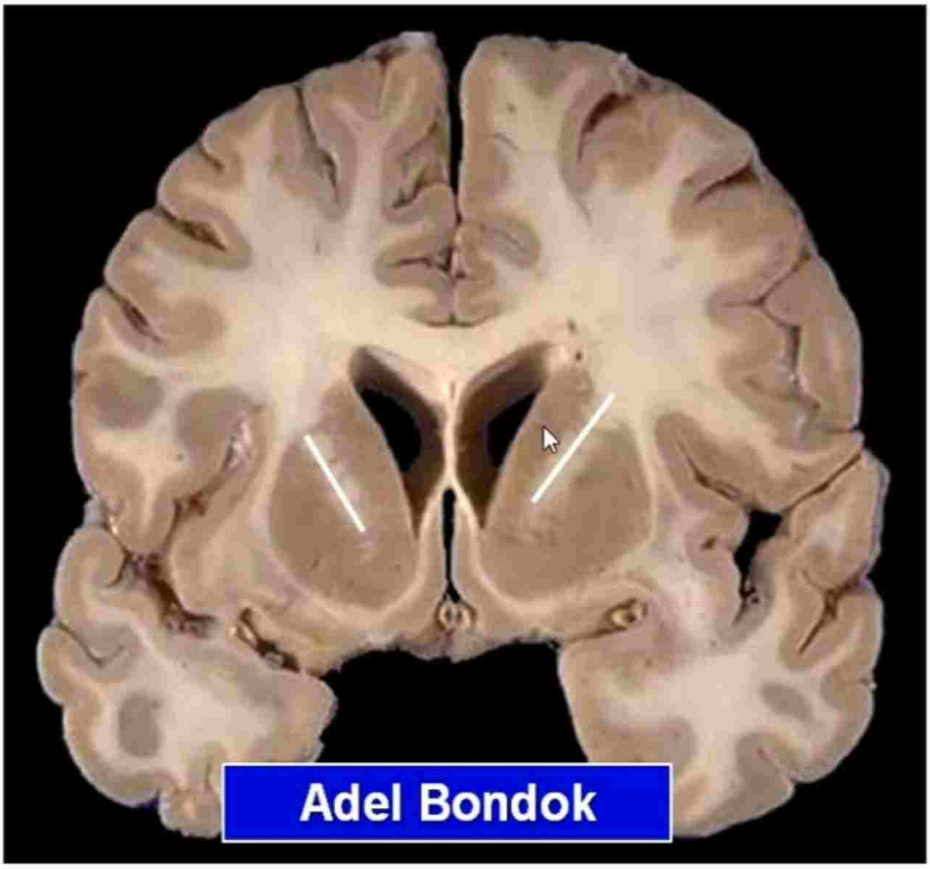
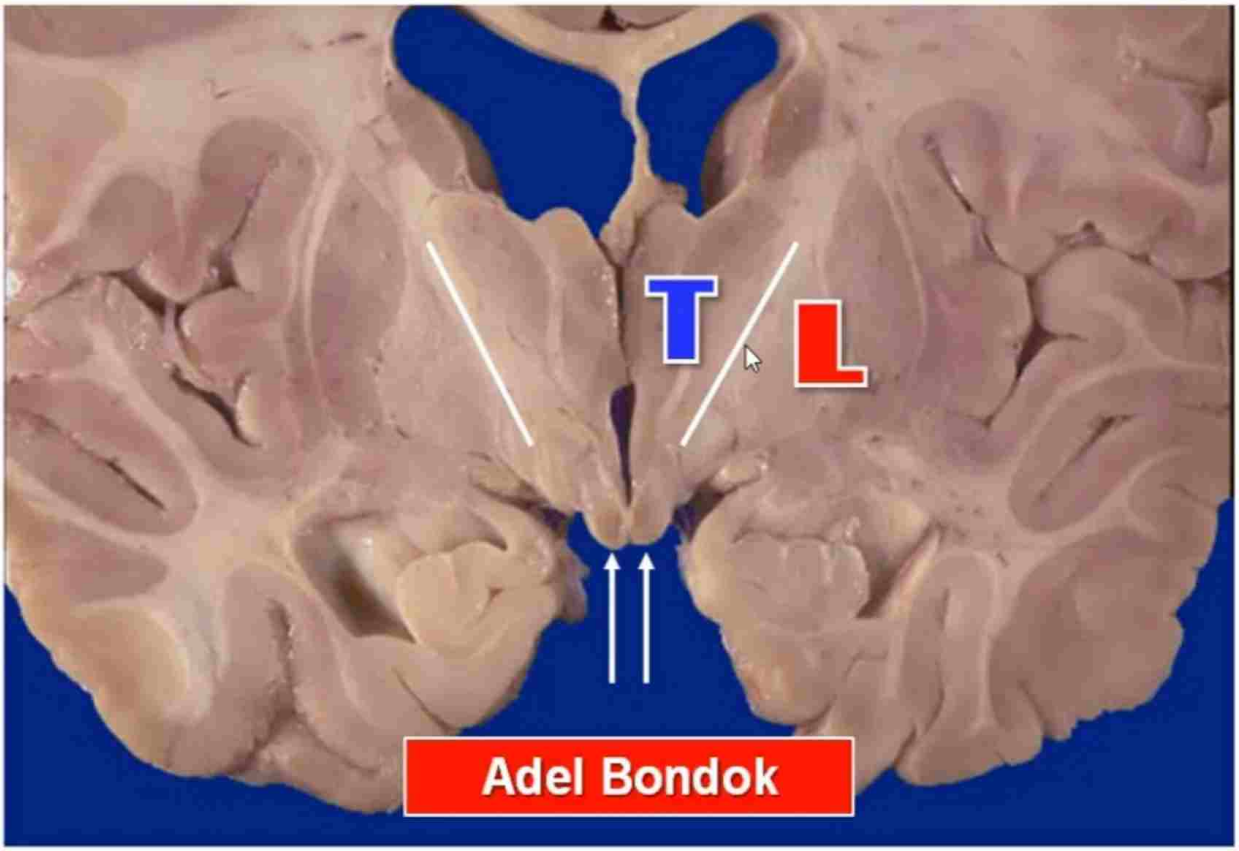




CORONAL SECTION
AT THE ROSTRUM



CORONAL SECTION
AT THE MAMILLARY BODY



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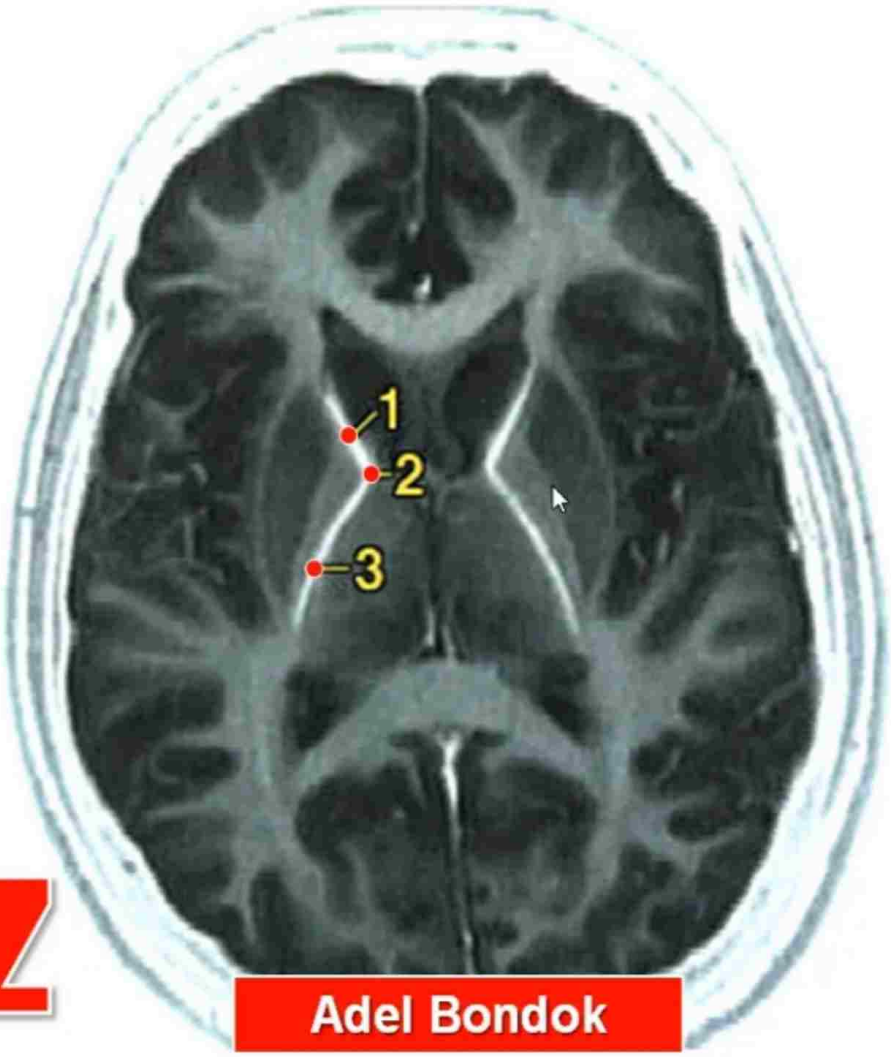
2: Genu
3: Posterior limb



QUIZ

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FIBER CONTENTS OF THE INTERNAL CAPSULE

