

ANATOMY OF THE CENTRAL NERVOUS SYSTEM

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Spinal Cord [Spinal Medulla]

Definition: Elongated cylindrical part of the central nervous system

Length: 45 cm

Weight: 30 gm

The Site of the Spinal Cord

Occupies the upper 2/3 of the vertebral canal

Extent; Extends from the upper border of Atlas to the Disc between the First and Second Lumbar vertebrae

Enlargements of the Spinal Cord

Two Enlargements;

1-Cervical Enlargement:

-Extends from the third cervical to the second thoracic segments; C3-T2

-Formed by the nuclear origin of the large nerves of the upper limbs

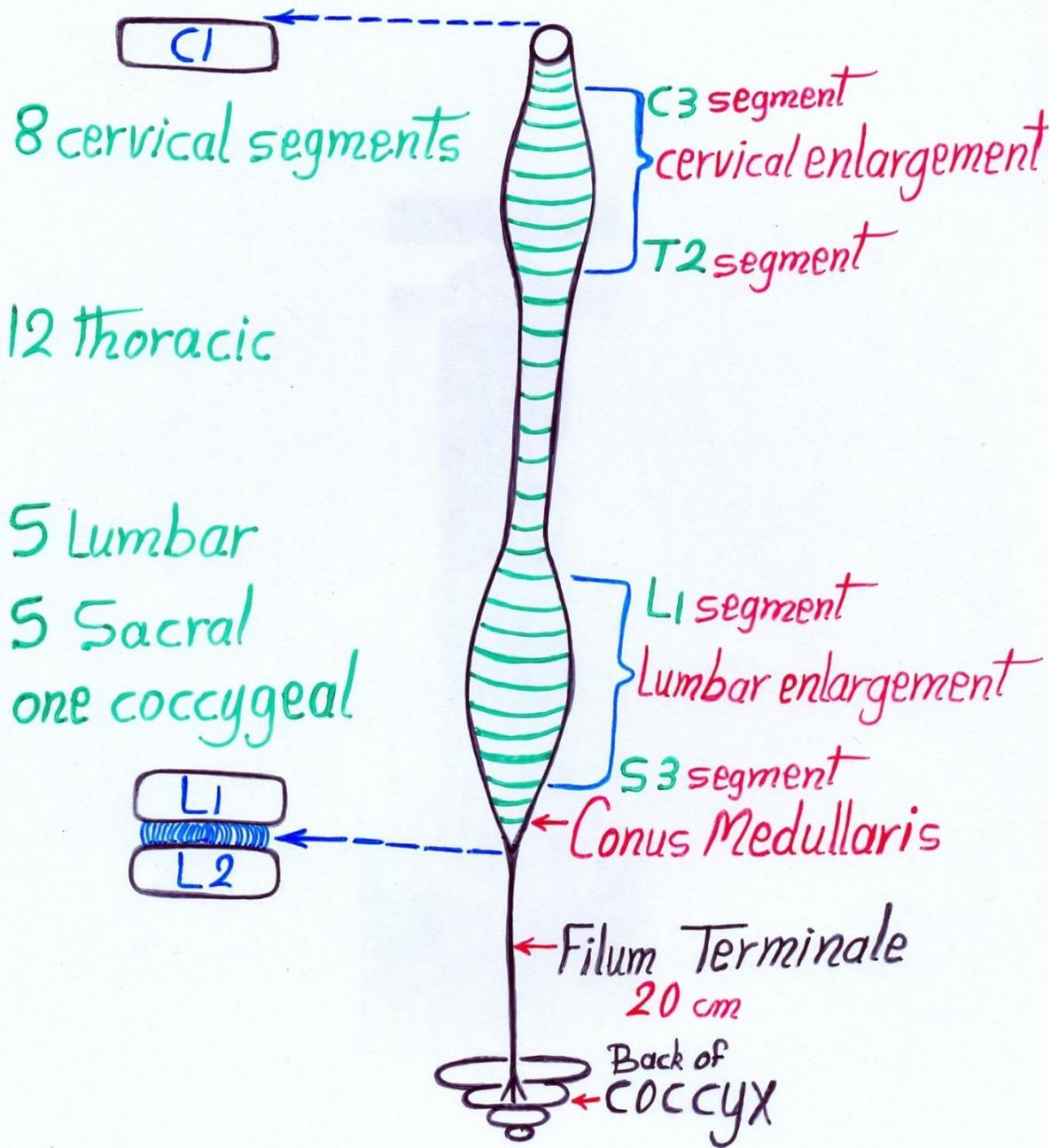
2-Lumbar Enlargement:

-Extends from the first lumbar to the third sacral segments; L1-S3

-Formed by the nuclear origin of the large nerves of the lower limbs

Conus Medullaris;

The caudal narrow part of the spinal cord



Filum Terminale:

1-Connective tissue filament

2-Extends from the Conus medullaris to the back of Coccyx

3-Its length: 20 cm

4-Its function:

Fixation of the spinal cord, in the center of the vertebral canal, to avoid injury of the cord during movement

Segments of the spinal cord

The spinal cord is formed of 31 segments;

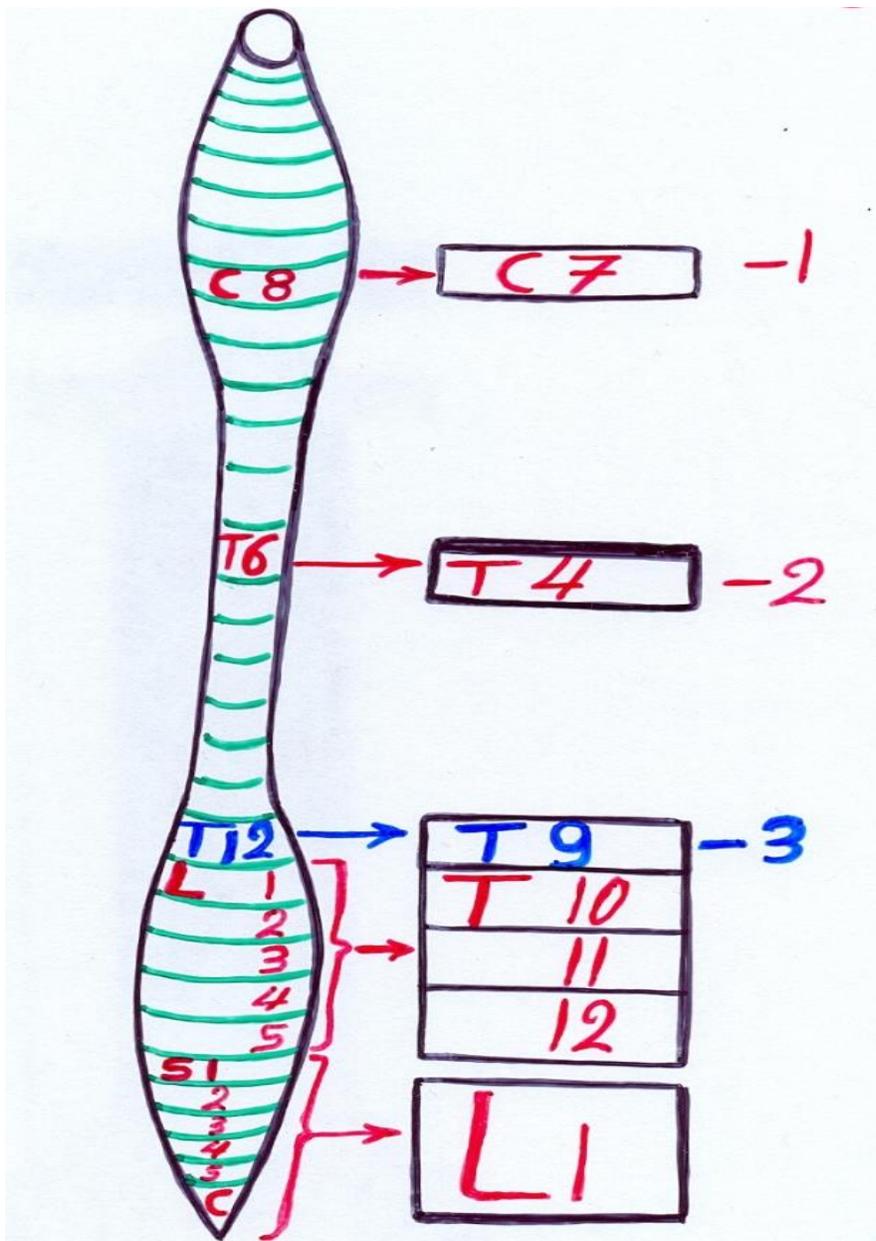
8 cervical, 12 thoracic, 5 lumbar, 5 sacral & one coccygeal

Each segment gives attachment to a single pair of spinal nerves

The Vertebral Level of the Segments

The segments are higher in level than the corresponding Vertebrae

- **8th cervical segment at the level of the 7th cervical vertebra [-1]**
- **6th thoracic segment at the level of 4th thoracic vertebra [-2]**
- **12th thoracic segment at the level of 9th thoracic vertebra [-3]**
- **All the lumbar segments lie at the level of the lower three thoracic vertebrae [T 10 , 11 & 12]**
- **Sacral and coccygeal segments at the level of the First Lumbar Vertebra**



Spinal Nerves

31 pairs of nerves: like segments; 8 cervical, 12 thoracic, 5 lumbar, 5 sacral & one coccygeal

Parts of the spinal nerves:

- 1- Rootlets : ventral and dorsal
- 2- Roots : ventral and dorsal
- 3- Trunk
- 4- Rami : ventral and dorsal

Rootlets;

-the parts attached to the spinal cord

-the rootlets fuse to form the roots

Roots;

A-Dorsal Root:

Contains afferent Sensory fibers

Formed by the central processes of the **Dorsal Root Ganglion** cells

B-Ventral Root:

Contains efferent Motor fibers

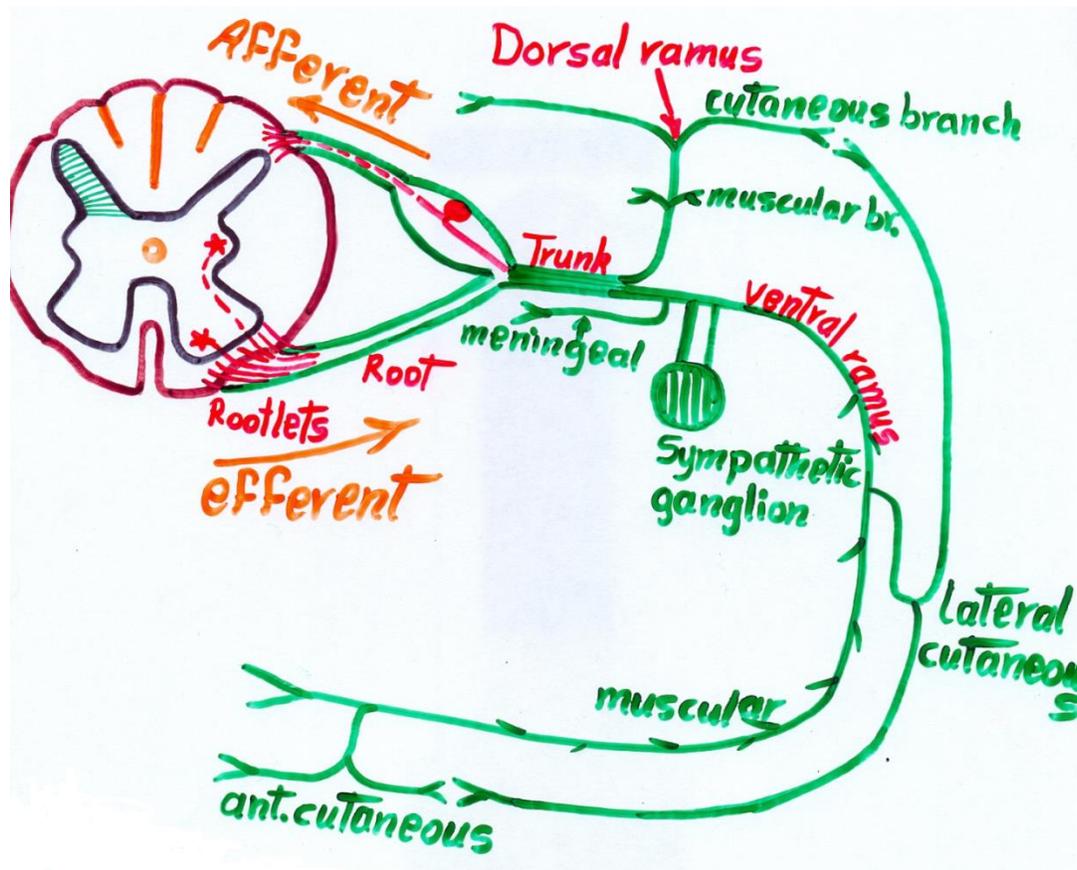
Formed by axons of the cells in the **Ventral and Lateral Gray Matter horns** of the spinal cord

The Nerve Trunk; lies in the intervertebral canal and divides into two rami

Rami of the spinal nerve [Dorsal and Ventral Rami];

A-Small Dorsal Ramus Supplies:

- Skin of the Back
- Deep muscles of the Back



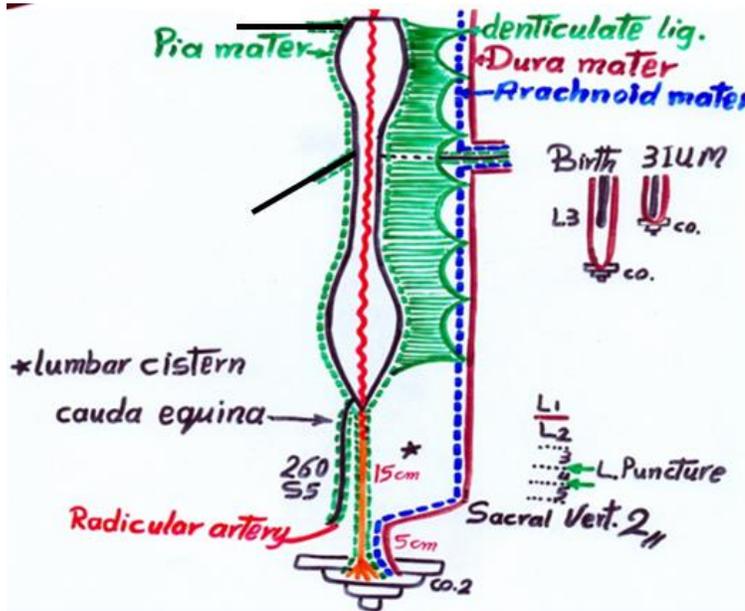
B-Large Ventral Ramus Supplies:

Anterolateral walls of the trunk and gives Five Branches;

- 1-Meningeal Branch
- 2-White Ramus Communicantes
- 3-Muscular Branches
- 4-Lateral Cutaneous Branch
- 5-Anterior Cutaneous Branch

- Length And Obliquity Of The Roots

- 1-upper cervical : shortest and horizontal
- 2-lower cervical and thoracic roots : moderate in length and oblique
- 3-lumbar , sacral &coccygeal roots : longest , vertical and forming the cauda equine



External Features of the Spinal Cord

1-Anterior Median Fissure: contains the anterior spinal artery

2-Antero-Lateral Sulcus: contains the ventral rootlets

4-Posterior Median Sulcus: between the two gracile tracts

3-Postero-Lateral sulcus: contains the dorsal rootlets

5-Posterior Intermediate Sulcus:

- Between Gracile and Cuneate Tracts
- Present only in the cervical and upper thoracic regions

Spinal Meninges

Dura, Arachnoid and Pia

Dura:

- The most superficial
- The thickest
- The strongest

Pia:

- The innermost one
- The thinnest
- The most delicate

The Extent of the Meningeal Tubes;

1-The Dural and Arachnoid tubes extend from the Foramen Magnum to the Second Sacral segment

2-The Pia extends from the Foramen Magnum to the lower End of the Spinal Cord

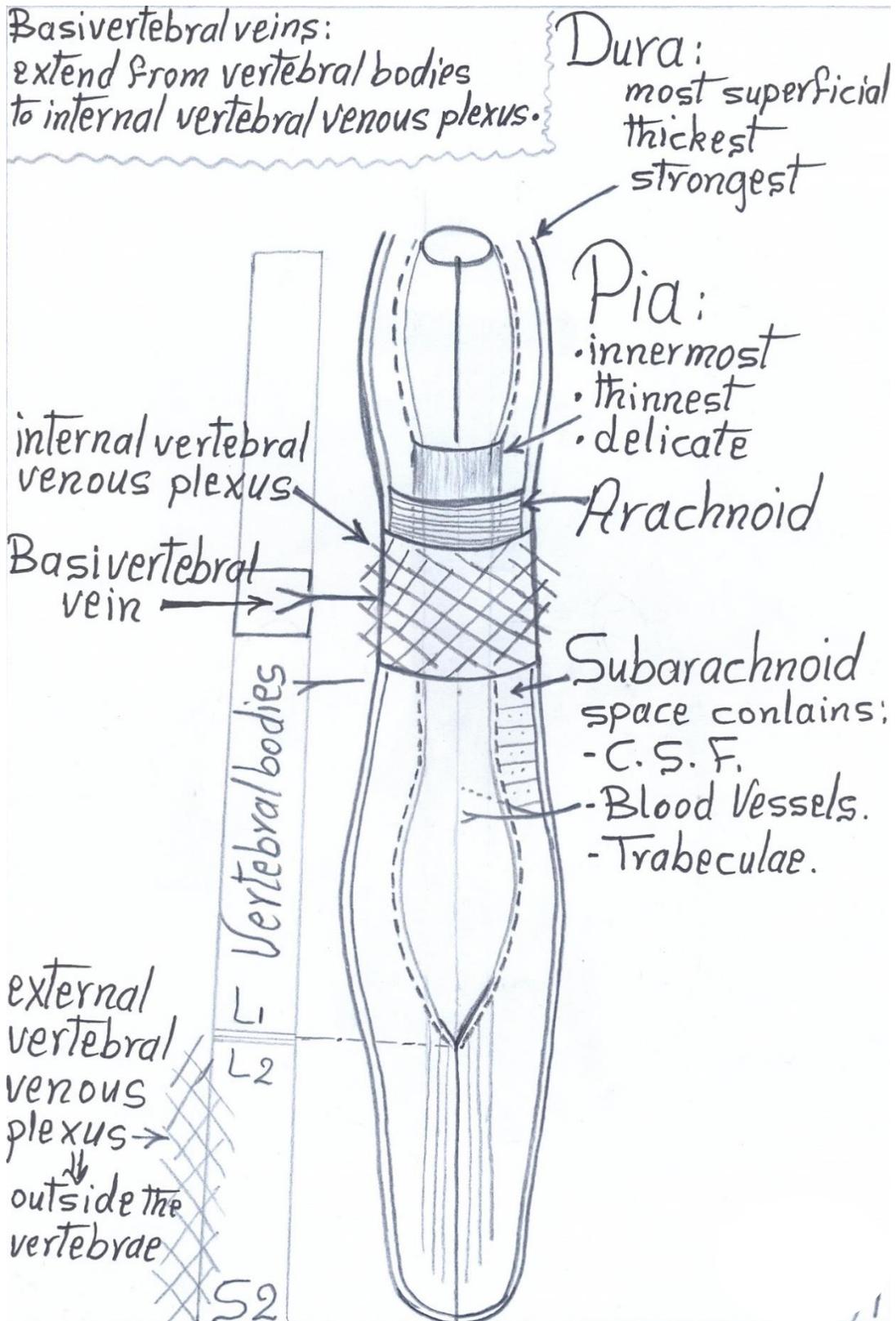
The spaces around the spinal meninges

1- Epidural Space:

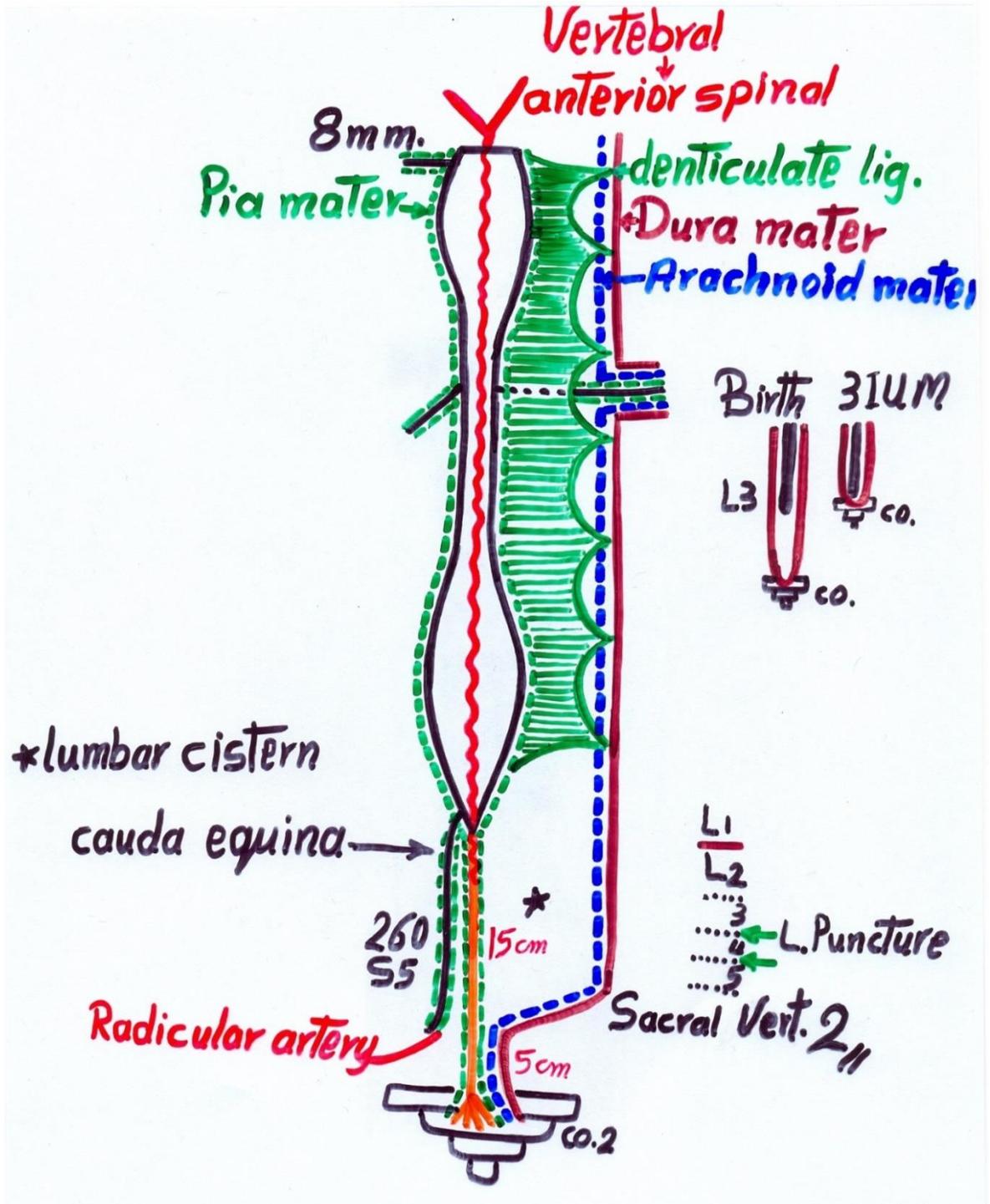
- Between the dura and the walls of the vertebral canal
- Contains : Fat & Internal Vertebral Venous Plexuses

2-Subarachnoid Space:

- Between Pia and Arachnoid
- The subarachnoid space Contains : Cerebrospinal Fluid [CSF] , Trabeculae , Blood Vessels and Spinal Nerves



The meninges form 3 tubes around the spinal cord



The subarachnoid space below the spinal cord is wide and forms the Lumbar Cistern

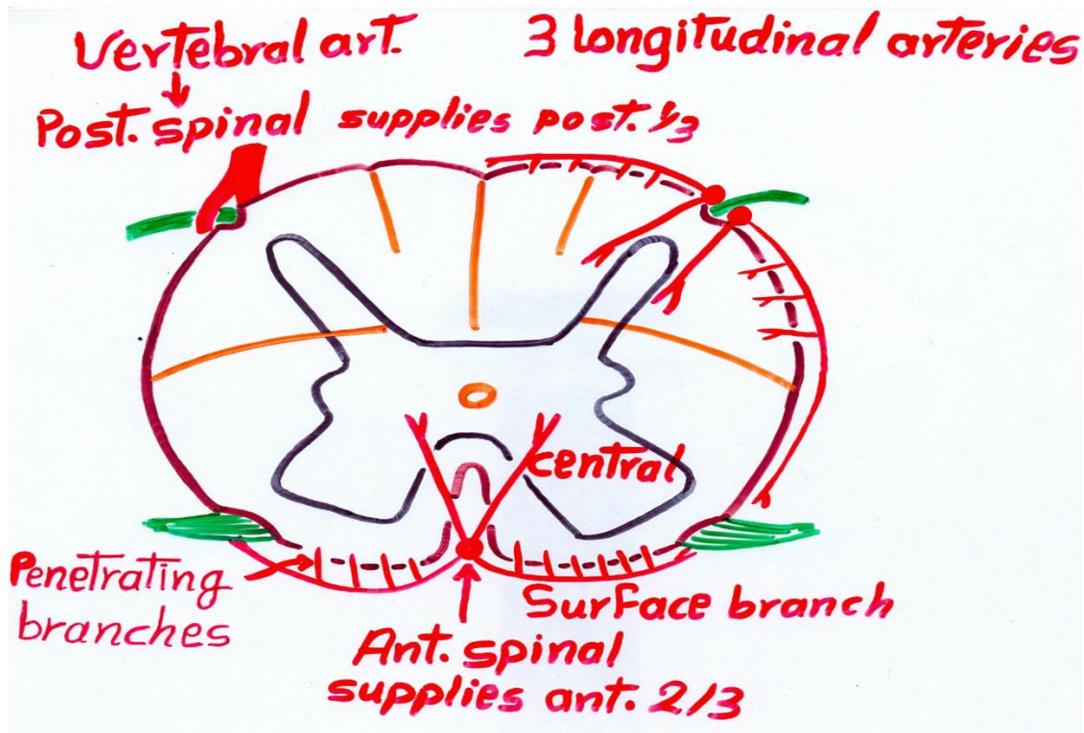
Denticulate Ligaments

- Two Folds from the Pia mater
- Extend from the side of the spinal cord to the dura mater
- Its lateral border forms tooth like processes
- Supports and suspends the spinal cord in the center of the vertebral canal

Blood supply of the spinal cord

The spinal cord is supplied by the following Spinal Arteries:

- 1-Anterior Spinal
- 2-Posterior Spinal
- 3-Spinal Of Intersegmental



Anterior Spinal Artery

Origin: joining of two branches; one from each vertebral artery

Course: descends downwards along the Anterior Median Fissure

End: in the Filum terminale

Branches:

- Surface and central branches
- Supply the anterior 2/3 of the spinal cord

Posterior Spinal Arteries

There are two posterior spinal arteries: one on each side

Origin: from the Vertebral artery in the cranial cavity

Course: leave the skull through the foramen magnum, then each artery divides into two branches which run downwards around the dorsal rootlets [in the Postero-Lateral Sulci]

End: in the Conus Medullaris

Branches of posterior spinal arteries:

- Surface and central branches
- Supply the posterior 1/3 of the spinal cord

Spinal Branches of the Inter-segmental Arteries

Origin: from Vertebral, Intercostal, Lumbar and lateral Sacral arteries

Course: enter the vertebral canal through the intervertebral foramen

Branches of the Spinal Branches of the Inter-segmental Arteries:

- 1-branches to the vertebral canal [bones and ligaments]
- 2-branches to the spinal meninges
- 3-neural branches to the parts of the spinal nerves, the branches of the roots named **Radicular Arteries**
- The posterior radicular artery supplies the dorsal root ganglion

Venous Drainage of the Spinal Cord

The drainage starts by the Internal Spinal Veins, which end in a peripheral venous plexus on the surface of the spinal cord

The Peripheral Plexus contains 6 longitudinal veins named External Spinal Veins

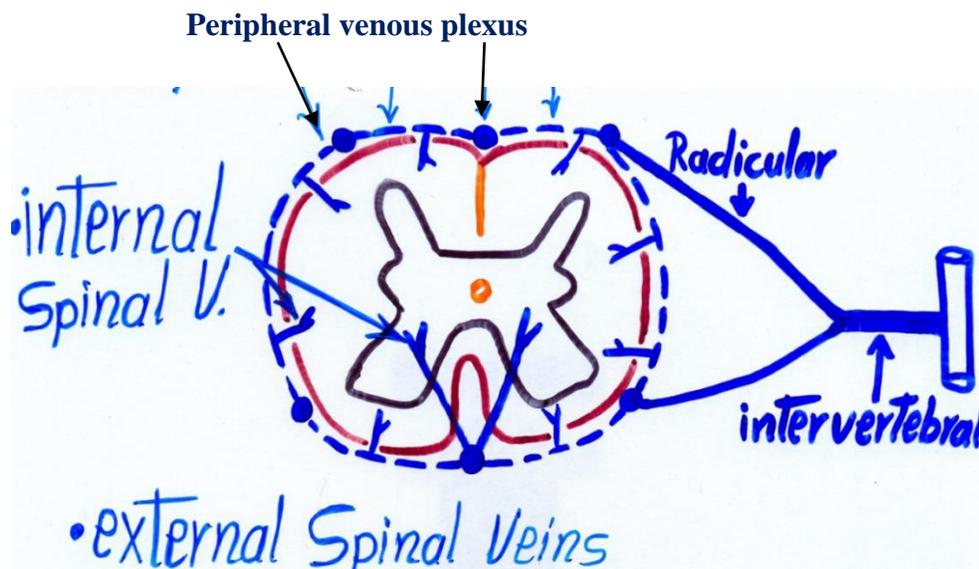
The peripheral plexus drains into the radicular veins

The Radicular Veins end into the intervertebral vein

The Intervertebral Vein ends in the Regional Veins

N.B. the **Basi-Vertebral Vein** draining the body of the vertebra and ends into internal vertebral venous plexus

N.B. the **External Vertebral Venous Plexus** surrounding the vertebra from outside



Internal Structure of the Spinal Cord

The Spinal Cord formed of Central Gray Matter and peripheral White Matter

Central Gray Matter:

- **Structure:** formed of nerve cells, non-myelinated nerve fibers, neuroglia and blood vessels
- **Shape:** H-shaped in cross section with three horns on each side; Anterior, Posterior and Lateral
- The two sides connected by the Gray Commissure which contains the Central Canal

The Lateral Horn is present only in two parts:

- A- Thoracic and Upper Lumbar segments forming the lower Sympathetic center
- B-Middle 3 Sacral segments act as a lower Parasympathetic center

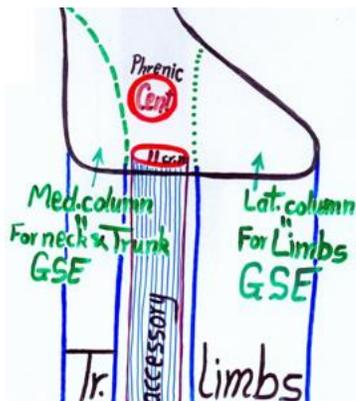
Nerve Cell Groups in the Anterior Horn

I – Medial Group; innervates the skeletal muscles of the Neck and Trunk

II- Lateral Group; innervates the skeletal muscles of the Limbs

III- Central Group; consists of Two Nuclei

- A-Phrenic Nucleus ; in 3rd, 4th & 5th Cervical segments and innervates the Diaphragm
- B-Accessory Nucleus ; in the Cervical segments from the First to the Fifth and innervates the Trapezius and Sternomastoid



Nerve Cell Groups in the Posterior Horn

I – Substantia Gelatinosa;

- **At the apex of the horn**
- **Concerned with pain and temperature**

II – Nucleus Proprius;

- **Anterior to substantia gelatinosa**
- **In the center of the horn**
- **Concerned with simple touch**

III – Clarke’s Nucleus;

- **At the base of the horn**
- **Concerned with unconscious proprioception**

IV – Reticular Nucleus;

- **Lateral to Clarke’s nucleus**
- **It is a visceral afferent nucleus**

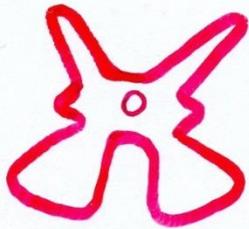
Nerve Cell Groups in the Lateral Horn; **Three Groups**

I – Lateral One = Visceral Efferent Nucleus

II – Medial Two Groups = Visceral Afferent Nuclei

str.

Gray matter



Substantia gelatinosa: Rolandi

S. G. Pain & Temp.

Clarke's = Thoracic N. unconscious proprioception

Prop.

proprio: Simple Touch

Reticular: VA.

Central canal → ○

G.V.A. G.V.R.

G.V.E.

gray commissure ↑

Phrenic Cent.

Il. Cent.

Med. column For neck & Trunk GSE

Lat. column For Limbs GSE

Tr.

accessory

Limbs

White Matter of the Spinal Cord

Structure; formed of myelinated nerve fibers, neuroglia and blood vessels

Forms Three Columns on each side; Anterior, Lateral and Posterior Columns

Posterior White Column

Contains Long and Short Tracts

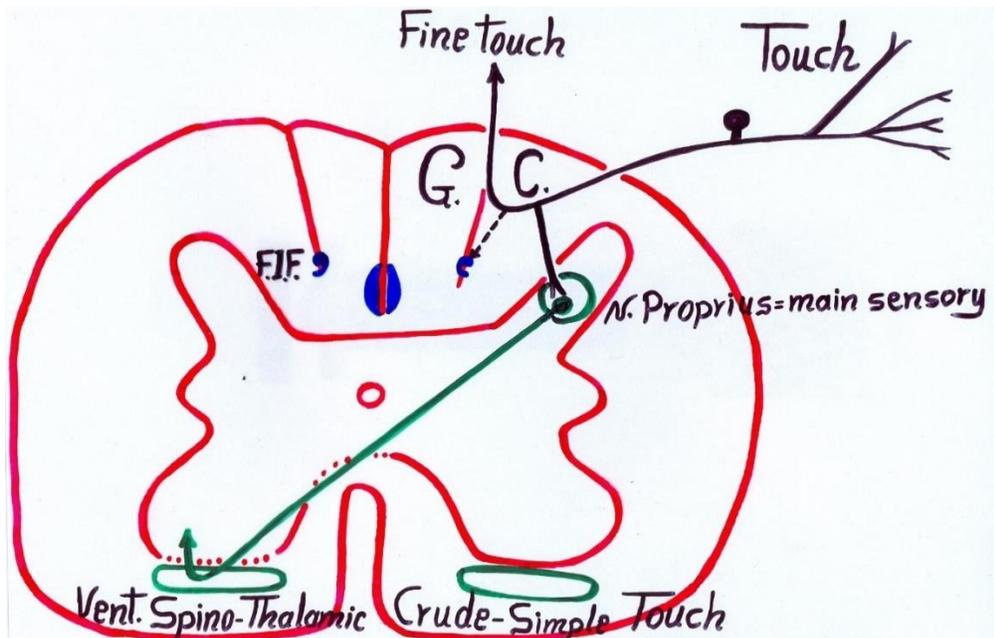
The Long Tracts include ONLY Two Ascending Tracts; both convey Conscious Proprioception and Fine Touch:

1-Gracile Tract;

- Lies close to the posterior median septum
- Conveys sensation from the following segments ; coccygeal , sacral , lumbar and lower thoracic segments

2-Cuneate Tract;

- Lies lateral to gracile tract
- Conveys sensations from the upper thoracic and cervical segments



Anterior White Column

Contains Long and Short Tracts

The Long Tracts include ONE Ascending Tract and FIVE Descending Tracts

A-the Ascending Tract in the Anterior White Column;

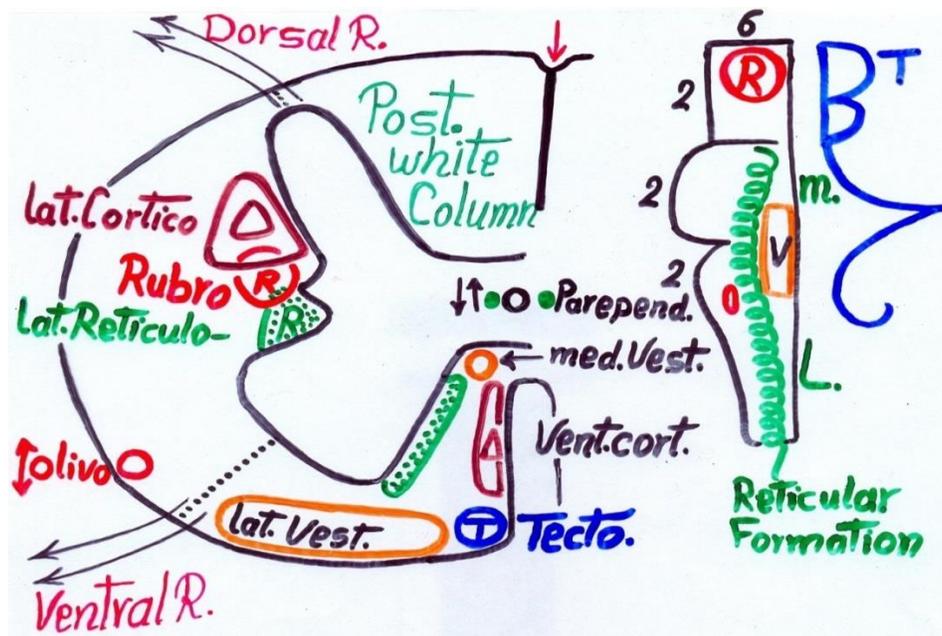
The Ventral Spino-Thalamic Tract which conveys Simple Touch

B -The Five Descending Tracts in the Anterior White Column;

-One Pyramidal Tract named Ventral Cortico-Spinal Tract

-Four Extrapyramidal Tracts ;

- 1-Tecto-Spinal Tract
- 2-Two Vestibulo-Spinal Tracts
- 3-Medial Reticulo-Spinal Tract



Lateral White Column

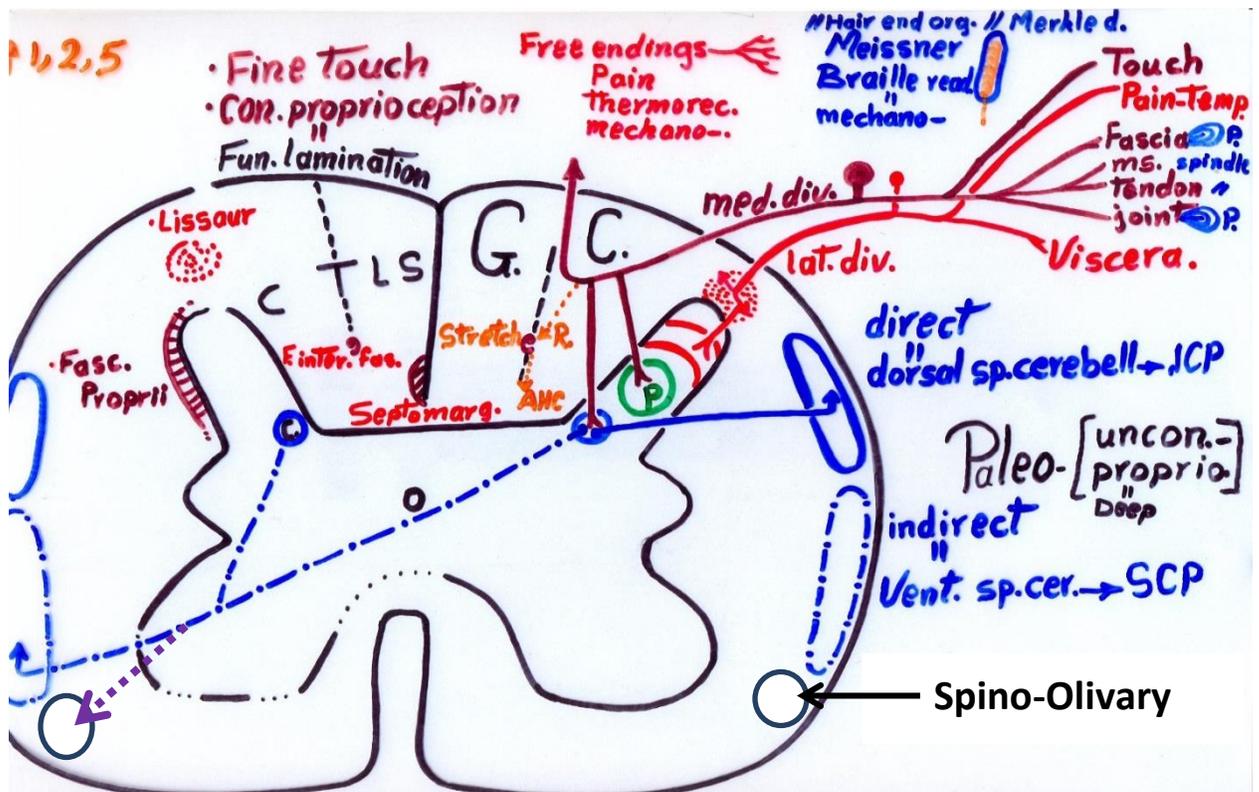
Contains Long and Short Tracts

The Long Tracts include Ascending and Descending groups;

A-The Ascending Group Includes 6 Tracts;

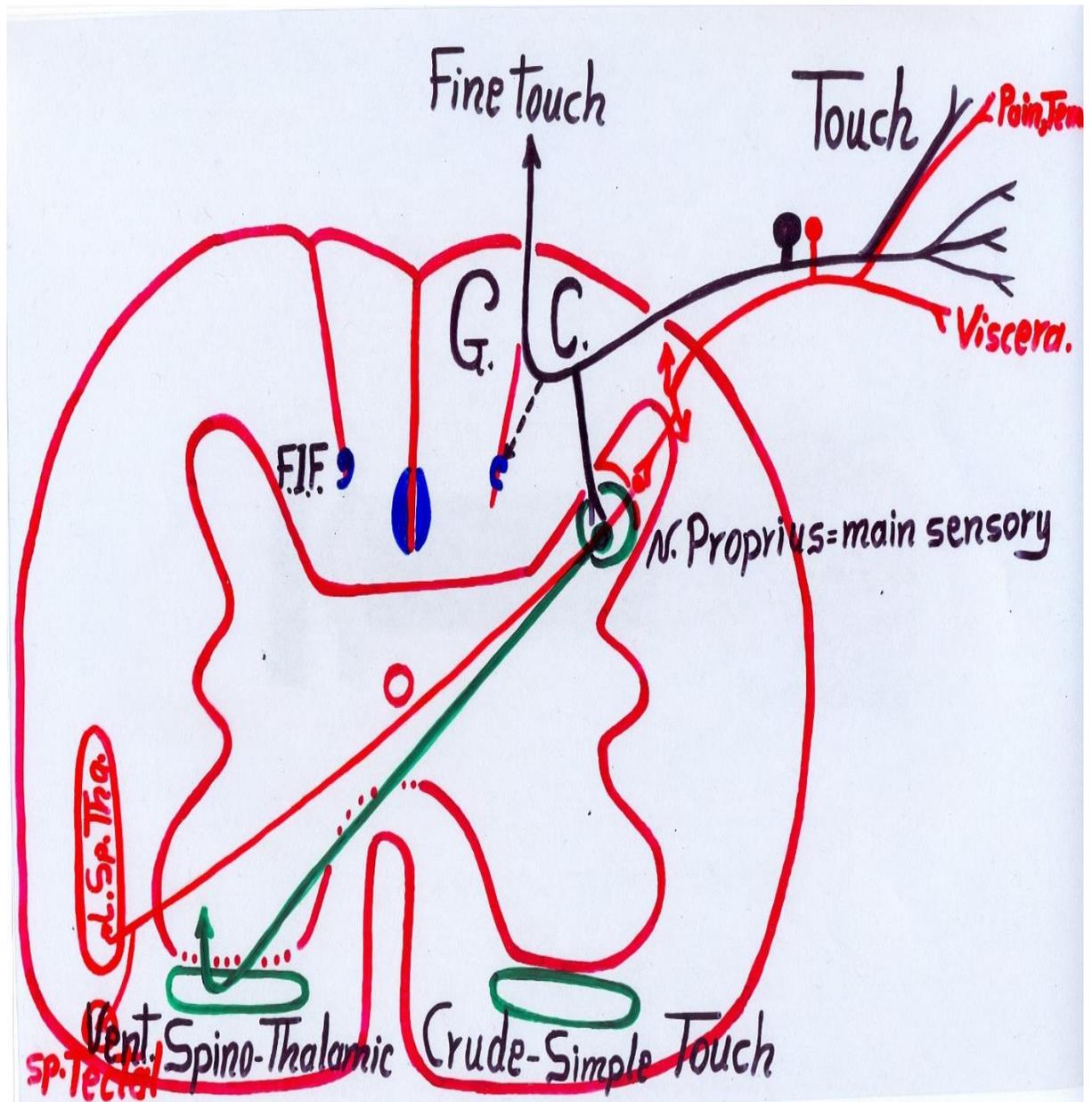
Three Tracts Conveying Unconscious Proprioceptive Sensations:

- 1-Dorsal Spino-Cerebellar Tract
- 2-Ventral Spino-Cerebellar Tract
- 3-Spino-Olivary Tract



Two Tracts Conveying Pain and Temperature:

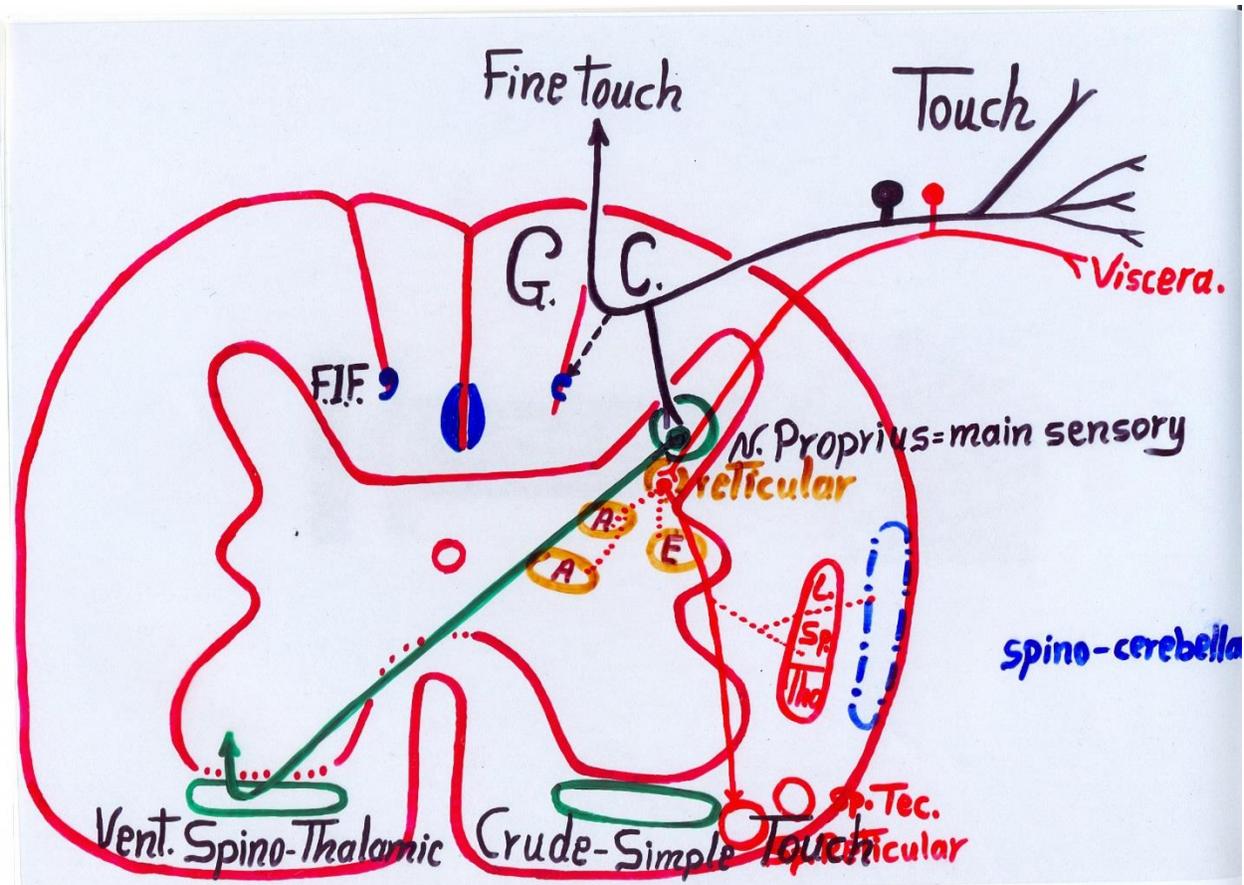
- 1-Lateral Spino-Thalamic Tract
- 2-Spino-Tectal Tract ; for Visual Reflexes



The 6th one named Spino-Reticular Tract:

Conveys Visceral Sensations

Ascend with Pain & Temperature and Proprioceptive Sensations



B-The Descending Group includes 4 tracts;

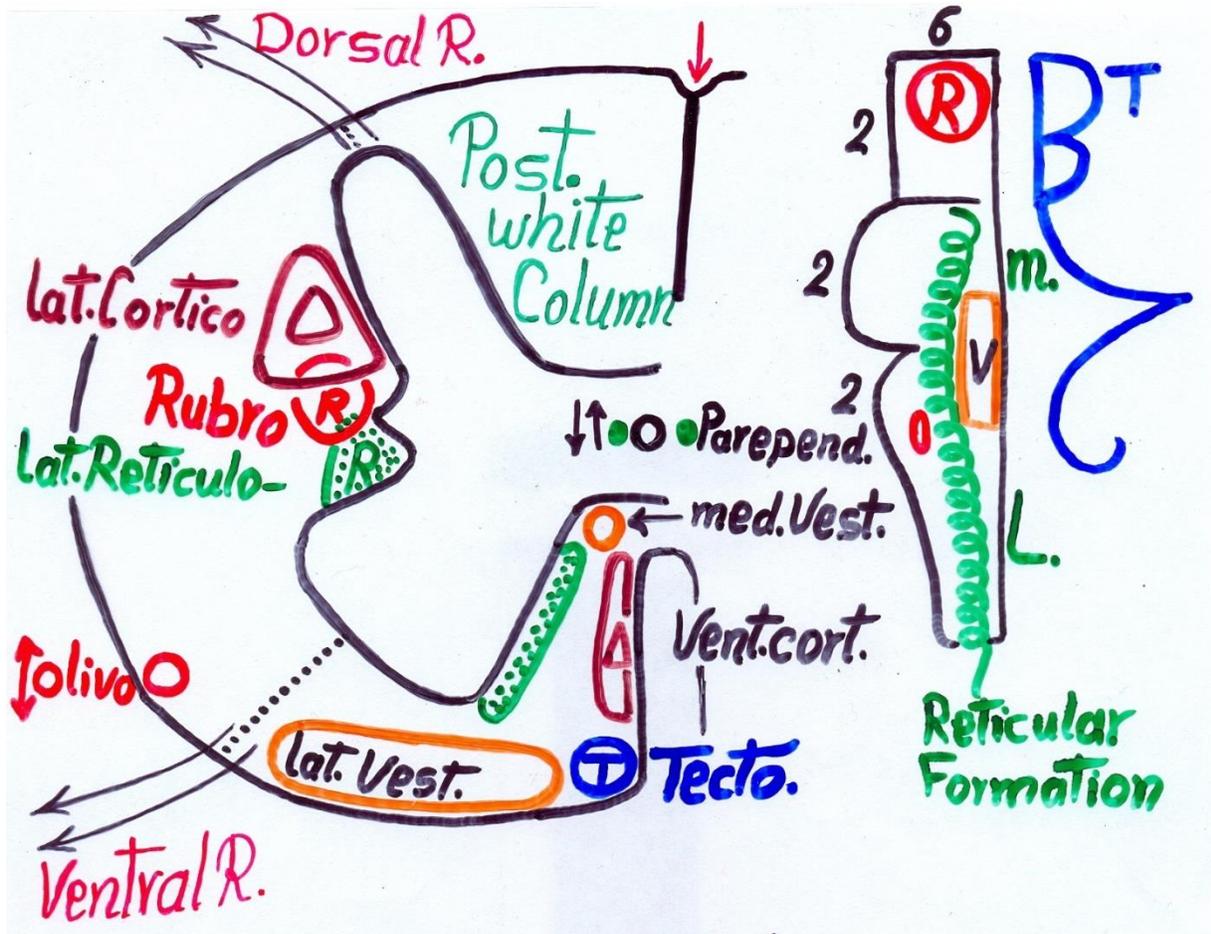
-One Pyramidal Tract named Lateral Cortico-Spinal Tract

-Three Extrapyrarnidal Tracts;

1-Rubro-Spinal Tract

2-Lateral Reticulo-Spinal Tract

3-Olivo-Spinal Tract



THE SHORT TRACTS

There are four short tracts in all white columns

1-Fasciculi Proprii;

- Lies around the gray matter , in all columns
- Concerned with Association between segments

2-Lissauer's Tract;

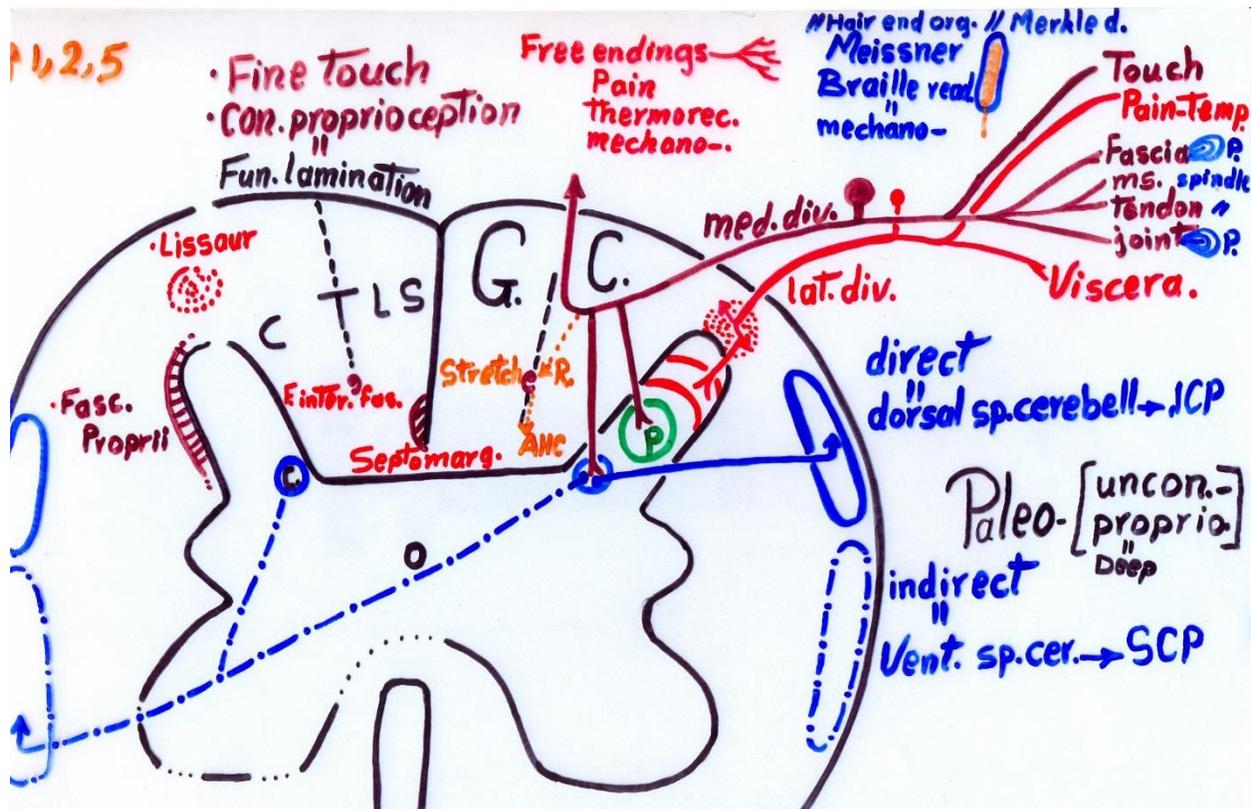
- In the lateral white column
- Conveys pain and temperature

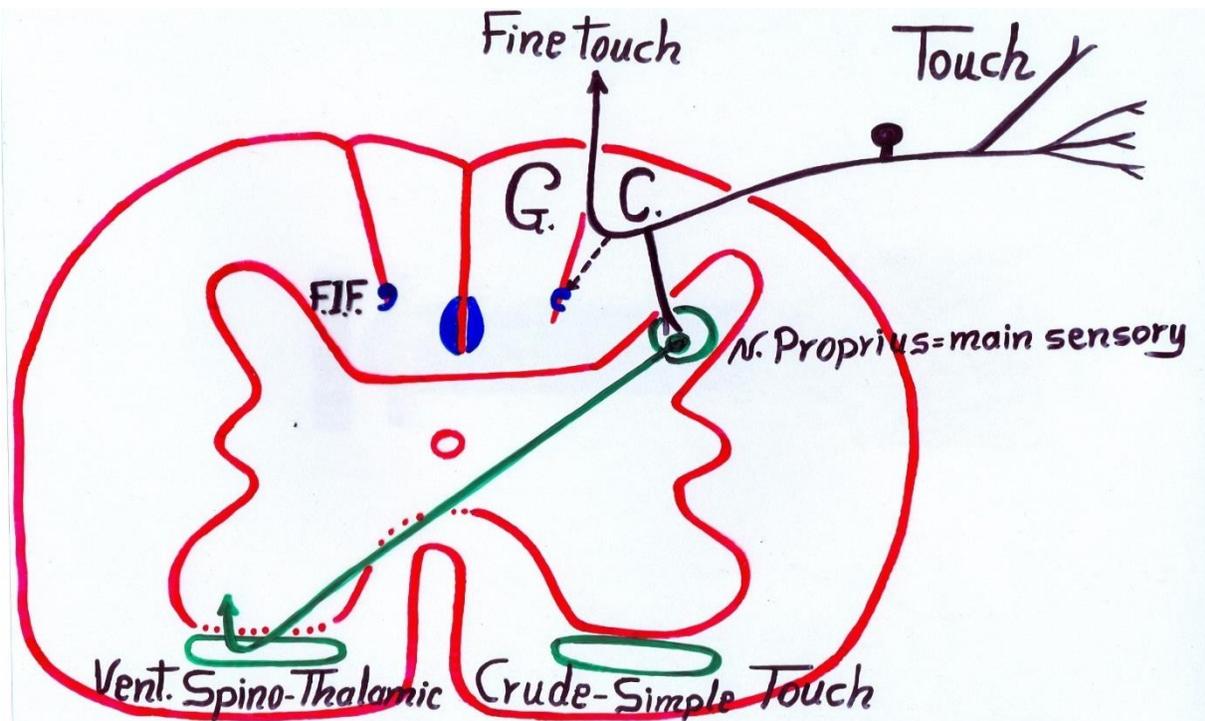
3-Fasciculus Interfascicularis;

- Lies between gracile and cuneate tracts
- Comma shaped
- Formed by collaterals from gracile and cuneate tracts
- Ends on the anterior horn cells
- Concerned with Stretch Reflex

4-Septomarginal Tract;

- Lies on each side of the posterior median septum
- Present Below the level of the Clarke's nucleus
- Carries Unconscious Proprioception below the Clarke's nucleus [below the 3rd lumbar segment]





MEDULLA OBLONGATA

General Features of the Medulla Oblongata

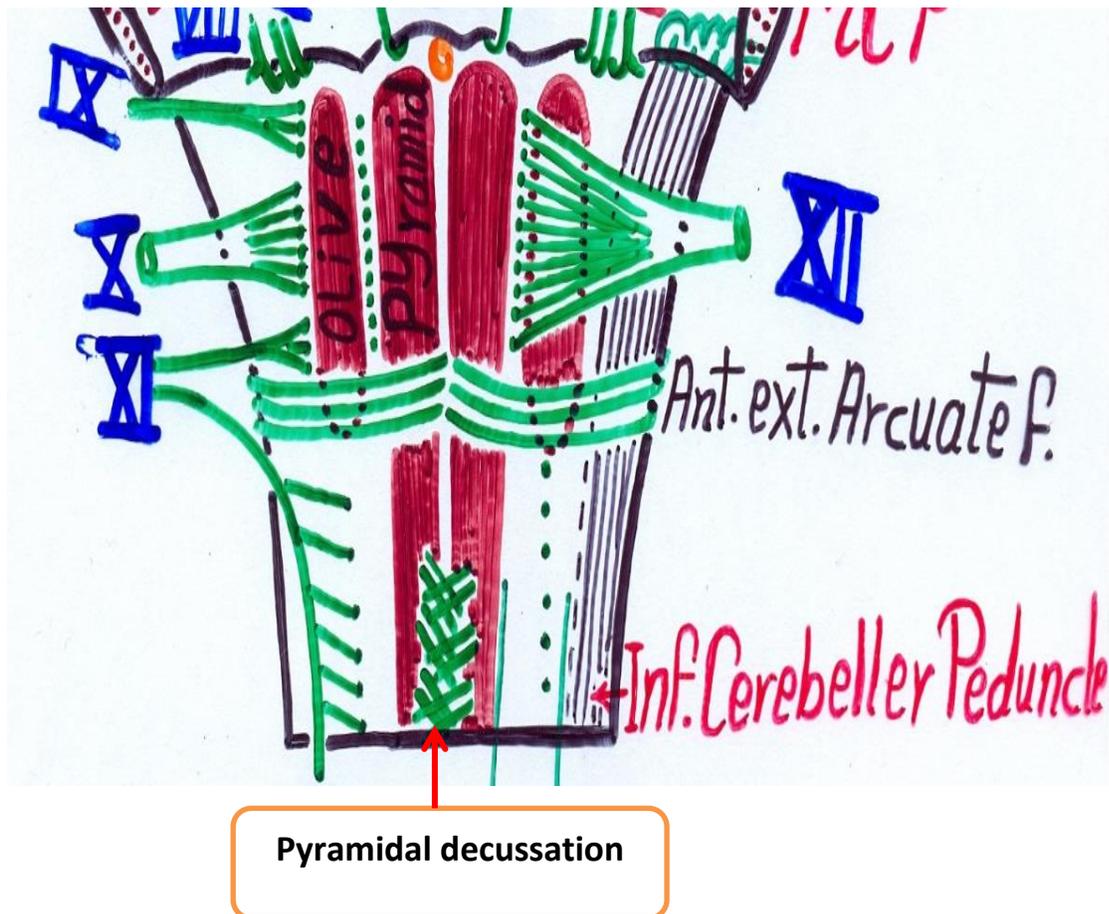
-Shape; conical in shape

-Length; 3cm

-Its upper half named open medulla; as it forms part of the floor of the 4th ventricle

-Its lower half named closed medulla; like the spinal cord as it has a central canal

Features of the Anterior Aspect of the Medulla;



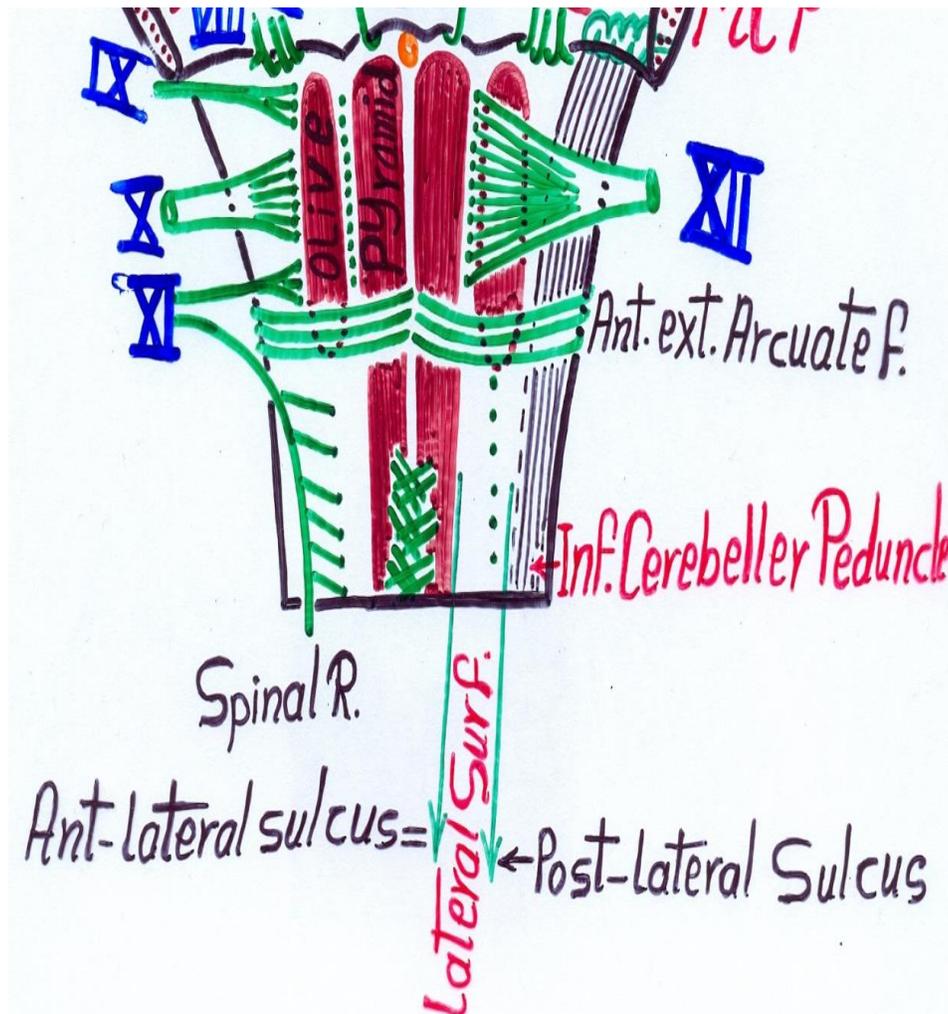
1-Anterior Median Fissure;

- A-its upper end is deep and named Foramen Caecum
- B-its middle part shows the anterior External Arcuate Fibers
- C-its lower end shows the Pyramidal Decussation

2-Pyramid;

- Elongated Ridge on each side of the anterior median fissure
- Formed by the corticospinal fibers [Pyramidal Tract]
- The 6th cranial nerve emerges at the upper end of the pyramid

Features of the Lateral Aspect of the Medulla;



Features of the Lateral Aspect Of The Medulla

1-Olive;

- Oval eminence
- Lateral to the pyramid
- Bounded by two sulci ; anterolateral and Postero-lateral sulci

2-Anterolateral Sulcus;

- Between olive and pyramid
- Contains rootlets of hypoglossal nerve

3-Posterolateral Sulcus;

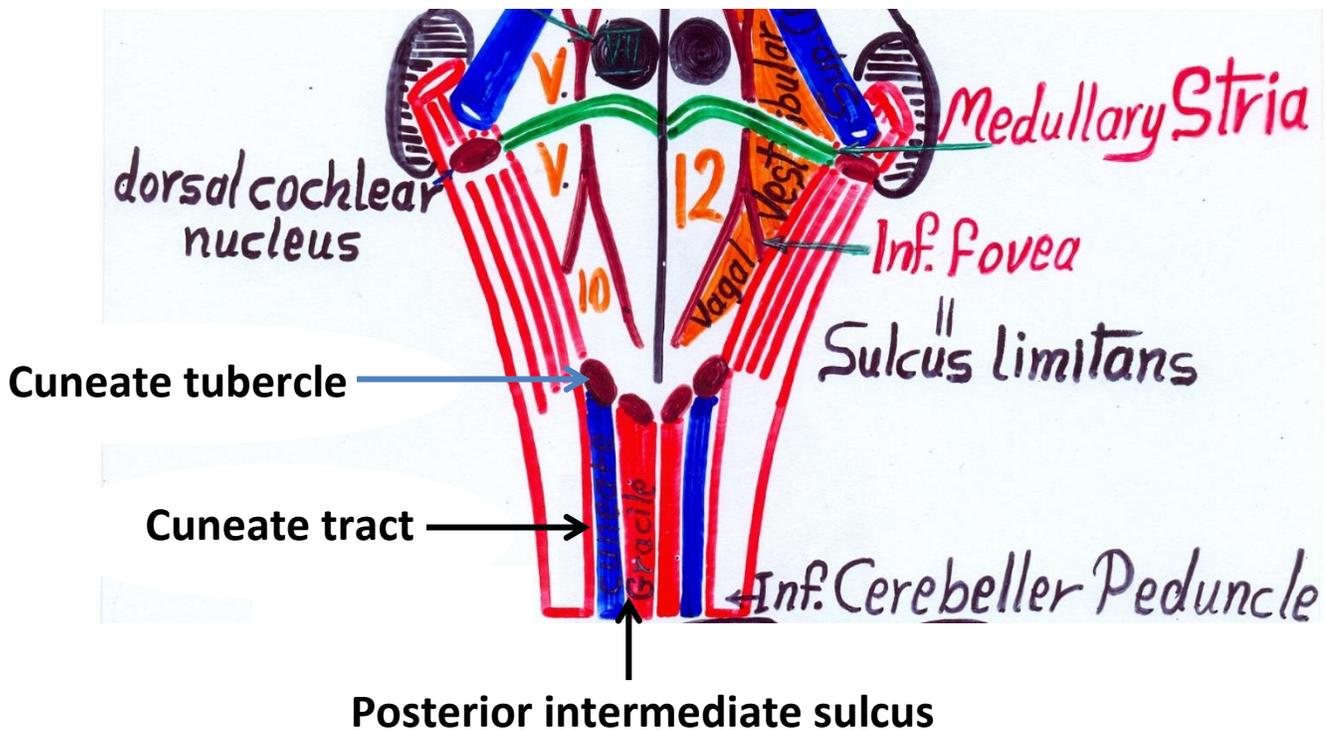
- Between olive and inferior cerebellar peduncle
- Contains rootlets of Glossopharyngeal , Vagus and cranial root of Accessory

4-The Inferior Cerebellar Peduncle;

Rounded Ridge behind the posterolateral sulcus

5-the lateral aspect below the olive shows the Rootlets of the Spinal Root of Accessory

Features of the posterior aspect of the Closed Medulla;



Features of the posterior aspect of the Closed Medulla;

1-Posterior Median Sulcus

2-GracileTracts on each side of the posterior median sulcus

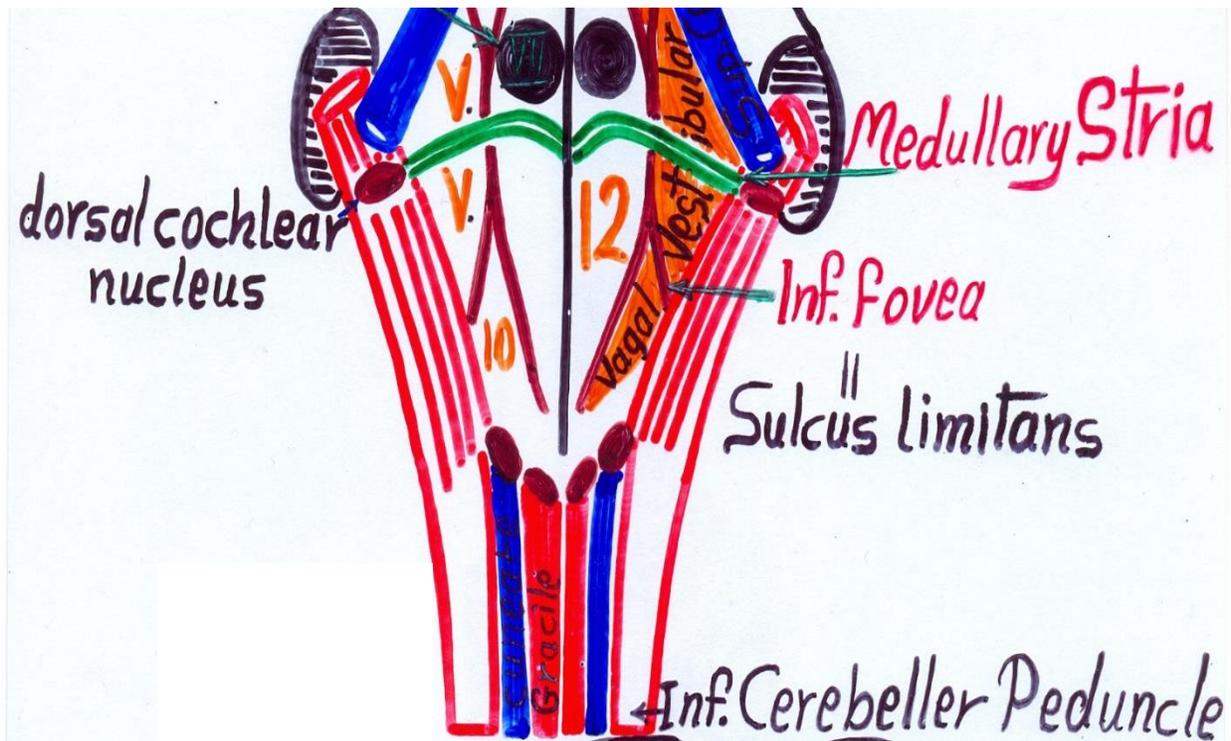
3-Gracile Tubercle at the upper end of the gracile tract

4-Posterior Intermediate Sulcus; between gracile and cuneate tracts

5-Cuneate Tract lateral to the gracile tract

6-Cuneate Tubercle at the upper end of the cuneate tract

Features of the posterior aspect of the Open Medulla;



Features of the Posterior Aspect of the Open Medulla;

A-Medullary Stria [Striae Medullaris];

Bundles of nerve fibers

At the upper end of the medulla

At the junction between the medulla and pons

B-Posterior Median Sulcus

C-Inferior Fovea = lower ½ of the Sulcus Limitans;

inverted Y-shaped sulcus between three areas

The three areas around the inferior fovea:

- **Vestibular Area Laterally**
- **Hypoglossal Triangle Medially**
- **Vagal Triangle Inferiorly**

The posterior aspect of the open medulla forms the lower part of the floor of the 4th ventricle

PONS

GENERAL FEATURES OF PONS:

Bridge-shaped

One inch long

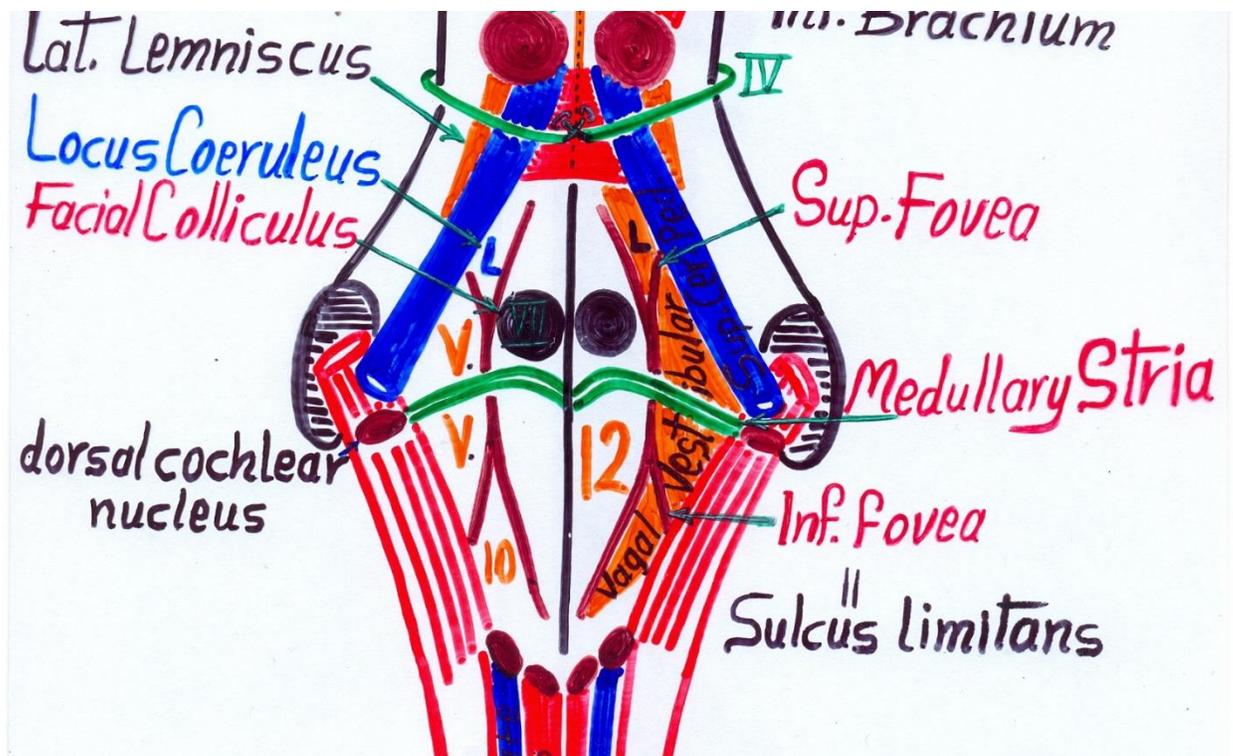
Separated from the medulla by transverse sulcus, containing the 6th, 7th and 8th cranial nerves