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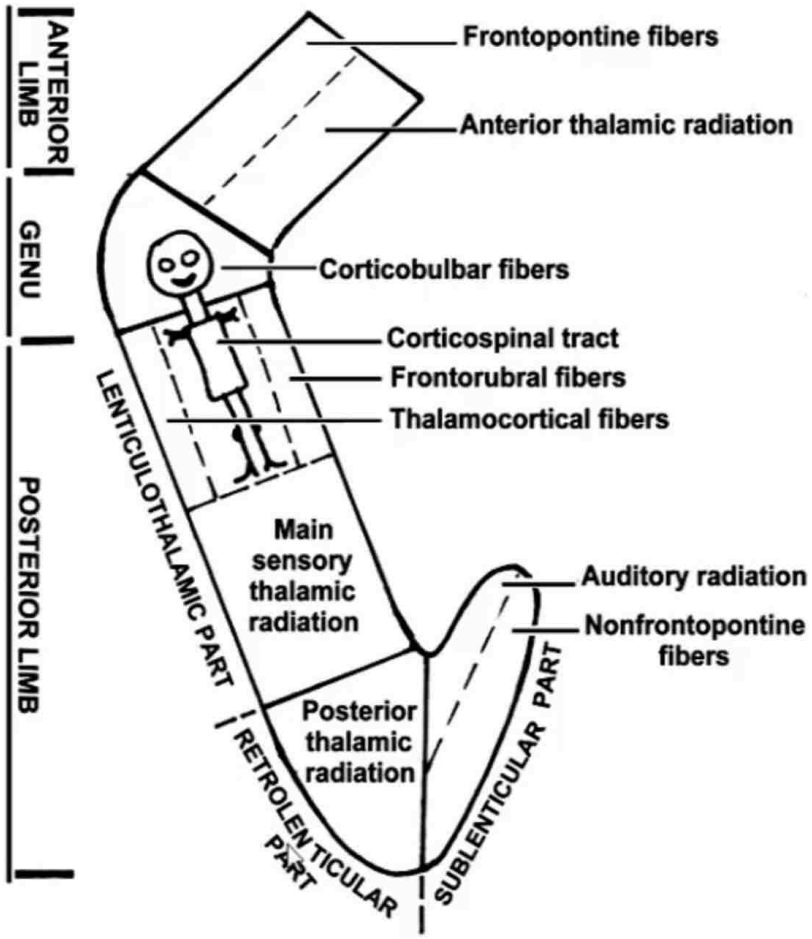

DIVISIONS AND FIBER CONTENTS OF THE INTERNAL CAPSULE

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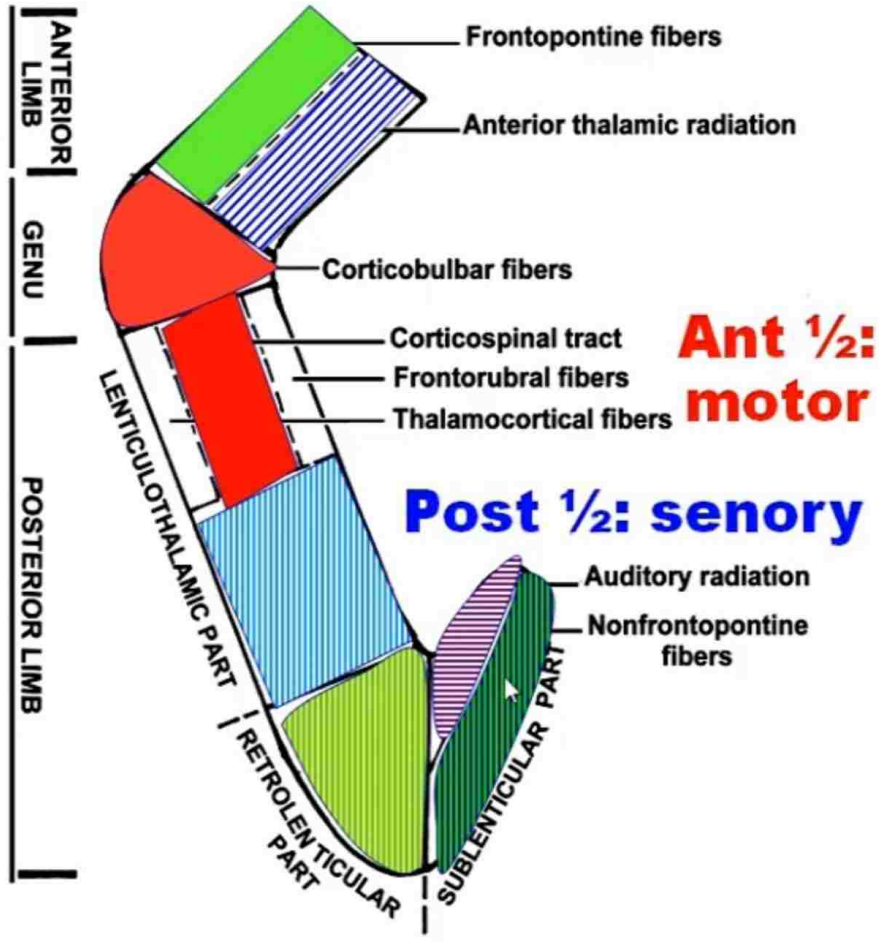

DIVISIONS AND FIBER CONTENTS OF THE INTERNAL CAPSULE

ARTERIAL SUPPLY OF THE INTERNAL CAPSULE

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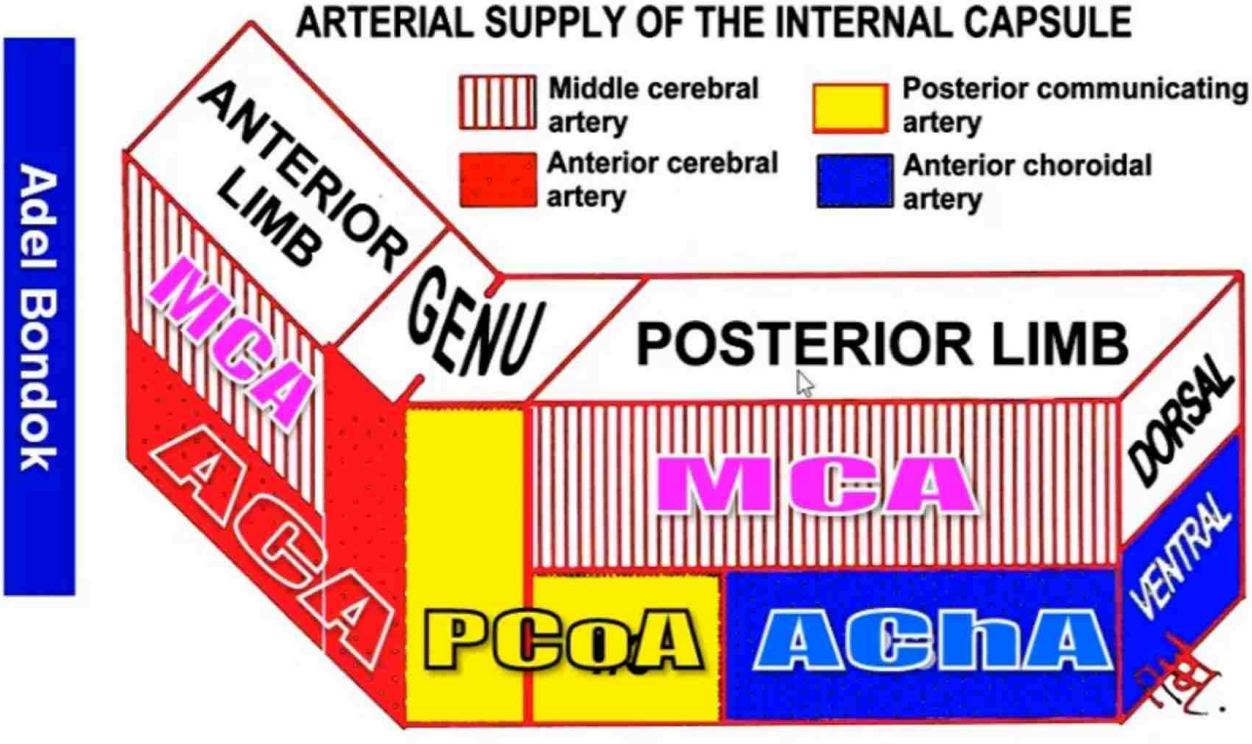
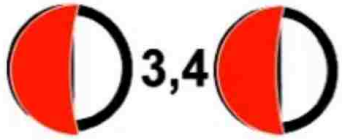


LESION IN THE POSTERIOR LIMB

Corticospinal Tract:
Contralateral Hemiplegia

Sensory Thal Radiation:
Contralat Hemianesthesia

Optic Radiation:
Contralat Homonymous Hemianopia



Contralateral homonymous hemianopia

Auditory Radiation:
Bilateral Weakness of Hearing

Adel Bondok

4 THALAMIC RADIATIONS

Adel Bondok ®

Radiation	Location	Origin	Termination	Function and Lesion
Anterior	Anterior limb	Anterior & medial nuclei	Cingulate gyrus Prefrontal cortex	Emotions, behavior, memory
Posterior	Retrolent-icular part	LGB: Lateral geniculate b	Primary visual area 17	Vision. Contralat hom hemianopia
Superior	Lenticulo thalamic p	VA and VL VP	Area 4 and 6 Area 3, 1, 2	Motor Sensory
Inferior	Sublentic part	MGB: Medial geniculate b	Primary audit area 41 & 42	Hearing. Bilat weakness of hearing