The Anterior part of pons named Basilar Part or Basal Pons or Basis Pontis

The Features of the Anterior Surface of the Basis Pontis;

- **1- Basilar Sulcus ; shallow vertical median sulcus which contains the Basilar Artery**
- **2-Transverse Pontine Ridges**

The basis Pontis continuous laterally with the middle cerebellar peduncle [MCP], the trigeminal nerve [5th] lies at the junction between the pons and MCP



LOCUS COERULEUS

- Dark area
- Contains noradrenergic neurons
- Controls ;
 - A -Attentiveness
 - B -Wake-Sleep Cycle
 - C -Blood Flow

MIDBRAIN

The uppermost part of the brain stem

The shortest part of the brain stem

Connects the pons with the forebrain

Contains narrow canal named cerebral aqueduct

Features of the Posterior Surface of Midbrain;

1-Large Superior Colliculi;

- Visual reflex center
- Connected with the lateral geniculate body by the superior brachium

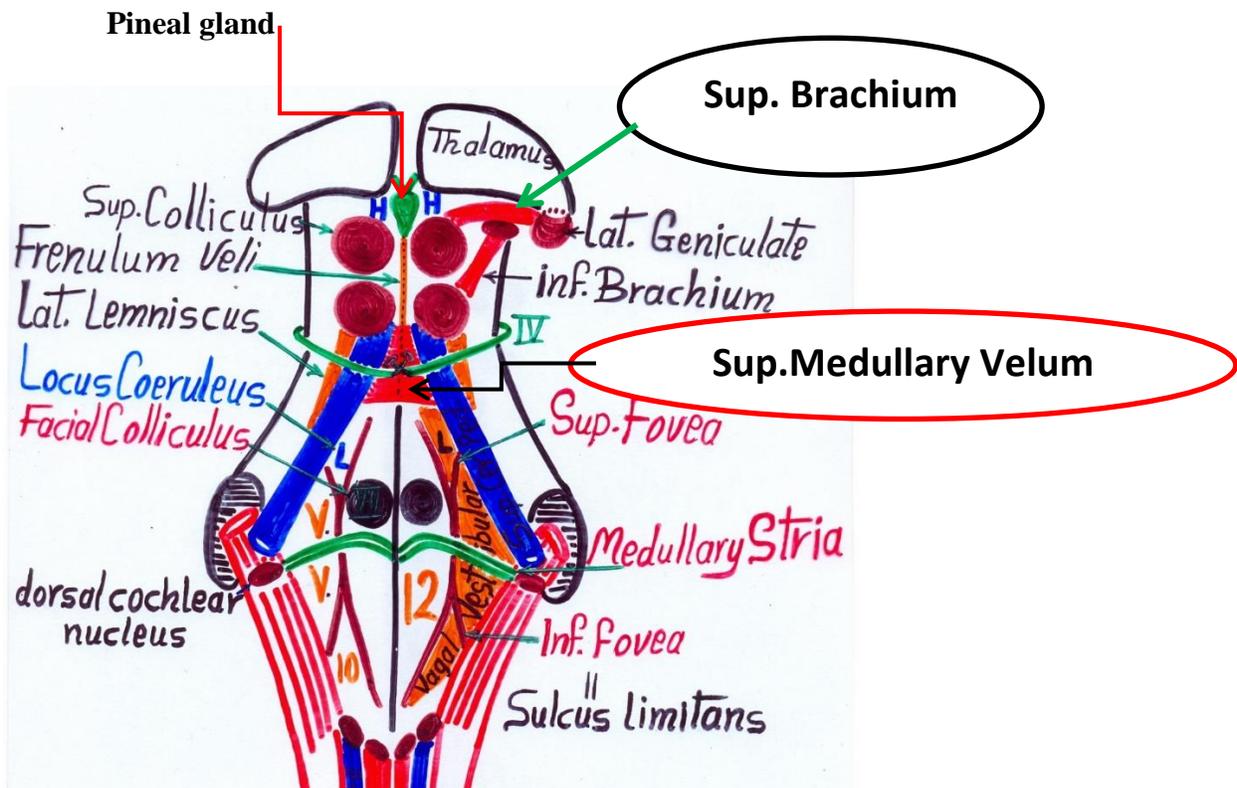
2-Small Inferior Colliculi;

- Auditory center
- Connected with the medial geniculate body by the inferior brachium

3-Frenulum Veli; median ridge, extending from the pineal gland to the superior medullary velum

4-The 4th Cranial Nerve; emerge from the superior medullary velum one on each side of the frenulum then decussate together and crossing to the opposite side

5-Lateral Lemniscus; part of the Auditory Pathway



Features of the Anterior Surface of the Midbrain

It shows the Two Cerebral Peduncles separated by the Inter-Peduncular Fossa

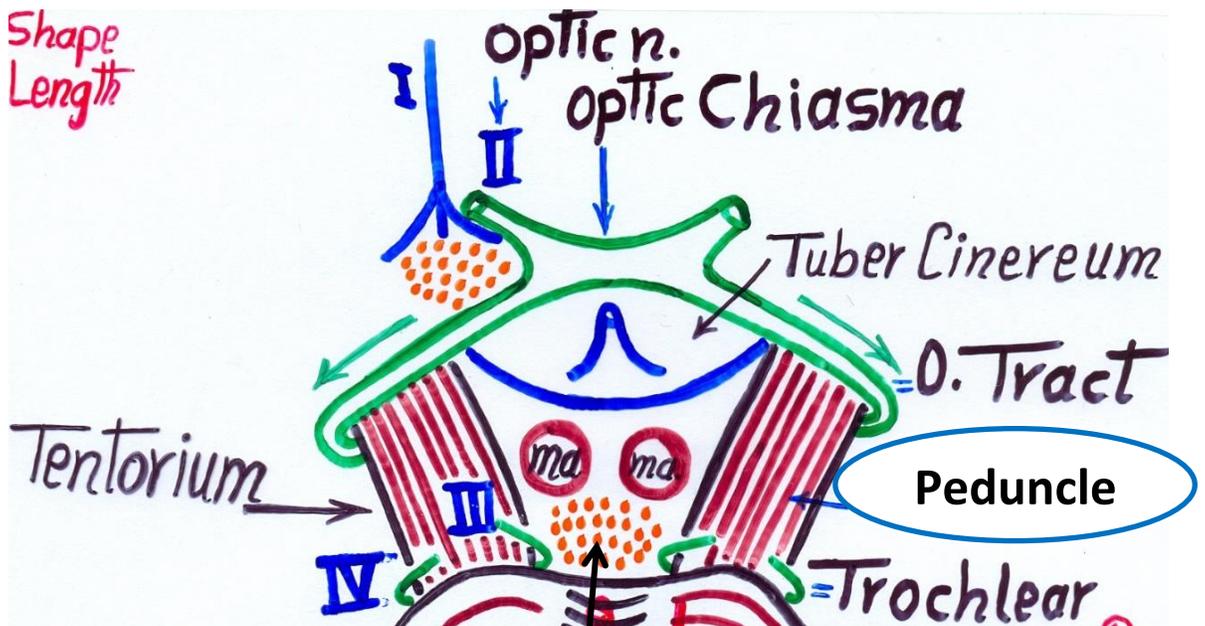
INTERPEDUNCULAR FOSSA

Boundaries

- Lateral boundaries ; cerebral Peduncles
- Superior boundaries ; Optic chiasma and optic tract
- Inferior boundary ; upper border of Pons

Floor of the fossa

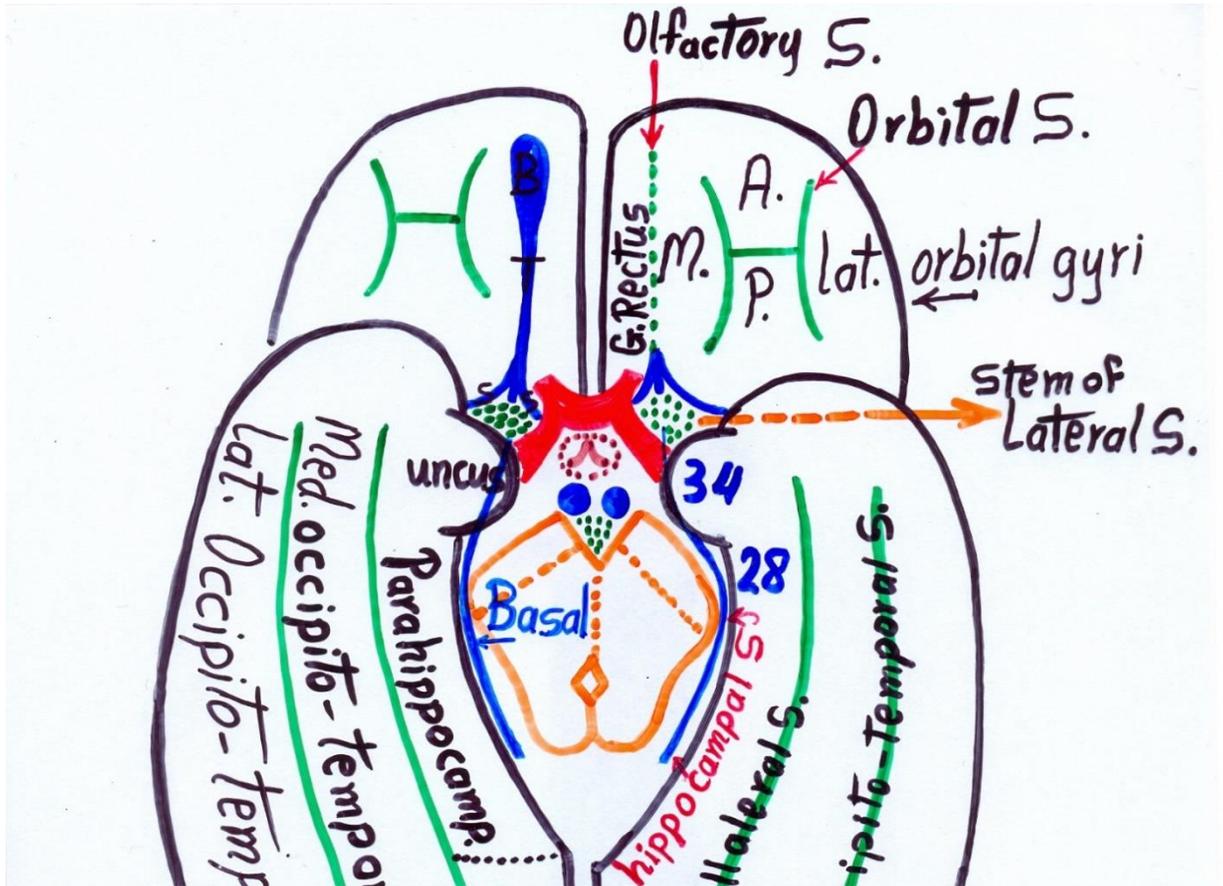
- Tuber Cinereum and infundibulum of the pituitary gland
- Mammillary Bodies
- Posterior Perforated Substance



Post. Perforated Substance

Lateral relations of the cerebral peduncles

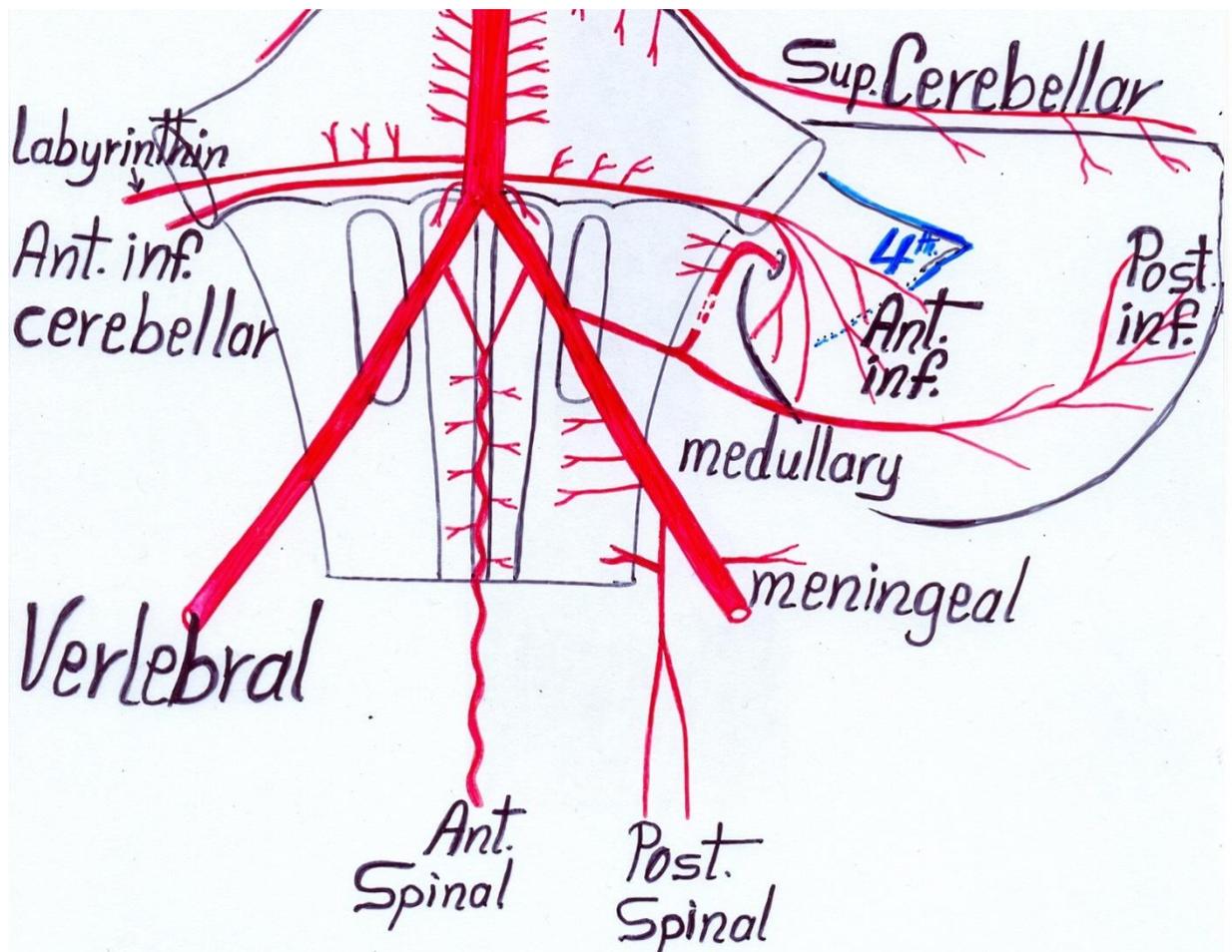
- 1-Tentorium cerebelli
- 2-Trochlear nerve
- 3-optic Tract
- 4-Basal Vein
- 5-Parahippocampal Gyrus



BLOOD SUPPLY OF THE BRAIN STEM

Blood supply of the Medulla Oblongata

- 1-Vertebral artery
- 2-Anterior spinal artery
- 3-Posterior spinal artery
- 4-Posterior inferior cerebellar artery
- 5-Basilar artery



Blood supply of the Pons

- 1-Basilar artery
- 2-Labyrinthin artery
- 3-Anterior inferior cerebellar artery
- 4-Superior cerebellar artery

Blood supply of the Midbrain

- 1-Basilar artery
- 2-Superior cerebellar artery
- 3-Posterior cerebral
- 4-Posterior communicating artery

VERTEBRAL ARTERY

Origin; from the subclavian artery

Course; in the cranial cavity; enter the skull through the foramen magnum and ascends on the medulla

End; at the lower border of pons by forming the basilar artery

Branches;

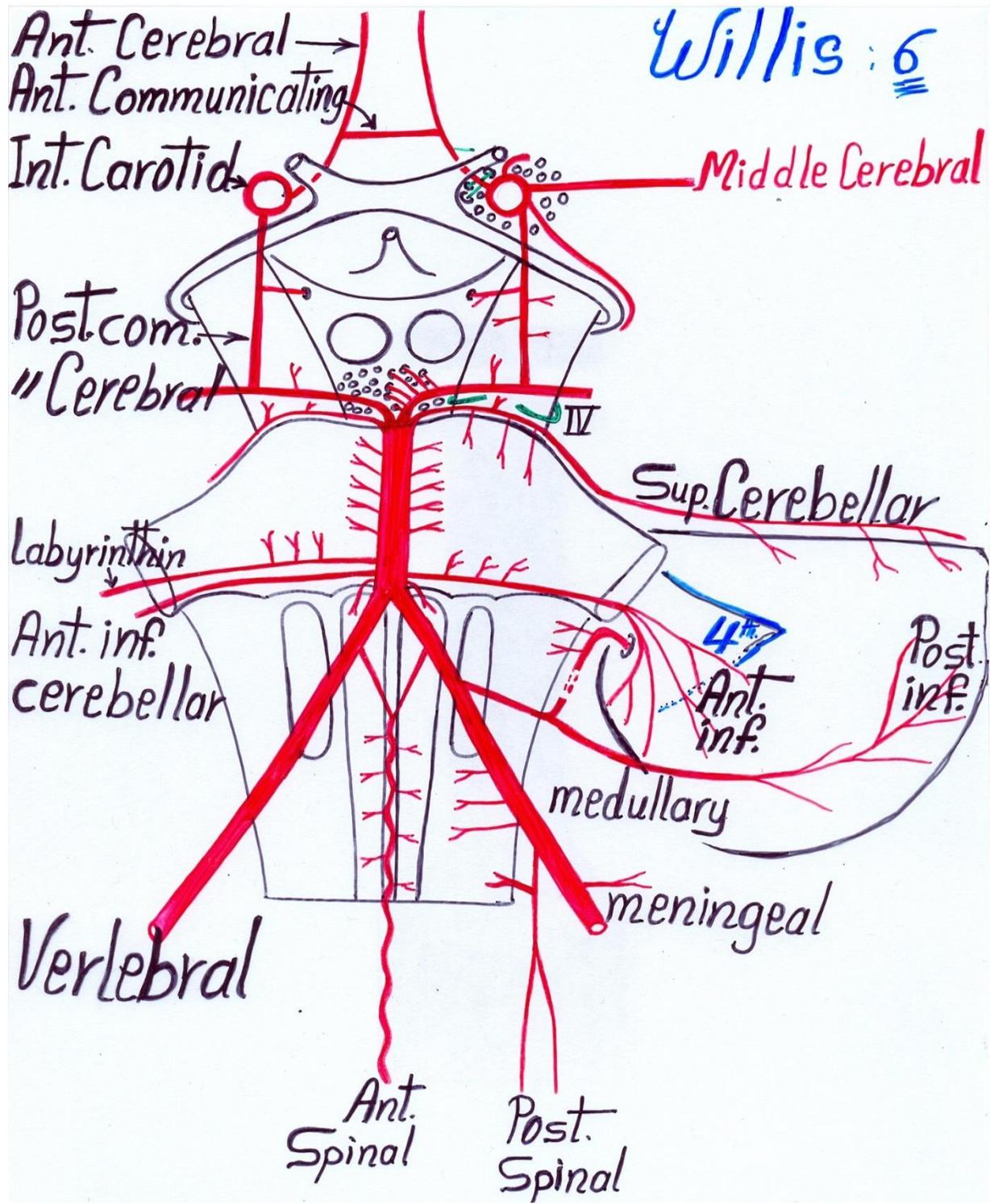
- 1-anterior spinal artery 2-posterior spinal artery
- 3-medullary branches 4-meningeal branches

5-posterior inferior cerebellar, which gives the following branches:

A-medullary branches to the medulla

B-choroidal artery to the 4th ventricle

C-branches to the posterior part of the inferior surface of the cerebellum



BASILAR ARTERY

Origin; at the lower border of pons by union of the two vertebral arteries

Then it ascends in the basilar sulcus

End; at the upper border of pons by giving the two posterior cerebral arteries

Branches;

- 1-Anterior inferior cerebellar artery
- 2-Labyrinthine artery to the inner ear
- 3-Ponine branches
- 4-Superior cerebellar
- 5-Posterior cerebral

Circulus Arteriosus of WILLIS

Formed on the base of the brain, by anastomoses between the following arteries:

1-Anterior communicating

2-Anterior cerebral

3-Internal carotid

4-Posterior communicating

5-Posterior cerebral

6-Basilar artery

The importance of this Circulus;

a-equalize the pressure and flow in both sides of the brain

b-provide collateral circulation if one artery is occluded

CEREBELLUM

Site;

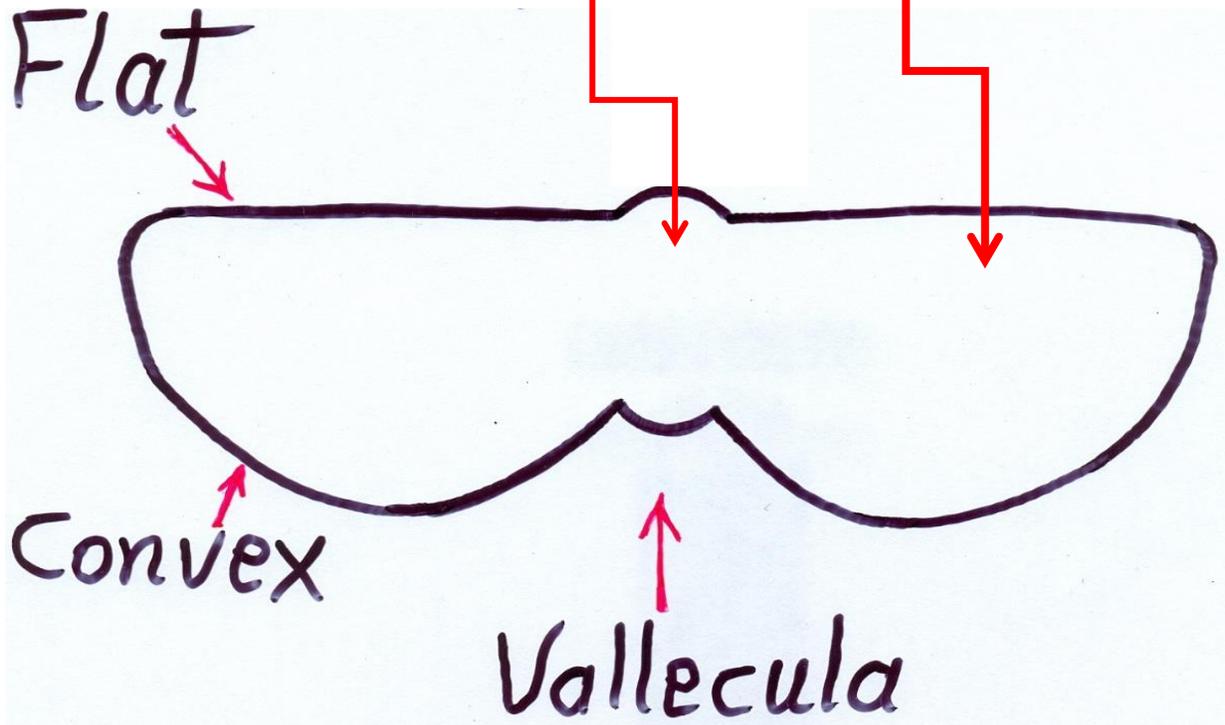
- In the posterior cranial fossa
- Behind pons and medulla
- Below the tentorium cerebelli

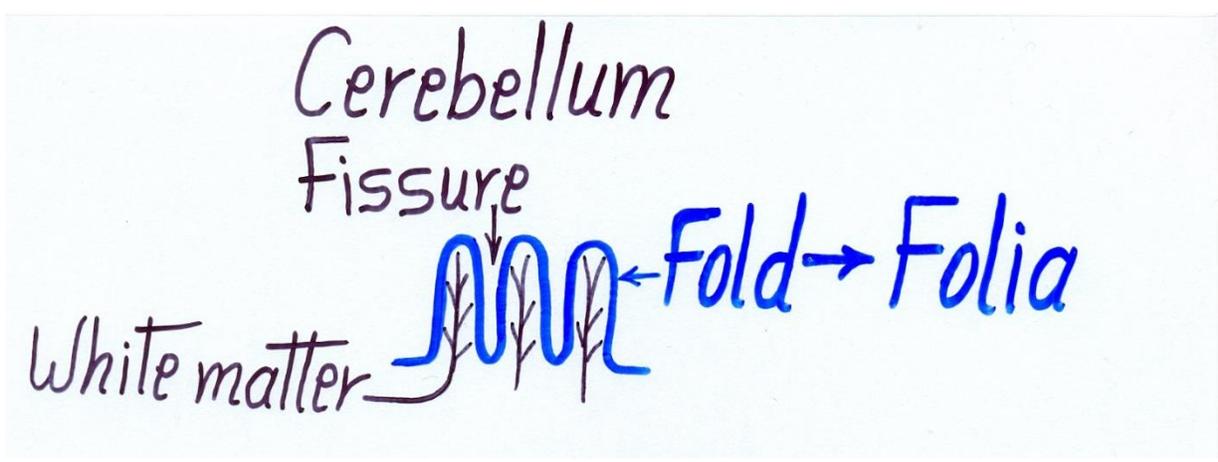
Structure;

- Superficial gray matter cortex
- Deep white matter core , containing the cerebellar nuclei

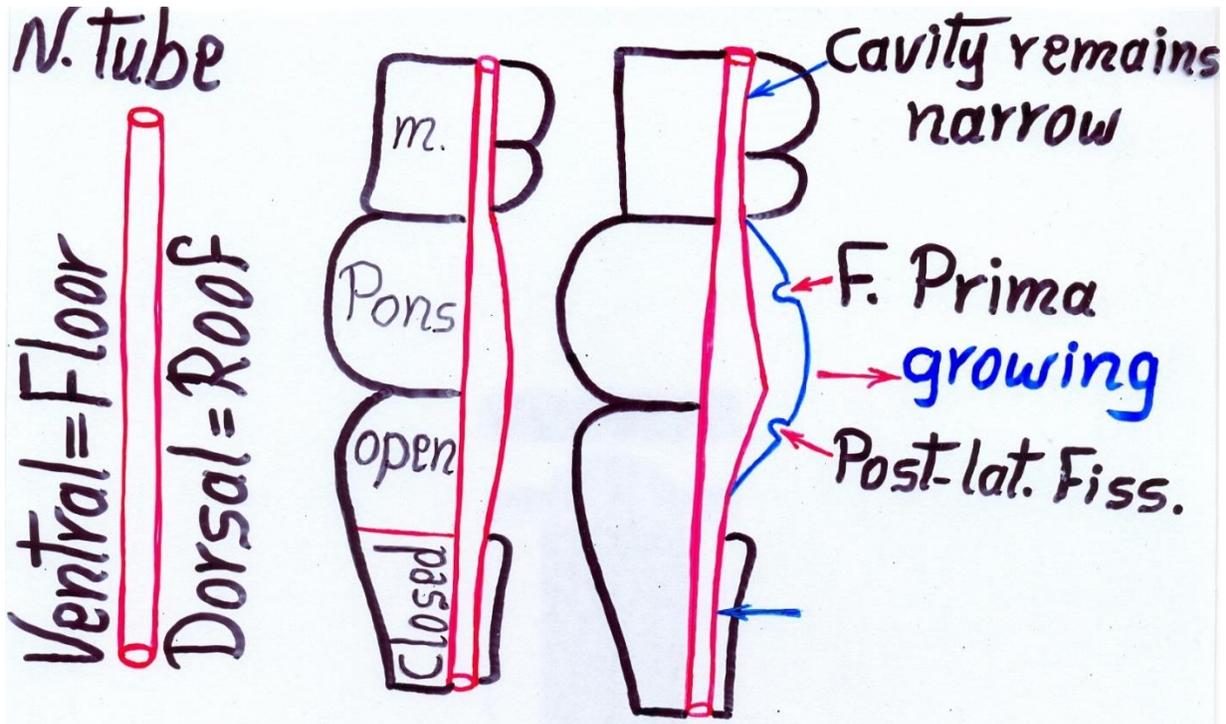
Parts of the cerebellum:

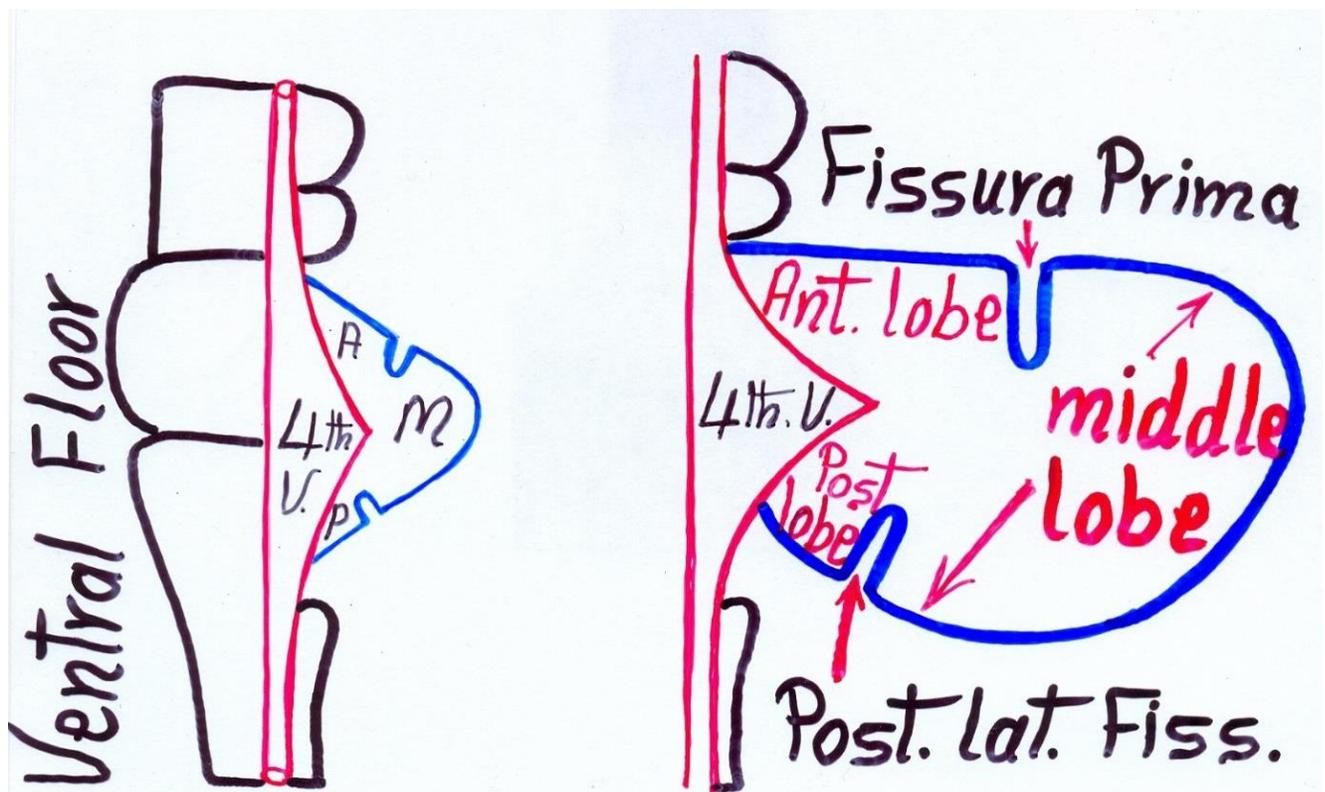
- Two large lateral parts named the Cerebellar Hemispheres
- Narrow median part named Vermis





The cortex is folded, the folds are separated by fissures





The Cerebellum is divided into Three Lobes by Two Deep Fissures

The Lobes are; Anterior, Middle and Posterior

The Separating Fissures are:

1-Fissura Prima between the anterior and middle lobes

2-Postero-Lateral Fissure between the middle and the posterior lobes

Features of the Superior Surface of the cerebellum

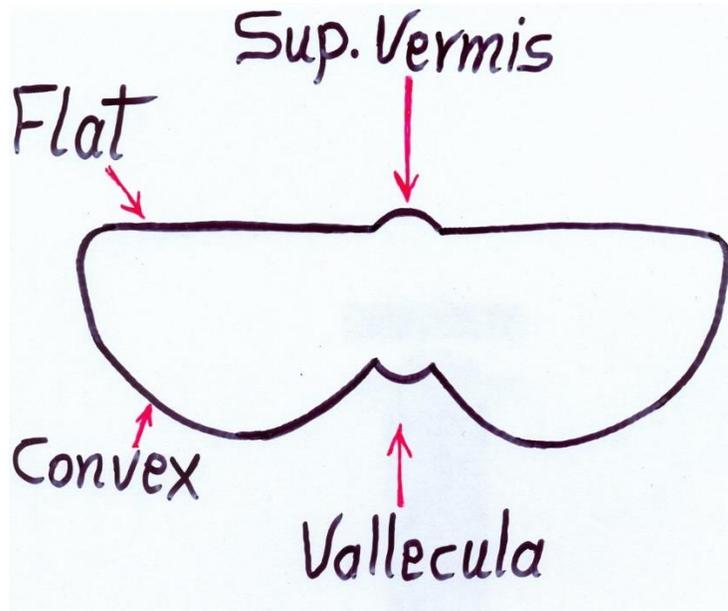
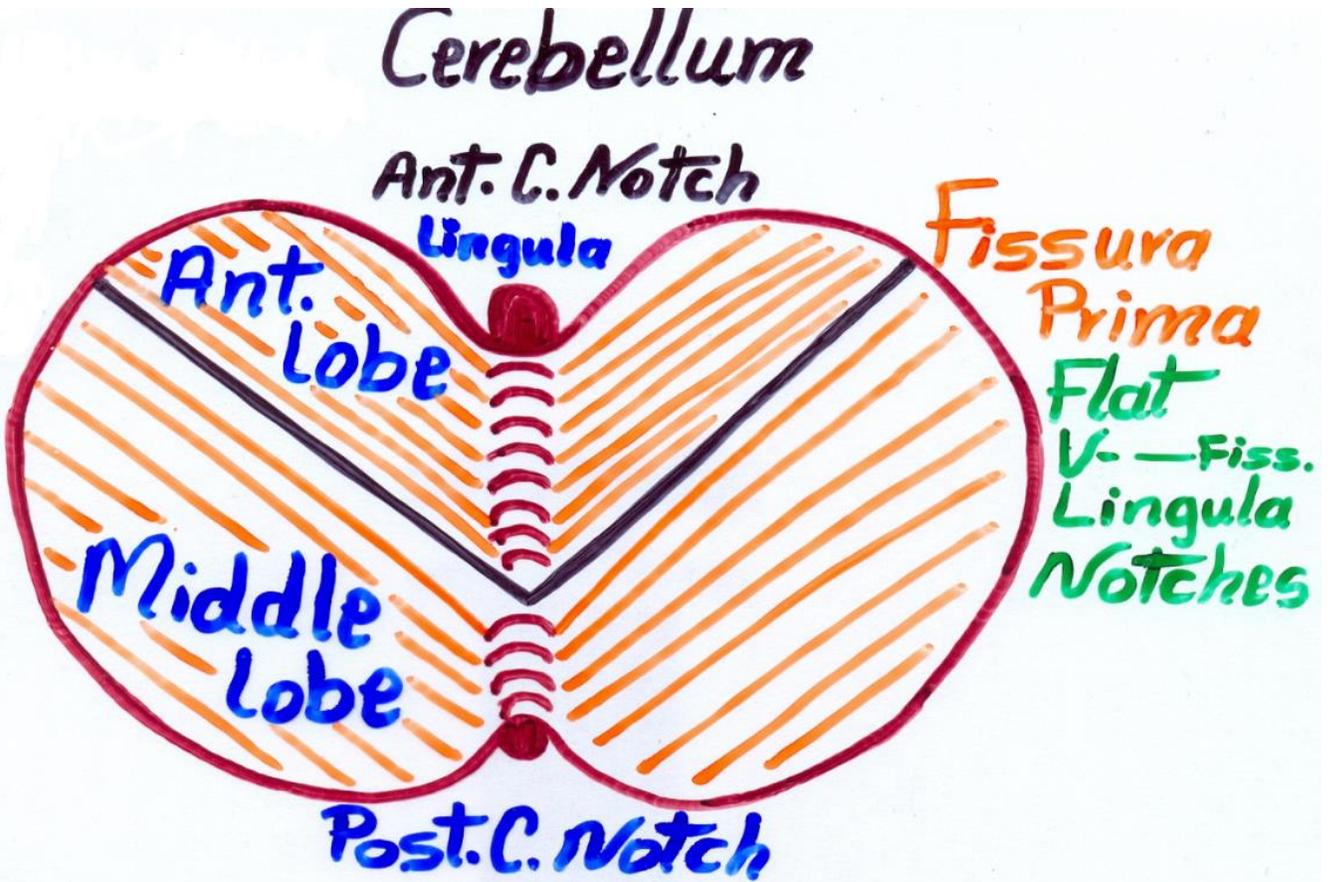
-Flat with median elevated part named superior vermis

-Lingula; the free anterior part of the vermis

-V-shaped Fissure Prima between the anterior and middle lobes

-Anterior Cerebellar Notch; related to pons and medulla

-Posterior Cerebellar Notch; related to falx cerebelli



Features of the Inferior Surface of the cerebellum

- Convex with deep median depression named Cerebellar Vallecule
- The floor of the Vallecule is formed by the inferior vermis

The inferior surface contains deep fissure named Postero-lateral fissure

The posterolateral fissure lies between the posterior and middle lobes

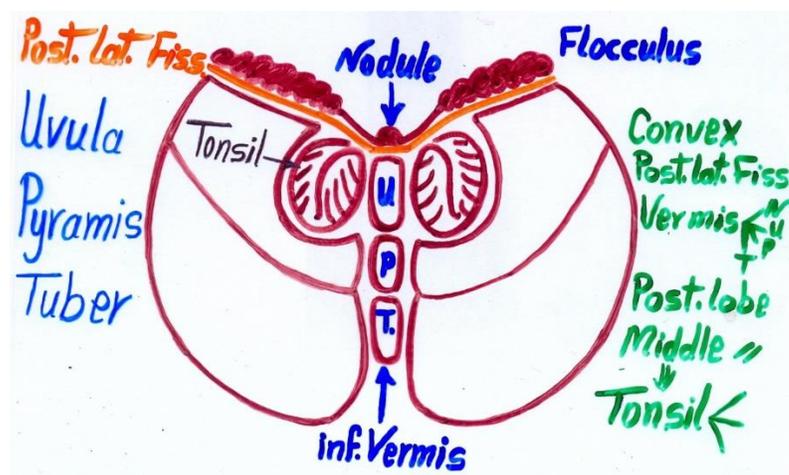
The Posterior Lobe also named Flocculo-Nodular Lobe:

- The most anterior part of the inferior surface
- Lies anterior to the posterolateral fissure
- formed of the nodule and flocculus

The middle lobe lies posterior to the posterolateral fissure

Cerebellar Tonsils:

- Part of the middle lobe - Spherical in shape
- Lies in the anterior part of inferior surface
- On the sides of the uvula [Part of inferior vermis]
- Overhangs the foramen magnum



Horizontal fissure;

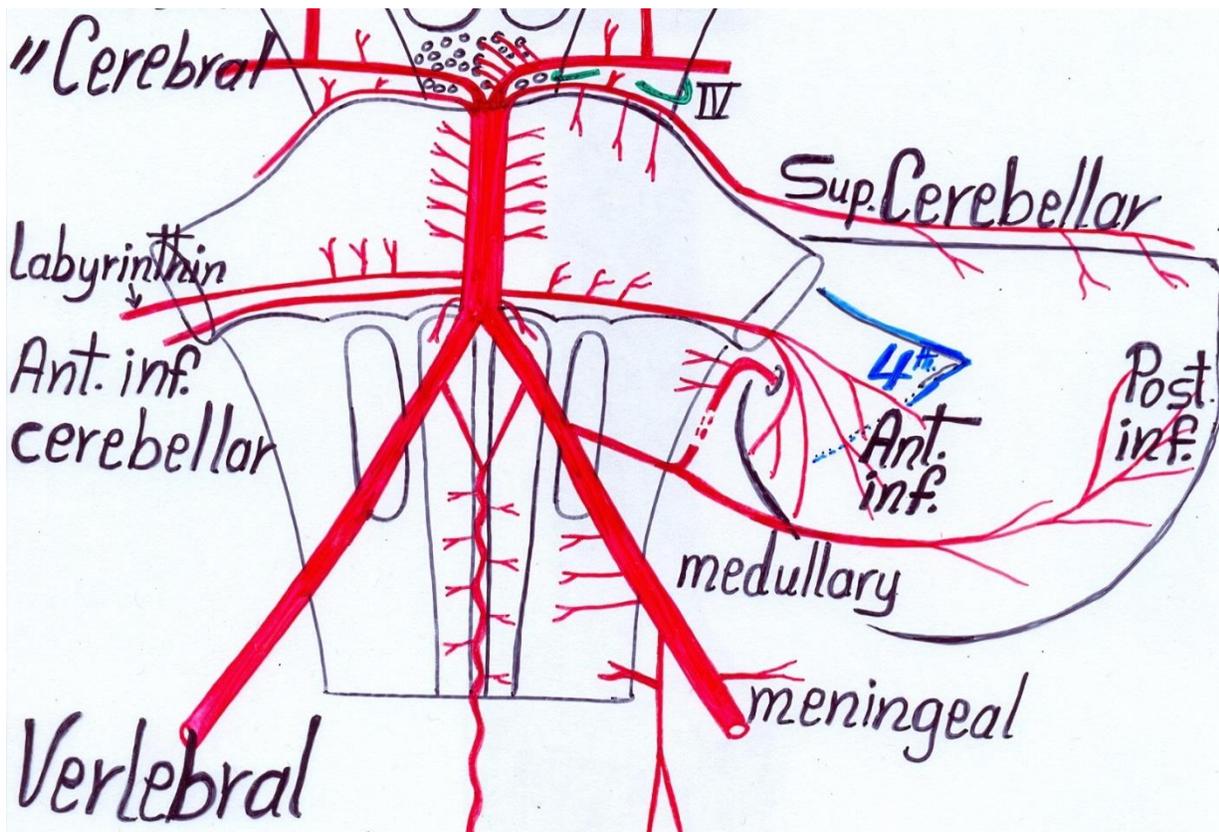
- Lies between the two surfaces
- Receives the three cerebellar peduncles

CEREBELLAR ARTERIES:

1-Superior cerebellar from Basilar

2-Anterior inferior cerebellar from Basilar

3-Posterior inferior cerebellar from Vertebral



4TH VENTRICLE

The cavity of the hind brain

Lies between the following;

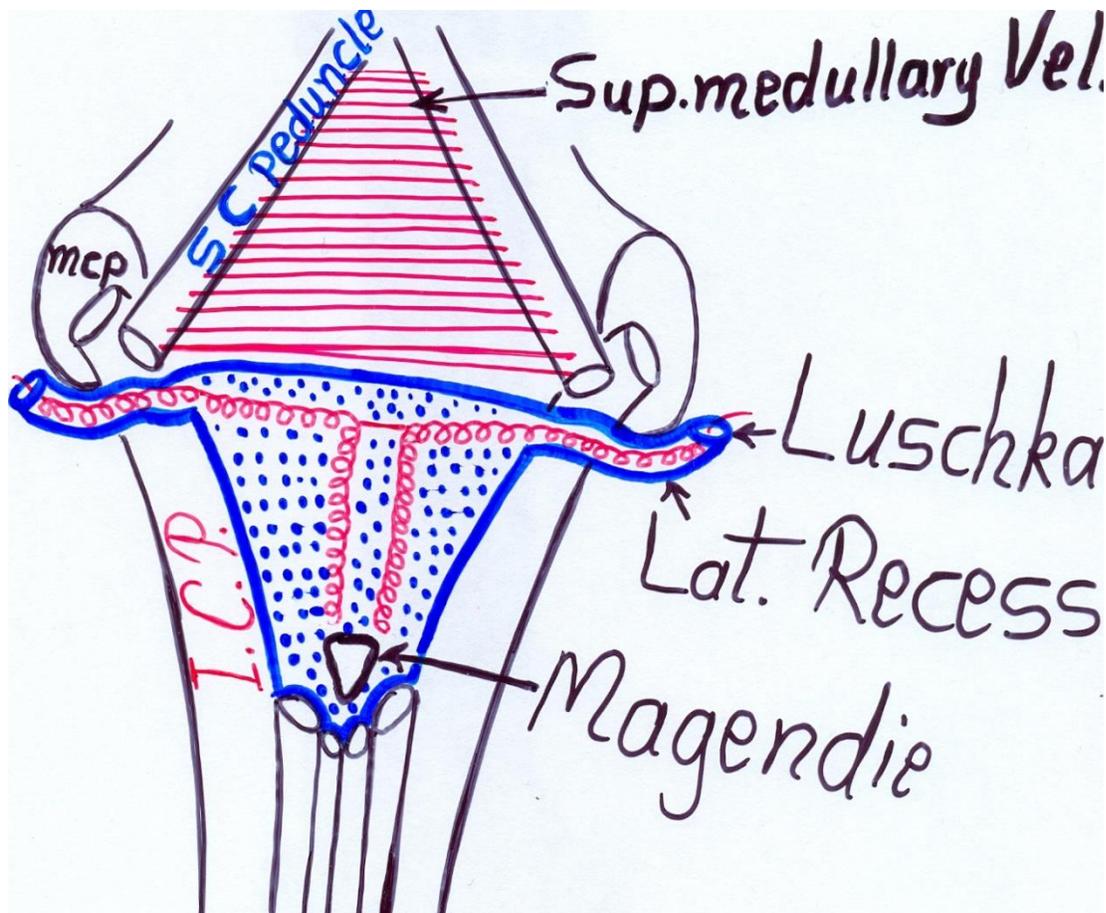
- Pons and medulla ventrally
- Cerebellum dorsally

Tent shaped

Boundaries of the 4TH VENTRICLE:

The Ventral Floor which named Rhomboid fossa

The Rhomboid fossa formed by the posterior surfaces of pons and open medulla



Boundaries of the Rhomboid fossa [FLOOR of the 4th ventricle]

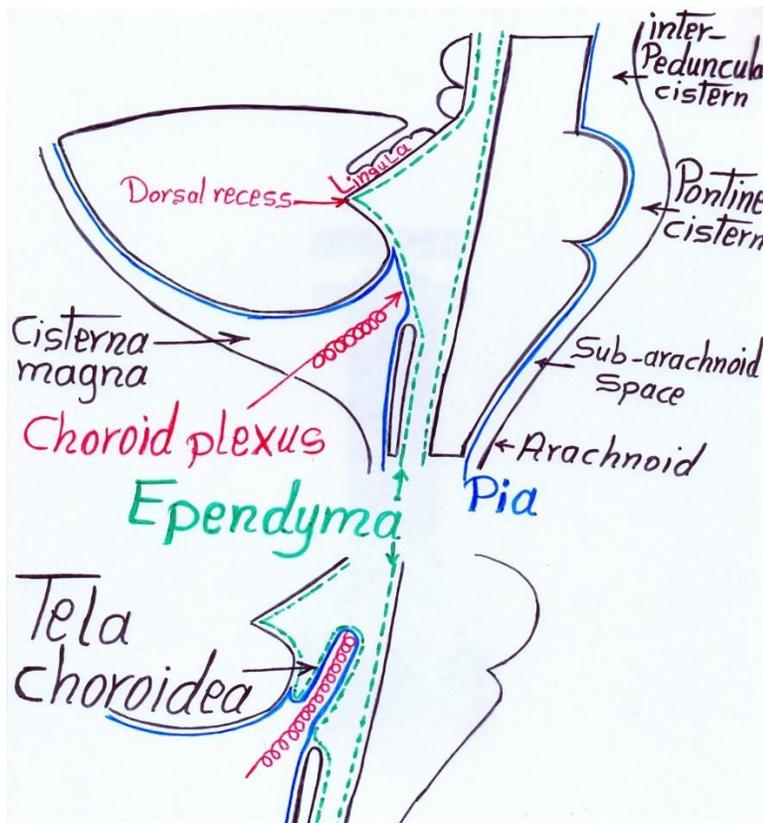
- The upper ½ is formed by the superior cerebellar peduncles
- The lower ½ is formed by the inferior cerebellar peduncles , gracile and cuneate tubercles

The Dorsal Roof;

The upper ½ of the roof is formed by the Superior Medullary Velum

The lower ½ of the roof is formed by Inferior Medullary Velum

The Superior Velum; Formed of white matter sheet and related to the Lingula



The Inferior Velum;

Formed of Ependyma and pia matter and contains the Tela choroidea of the 4th ventricle

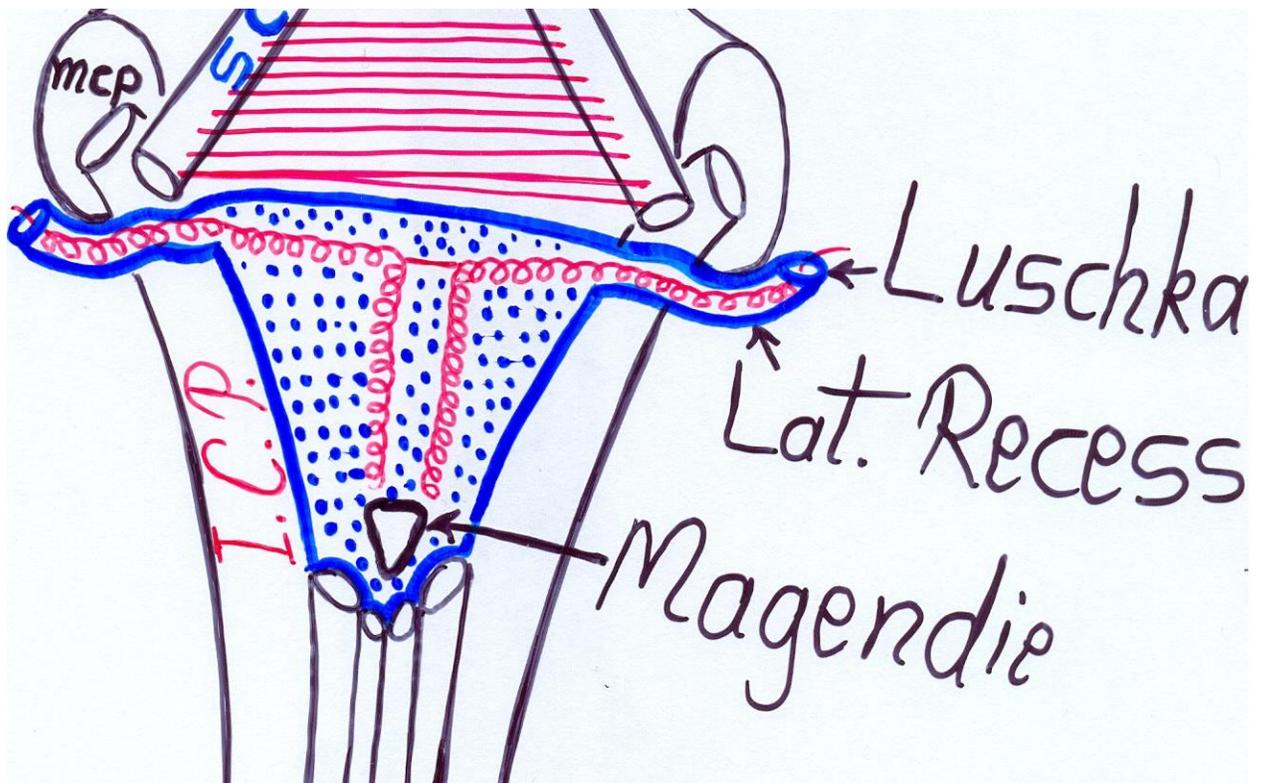
Recesses of the 4th Ventricle:

1-The Dorsal one:

- It is the apex of the tent-shaped roof
- Lies in the white matter core of the cerebellum

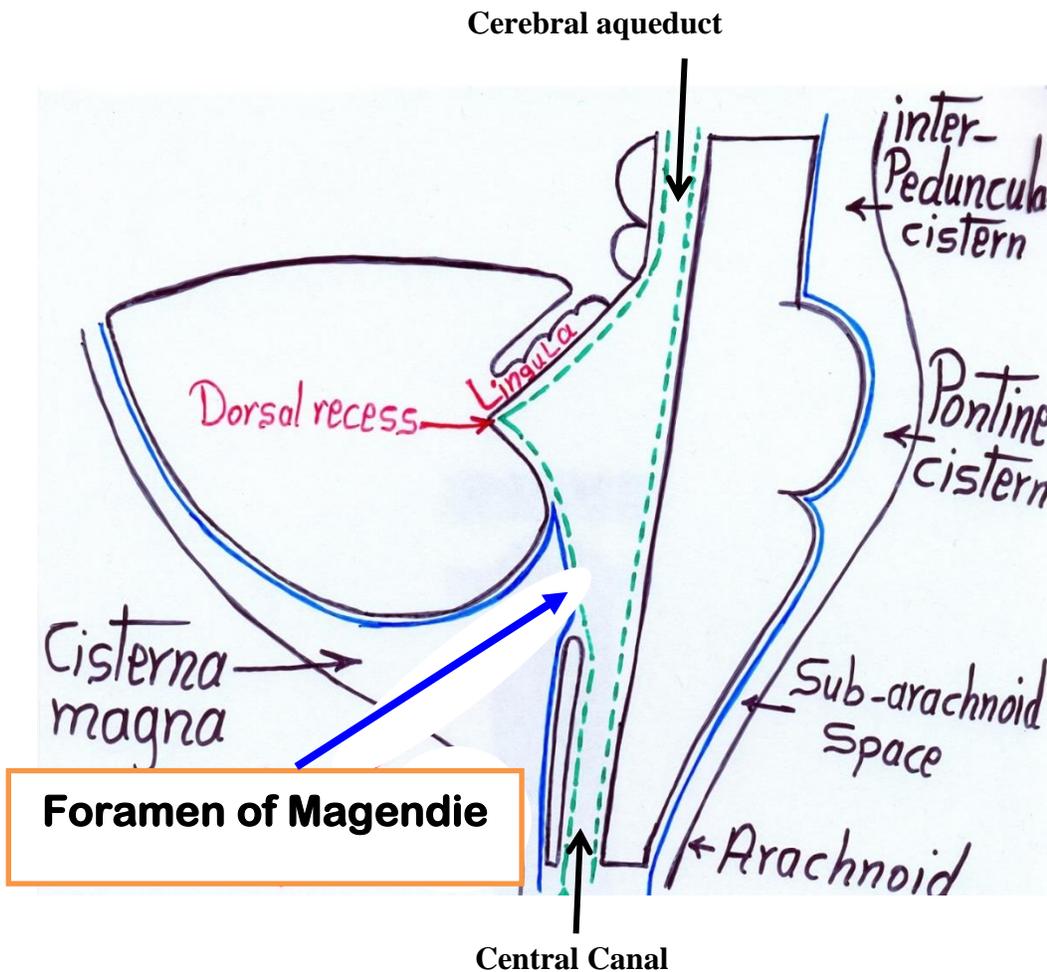
2-Two Lateral Recesses:

- It is a Tubular lateral extension of the roof
- Lies over the inferior cerebellar peduncles
- End laterally by openings of Luschka



Communications of the 4th ventricle;

- 1-Laterally with the Pontine Cistern through the foramen of Luschka
- 2-Upwards with the Aqueduct
- 3-Downwards with the Central Canal
- 4-Dorsally with the Cerebellomedullary Cistern through the foramen of Magendie



Internal Structure of the Medulla

It Contains White and Gray Matters

The Gray Matter Consists Of Two Groups;

- **Cranial Nerve Nuclei**
- **Extrapyramidal Centers**

The Cranial Nerves Nuclei in the Medulla

For the Lower Four Cranial Nerves

Hypoglossal Nucleus

For the hypoglossal nerve [12th cranial nerve] [XII]

The hypoglossal nucleus is a General Somatic Efferent nucleus

Nucleus Ambiguus

For the cranial root of accessory [11th cranial nerve] [XI]

The nucleus ambiguous is a Special Visceral Efferent nucleus

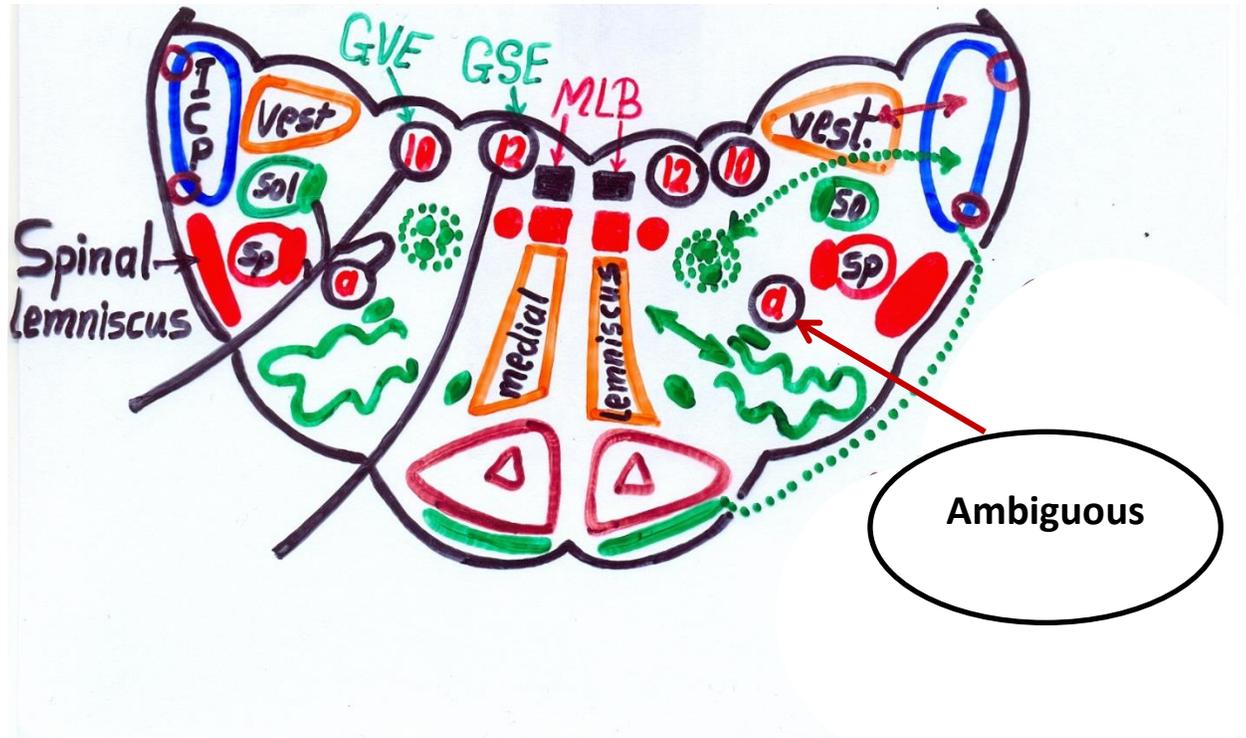
The Vagus Nerve [10th cranial nerve] [X] has the following Four Nuclei;

Two Motor nuclei which are;

- **Nucleus Ambiguus [special visceral efferent nucleus]**
- **Dorsal Motor nucleus [general visceral efferent nucleus]**

Two Sensory nuclei which are;

- **Spinal Nucleus of trigeminal nerve [general somatic afferent nucleus]**
- **Nucleus Solitarius [special visceral afferent nucleus]**



The Glossopharyngeal nerve [9th cranial nerve] [IX] has the following Four Nuclei;

Two Motor nuclei which are;

- Nucleus Ambiguus [special visceral efferent nucleus]
- Inferior Salivatory nucleus [general visceral efferent nucleus]

Two Sensory nuclei which are;

- Spinal Nucleus of trigeminal nerve [general somatic afferent nucleus]
- Nucleus Solitarius [special visceral afferent nucleus]

The Nucleus Ambiguus gives origin to the 9th, 10th and 11th cranial nerves which supply the larynx, pharynx and palate

There are Two Parasympathetic Nuclei [General Visceral Efferent nuclei] in the medulla;

1-Dorsal Motor Nucleus of Vagus supplying the viscera in the neck, thorax and abdomen

2-Inferior Salivatory Nucleus of 9th cranial nerve supplying the parotid gland

Spinal Nucleus of Trigeminal Nerve;

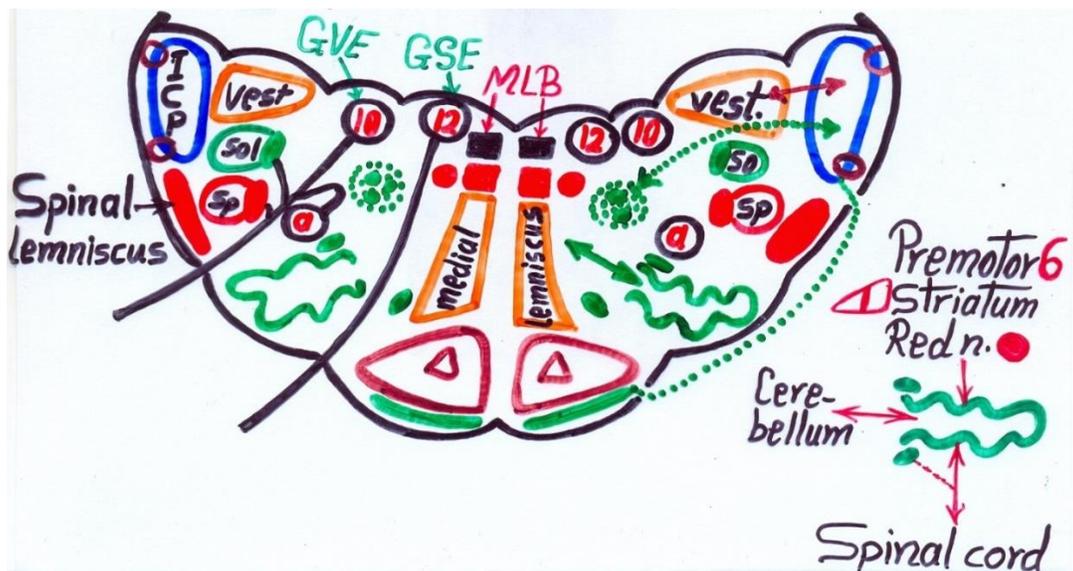
- General somatic afferent nucleus
- Receives pain and temperature from 5th , 7th , 9th ,and 10th cranial nerves

Nucleus Solitarius;

- Special visceral afferent nucleus
- Receives taste sensation from 7th , 9th and 10th cranial nerve

The Main Extrapyrmidal Centers in Medulla and Pons Includes Three Groups;

- Vestibular Nuclei
- Reticular Formation Nuclei
- Olivary Nuclei



The Main Connection of these Extra-pyramidal nuclei

- 1-receive Afferents from the cortex; Area 6 & other extrapyramidal centers
- 2-connects by afferents and Efferents with the Cerebellum
- 3- Connects by afferents and Efferents with the Spinal Cord

The White Matter of the Medulla Consists Of the Following;

1-Medial Longitudinal Bundle

2-Tectospinal and Spinotectal Tracts

3-Medial Lemniscus

4-Pyramidal Tract

5-The Inferior Cerebellar Peduncle

6-Also the white matter includes THE DECUSSATIONS

DECUSSATIONS IN THE MEDULLA

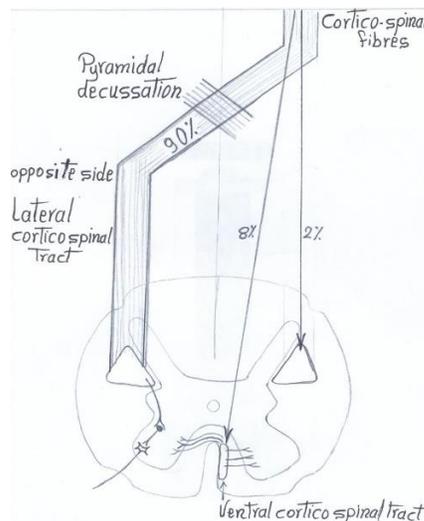
Pyramidal Decussation = Motor Decussation

1-The Majority [90%] of corticospinal fibers in the pyramid,

Decussate [Cross the midline] and descend in the opposite side Lateral Corticospinal Tract

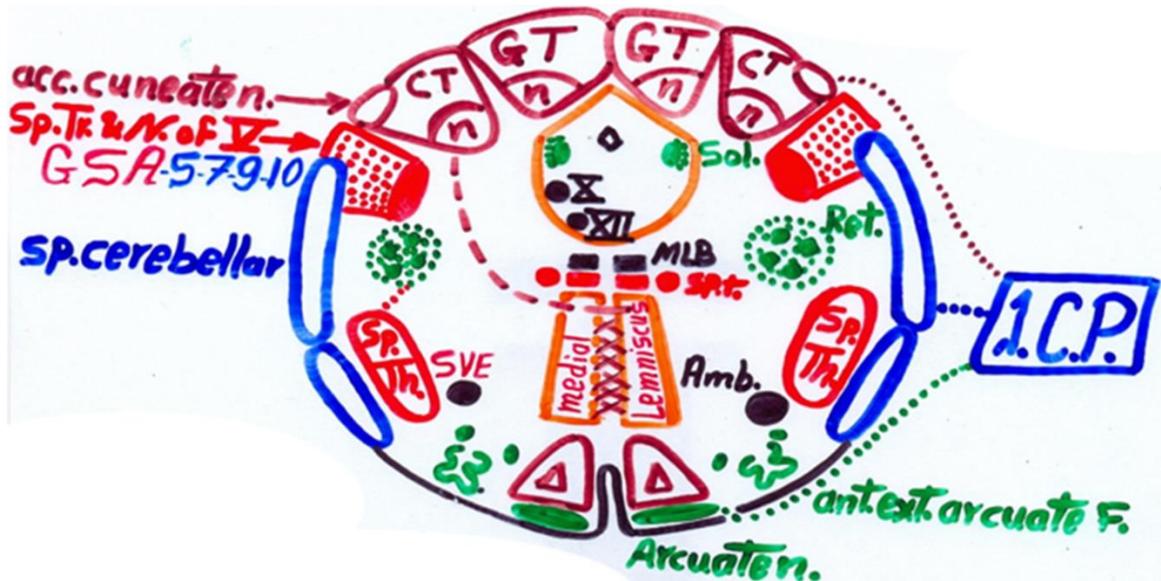
2-The Uncrossed fibers [10%];

- **Most of the uncrossed fibers descend in the same side Ventral Corticospinal Tract**
- **A minority of the uncrossed fibers descend in the same side lateral corticospinal tract**



DECUSSATION OF THE LEMNISCUS = SENSORY DECUSSATION

The fibers of the Gracile and Cuneate nuclei form the Internal Arcuate fibers which decussate with the opposite side and ascend in the opposite side **MEDIAL LEMNISCUS**



THE SPINAL LEMNISCUS;

Formed by the Lateral and Ventral Spinothalamic Tracts

The Inferior Cerebellar Peduncle

Formed mainly of the following [8] Afferent fibers;

1-Arcuate fibers [external arcuate fibers]

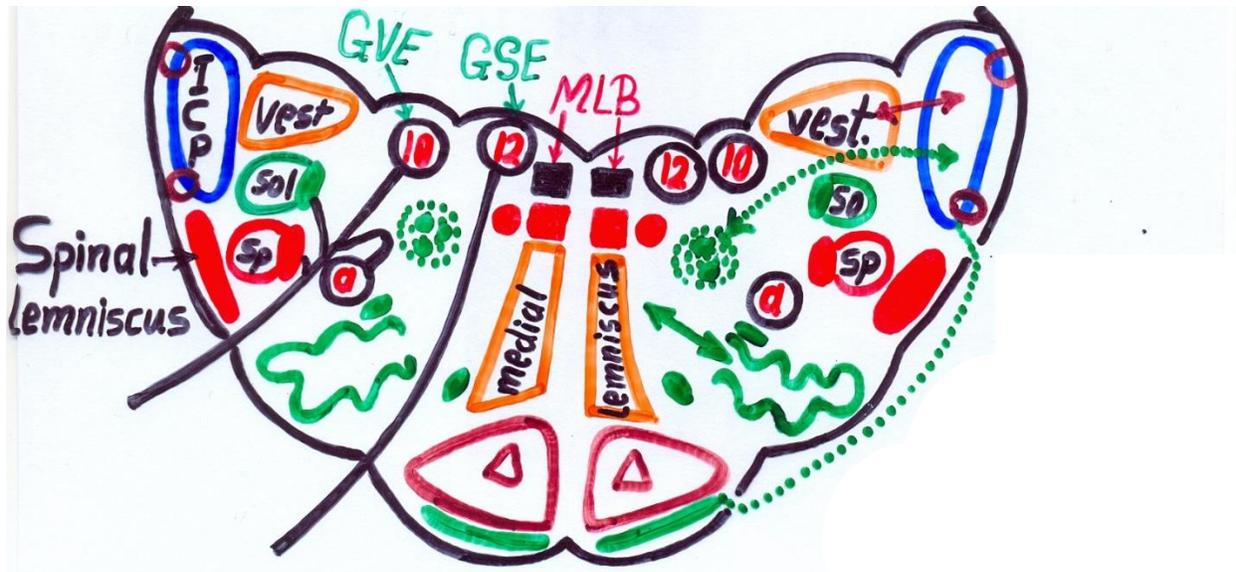
2-Dorsal Spinocerebellar tract 3-Trigemino-cerebellar tract 4-Cuneocerebellar tract

5-Vestibulocerebellar tract

6-Reticulocerebellar tract

7-Olivocerebellar tract

8-Cochlear fibers



The inferior cerebellar peduncle also contains some efferent fibers to the Vestibular nuclei, Reticular nuclei and Olivary nuclei

The Internal Structure of the PONS

The pons is formed of two parts;

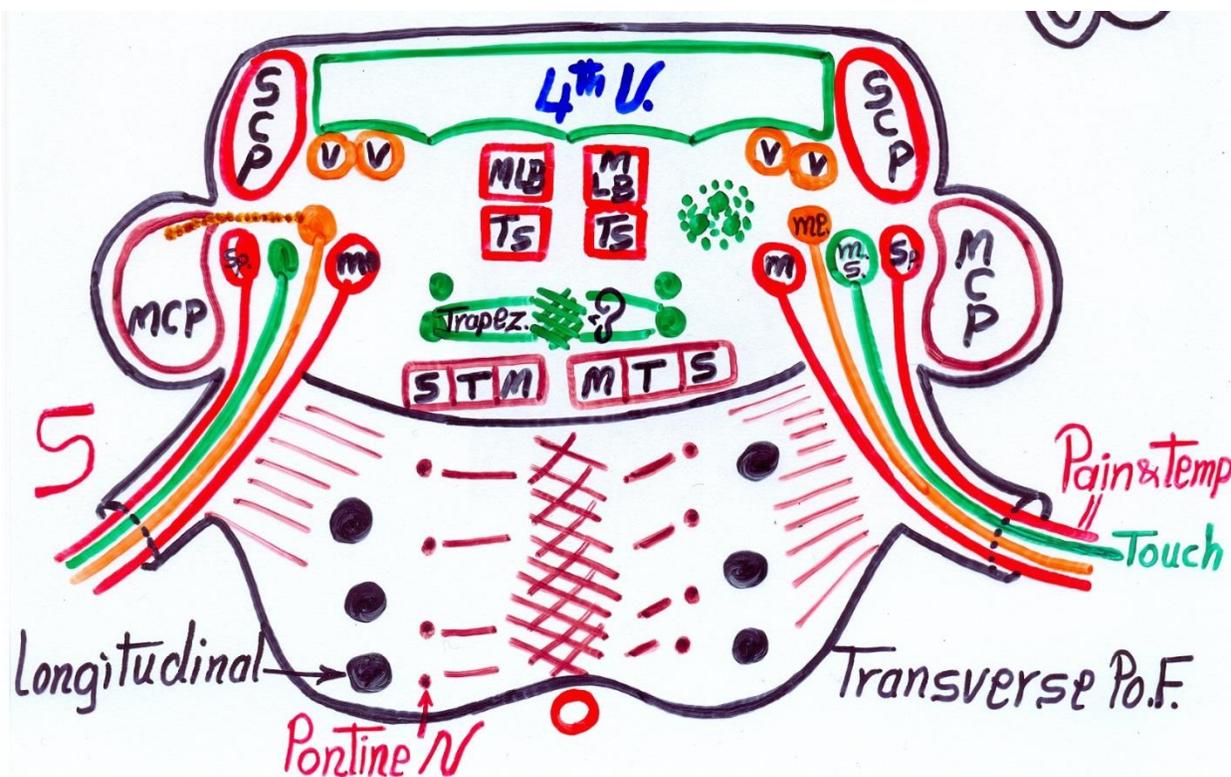
- Anterior part named basis Pontis
- Posterior part named tegmentum Pontis

Basis Pontis

It Contains White and Gray Matters

The gray matter consists of the Pontine Nuclei

The white matter consists of both Longitudinal and Transverse fibers



A-Transverse Pontine Fibers;

Arising from the Pontine Nuclei, crossing the midline, decussating with the fibers of the opposite side and continuous in the Middle Cerebellar Peduncle

B-Longitudinal Fibers; includes the following types,

1-Cortico-Pontine

2-The two parts of the Pyramidal Tract which are

- Cortico-spinal fibers
- Cortico-nuclear fibers

Tegmentum Pontis

It contains White and Gray matters

The White Matter of Tegmentum Pontis Consists of the Following;

1-Medial Longitudinal Bundle

2-Tectospinal and Spinotectal Tracts

3-Trapezoid Body

4-The Four Lemnisci; Medial, Spinal, Trigeminal and Lateral Lemnisci

5-The Middle Cerebellar Peduncle

IADDITION TO THE DECUSSATIONS

The Middle Cerebellar Peduncle;

The largest and most lateral [superficial] of the three peduncles

Contains two afferent fibers to the cerebellum;

- **1-Pontocerebellar fibers**
- **2-Trigeminocerebellar fibers**

The Gray Matter of the Tegmentum Pontis Consists Of Two Groups;

- **Cranial Nerve Nuclei**
- **Extrapyramidal Centers**

The Cranial Nerves Nuclei in the Pons

For The Middle Four Cranial Nerves

Vestibular and Cochlear Nuclei;

- **Special somatic afferent nuclei**
- **For the vestibulocochlear nerve**

The Facial Nerve [7th cranial nerve] [VII]