SUBSCRIBE

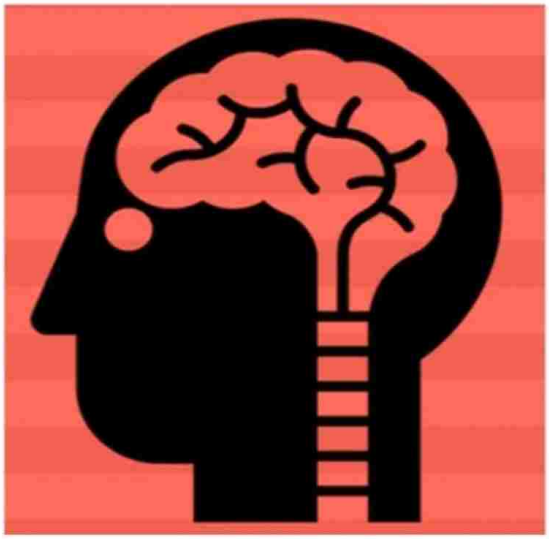
Aphasia
Agnosia
Apraxia

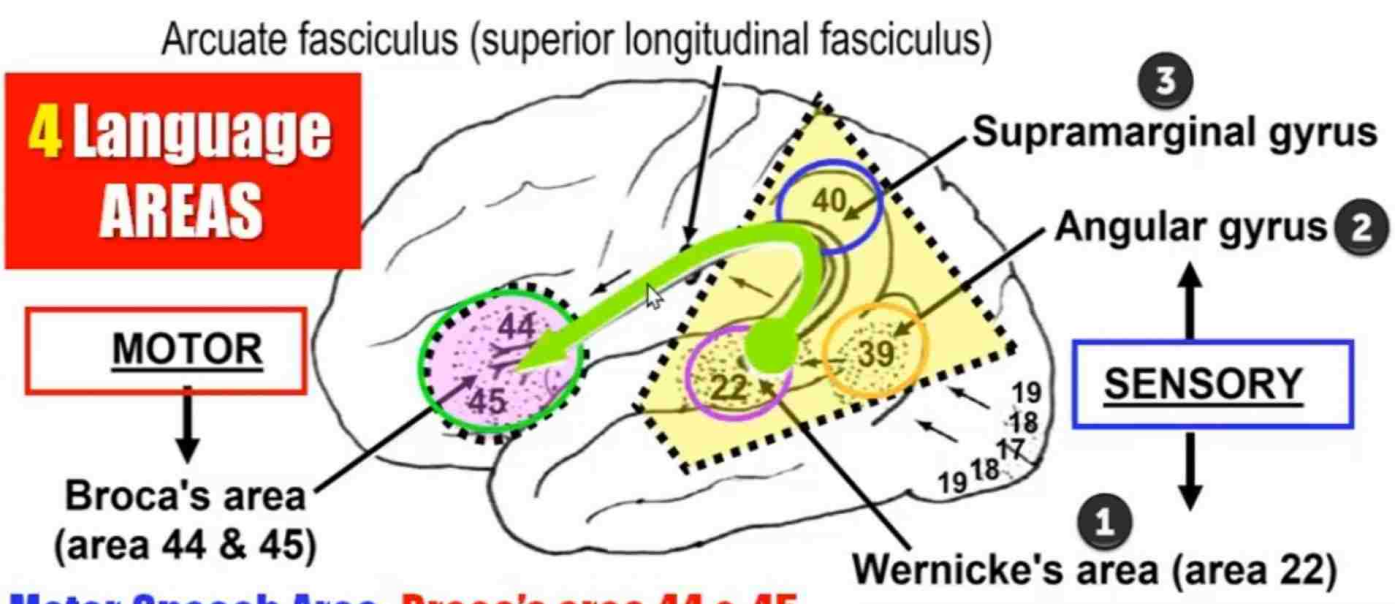
Dr. Adel Bondok

Mansoura University – Egypt

Neuroanatomical Basis of 3 Disorders of the Higher Brain Function

- Aphasia
- Agnosia
- Apraxia





Motor Speech Area: Broca's area 44 & 45

Function: formulation of words

Are present in the dominant hemisphere

3 Sensory Speech Areas: Areas 22, 39 & 40

@ Wernicke's area 22: understands the spoken language

@ Angular gyrus: area 39: understands the written language

@ Supramargial gyrus: #40: understands sizes, shapes & texture and recognition of the body parts and left side from right side

Motor & sensory speech areas are connected by the arcuate fasciculus

APHASIA

Aphasia is language disability that causes 4 main problems

1. Difficulty understanding
2. Difficulty speaking
3. Difficulty reading
4. Difficulty writing

Types of Aphasia & Site of the Lesion

Broca's (expressive) Aphasia

- Broca's area

Wernicke's (Sensory) Aphasia

- Wernicke's area

Global (Total) Aphasia

- Both Broca's and Wernicke's areas

Conduction Aphasia

- Arcuate fasciculus

Anomic Aphasia

- Angular gyrus

1 Broca's Aphasia

- **Site of lesion:** Broca's area
- **The words are difficult to come** with inability to speak.
- **Comprehension of language is normal** and ability to write is normal
- **The patient can point** at objects
- **Also called:** **expressive aphasia, motor aphasia, non-fluent aphasia**

2 Wernicke's Aphasia

- **Site of lesion:** Wernicke's area
- Patient **doesn't understand** and doesn't comprehend the spoken / written language
- **Patients speak fluently**, but what they say is meaningless.
- **Also called:** **sensory aphasia, receptive aphasia, fluent aphasia**

3 Global Aphasia

- **Site of lesion:** total damage of Wernicke's area, Broca's area and arcuate fasciculus
- **They can't** read, write, repeat sentences or name an object

Conduction Aphasia

4

- **Site of lesion: arcuate fasciculus** (connects Broca's area with Wernicke's area)
- **Comprehension is normal**, but the speech is fluent & meaningless because Broca's area is disconnected from Wernicke's area

Anomic Aphasia

5

- **Site of lesion:** the lesion is **limited to** the angular gyrus
- **Manifested by** alexia & agraphia
- **Alexia** is inability to read.
- **Agraphia** is inability to write

AGNOSIA

Agnosia is inability to recognize a sensory modality although the sense is intact such as auditory, visual or tactile

Example: patient with auditory agnosia hears the door bell ring but **doesn't recognize its meaning**

1. Auditory Agnosia
2. Visual Agnosia
3. Tactile Agnosia
4. Proso-pagnosa

Auditory Agnosia

It is **inability** to recognize familiar sounds although hearing is normal

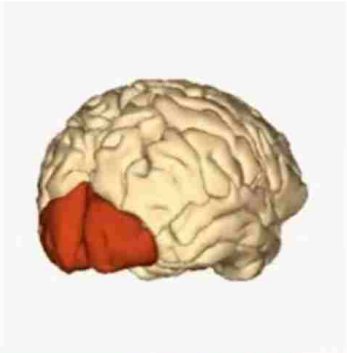
Site of the lesion:
Wernicke's area (area 22) **of the dominant hemisphere**

Tactile Agnosia Astereognosis

It is **inability** to recognize objects by sense of touch with eyes closed although touch sensation is intact

Site of the lesion:
Somatic sensory association area (area 5, 7, 40)

Visual Agnosia

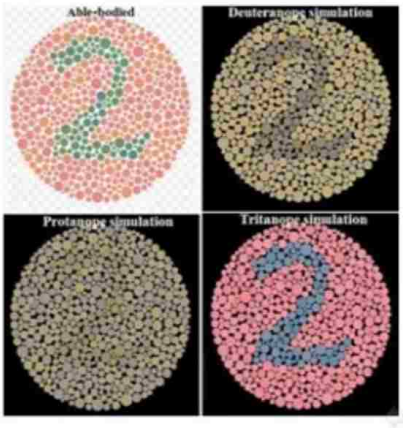


It is **inability to recognize** what we see although vision is normal

All of what is being seen **is meaningless**

Site of the lesion:
Visual association area (area 18 & 19)

Color Agnosia is absence of color vision.