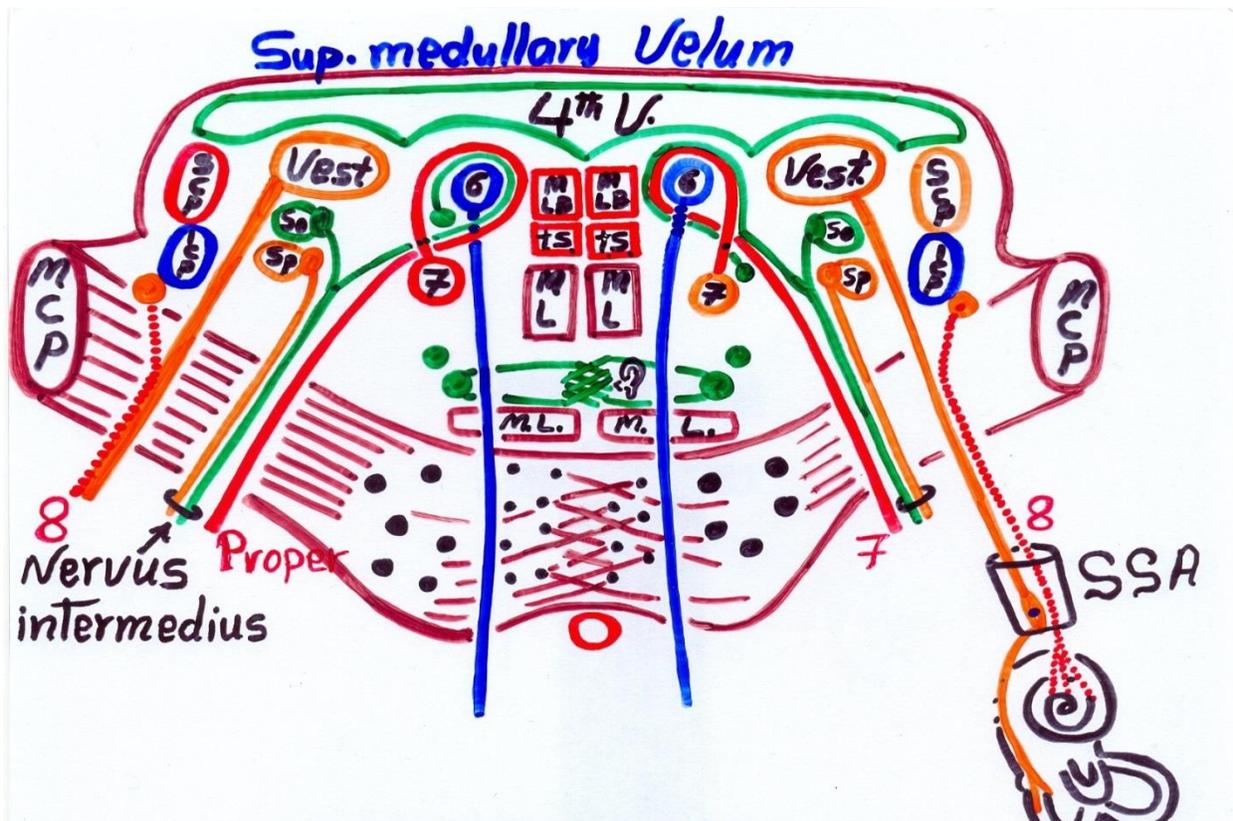
Has the following Four Nuclei;

Two Motor Nuclei which are;

- Motor nucleus of facial nerve [special visceral efferent nucleus]
- Superior Salivatory nucleus [general visceral efferent nucleus]

Two sensory nuclei which are:

- Spinal nucleus of trigeminal nerve [general somatic afferent nucleus]
- Nucleus Solitarius [special visceral afferent nucleus]



Nucleus of Abducent:

- General somatic efferent nucleus
- Gives origin to the Abducent [6th cranial nerve] [VI]

The Trigeminal Nerve [5th cranial nerve] [V]

Has the following Four Nuclei;

One Motor Nucleus [special visceral efferent nucleus]

Three Sensory Nuclei which are;

1-Main Sensory Nucleus;

General somatic afferent nucleus

Concerned with Touch sensation

2-Spinal Nucleus of Trigeminal Nerve

General somatic afferent nucleus

Concerned with Pain and Temperature

3-Mesencephalic Nucleus;

General somatic afferent nucleus

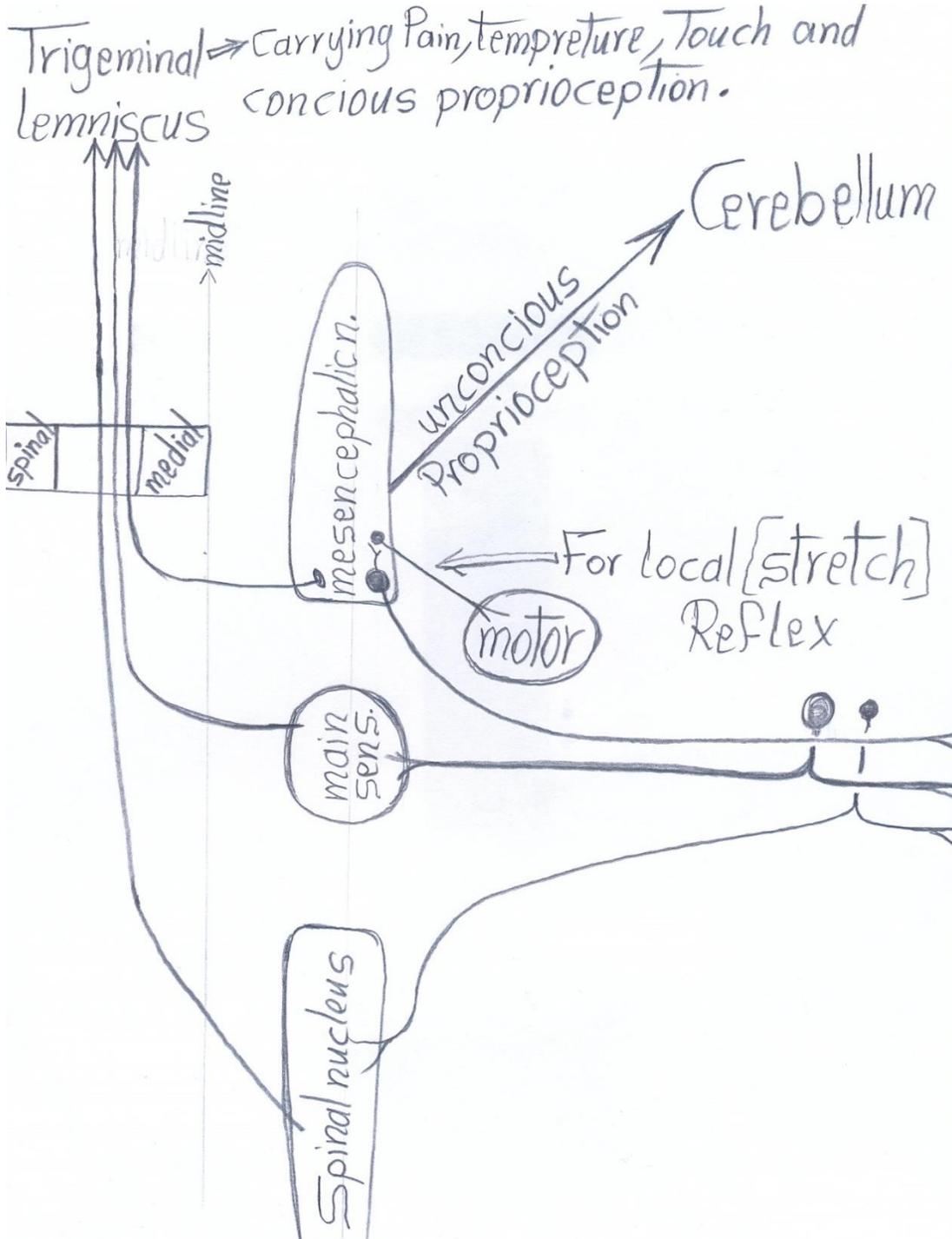
Concerned with Proprioception

Facial Colliculus;

Formed by the motor nucleus of the Abducent nerve and the curving motor fibers of the facial nerve

Trigeminal Lemniscus:

Carries the touch, conscious proprioception, pain and temperature from the opposite side of the head and ends in the thalamus



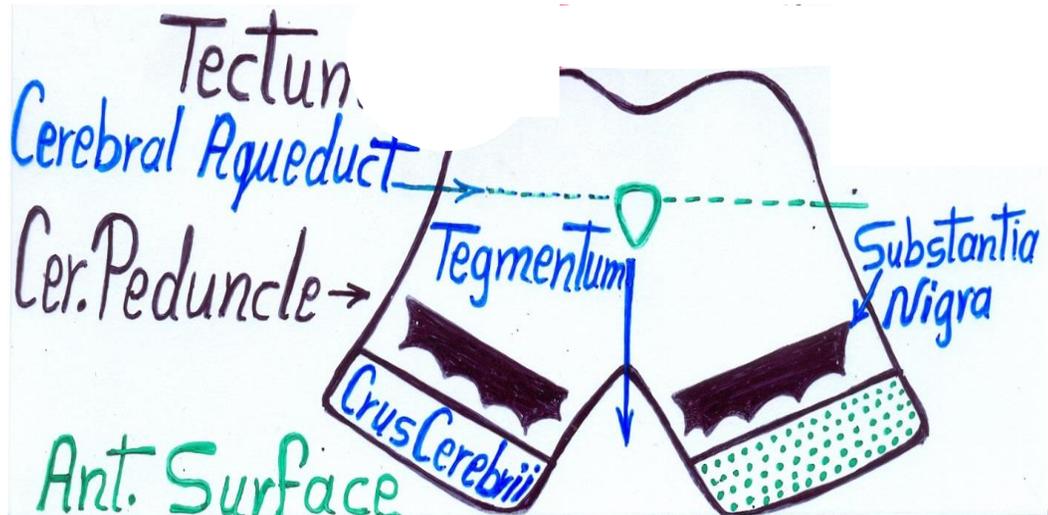
Trapezoid Body

Formed by the decussating Hearing fibers which ascend upwards forming the Lateral Lemniscus

Internal Structure of the Midbrain

The midbrain is divided into ventral and dorsal parts by coronal plane passing through the cerebral aqueduct;

- The ventral part named Cerebral Peduncle
- The dorsal part named Tectum



The cerebral peduncle formed of three parts;

A – Crus Cerebri

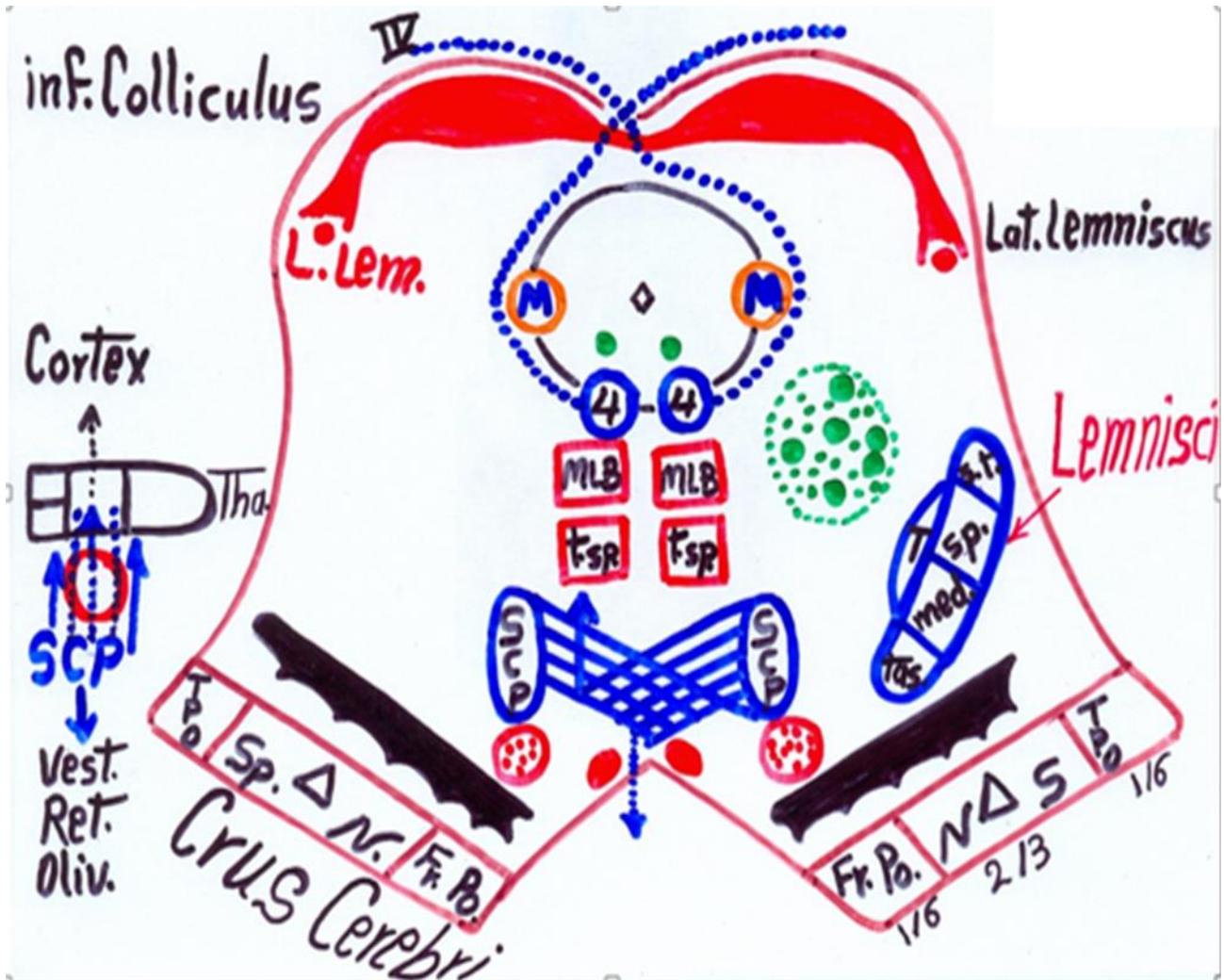
-lies anterior to the substantia nigra

The crus cerebri contains the following descending fibers;

1-Pyramidal tract in the middle 2/3

2-Frontopontine fibers in the medial 1/6

3-Parietopontine, Temporopontine and Occipitopontine fibers in the lateral 1/6



B -Substantia Nigra

-Extrapyramidal center

The substantia nigra is connected with the following extrapyramidal centers;

- Corpus striatum
- Red nucleus
- Reticular formation



C –Tegmentum of the Midbrain

-lies dorsal to the substantia nigra

-studied at two levels; level of superior colliculus and level of inferior colliculus

The Main Contents at the Level of Inferior Colliculus

The White Matter at the level of the inferior colliculus;

I – The Four Lemnisci; medial, spinal, trigeminal and lateral

II – Medial Longitudinal Bundle

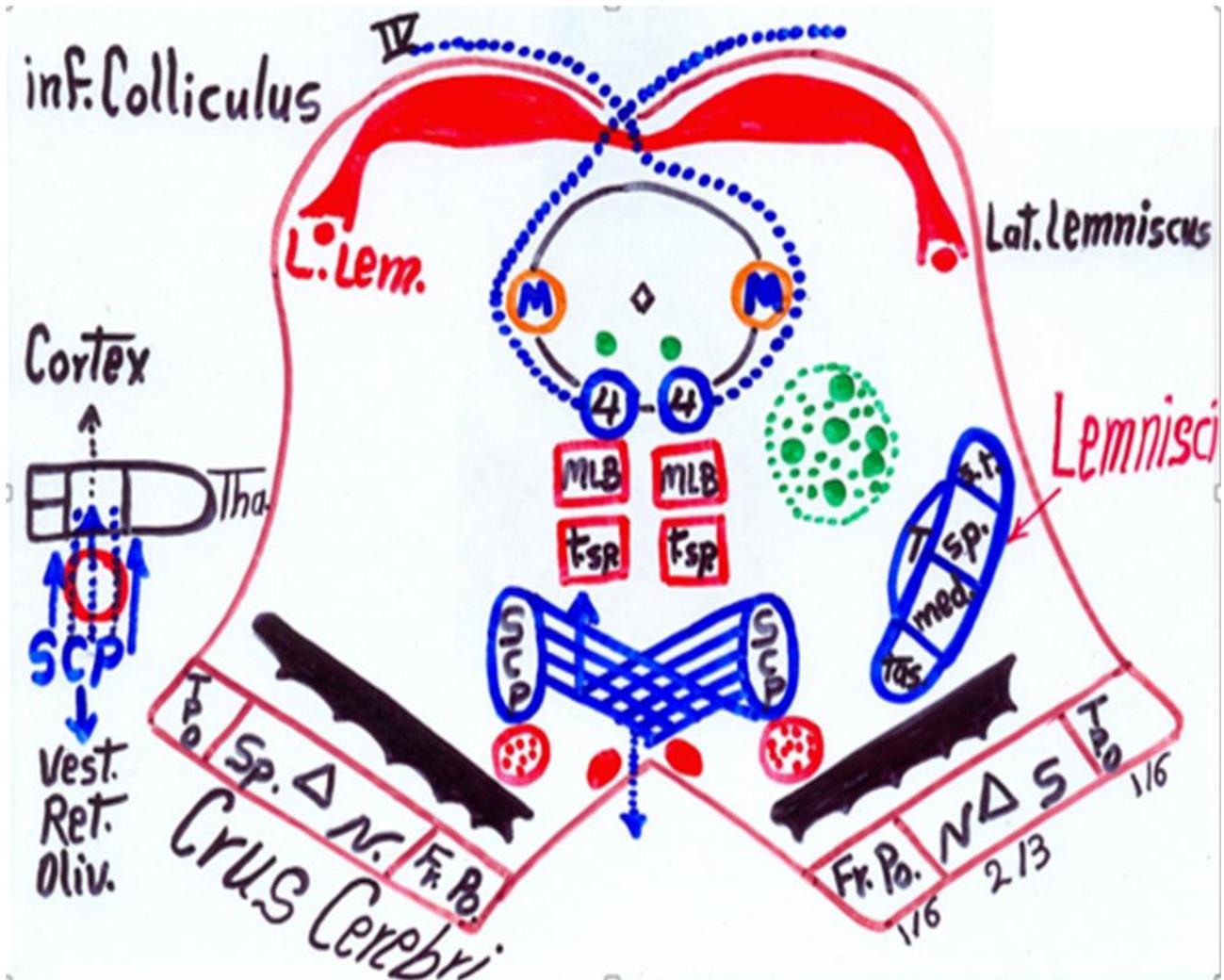
III – Decussation of the superior cerebellar peduncle

Medial Longitudinal Bundle [MLB]

Lies close to the midline, close to the somatic efferent nuclei; [3rd, 4th, 6th and 12th cranial nerve nuclei]

Connects and associates between the Somatic efferent nuclei and Vestibular and Cochlear nuclei

Coordinates the movements of the eyes with the movements of the head and neck, in response to the Vestibulo-cochlear impulses



Superior Cerebellar Peduncle;

- Connects the midbrain with the cerebellum

The Superior Cerebellar Peduncle Contains Afferent Fibers and Efferent Fibers;

A -Two Afferent Fibers;

1-Ventral spinocerebellar tract

2-Tectocerebellar fibers

B –The Superior Cerebellar Peduncle Contains the main Efferent Fibers from the cerebellum:

These fibers crossing to the opposite side forming the decussation of the superior cerebellar peduncle, after decussation the efferent cerebellar fibers ascend and descend to the other extrapyramidal centers,

- **Ascend to the Red nucleus and Thalamus**
- **Descend to the Vestibular , Reticular and Olivary nuclei**

The Gray Matter at the level of the Inferior Colliculus;

I – Trochlear nerve nucleus

II – Mesencephalic nucleus of trigeminal nerve

III- Reticular formation

The Main Contents at the level of Superior Colliculus

The white matter at the level of the Superior Colliculus;

I –Lemnisci; medial, spinal & trigeminal

II – Medial Longitudinal Bundle

III – Two Decussations;

- **Decussation of tecto-spinal tracts**
- **Decussation of rubro-spinal tracts**

The Gray Matter at the level of the Superior Colliculus

I – Oculomotor nerve nuclei

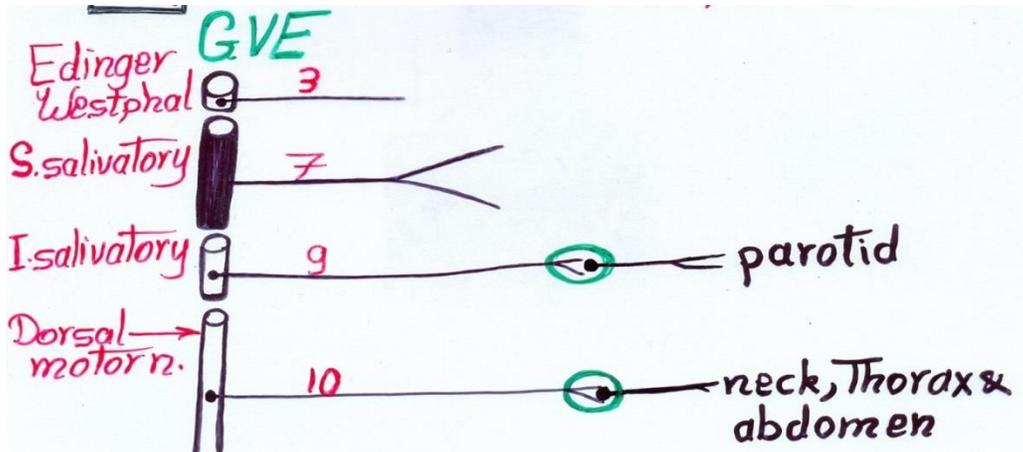
II – Mesencephalic nucleus of trigeminal nerve

III- Reticular formation

IV – Red nucleus

Oculomotor Nerve Nuclei;

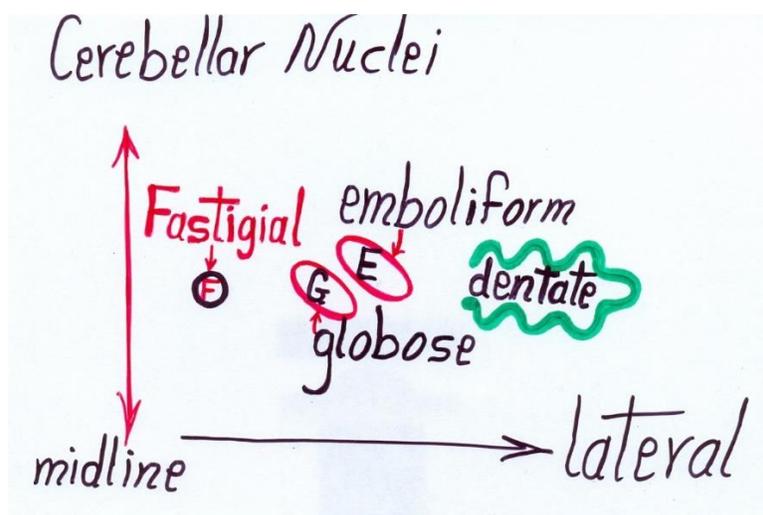
- Motor nucleus supplies the extraocular muscles
- Edinger – Westphal nucleus ;
Parasympathetic nucleus
Supplies the sphincter pupillae and ciliaris muscle



The Internal Structure of the Cerebellum

The Four Intracerebellar Nuclei;

- Present in the white matter core of the cerebellum
- Arranged from medial to lateral as follow;
Fastigial, Globose, Emboliform and Dentate



Functional lobes of the cerebellum

1-Archi-Cerebellum;

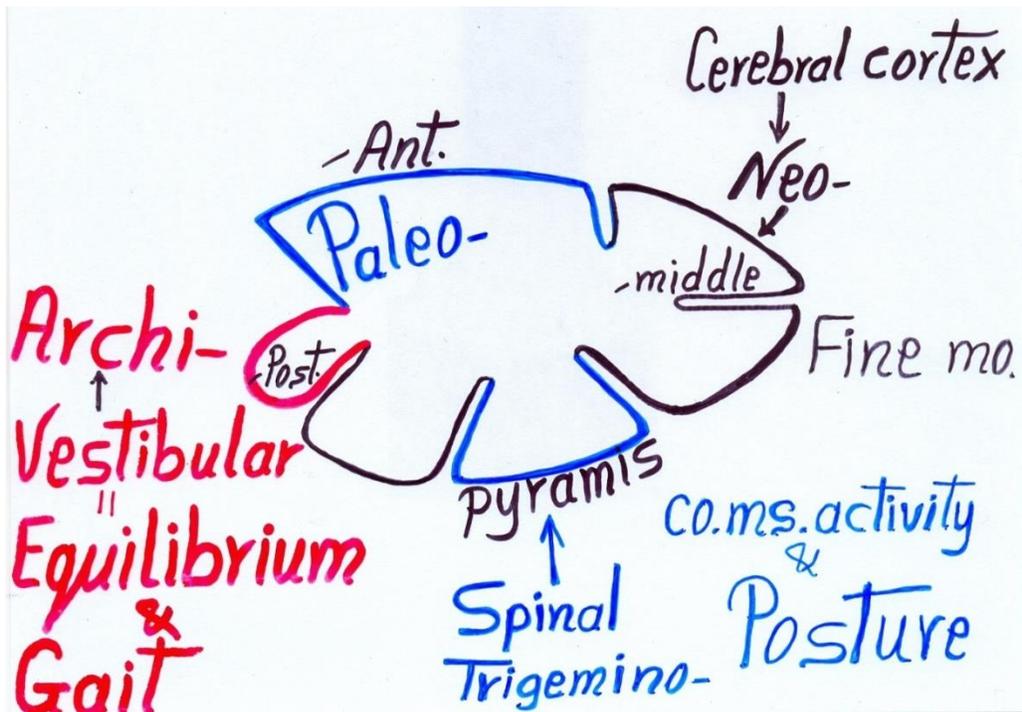
- Includes posterior lobe and fastigial nucleus
- Connected with vestibular nerve and nuclei
- Maintain equilibrium [balance] and gait

2-Paleo-Cerebellum;

- Includes anterior lobe & pyramis and globose & emboliform nuclei
- Connected with spinal cord and trigeminal nuclei
- Coordinates the activities of the muscles and maintain posture

3-Neo-Cerebellum;

- Includes middle lobe except pyramis
- Also includes the dentate nucleus
- Connected with the cerebral cortex
- Controls fine movements



FOREBRAIN

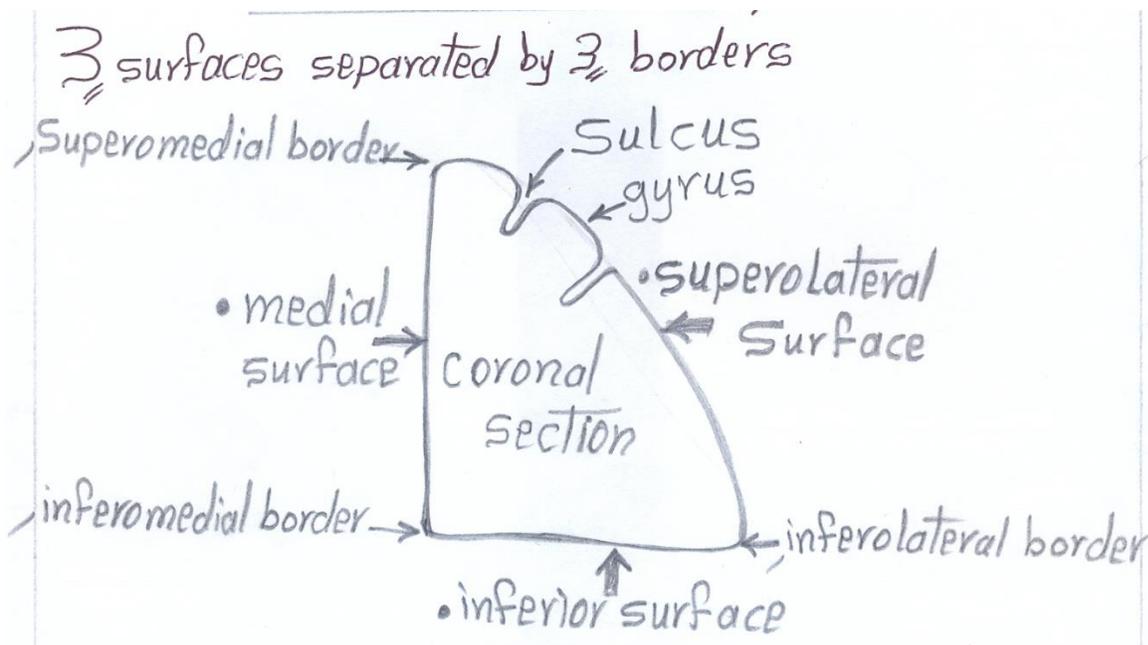
Formed of two cerebral hemispheres separated by the median longitudinal fissure

Formed of superficial gray matter cortex and deep white matter core

The cortex is folded into folds separated by sulci

The Folds named Gyri

Surfaces and Borders of the Cerebral Hemispheres



Three Surfaces;

- Medial Surface
- Superolateral Surface
- Inferior Surface

Three Borders:

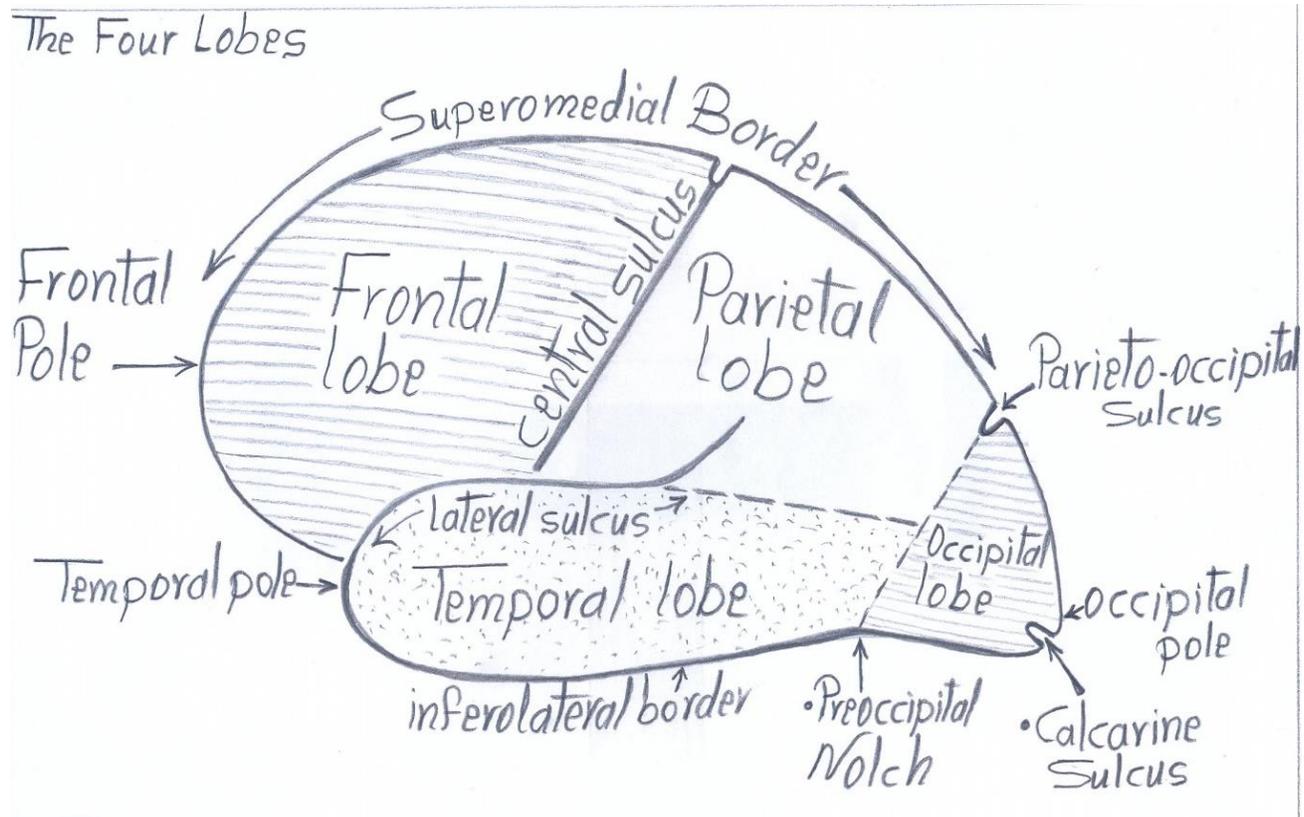
- Supero-medial Border
- Infero-medial Border
- Infero-lateral Border

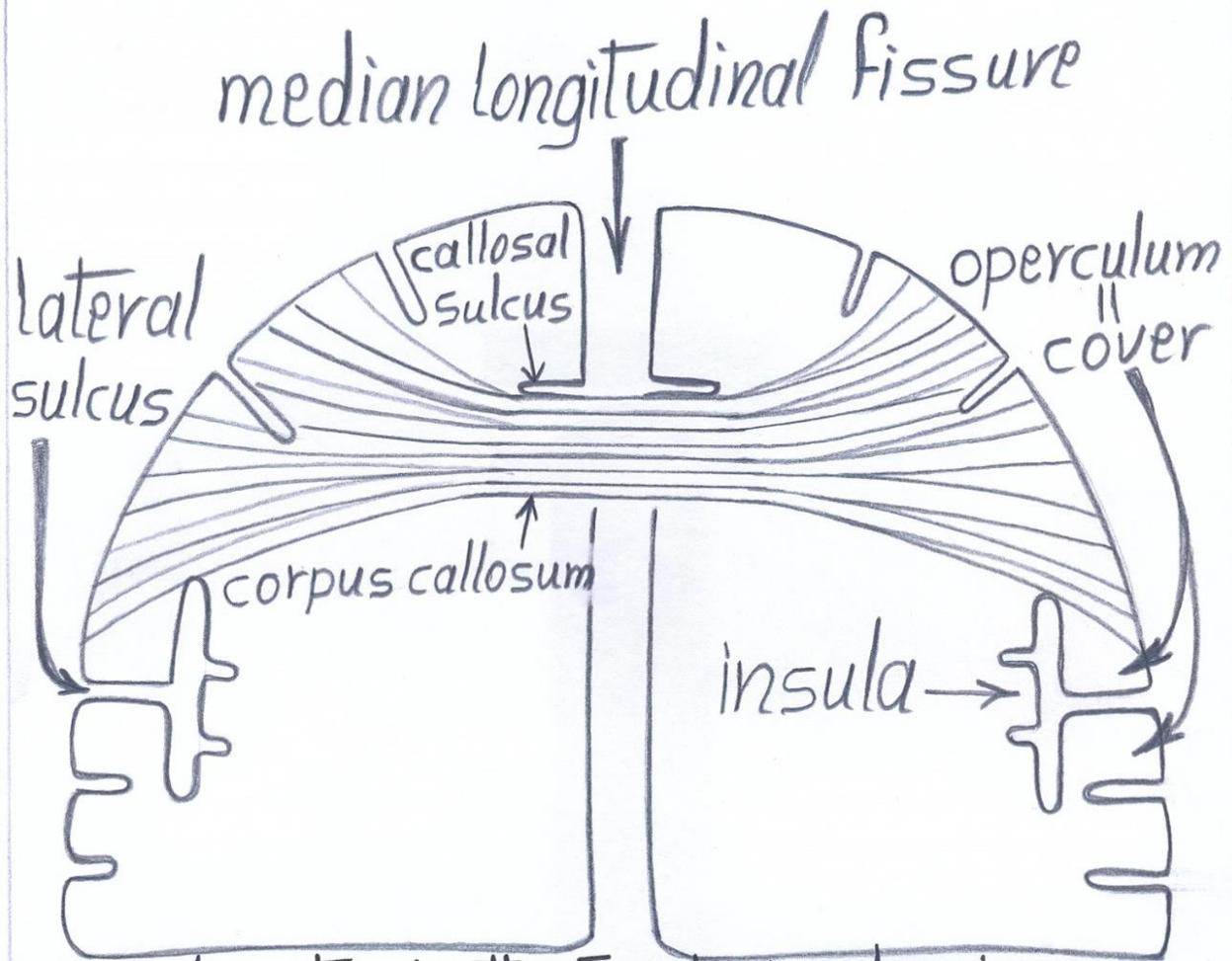
The Lobes of the cerebral hemisphere

Each Cerebral Hemisphere is divided into Four Lobes;

Frontal, Parietal, Temporal and Occipital

Pole; is the free end of the lobe





coronal section in the Fore brain showing:
 The two cerebral hemispheres separated by the
 median longitudinal fissure.

Deep lateral sulcus

The insula in the floor of the lateral sulcus.

The gyrus covering the insula above or below
 the sulcus named operculum.

FRONTAL LOBE

Extent

- from the frontal pole in front to the central sulcus behind
- from the Supero-medial border above to the lateral sulcus below

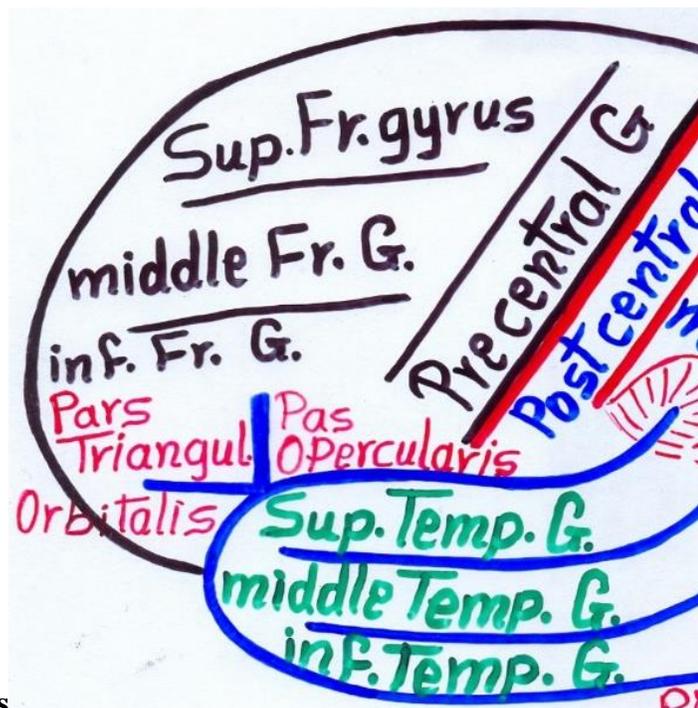
Sulci of the frontal lobe;

Superior frontal, inferior frontal and precentral sulci

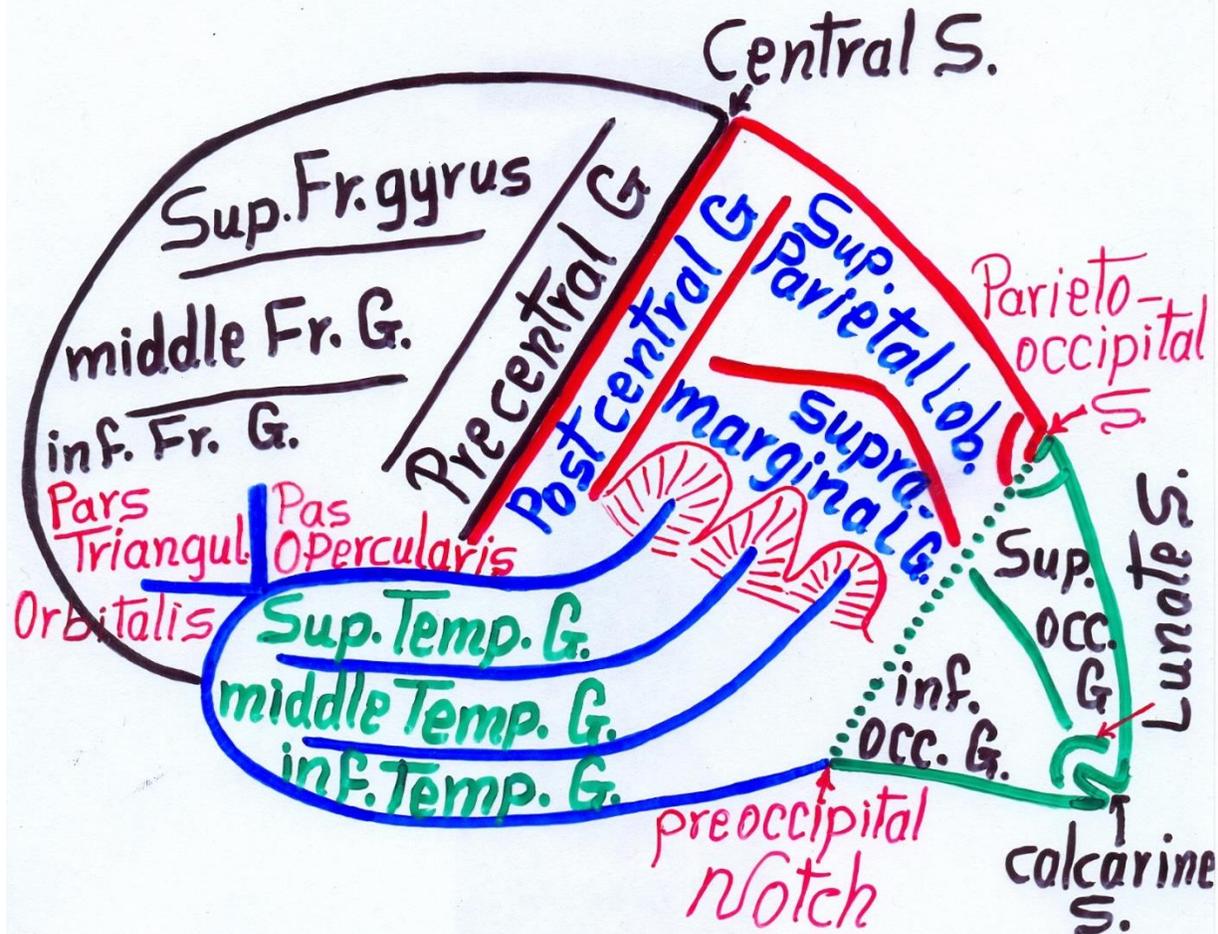
Gyri of the frontal lobe;

- Superior , middle and inferior frontal gyri
- Precentral gyrus

The inferior frontal gyrus is divided by the rami of the lateral sulcus into three parts;



- 1-pars Orbitalis
- 2-pars Triangularis
- 3-pars Opercularis



Parietal Lobe

Extent

-from the central sulcus in front to line from the parieto-occipital sulcus to the preoccipital notch

-from the Supero-medial border above to the lateral sulcus below

Sulci of the parietal lobe: postcentral sulcus and intraparietal sulcus

Gyri of the parietal lobe;

- Superior and inferior parietal lobules
- Postcentral gyrus

The inferior parietal lobule contains three supramarginal gyri;

- **Anterior , Middle and Posterior supramarginal gyri**

Temporal lobe

Extent

-from the temporal pole to the line from the parieto-occipital sulcus to the preoccipital notch

-from the lateral sulcus to the infero-lateral border

Sulci of the temporal lobe:

Superior and inferior temporal sulci

Gyri of the temporal lobe:

Superior, middle and inferior temporal gyri

Occipital Lobe

Extent

Anterior boundary:

Line from the parieto-occipital sulcus to the preoccipital notch

Posterior boundary: the occipital pole

Sulci of the occipital lobe:

Lateral occipital sulcus and Lunate sulcus

Gyri of the Occipital lobe:

Superior and inferior occipital gyri

Features of the Medial Surface of the cerebral hemisphere

It shows the corpus callosum in addition to sulci and gyri on the medial surface

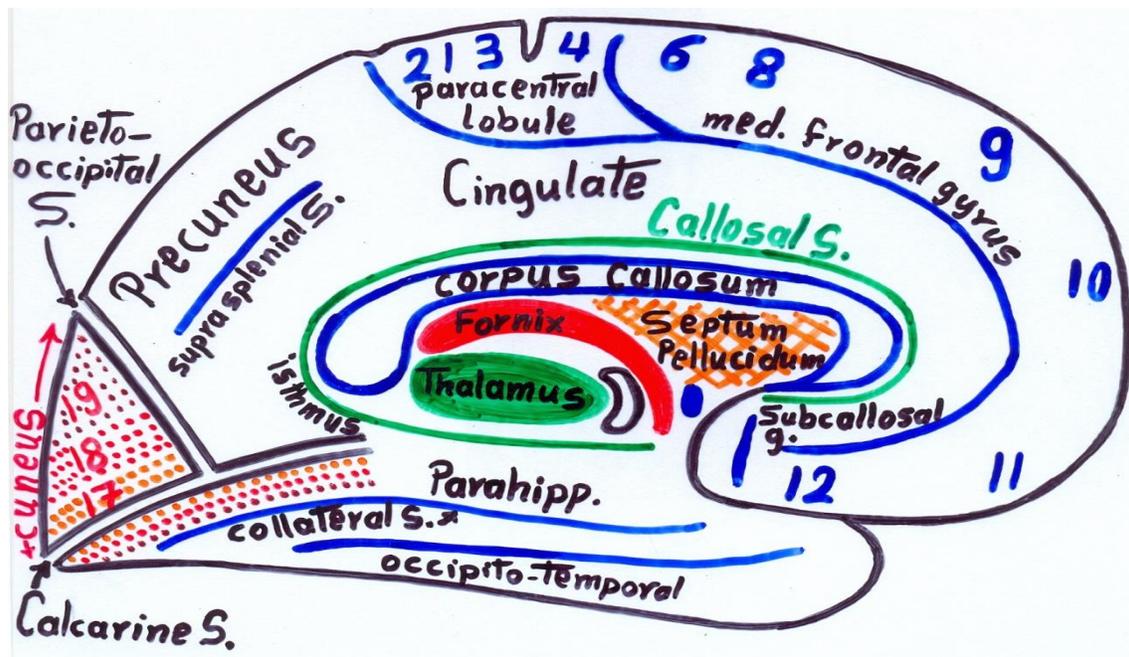
The Corpus Callosum

-The greatest commissure, measures 10 cm long

-Holds the two hemispheres

-Helps in coordination of the functions of the two hemispheres

The corpus callosum is surrounded by the Callosal Sulcus



Cingulate Gyrus

-Surrounds the superior surface of the corpus callosum

-it is continuous in front with the subcallosal gyrus below the rostrum and genu

-it is continuous behind with the isthmus below and behind the splenium

Parts of the Corpus Callosum

1-Splenium:

- The thickest part
- It is the expanded posterior part of the corpus callosum

2-Genu:

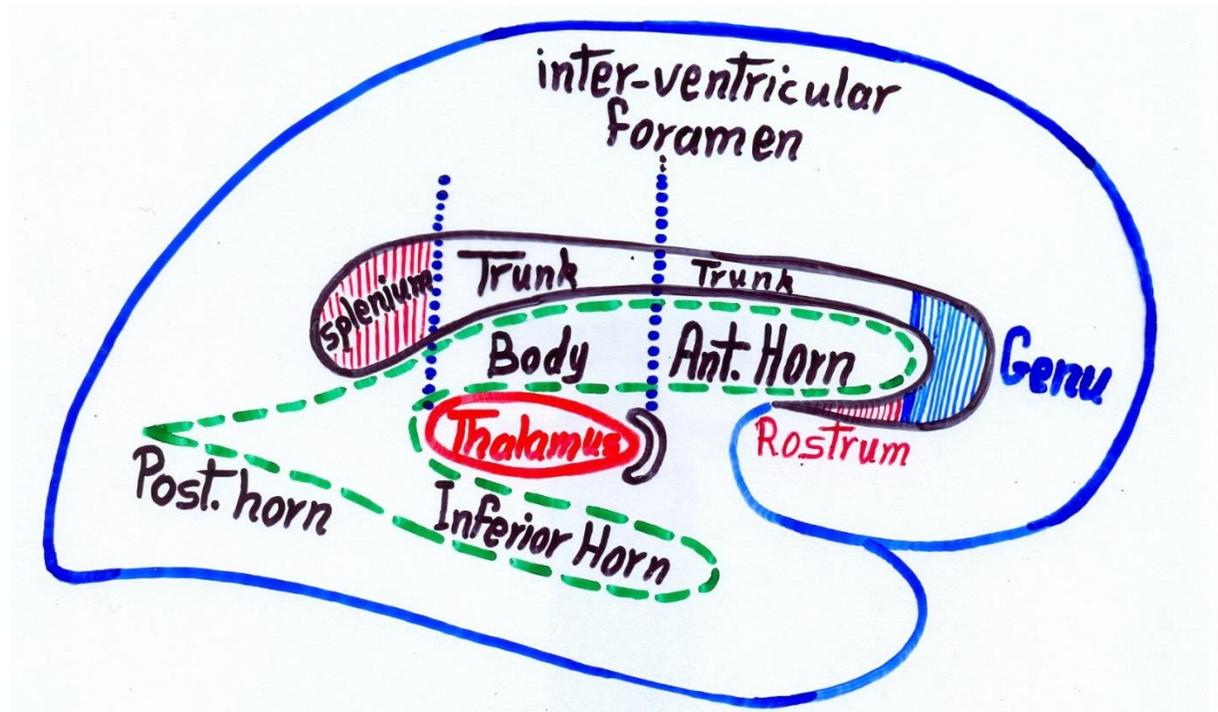
- The anterior end of the corpus callosum
- Comma-shaped

3-Trunk;

- The main part between splenium and genu

4-Rostrum;

- thin part, extending backwards from the genu

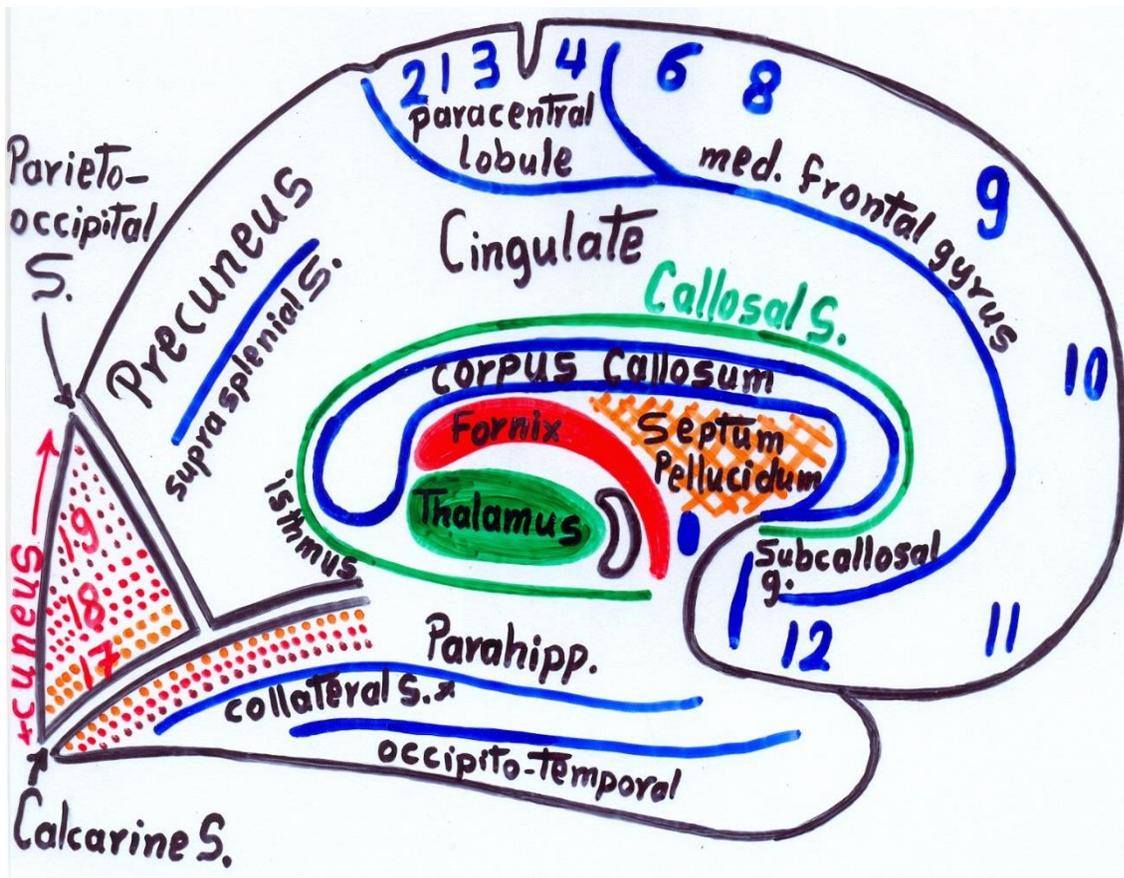


Parahippocampal Gyrus

- in the inferior surface of the temporal lobe
- lies between the collateral and hippocampal sulcus
- its anterior end is swollen and expanded to form the uncus
- its posterior end is divided into two gyri which are:

1- Lingual Gyrus in the inferior surface of the occipital lobe

2-Isthmus; below and behind the splenium



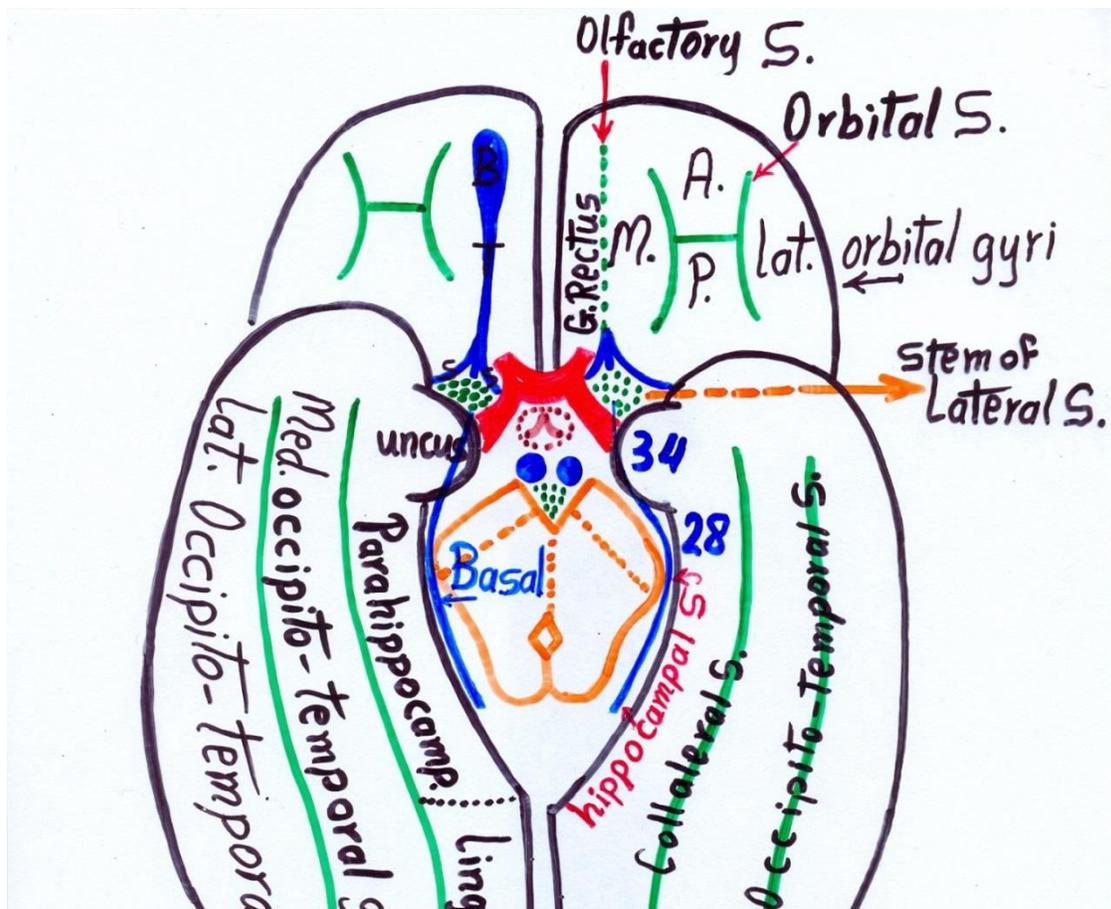
Anterior Perforated Substance

Boundaries

- 1-Anterior boundary; by the olfactory Striae
- 2-Posterior boundary; by the uncus
- 3-Medial boundary; by the optic tract and chiasma
- 4-Lateral boundary; by the stem of the lateral sulcus

Relations of the anterior perforated substance; it is related to

- End of the Internal carotid artery
- Beginning of the Basal vein

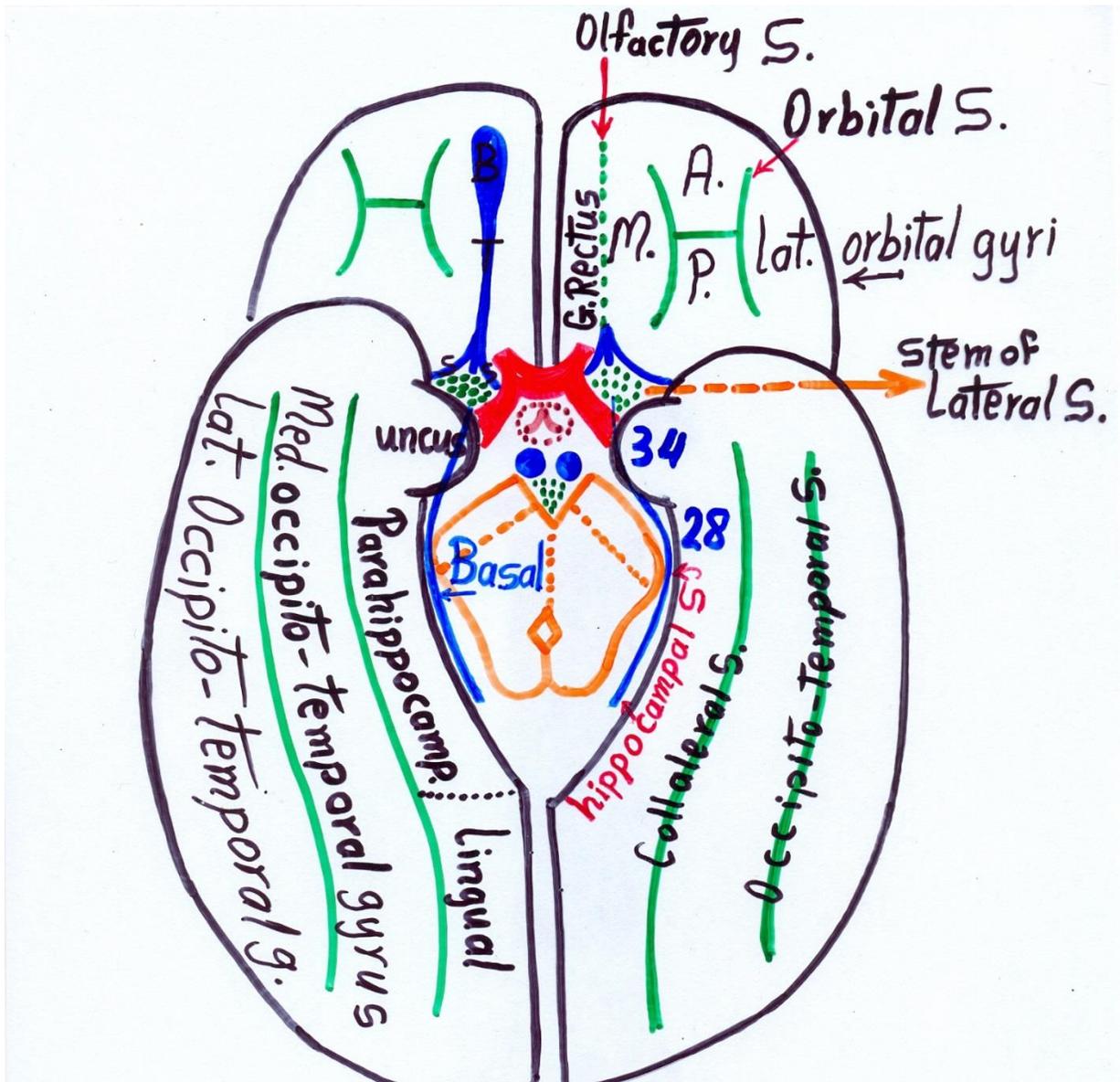


The Stem of the Lateral Sulcus

- Separates the frontal and temporal lobes
- Extends from the anterior perforated substance to the lateral surface

Features of the Inferior Surface

Includes Two Parts; Orbital and Tentorial parts



The Inferior Surface of the Frontal Lobe [Orbital Surface] Shows;

Two Sulci;

- H-shaped orbital sulcus
- Olfactory sulcus containing the olfactory bulb and tract

Gyri;

- Gyrus rectus medially
- Orbital gyri [anterior, posterior, medial and lateral]

The Inferior Surfaces of the Temporal and Occipital Lobes Named the Tentorial Surface shows;

Two Sulci;

- Collateral sulcus
- Occipito-temporal sulcus

Three Gyri;

- 1- Lateral Occipitotemporal gyrus
- 2- Medial Occipitotemporal gyrus
- 3- Parahippocampal gyrus on the temporal lobe and continuous into the occipital lobe forming the Lingual gyrus

The Functional Areas of the Frontal Lobe

Area 4;

- The primary motor area
- Gives the pyramidal tract

Area 6;

- The premotor area
- Cortical extrapyramidal center

Area 8;

- Frontal eye field
- Produces contralateral conjugate eyes deviation

Areas 44 and 45;

- Motor speech area of Broca
- Only in the dominant hemisphere

Areas 9, 10, 11;

- Prefrontal areas
- Concerned with information processing , memory , calculation , thinking , understanding time , decision making and ability to predict

The Functional Areas of the Parietal Lobe

Areas 3, 1, 2; primary somatosensory area

Superior Parietal Lobule; concerned with recognition of the shape by touch which named [Stereognosis]

Areas 39 and 40; speech area of Wernike

The Functional Areas of the Temporal Lobe

Areas 41, 42; primary auditory cortex

Areas 21, 22;

- Auditory association cortex
- Connect hearing areas with other sensory areas , prefrontal areas and memory

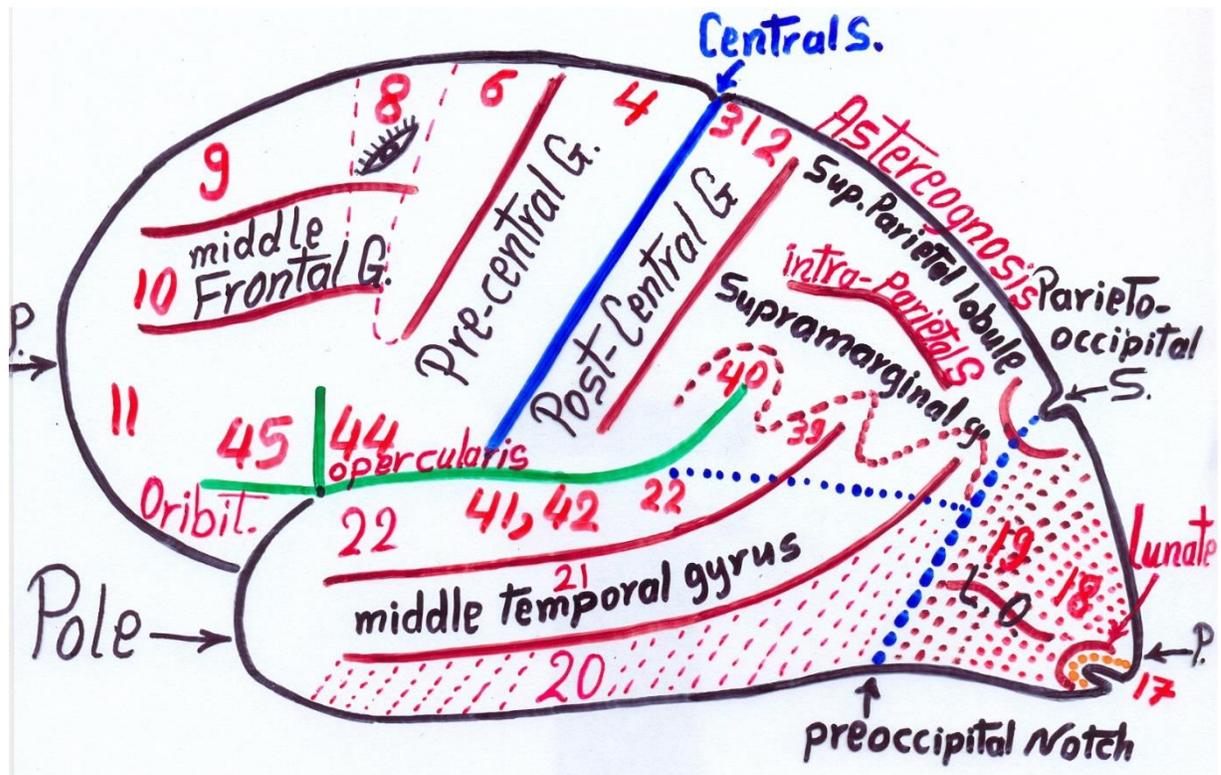
The Functional Areas of the Occipital Lobe

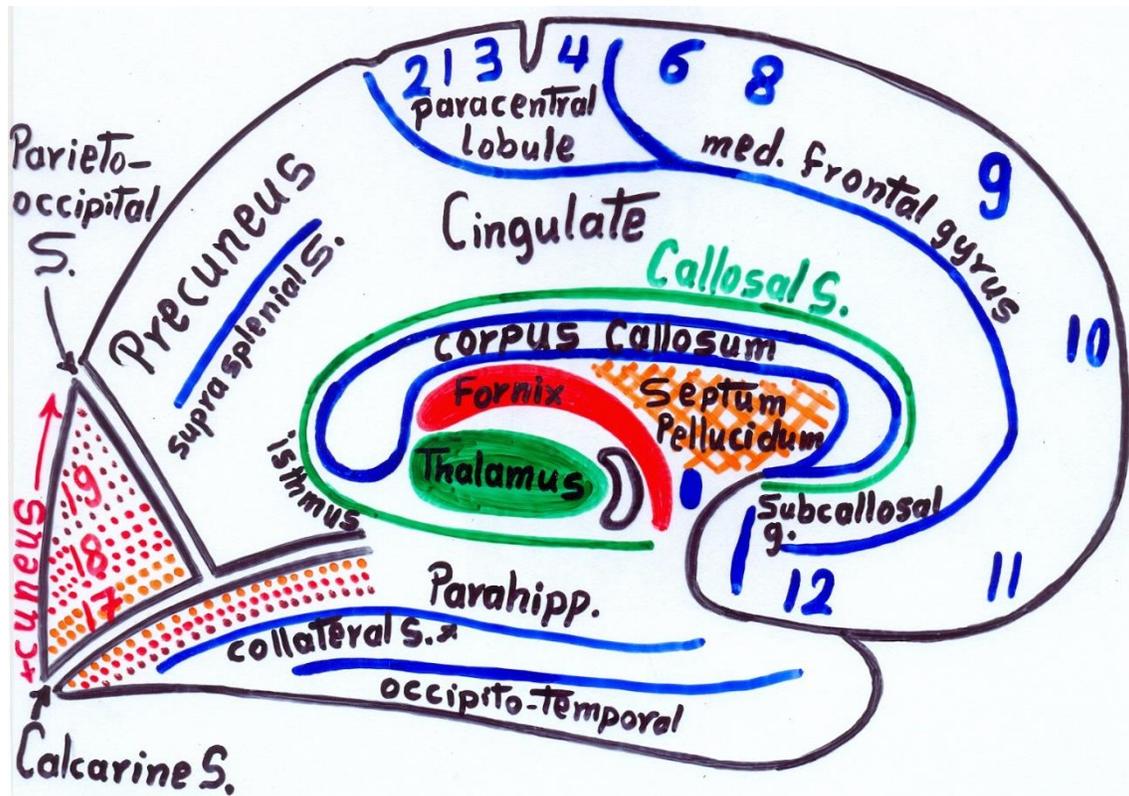
Area 17;

- Primary visual cortex
- Named striate cortex
- Lies around the calcarine sulcus

Areas 18, 19, 20;

- Visual association cortex
- Connect visual areas with other sensory areas , prefrontal areas and memory





LATERAL VENTRICLE

One in each cerebral hemisphere

Each ventricle is divided into body and three horns

Body of the Lateral Ventricle

Site of the Body:

In the parietal lobe

Above the thalamus

Extending from the interventricular foramen to the posterior end of thalamus

Boundaries of the Body:

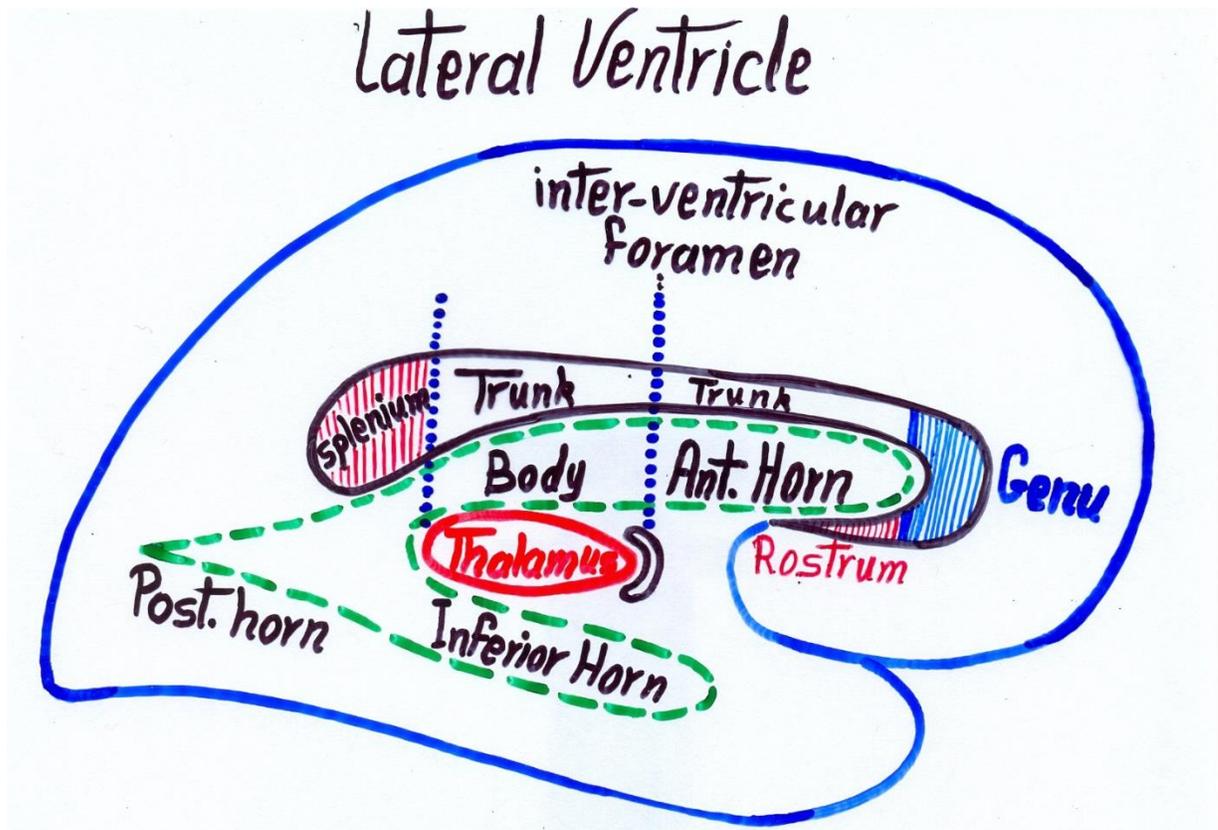
Roof of the Body; formed by the trunk of the corpus callosum

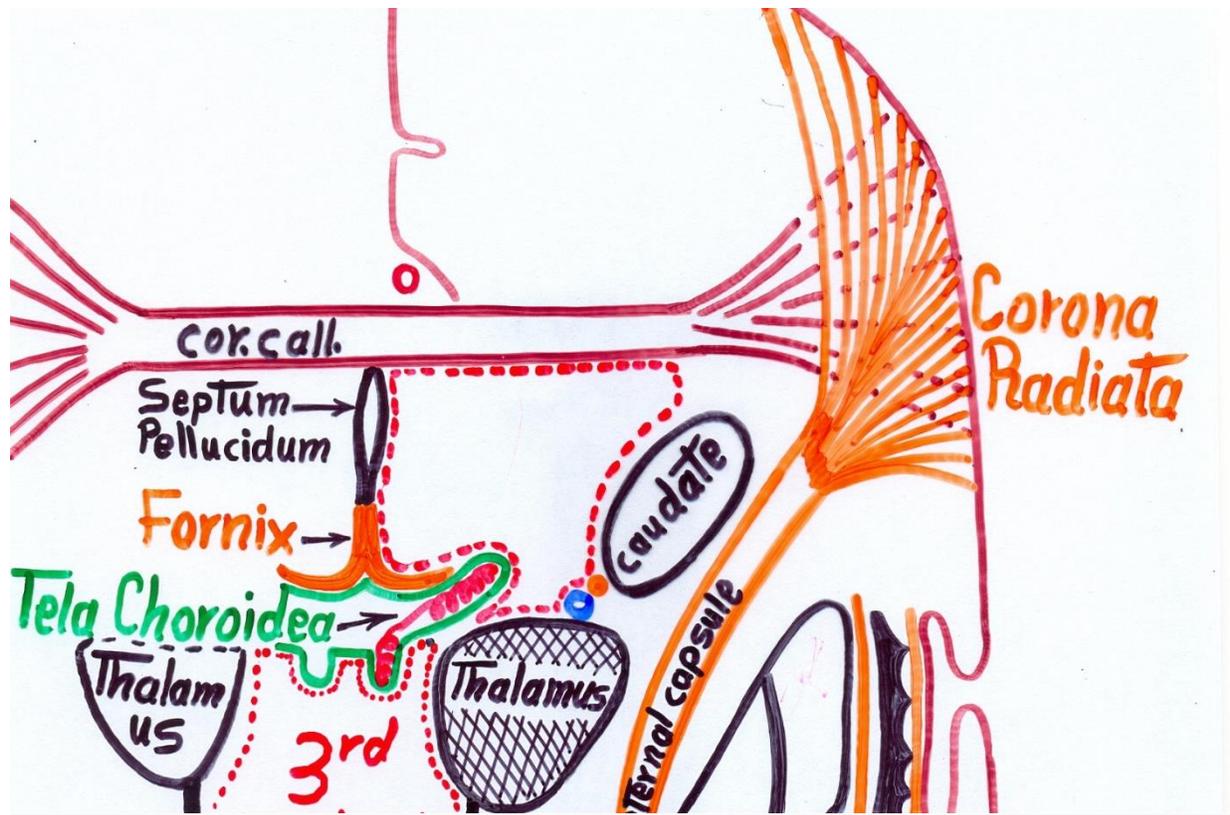
Medial wall of the Body; formed by

- Septum pellucidum
- Body of fornix

Floor of the Body; formed by

- Body of caudate nucleus
- Thalamus
- Body of fornix
- Tela choroidea between fornix and thalamus
- Stria terminalis and Thalamostriate vein between caudate and thalamus





Anterior Horn of the Lateral Ventricle

Site:

In the frontal lobe

Anterior to the interventricular foramen

Boundaries of the Anterior Horn

Roof; formed by the trunk of the corpus callosum

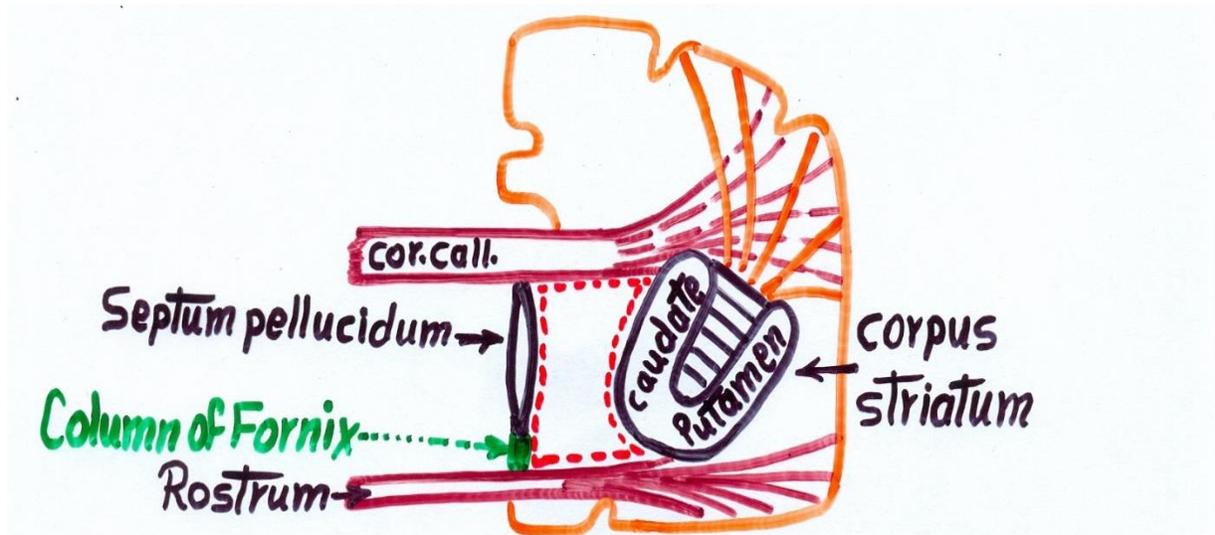
Medial wall; formed by

- Septum pellucidum
- Column of fornix

Floor; the infero-lateral boundary formed by

- Rostrum of the corpus callosum
- Head of caudate nucleus

Anterior wall; formed by the genu of the corpus callosum



Posterior Horn of the Lateral Ventricle

-lies in the occipital lobe

Boundaries of the Posterior Horn

Roof; formed by the Tapetum

Lateral wall; formed by

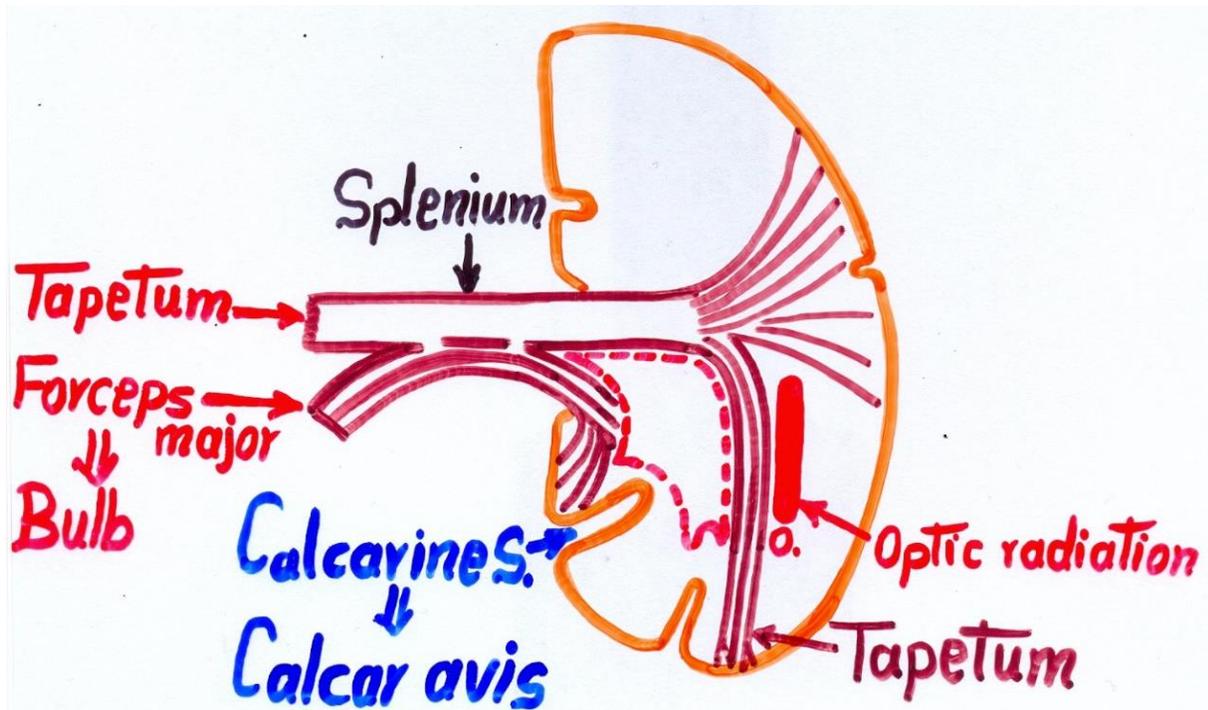
- Tapetum
- Optic radiation

Floor; formed by

- Bulb of the posterior horn
- Calcar avis

The bulb is formed by the forceps major

The calcar avis is formed by the calcarine sulcus



Inferior Horn of the Lateral Ventricle

Lies in the temporal lobe

Boundaries of the inferior horn

Roof; formed by

Tapetum

Tail of caudate nucleus

Stria Terminalis

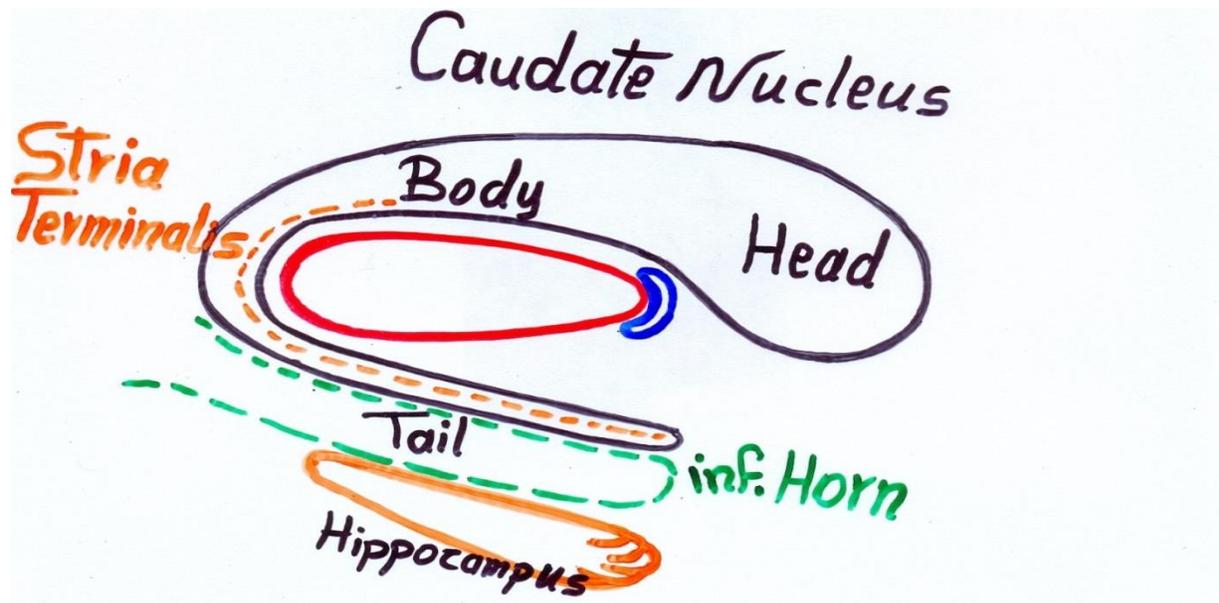
Lateral wall; formed by Tapetum

Floor: formed by

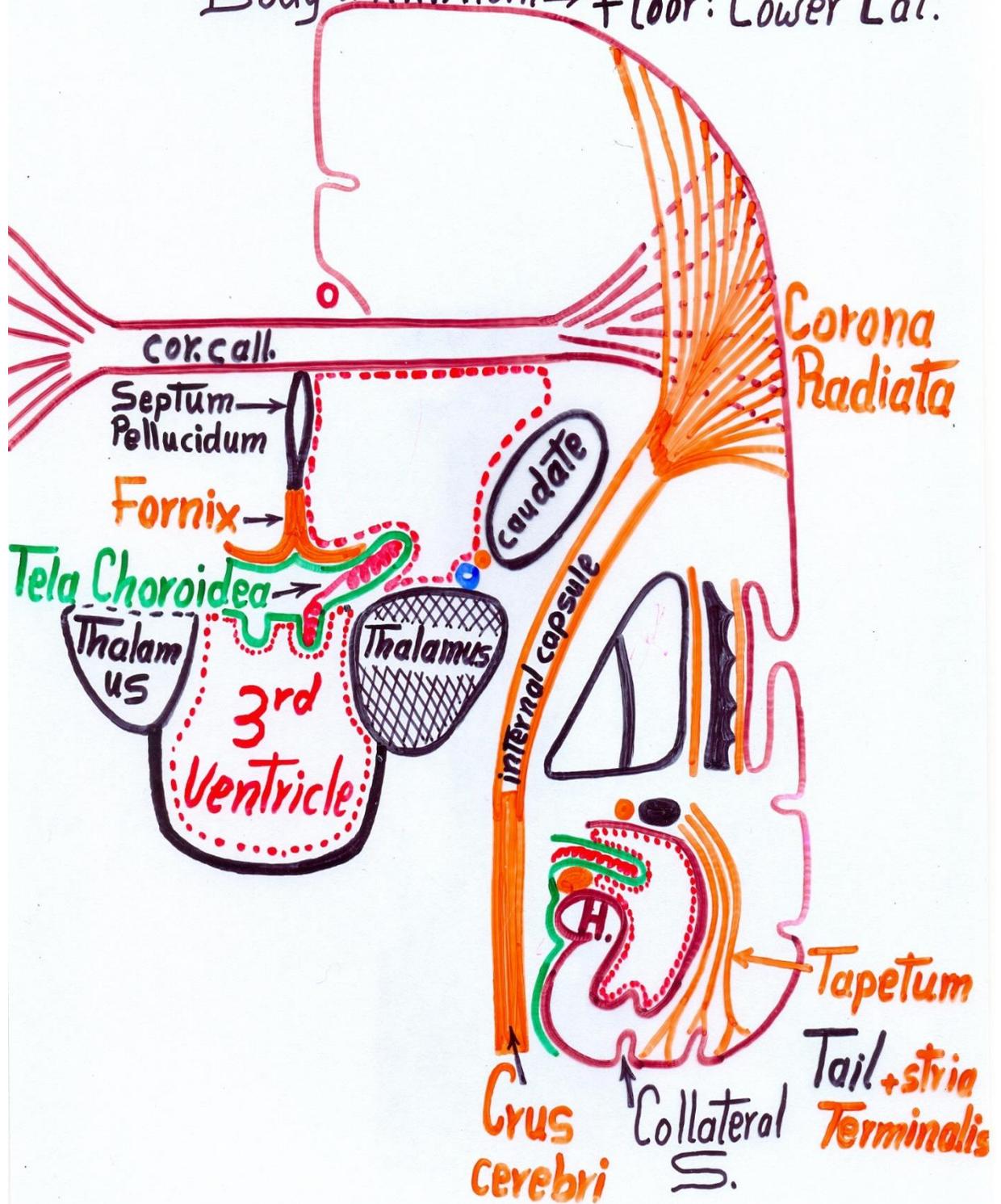
- hippocampus and fimbria
- collateral eminence

The choroidal fissure lies between the fimbria and Stria terminalis

Medial boundary: formed by the Telachoroidea



Body & Ant. Horn \Rightarrow Floor: Lower Lat.

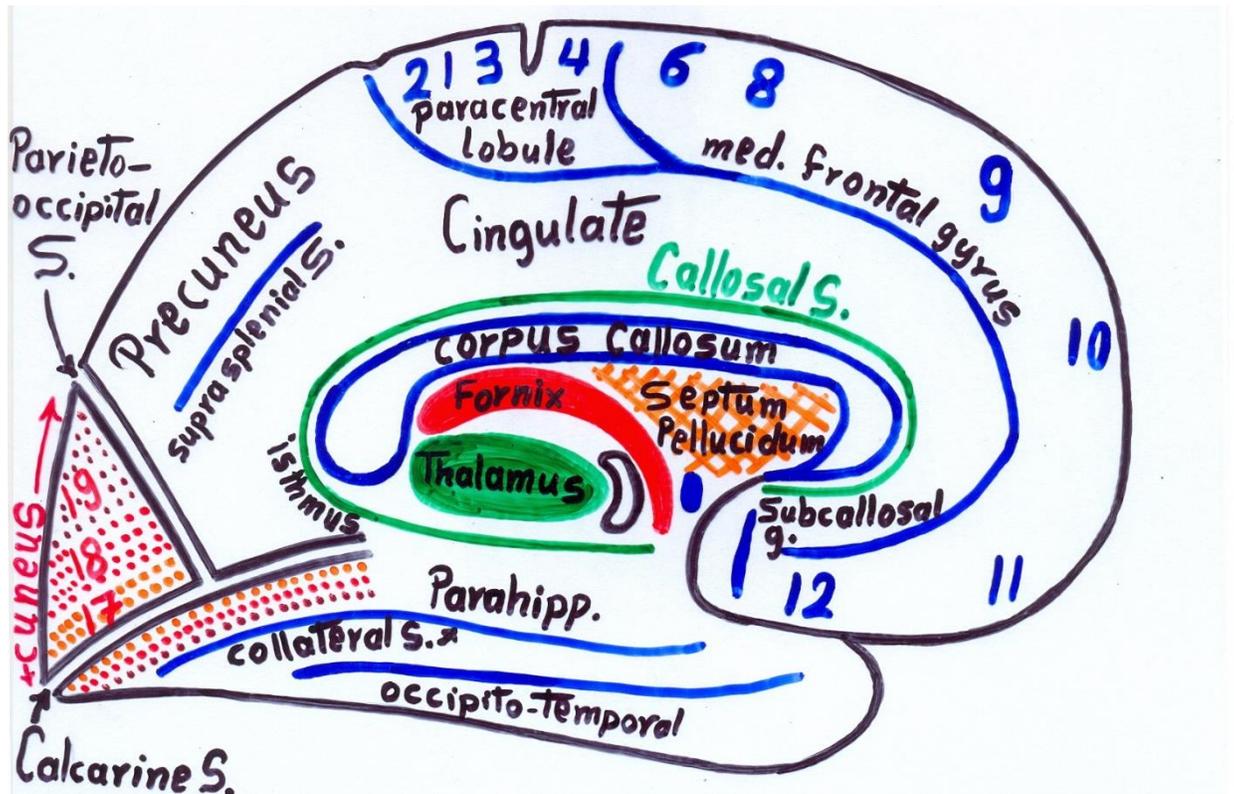


The Interventricular Foramen of Monro

Shape: Semilunar

Boundaries: lies between

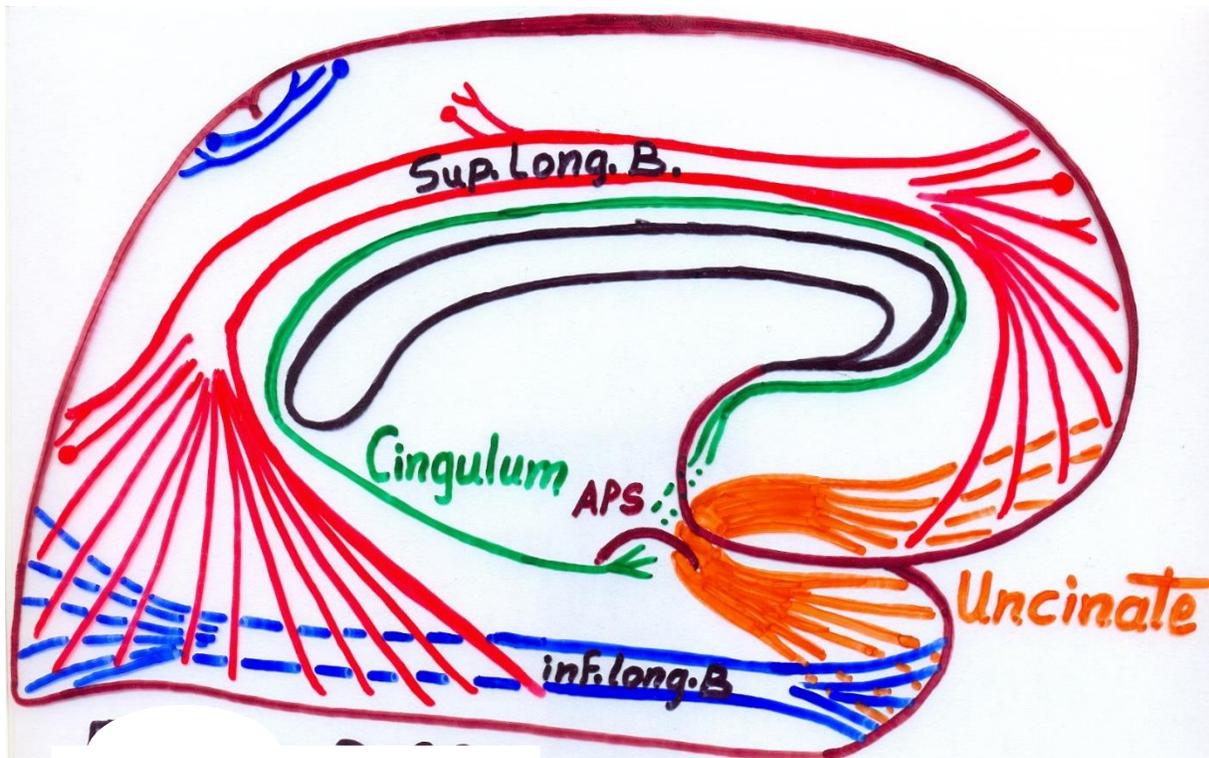
- the anterior end of thalamus and
- column of fornix



TYPES OF THE CEREBRAL WHITE MATTER

Three Types;

- 1-Association fibers
- 2-Commissural fibers
- 3-Projection fibers



Association fibers

Two types; short and long

A – Short association fibers; connect adjacent gyri

B – Long association fibers; connect the lobes in the same side [connect the lobes of one side hemisphere]:

Long association fibers include the following Five Bundles;

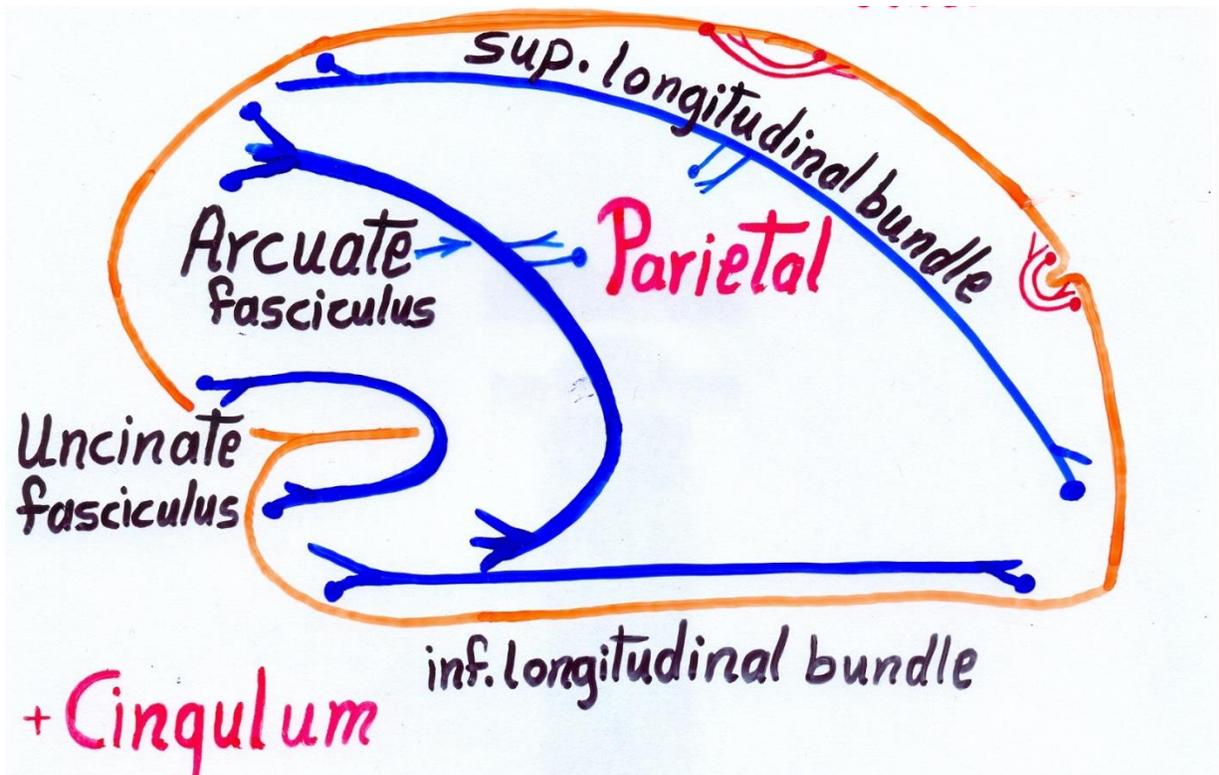
1-Superior Longitudinal Bundle; between frontal, parietal and occipital lobes

2-Inferior Longitudinal Bundle; between temporal and occipital lobes

3-Uncinate Fasciculus; between frontal and temporal

4-Cingulum; in the cingulate gyrus and connects the parts of the limbic lobe

5-Arcuate Fasciculus; between frontal, parietal and temporal lobes



Commissural Fibers

Connect the corresponding parts of the two hemispheres

I – in the Forebrain;

- Corpus callosum
- Anterior and posterior commissures
- Commissure of the fornix

II – in the Midbrain;

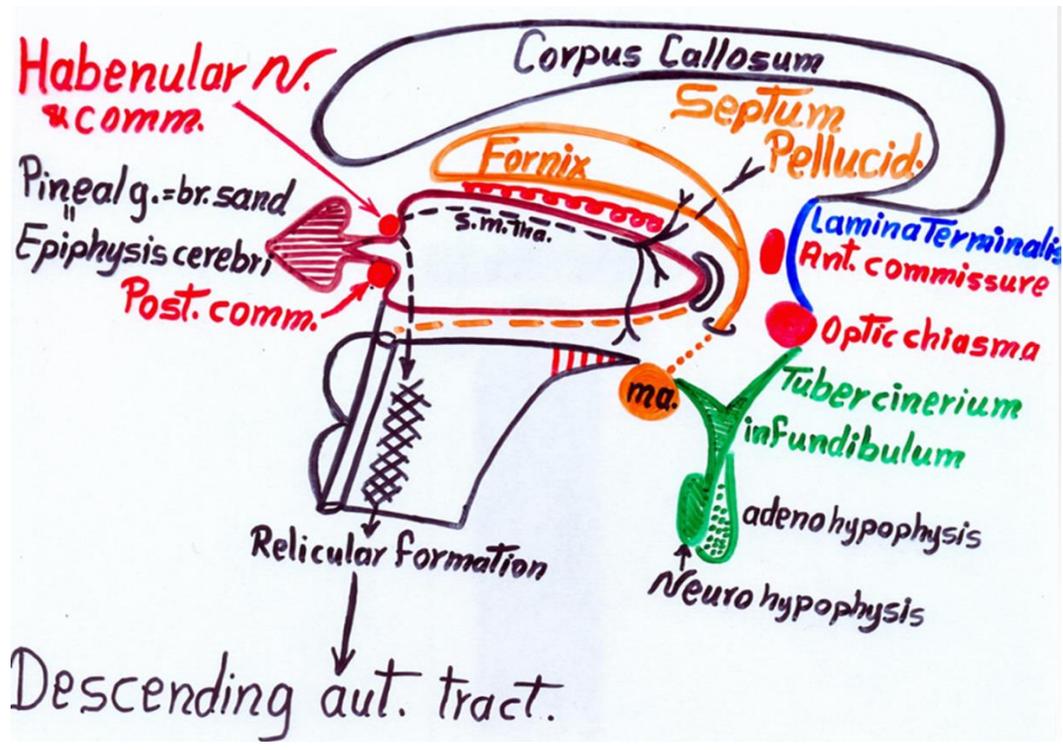
- Commissures of the colliculi

III – in the Hind brain;

- Cerebellar commissures

IV – in the Spinal Cord;

- White commissure



Projection Fibers

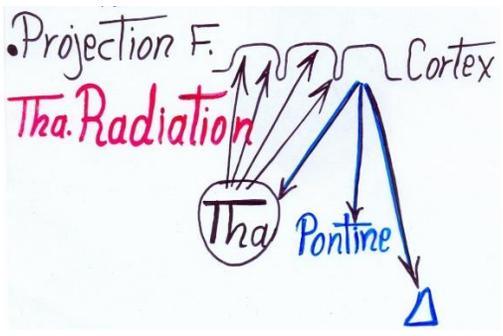
Connect the cortex with the other parts of the brain and spinal cord

I – Ascending Fibers;

The Thalamic Radiations

II – Descending Fibers; Three types

- Pyramidal tract
- Cortico-pontine fibers
- Cortico-thalamic fibers



Olfactory Pathway

1-Olfactory Nerves; formed by the central processes of the olfactory cells in the nasal mucous membrane and end in the olfactory bulb

2-Olfactory Bulb; containing Mitral cells

3-Olfactory Tract; formed by the axons of the Mitral cells

4-the olfactory tract divided into medial and lateral olfactory Striae

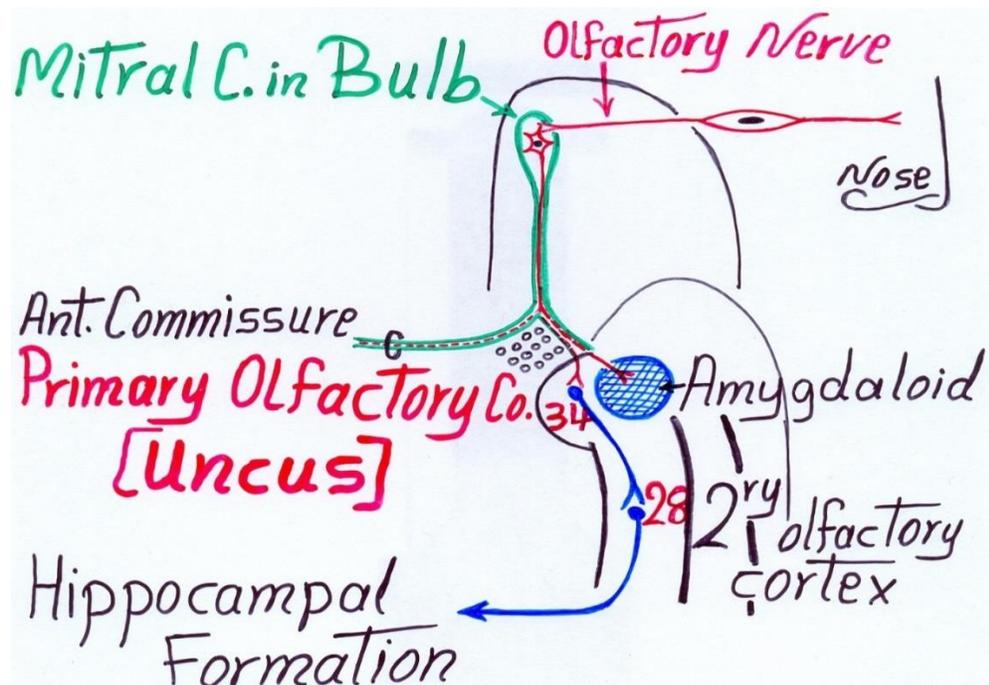
- A – Lateral Olfactory Stria ; ends in the area 34 and amygdaloid nucleus
- B – Medial Olfactory Stria ; passes in the anterior commissure to communicate with the opposite side olfactory centers

5-Primary Olfactory Cortex; in the area 34 in the uncus

6-Secondary Olfactory Cortex; in the area 28 in the Parahippocampal gyrus

7-the secondary cortex sends Efferents to the Hippocampal Formation

N.B. the olfactory impulses terminates directly in the cortex without thalamic relay

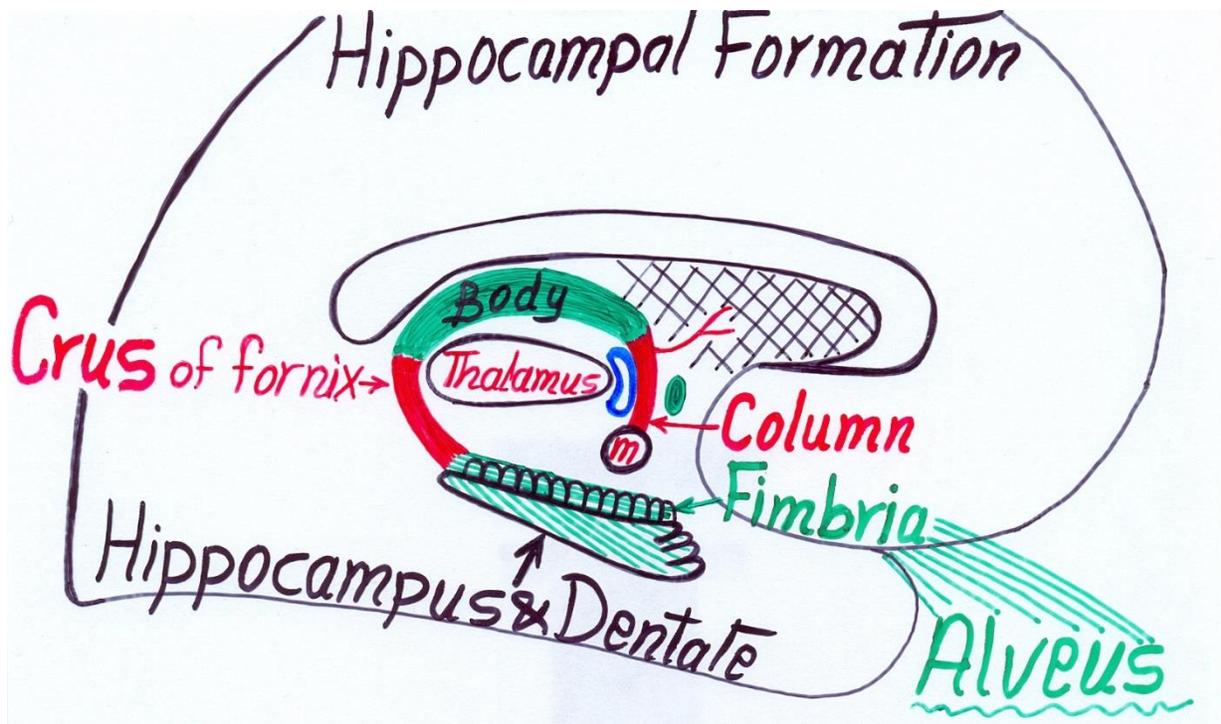


LIMBIC LOBE

Components; subcallosal gyrus, cingulate gyrus, isthmus, Parahippocampal gyrus, uncus and hippocampal formation

Functions of the limbic lobe;

- Olfaction
- Controls the autonomic nervous system
- Control emotions , behavior and memory



Hippocampal Formation

Components; formed of hippocampus, dentate and their Efferents

The Efferent Fibers cover the hippocampus by thin layer of white matter named Alveus

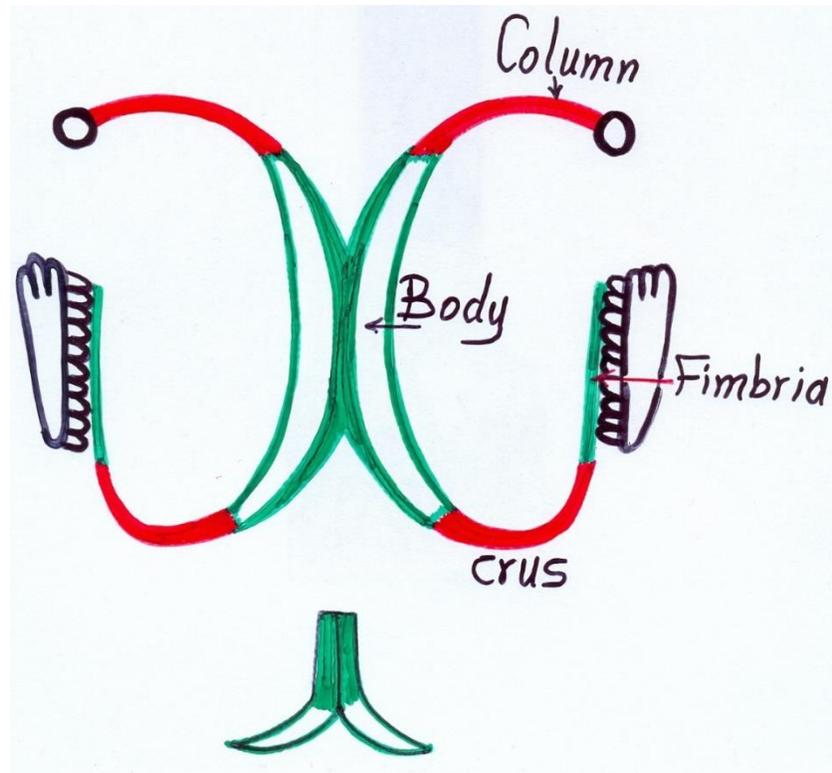
The fibers of the alveus converge to form a bundle named Fimbria

The fimbria ascends behind the thalamus to form the Crus of the Fornix

The right and left crura fuse above the thalamus to form the Body of the Fornix

The body of the fornix divides into two Columns

The columns end in the corresponding Mammillary Bodies



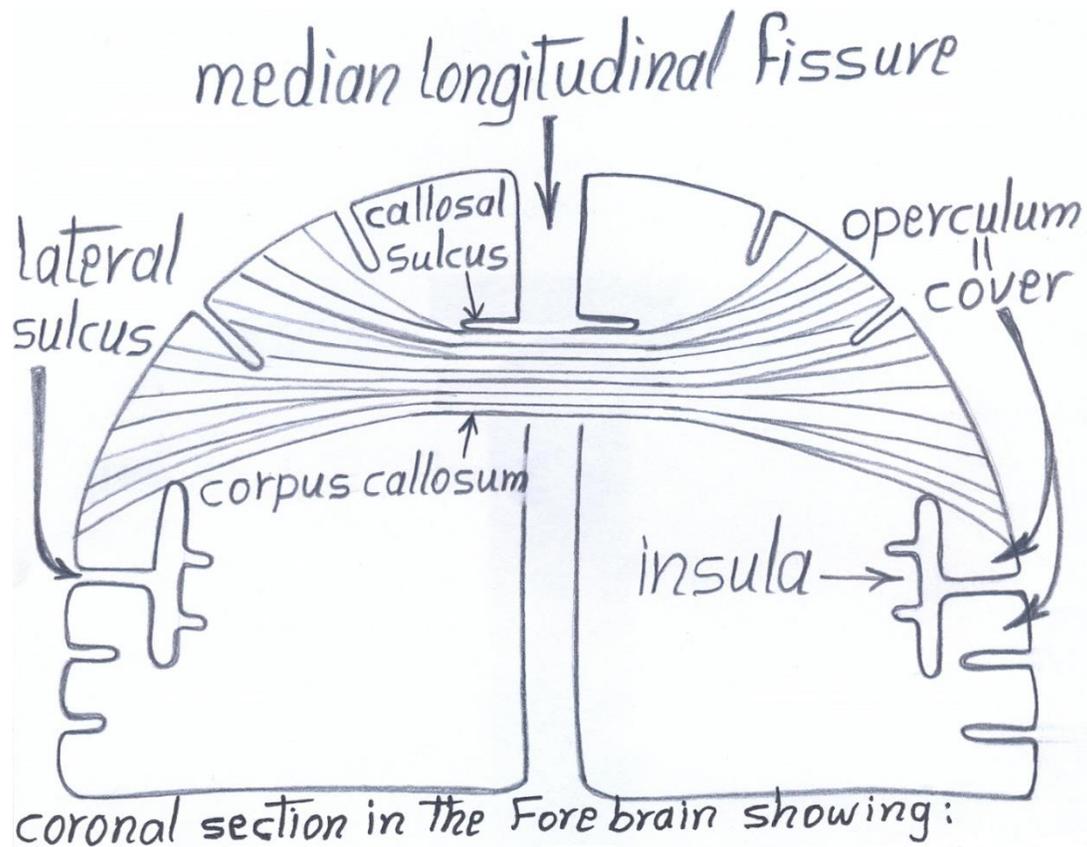
INSULA

The part of the cortex in the bottom of the lateral sulcus; it forms the floor of the lateral sulcus

The insula is pyramidal and formed of insular gyri

Functions of the insula; it has a role in the following

- **Olfaction**
- **Taste**
- **Language**
- **Discriminative touch**



Basal Nuclei

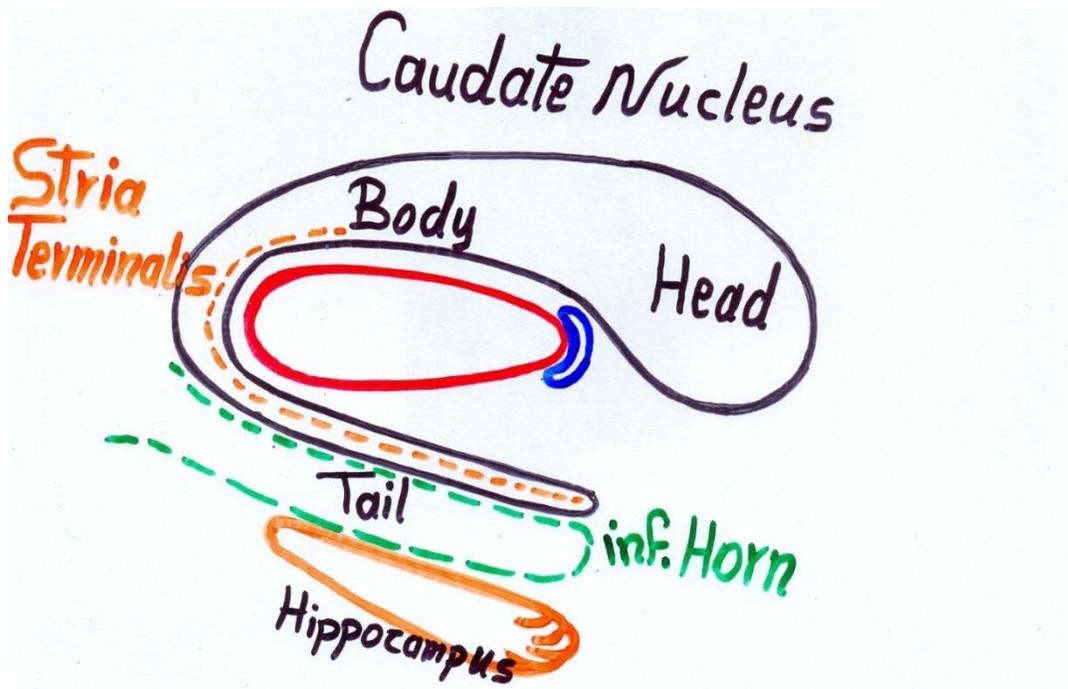
Includes Four nuclei; caudate, Lentiform, amygdaloid and claustrum