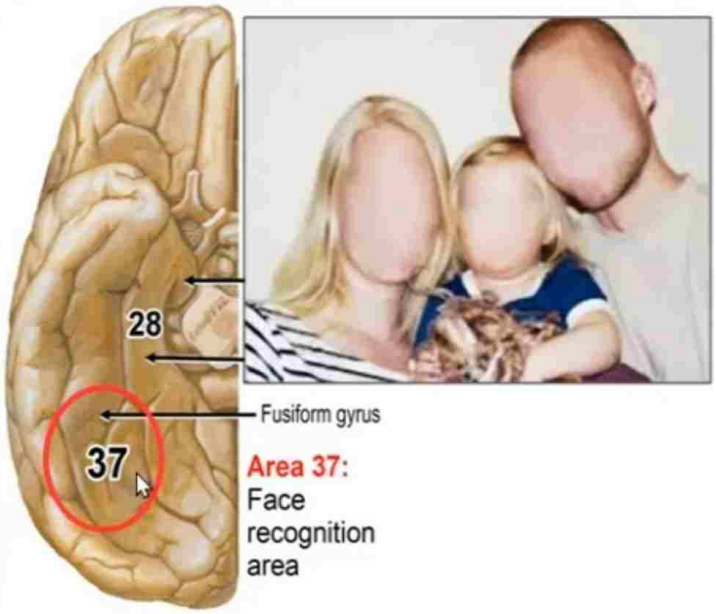


Prosopagnosia
Face Blindness

It is **inability** to recognize familiar faces even their own face

They rely on sounds for proper recognition

Site of the lesion: Posterior part of the fusiform gyrus (**area 37**) on the inferior surface of the temporal lobe



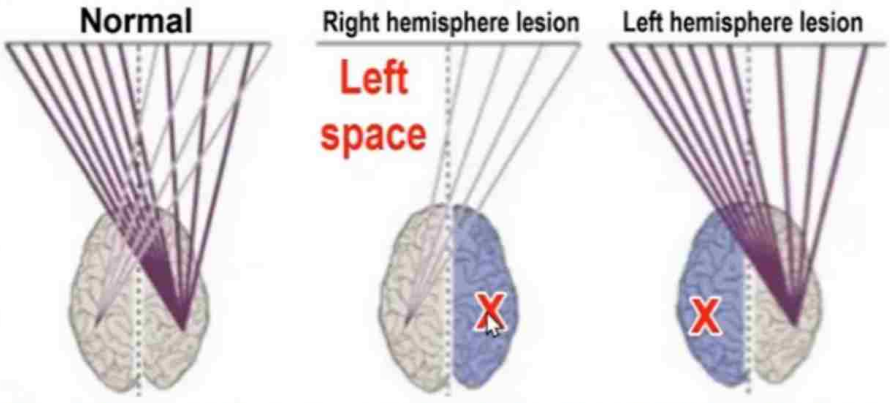
Unilateral Neglect & Finger Agnosia

It is usually left side neglect. The left part of the space doesn't exist. **WHY?**

@ A man may only shave the right side of his face

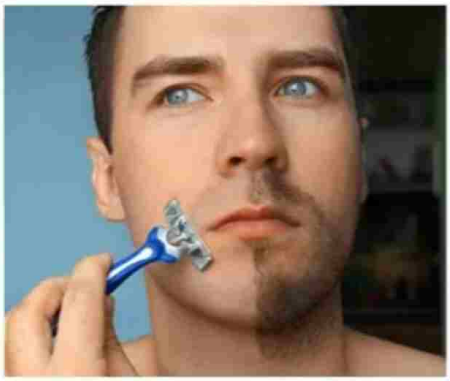
@ A woman may only apply make-up to her right side

@ **Site of lesion:** the right supramargial gyrus (#40)



The left space is processed only by the right hemisphere

The right space is processed by the 2 hemispheres



APRAXIA

Apraxia is a motor disorder causing inability to perform learned (familiar) movements on command although there is no paralysis

Example: a person with **apraxia** may be unable to tie their shoes or open a door on command

Apraxia is usually due to a lesion in the dominant hemisphere of the brain (usually the left), typically in the premotor area and inferior parietal lobule **or in** the corpus callosum

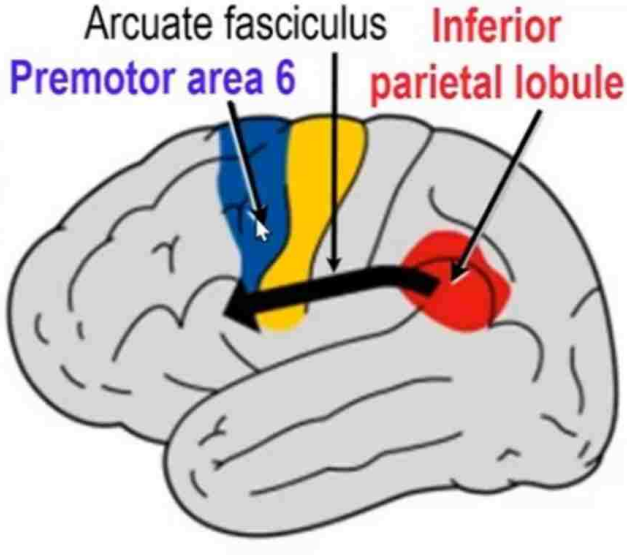
Motor Apraxia | **Callosal Apraxia** | **Constructional Apraxia**

Motor Apraxia

It is inability to plan or perform any motor activity upon oral command although it is perfectly done spontaneously.

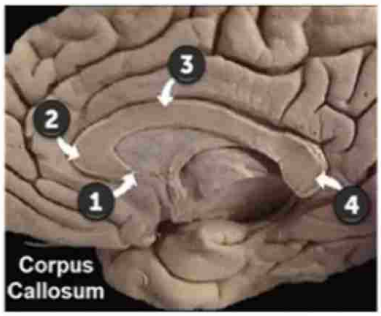
Example: the patient can't open a door upon command but can perform the action spontaneously without thinking.

Site of the lesion:
in the premotor area 6, inferior parietal lobule or arcuate fasciculus of the dominant hemisphere.



Callosal Apraxia: Split-Brain
Callosal Disconnection Syndrome

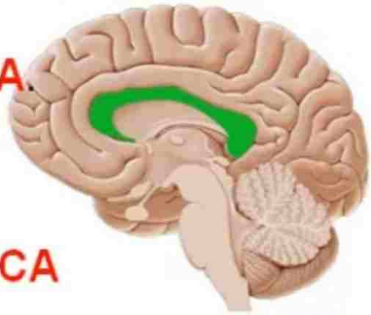
Corpus callosum is formed of commissural fibers connecting the dominant hemisphere with the non-dominant hemisphere.



It is formed of 4 parts: R – G – B – S

It transfers information (memory and language) between the 2 hemspheres.

The corpus callosum is supplied mainly by the **ACA**.



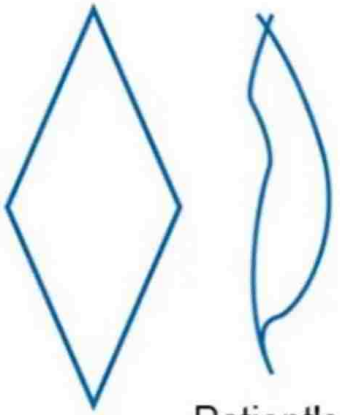
- The **rostrum** may receive branches from the anterior communicating artery.
- The **splenium** may receive a branch from the **PCA**

Callosal apraxia is due to total disconnection of corpus callosum, resulting in apraxia **confined to the left hand**. **It is usually due** to acute ischemic infarction of corpus callosum.

Constructional Apraxia

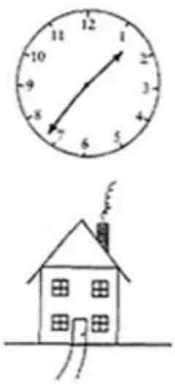
It is inability to draw shapes like circles or squares and to design or copy simple diagram.

Site of the lesion: in the **inferior parietal lobule** **of the non-dominant hemisphere**.

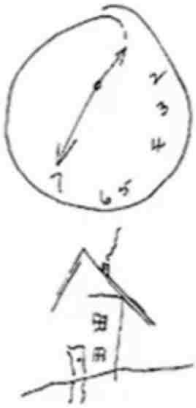


Diamond

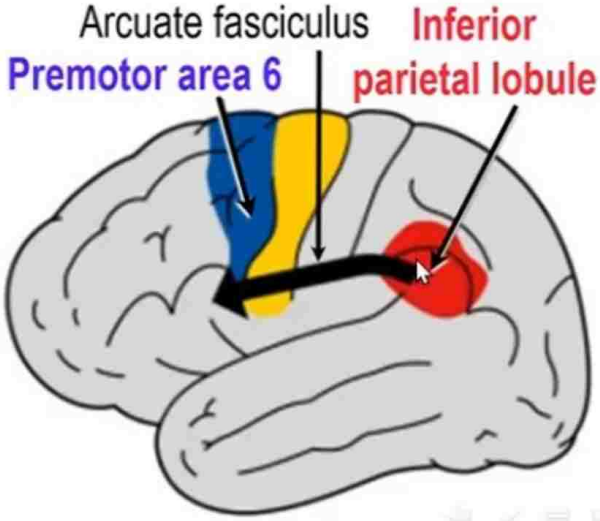
Patient's drawing



Figure



Patient's drawing



SUBSCRIBE

Higher Brain Function

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CORTICAL AREAS

- Motor Areas
- Sensory Areas
- Personality Center

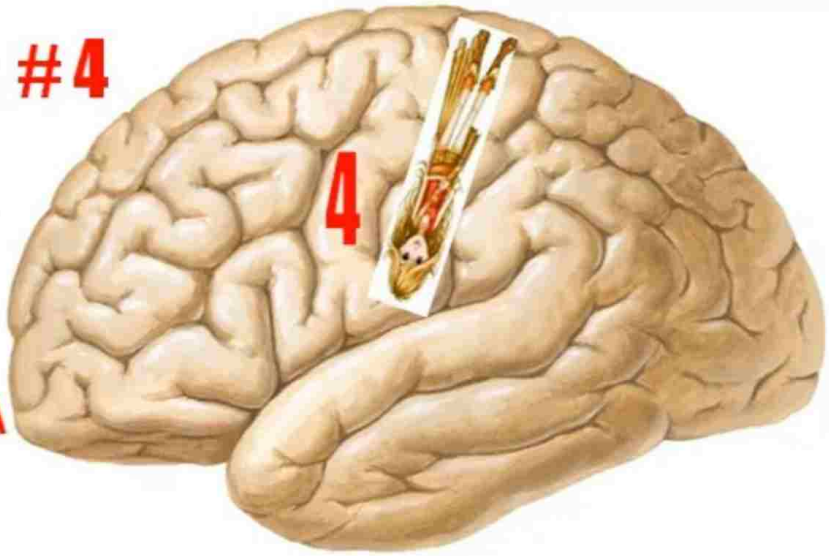
4 MOTOR AREAS

1. Primary motor area (# 4)
2. Premotor area (# 6)
3. Motor eye field area (# 8)
4. Broca's area (# 44 & 45)

Remember

1. Site
2. Arterial supply
3. Function
4. Lesion

Primary Motor Area: # 4



Site:

Precentral gyrus & anterior part of paracentral lobule

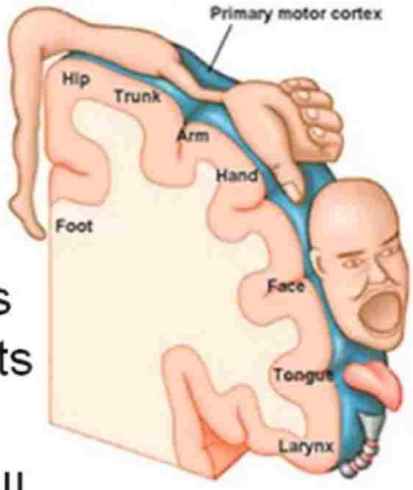
Arterial supply:

1. Upper ¼ & PCL: ACA
2. Lower ¾: MCA

Representation:

Opposite half of the body is **upside down**

1. **Lower third:** head region
2. **Leg and foot:** paracentral lobule



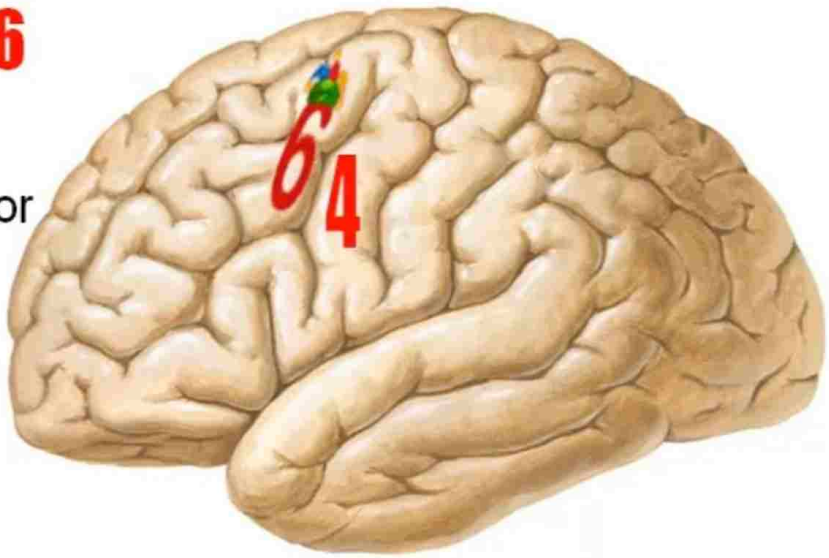
Function:

1. Origin to corticospinal & corticobulbar tracts
2. Initiation of the highly skilled fine movements

Lesion:

Contralateral hemiplegia with signs of UMNL

Premotor Area: # 6



Site:

Anterior to the primary motor area 4

Arterial supply:

1. Upper ¼: ACA
2. Lower ¾: MCA

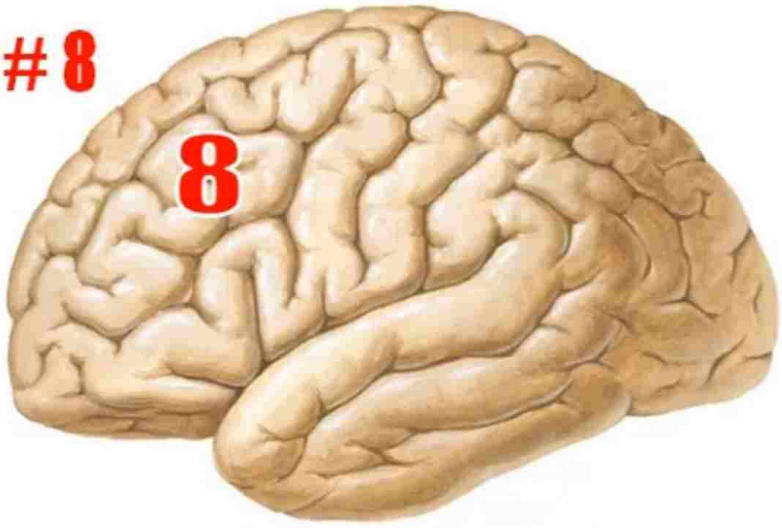
Function:

1. **Stereotyped movements** of muscles through connection with the basal ganglia
2. **Planning and execution** of the learned motor activity by storing the programs of motor activity learned by experience such as walking and dancing

Lesion:

Apraxia: difficulty in performing a learned movement without paralysis

Motor Eye Field Area: # 8

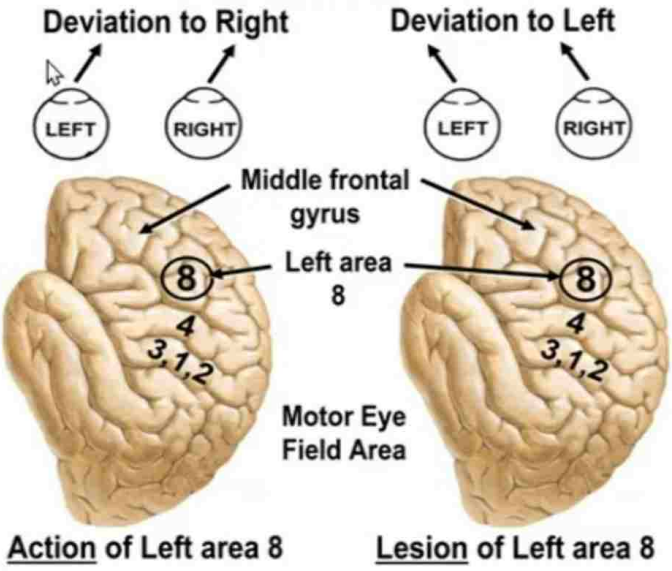


Site:
Posterior part of the middle frontal gyrus

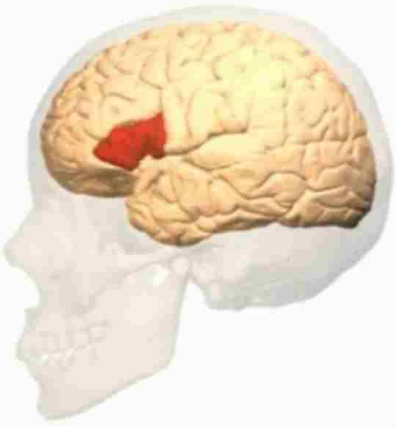
Arterial supply: MCA

Function:
Horizontal movement of the 2 eyes **to the opposite side**

Lesion:
Ipsilateral deviation of the 2 eyes due to the unopposed action of the intact are 8

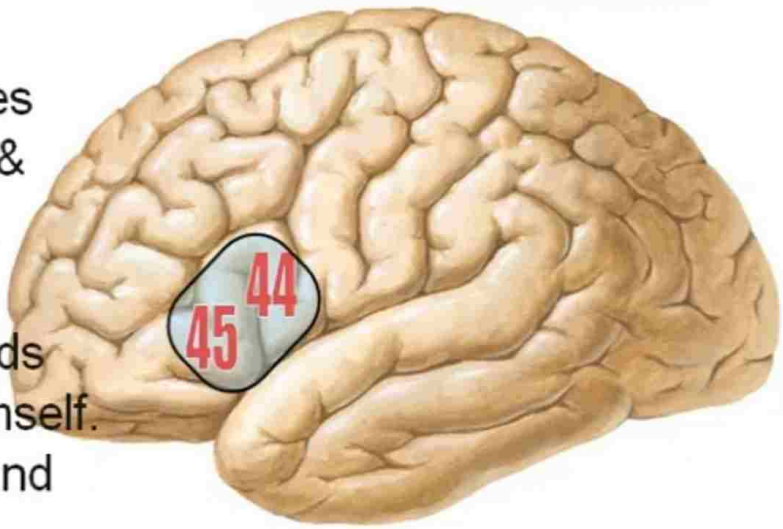


Broca's Area: # 44 & 45



Site: in the dominant hemisphere
In the posterior part of the inferior frontal gyrus:
1. **Opercular gyrus:** area 44
2. **Triangular gyrus:** area 45

Arterial supply: MCA



Function: coordinates muscles used in speech (lips, tongue & larynx) for speech production

Lesion: motor aphasia
@ The patient can't form words & is unable to express himself.
@ The patient understands and can point at objects.
@ **Lesion in the nondominant** hemisphere has no effect.

Prefrontal Cortex: 9, 10, 11, 12
Personality Center

Site: Frontal pole

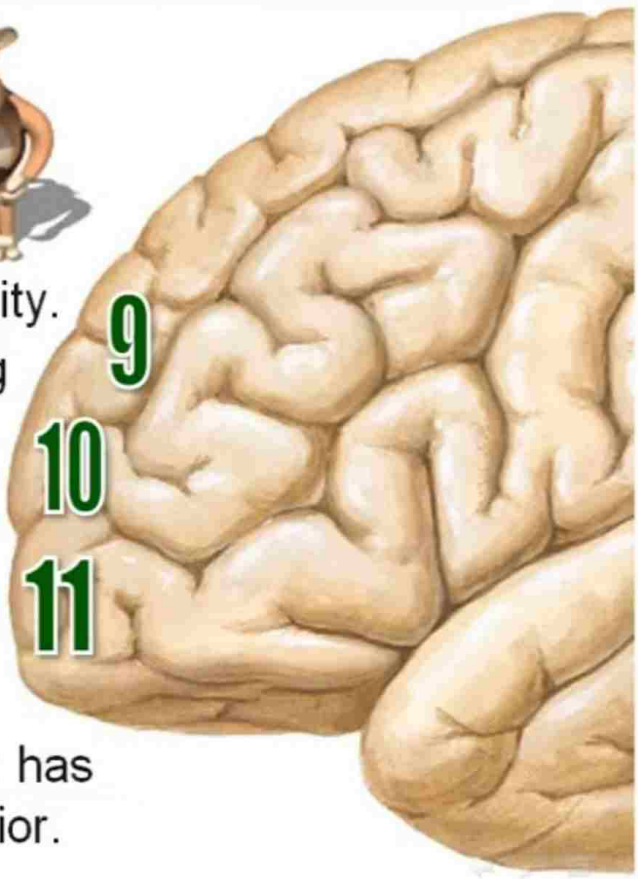
Arterial supply: ACA & MCA

Function:

@ Makeup of the person's personality.

@ Regulation of the depth of feeling and emotional behavior.

@ Higher intellectual function such as production of ideas and judgment.



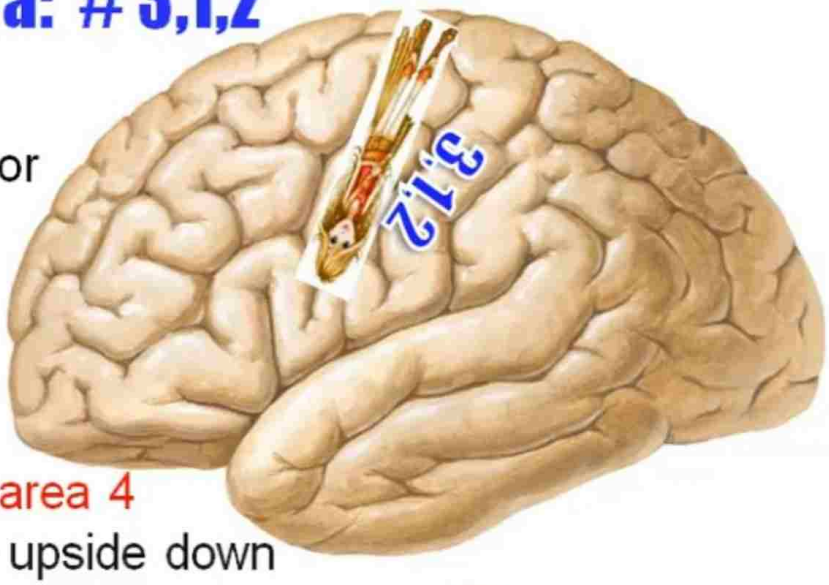
Lesion:

Loss of personalty and the patient has no appreciation to any social behavior.

SENSORY AREAS

1. General sensory area (3, 1, 2)
2. Sensory association area (5, 7, 40)
3. Primary auditory area (41, 42)
4. Auditory association area (22)
5. Primary visual area (17)
6. Visual association area (18, 19)
7. Others: taste, olfactory & vestibular

General Sensory Area: # 3,1,2



Site:

Postcentral gyrus & posterior part of paracentral lobule

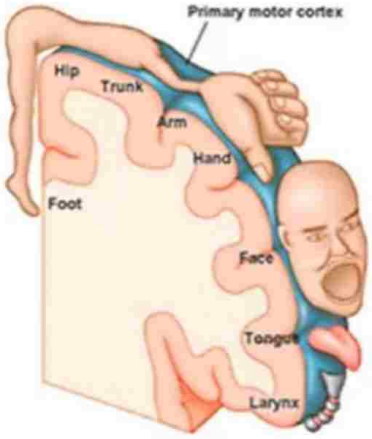
Arterial supply:

1. **Upper ¼ & PCL**: **ACA**
2. **Lower ¾: MCA**

Representation: similar to area 4

Opposite half of the body is upside down

1. **Lower third:** head region
2. **Leg and foot:** paracentral lobule



Function:

Receives general sensations from the opposite side of the body & face through the VPTN

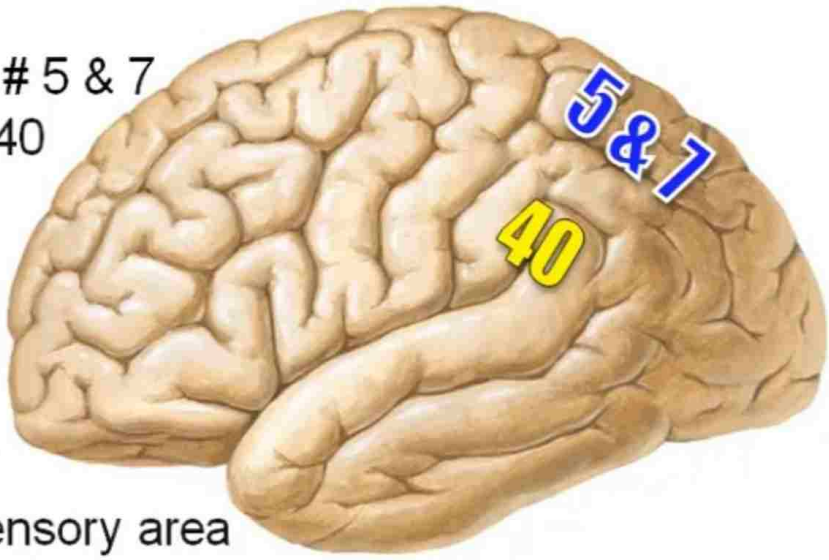
Lesion:

Contralateral hemianesthesia

Somatic Sensory Association Area: # 5, 7, 40

Site:

1. Superior parietal lobule: # 5 & 7
2. Supramarginal gyrus: # 40



Arterial supply:

ACA & MCA

Function: Stereognosis

Interpretation of senses perceived in the general sensory area

Lesion:

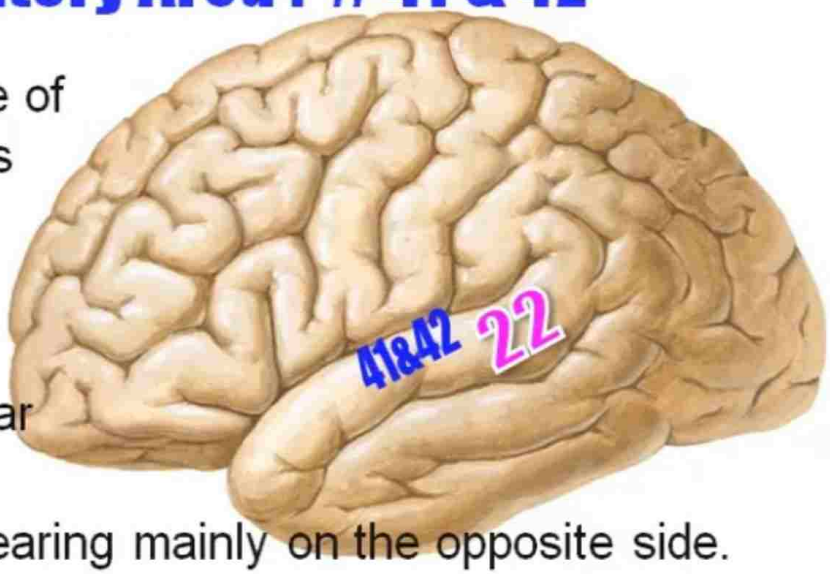
1. **Astereognosis:** inability to recognize objects by the sense of touch with the eyes closed.
2. **Unlateral neglect:** lesion in area 40 with inability to recognize left from right side

Primary Auditory Area : # 41 & 42

Site:
Middle of the upper surface of the superior temporal gyrus

Arterial supply: MCA

Function:
Hearing from the 2 ears, mainly from the opposite ear



Lesion:
Bilateral diminution of hearing mainly on the opposite side.

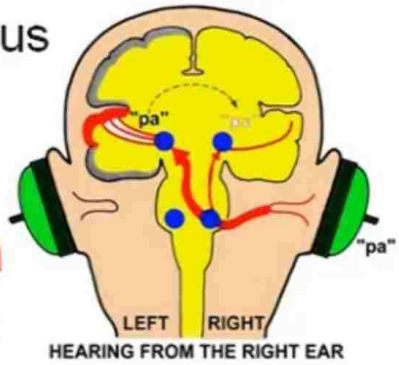
Auditory Association Area: Wernicke's Area: # 22

Site: posterior part of the superior temporal gyrus

Arterial supply: MCA

Function: recognition of sounds

Lesion: auditory agnosia & sensory aphasia
Inability to understand the spoken language

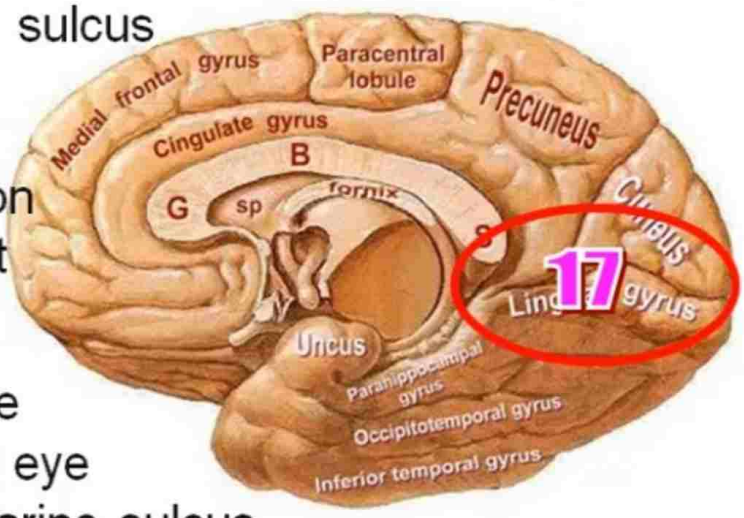


Primary Visual Area: Area 17

Site: above and below calcarine sulcus

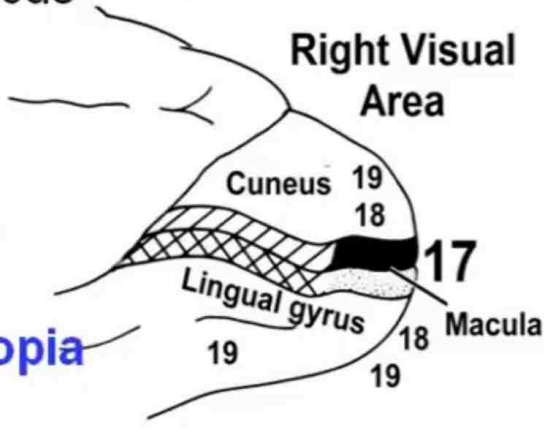
Arterial supply: PCA

Function: receives optic radiation from LGB for perception of light



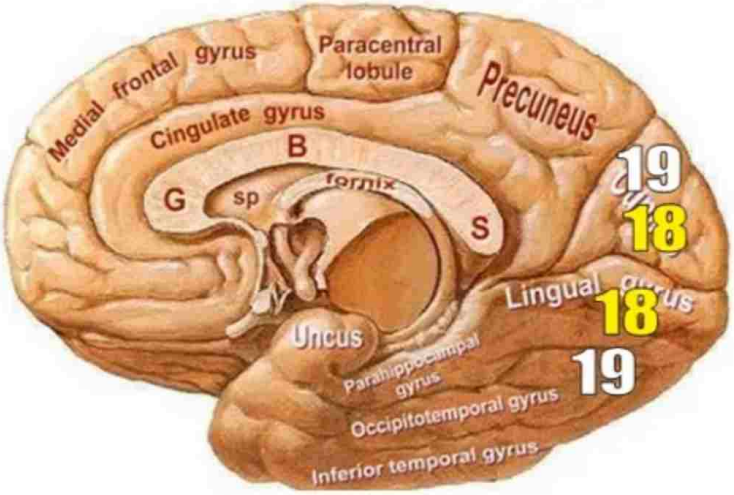
Representation of the retina:
Temporal fibers of the same eye and nasal fibers of the opposite eye

1. **Macula:** posterior 1/3 of calcarine sulcus
2. **Upper retinal fibers:** above calcarinr sulcus (cuneus)
3. **Lower retinal fibers:** below calcarine sulcus (lingual gyrus)



Lesion:
Contralateral homonymous hemianopia with macular sparing

Visual Association Area: Areas 18. 19. 39



Site:

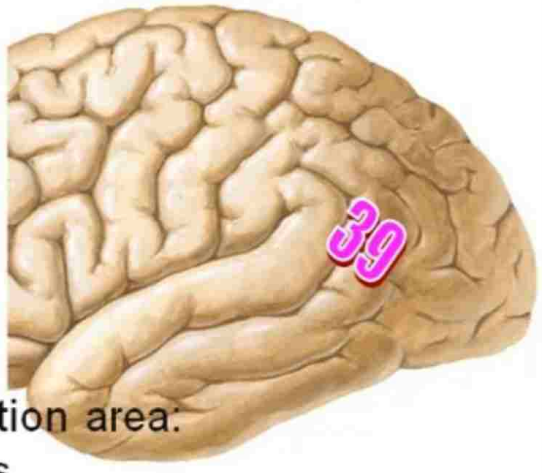
1. **Areas 18 & 19:** above and below area 17.
2. **Area 39:** angular gyrus

Arterial supply:

1. **Areas 18 & 19: PCA**
2. **Area 39: MCA**

Function:

1. Recognition of what we see.
2. Color vision: inferior association area
3. Angular gyrus: comprehension of written language



Lesion:

1. **Visual agnosia:** inability to recognize what we see.
2. **Loss of color vision:** lesion in inf association area.
3. **Alexia & agraphia:** lesion in angular gyrus

Primary olfactory area: Area 34

Site: Uncus

Irritative lesion: olfactory hallucination

Olfactory association area: Area 28

Site: ant part of parahippocampal gyrus

Function: discrimination of odors

Face recognition area: Area 37

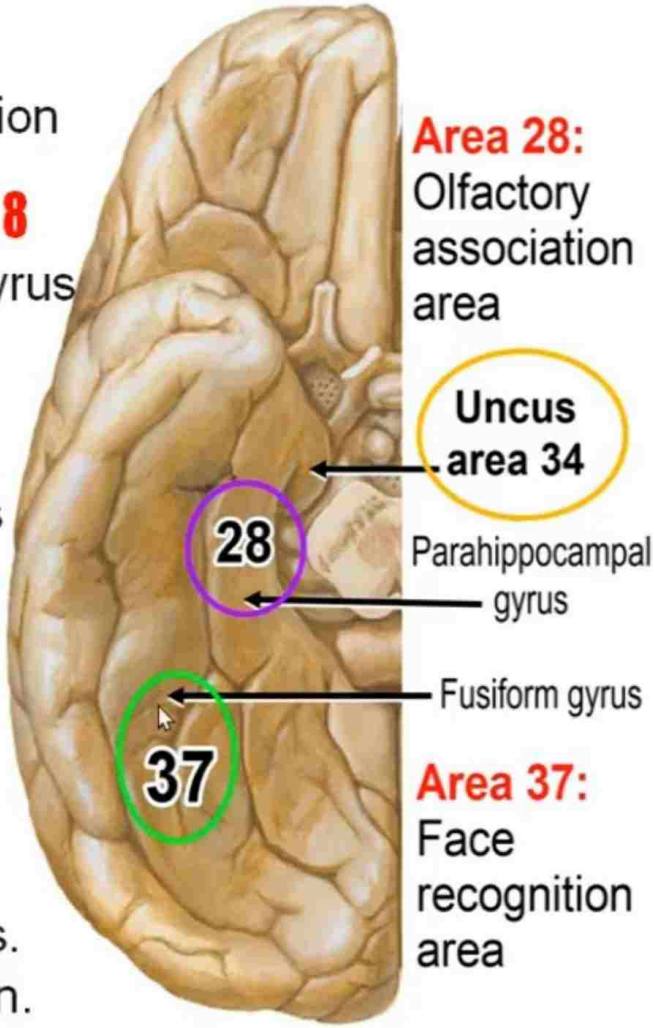
Site: Posterior part of fusiform gyrus

Function: similar to area19 & 39

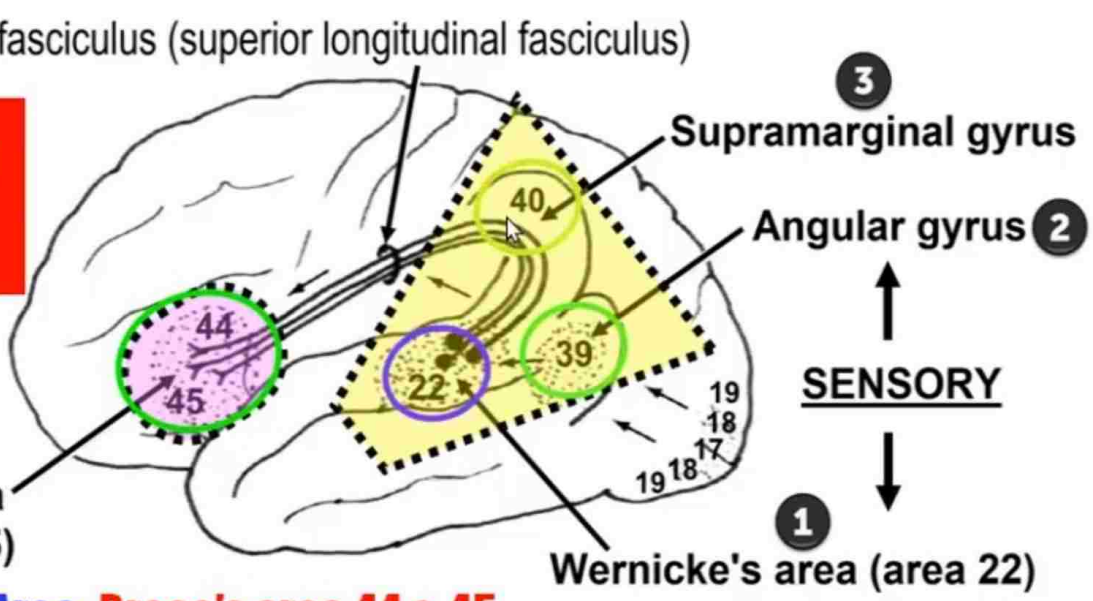
1, Face and body recognition
2. Word recognition
3. Number recognition

Lesion:

Prosopagnosia (face blindness).
Inability to recognize familiar faces.
They rely on sounds for recognition.



Language AREAS



Motor Speech Area: Broca's area 44 & 45

Lesion: expressive (motor) aphasia

3 Sensory Speech Areas: Areas 22, 39 & 40

@ Wernicke's area 22: understands the spoken language

Lesion: sensory aphasia, inability to understand spoken / written language

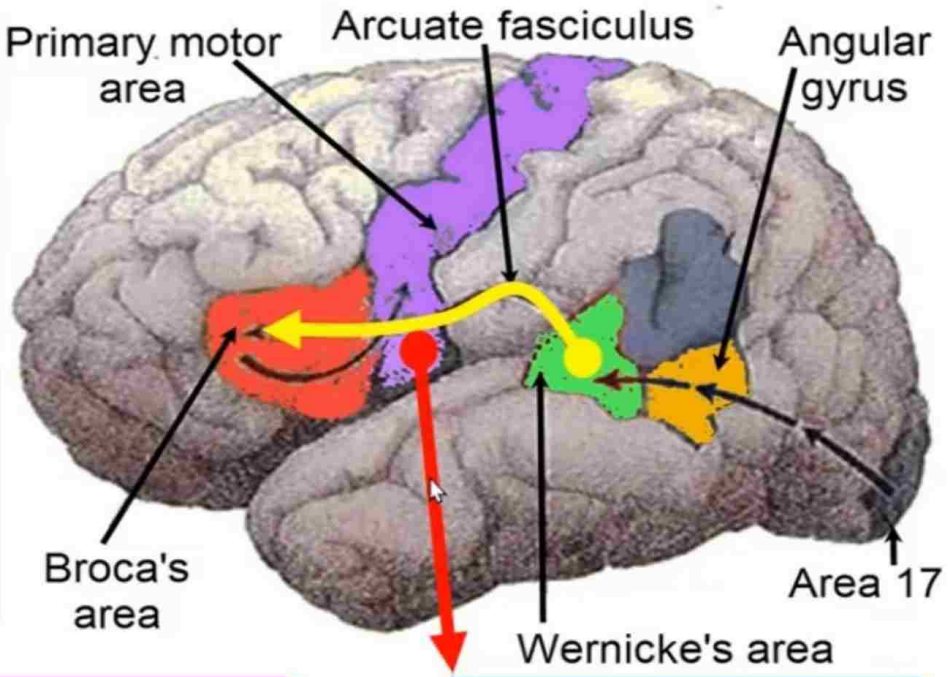
@ Angular gyrus: area 39: understands the written language

Lesion: alexia and agraphia

@ Supramargial gyrus: #40: understands sizes, shapes & texture and recognition of the body parts and left side from right side

Processing of Written Language

Reading from a book



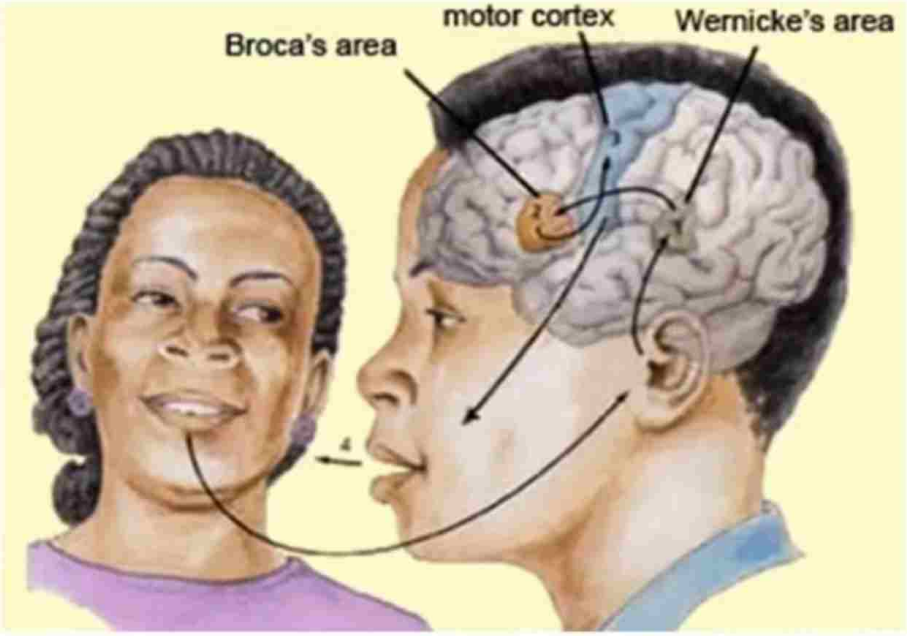
Retina → Primary visual area → #18 &19 for recognition

Angular gyrus to comprehend the written form → Wernicke's area to comprehend the auditory form → Broca's area via arcuate fasciculus to formulate the words

Area 4 → Coticobulbar tract → VII, X, XII to lips, larynx and tongue

Processing of Spoken Language

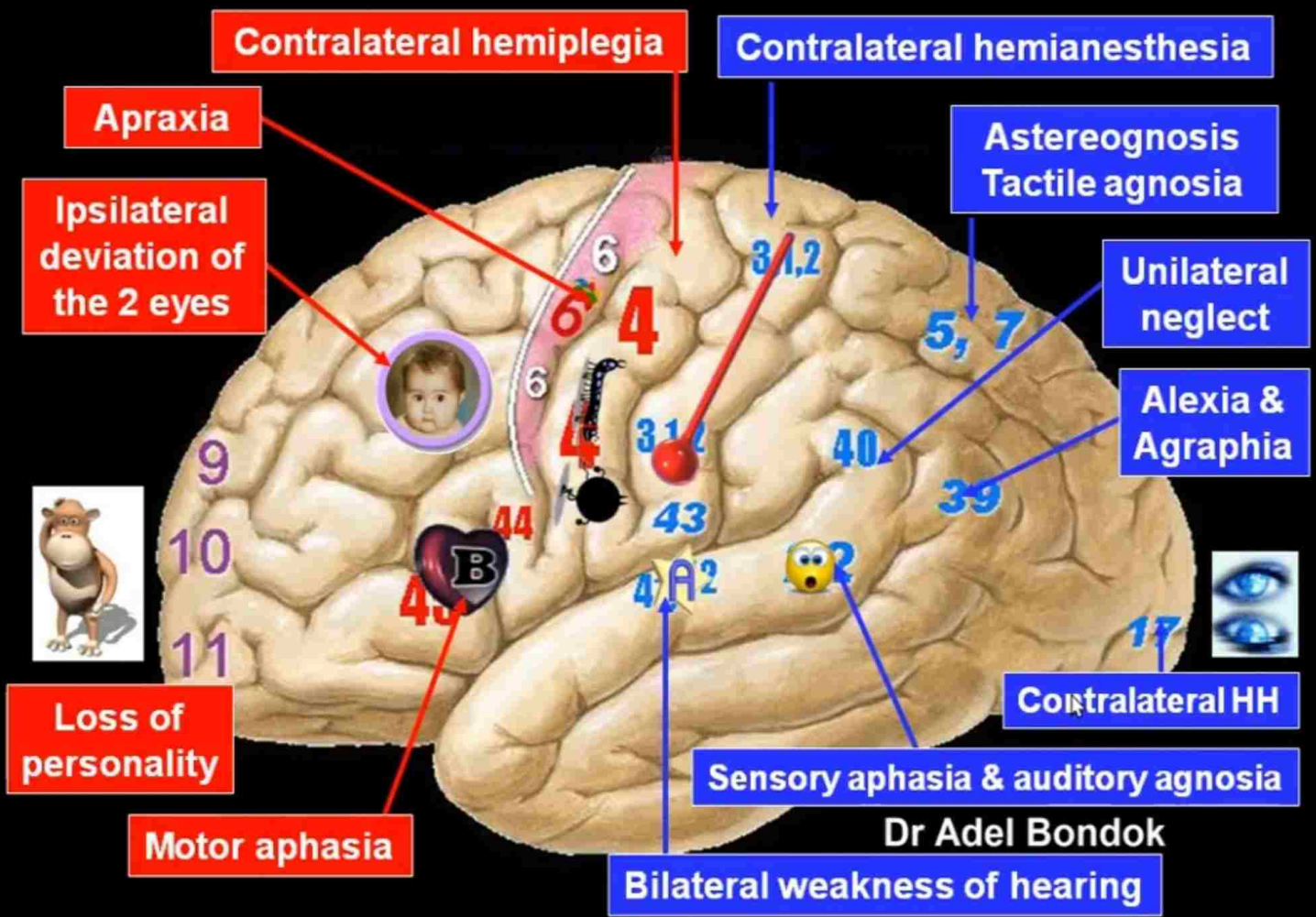
Answering a Question



Ear → Primary auditory area 41, 42 → Wernicke's area to comprehend the spoken words

Broca's area via arcuate fasciculus to formulate the words → Primary motor Area 4 → Corticobulbar tract

VII, X & XII nerves → Muscles of lips, larynx and tongue



Summary of Lesions in the Cortical Areas