CAUDATE NUCLEUS

The caudate nucleus consists of Three Parts; head, body and tail

1- Head of Caudate;

- the part anterior to the interventricular foramen
- large and rounded in shape
- lies in the floor of the anterior horn of the lateral ventricle
- fuses with the putamen to form the corpus striatum



2- Body of Caudate;

- the part above the thalamus
- lies in the floor of the body of the lateral ventricle
- long and narrow

3- Tail of Caudate;

- begins at the posterior end of the thalamus
- ends in the amygdaloid nucleus
- lies in the roof of the inferior horn of the lateral ventricle
- long and slender

The lateral relation of the caudate;

- Internal capsule
- Lentiform nucleus

LENTIFORM NUCLEUS

Biconvex nucleus

Formed of two parts;

- **Outer dark part named Putamen**
- **Inner pale part named Pallidum**

Relations;

Related medially to the internal capsule

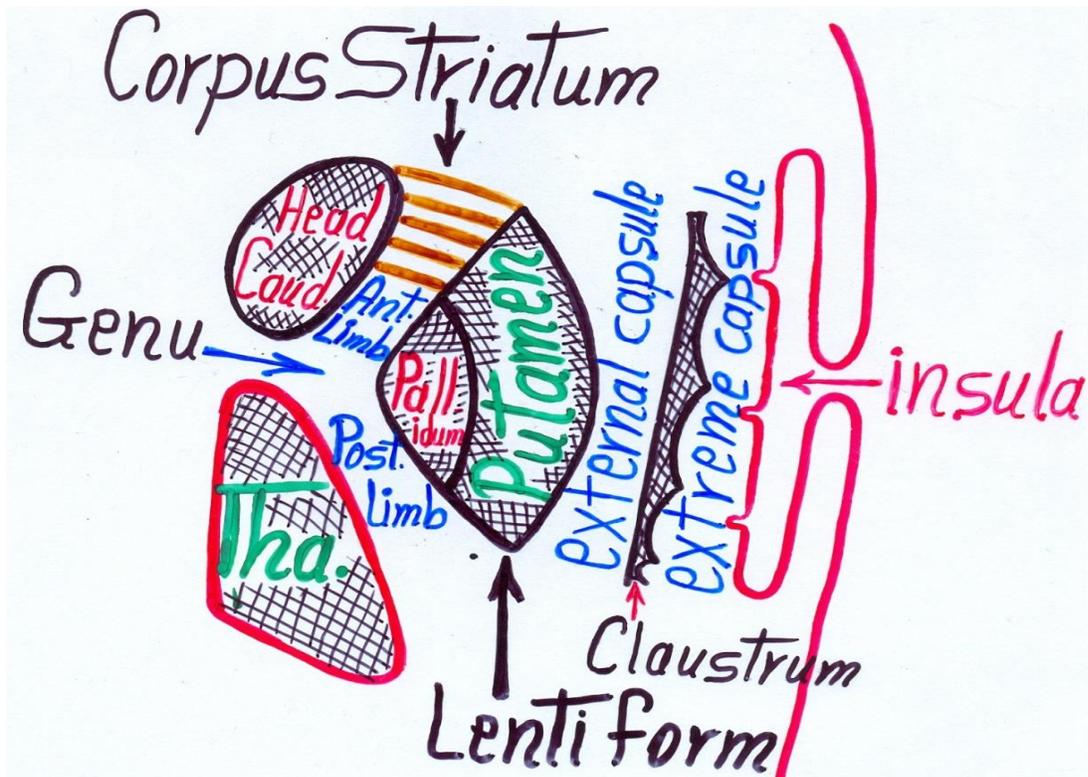
Related laterally to the followings;

- **External capsule**
- **Clastrum**
- **Extreme capsule**
- **Insula**

The putamen is connected with the head of caudate by strands of gray matter to form the Corpus Striatum

Corpus Striatum is an important extrapyramidal center, it controls the followings;

- **Controls gross automatic movements**
- **Regulates the movements with emotions**
- **Controls the functions of the cerebellum**



Internal Capsule [Porta Cerebri]

Formed by the projection fibers of the cerebrum

It has five parts;

1-Anterior Limb of the internal capsule;

Site; between head of caudate and Lentiform

Type of Fibers in the Anterior Limb;

- Anterior thalamic radiation
- Frontopontine fibers

2-Genu of the internal capsule;

Site; -between the two limbs

-At the apex of pallidum

Type of fibers in the genu;

- Superior thalamic radiation
- Frontopontine fibers
- Corticonuclear fibers

3-Posterior Limb of the internal capsule;

Site; between the thalamus and Lentiform nucleus

Type of Fibers in the Posterior Limb of the Internal Capsule;

- Superior thalamic radiation
- Frontopontine fibers
- Corticospinal fibers

4-Sublenticular part of the internal capsule;

it contains the following fibers;

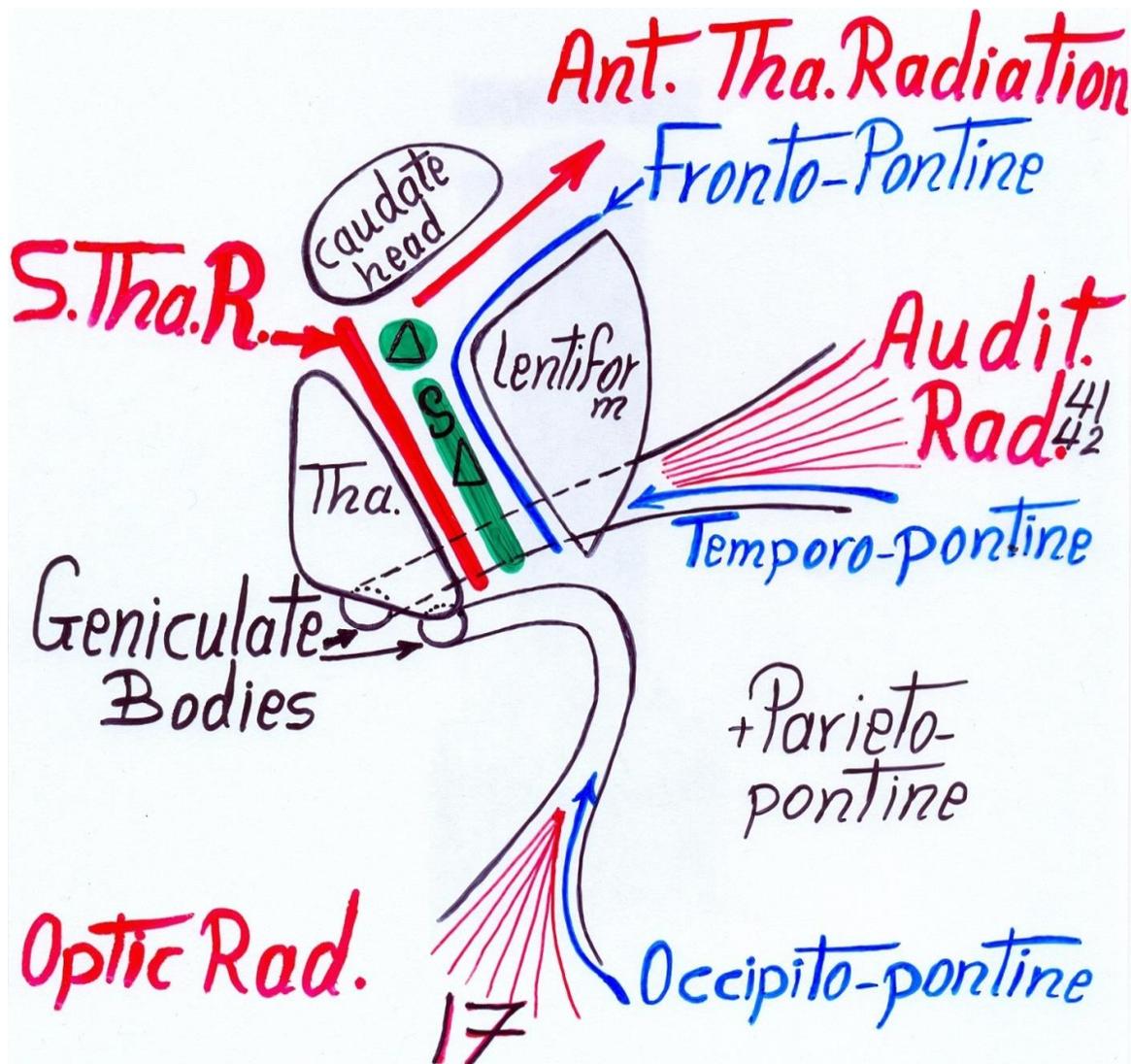
- Inferior thalamic radiation [auditory radiation]
- Temporopontine fibers and parietopontine fibers

5- Retro lenticular part of the internal capsule;

it contains the following fibers;

- posterior thalamic radiation [visual radiation] [optic radiation]
- Occipitopontine fibers and parietopontine fibers

The internal capsule continuous above with the Corona Radiate and below with the Crus Cerebri

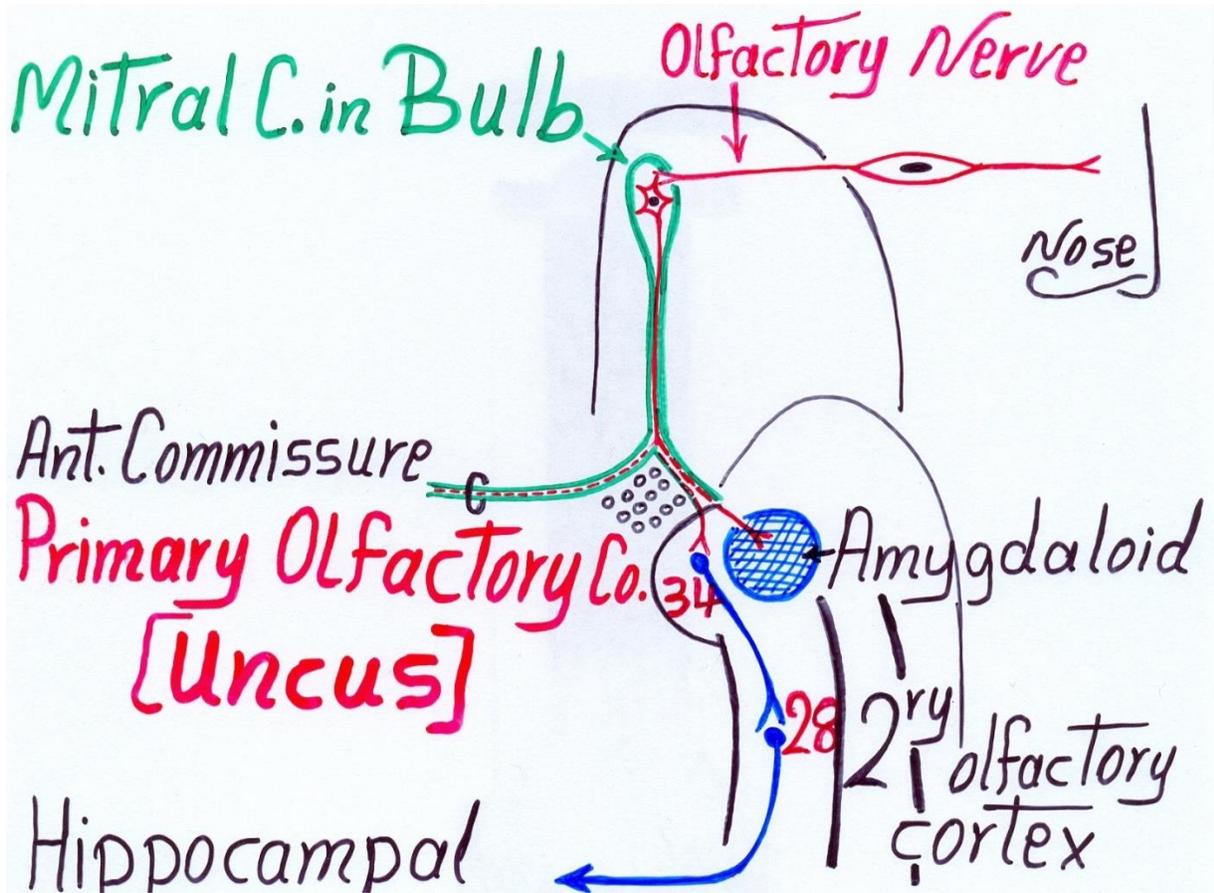


Amygdaloid Nucleus

Site; lies deep to uncus at the anterior end of the inferior horn of the lateral ventricle

Afferent fibers; it receives olfactory fibers from the lateral olfactory Stria

Efferent fibers; it gives the Stria terminalis to the thalamus, hypothalamus, fornix and septum pellucidum



Parts of the brain

Forebrain; the cerebral hemispheres

Midbrain; the upper part of the brain stem

Hindbrain; includes pons, medulla and cerebellum

The Forebrain named Prosencephalon

The forebrain is divided into two parts;

- **Superolateral part named Telencephalon**
- **Inferomedial part named Diencephalon**

DIENCEPHALON

The inferomedial part of the forebrain

It continuous below with the midbrain

It is divided by the third ventricle into two halves

Each half is divided into five parts:

1-thalamus

2-hypothalamus

3-subthalamus

4-metathalamus

5-epithalamus

THALAMUS

The thalamus is an oval mass of gray matter on the medial surface

It has two ends and four surfaces

The Ends of the thalamus

Anterior End;

- narrow
- forms the posterior boundary of the interventricular foramen

Posterior End;

- expanded and called Pulvinar
- related below to the geniculate bodies

The Surfaces of the thalamus

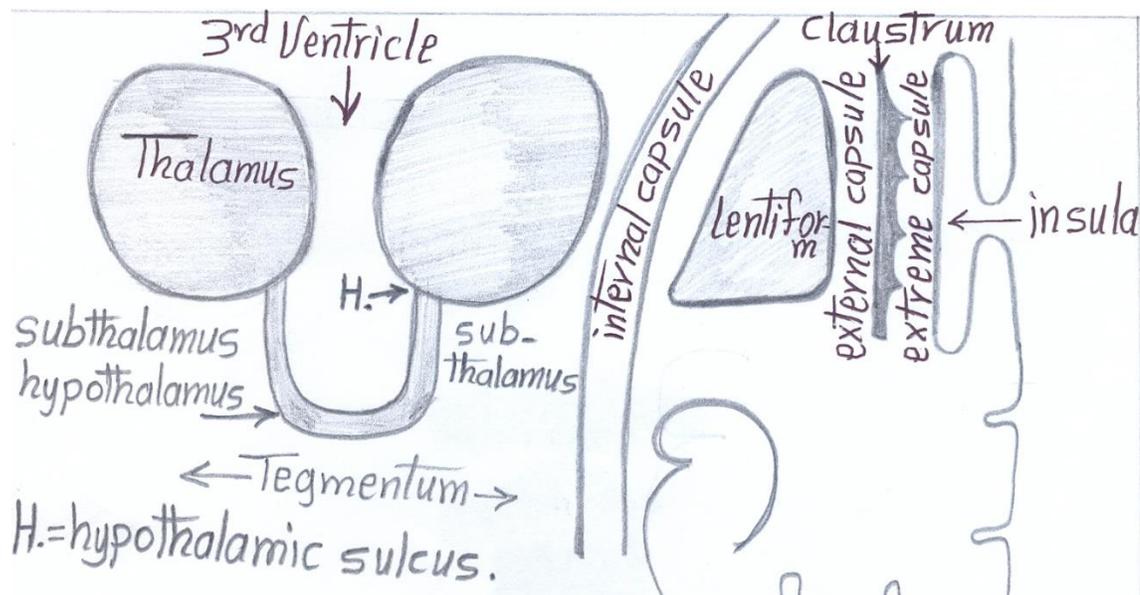
The thalamus has four surfaces which are superior, inferior, medial and lateral

The Superior Surface is related to;

- 1 – Body of fornix
- 2 – Body of the lateral ventricle
- 3 – Body of caudate
- 4 – Tela choroidea
- 5 – Stria Terminalis
- 6 – Thalamostriate vein

The Medial Surface is related to;

- 1- third ventricle
- 2-separated from hypothalamus by hypothalamic sulcus
- 3-the medial surfaces of both sides are connected by mass of gray matter named Interthalamic adhesion



The lateral surface is related to;

- 1-internal capsule
- 2-lentiform nucleus
- 3-external capsule
- 4-claustrum
- 5-extreme capsule
- 6-insula

The inferior surface is related to;

- 1-hypothalamus
- 2-subthalamus
- 3-tegmentum of the midbrain

Structure of the Thalamus

It contains Y-shaped white matter named internal medullary lamina

This lamina divides the thalamus into Three Groups;

- Anterior , medial and lateral

A -the Anterior Group;

Connection of the anterior group;

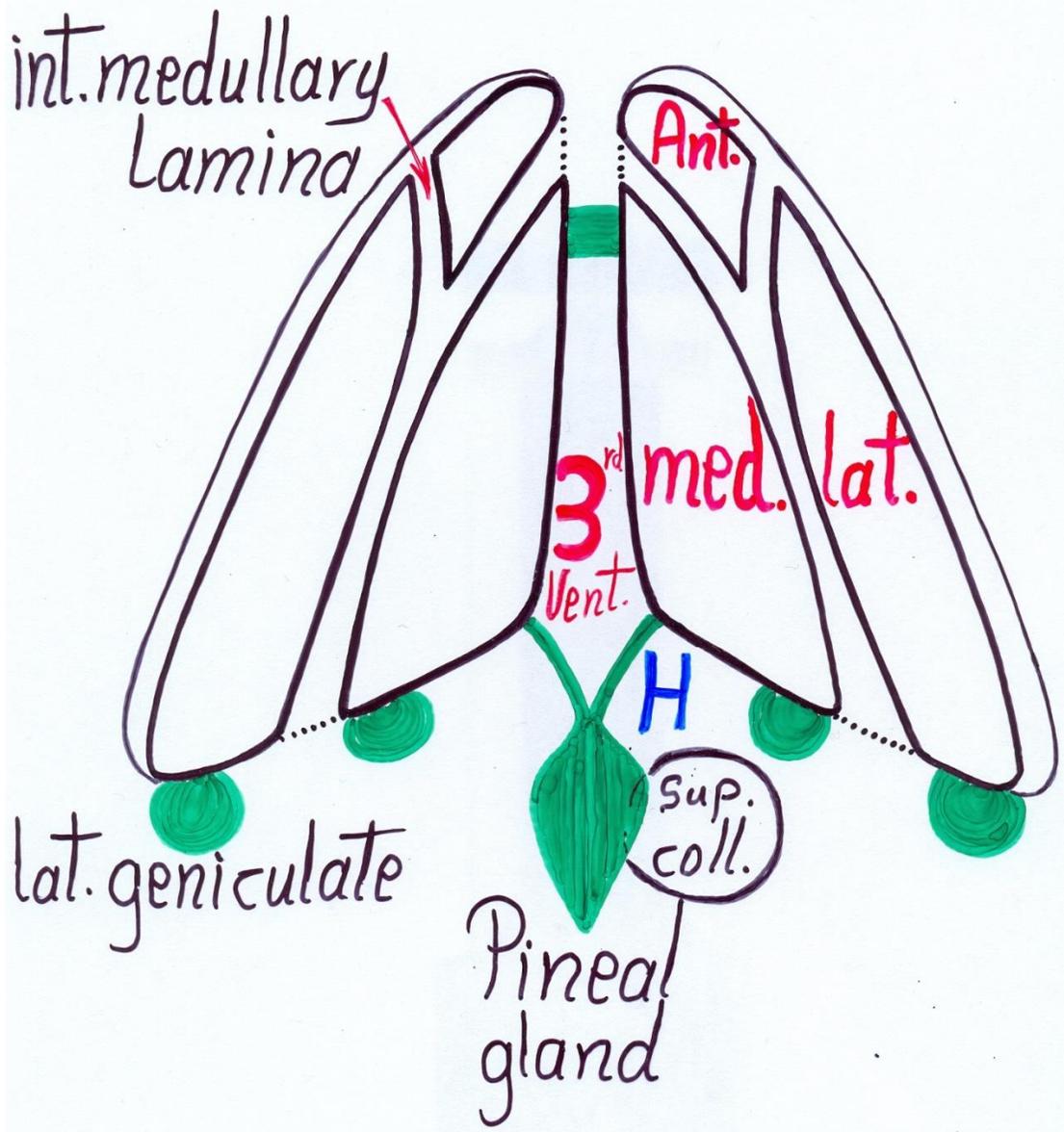
- Afferents ; Mamillo-thalamic tract
- Efferents ; anterior thalamic radiation to the cingulate gyrus

Functions of the anterior group; as the limbic system

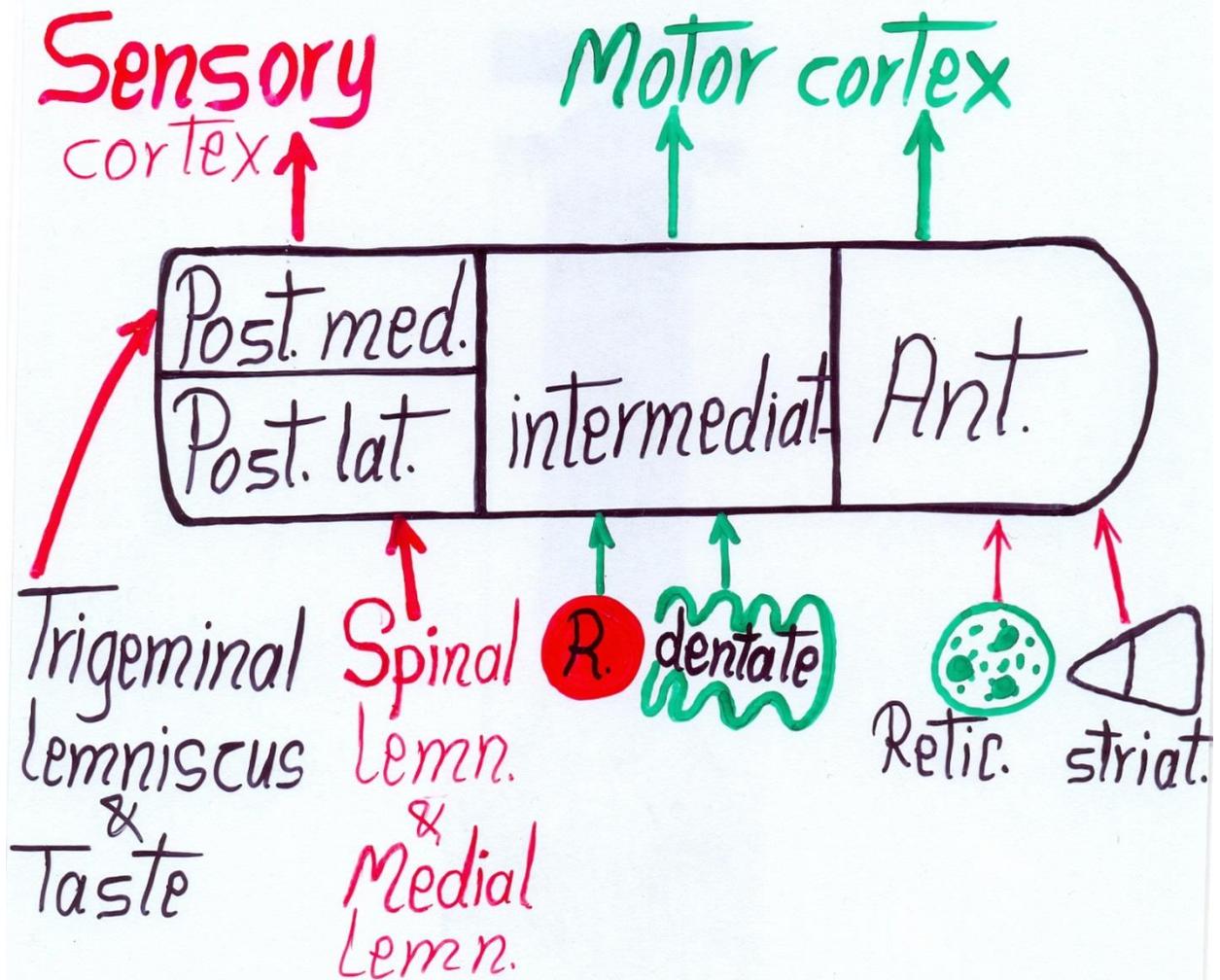
B -the Medial Group;

Connected with hypothalamus, corpus striatum and prefrontal areas

Function; integration of visceral and somatic function



Ventro-lateral N.



C -the Lateral Group; is divided into dorsal and ventral parts named dorsolateral and ventrolateral parts

I -Dorsolateral part and Pulvinar;

- Connected with all lobes
- Integrates visual , hearing and somatic impulses

II-Ventrolateral part;

This part is divided into three groups;

Anterior, intermediate and posterior named as follow;

Ventrolateral Anterior

Ventrolateral Intermediate

Ventrolateral Posterior

Ventrolateral anterior and ventrolateral intermediate acting as [motor] extrapyramidal center

Ventrolateral posterior acting as sensory center

1-the Ventrolateral Anterior group; receives afferents from:

Reticular formation and corpus striatum

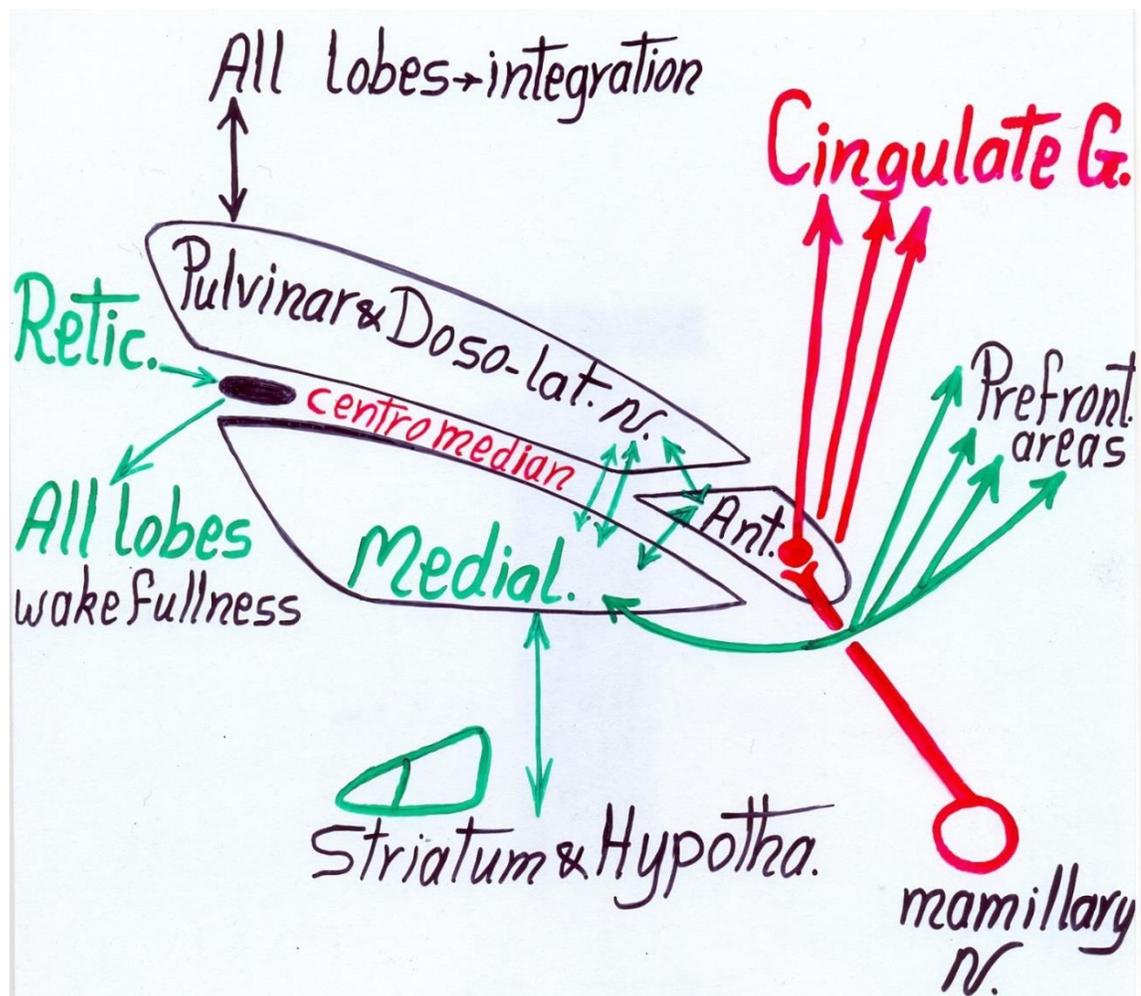
2-Ventrolateral Intermediate group; receives afferents from:

Red nucleus and dentate nucleus of the cerebellum

3-Ventrolateral Posterior group; receives the lemnisci and divided into two groups; medial and lateral groups

3-Ventrolateral Posterior group;

- Ventrolateral , Posteromedial receives the Trigeminal lemniscus and Taste fibers
- Ventrolateral , Posterolateral receives the medial and spinal lemnisci



Thalamic Functions;

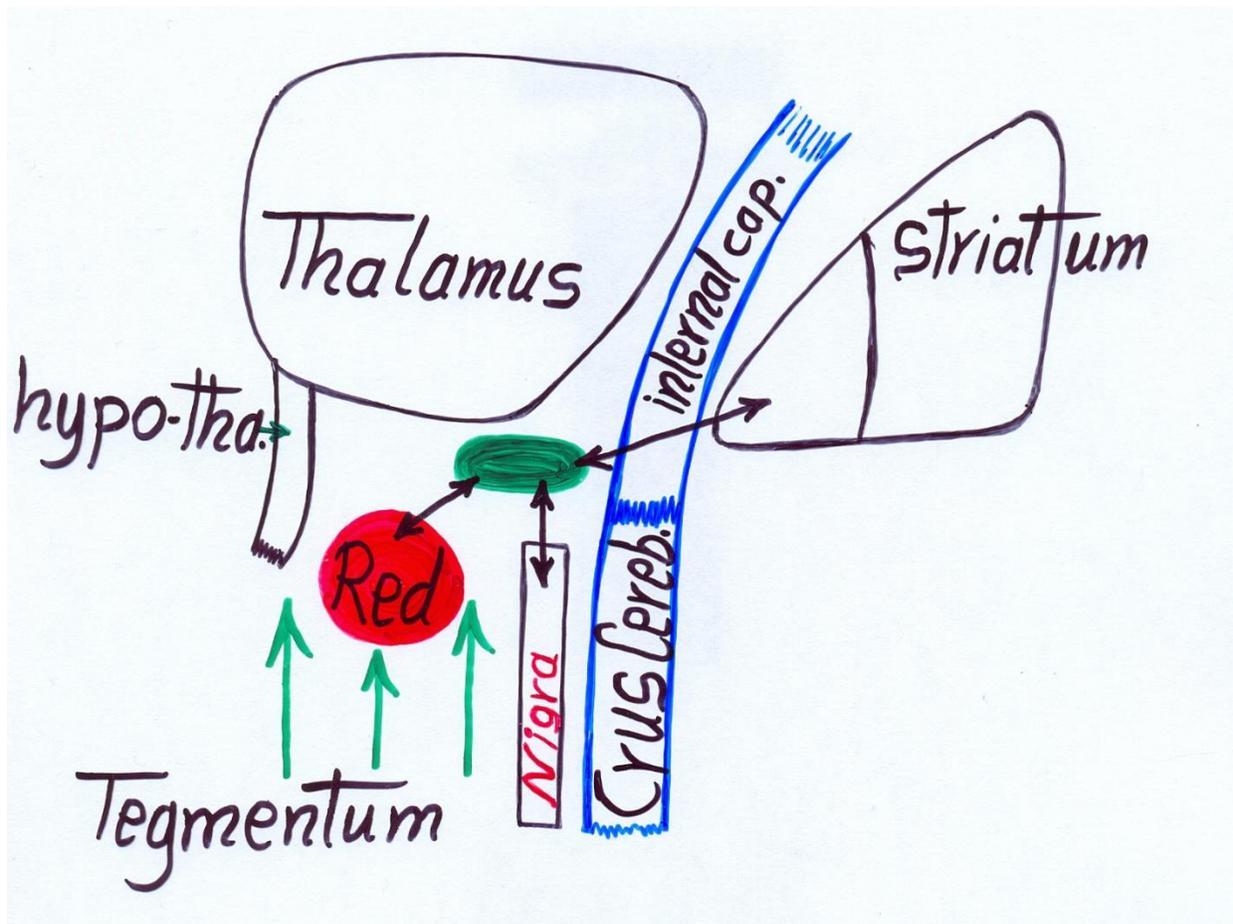
1-relay station for all sensations

2-integration and association function

3-wakefulness, through the Centro-median nucleus in the internal lamina

4-control the emotional state and mood

5-receives the extremes pain and temperature



Subthalamus

Boundaries

- Superior Boundary ; by the **Thalamus**
- Inferior Boundary ; by **Tegmentum of the midbrain**
- Medial Boundary ; by the **Hypothalamus**
- Lateral Boundary ; by **junction between the internal capsule and the crus cerebri**

Structure of the Subthalamus;

It consists of Gray and White matters

1-The Gray Matter of the subthalamus is formed by an extrapyramidal center named **Subthalamic nucleus**

2-The White Matter of the subthalamus includes; the **Lemnisci and other Ascending fibers**

Hypothalamus

Boundaries

- Anterior Boundary ; **by the optic chiasma**
- Posterior Boundary ; **by posterior perforated substance**
- Superior Boundary ; **by hypothalamic sulcus**
- Inferior Boundary ; **by the base of the brain**

Hypothalamic Nuclei;

- 1-Mamillary Nucleus ; **acting as limbic center**
- 2-Supraoptic And Paraventricular Nuclei ; **produce the secretions of the neurohypophysis [ADH and oxytocin]**
- 3-Tuber Cinereum ; **produces the releasing and inhibiting factors ; which control the secretions of the adenohypophysis**

Hypothalamic Functions;

1-Control the Autonomic Nervous System

2-Control the Water Balance and Food Intake

3-Regulate the Body Temperature

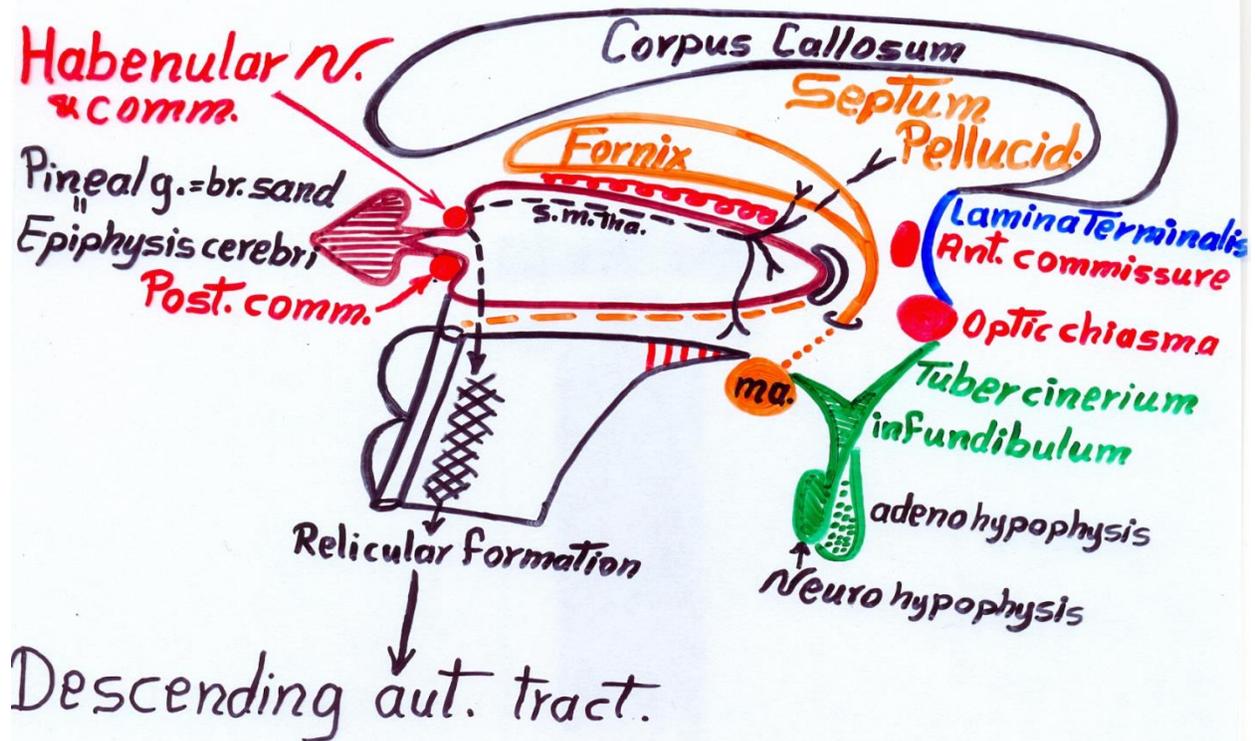
Epithalamus

Parts of Epithalamus;

1-Pineal gland

2-Posterior commissure

3-Habenular nucleus and commissure



Pineal gland [brain sand] [epiphysis cerebri];

- Conical in shape
- Connected with the posterior part of the thalamus by the pineal stalk

The stalk is formed of two laminae; separated by recess

A-upper lamina of pineal stalk, contains the habenular commissure

B-lower lamina of pineal stalk, contains the posterior commissure

c-the pineal recess presents between the two laminae

Function of the pineal gland;

The gland stimulated by darkness and inhibits the pituitary gland

The gland calcified with age, so named brain sand or epiphysis cerebri

The posterior commissure;

Connects the Pulvinar and midbrain in both sides

The medial longitudinal bundle starts from the posterior commissure

HABENULAR NUCLEUS

Lies on each side of the pineal gland

Receives the afferent fibers through the Stria medullaris thalami

The Stria medullaris thalami contains fibers from the following;

- **Thalamus**
- **Hypothalamus**
- **Fornix**
- **Septum pellucidum**

The habenular nucleus gives Efferents to the reticular formation

Function of the habenular nucleus;

Controls the lower autonomic centers in the brain stem and spinal cord

HABENULAR COMMISSURE

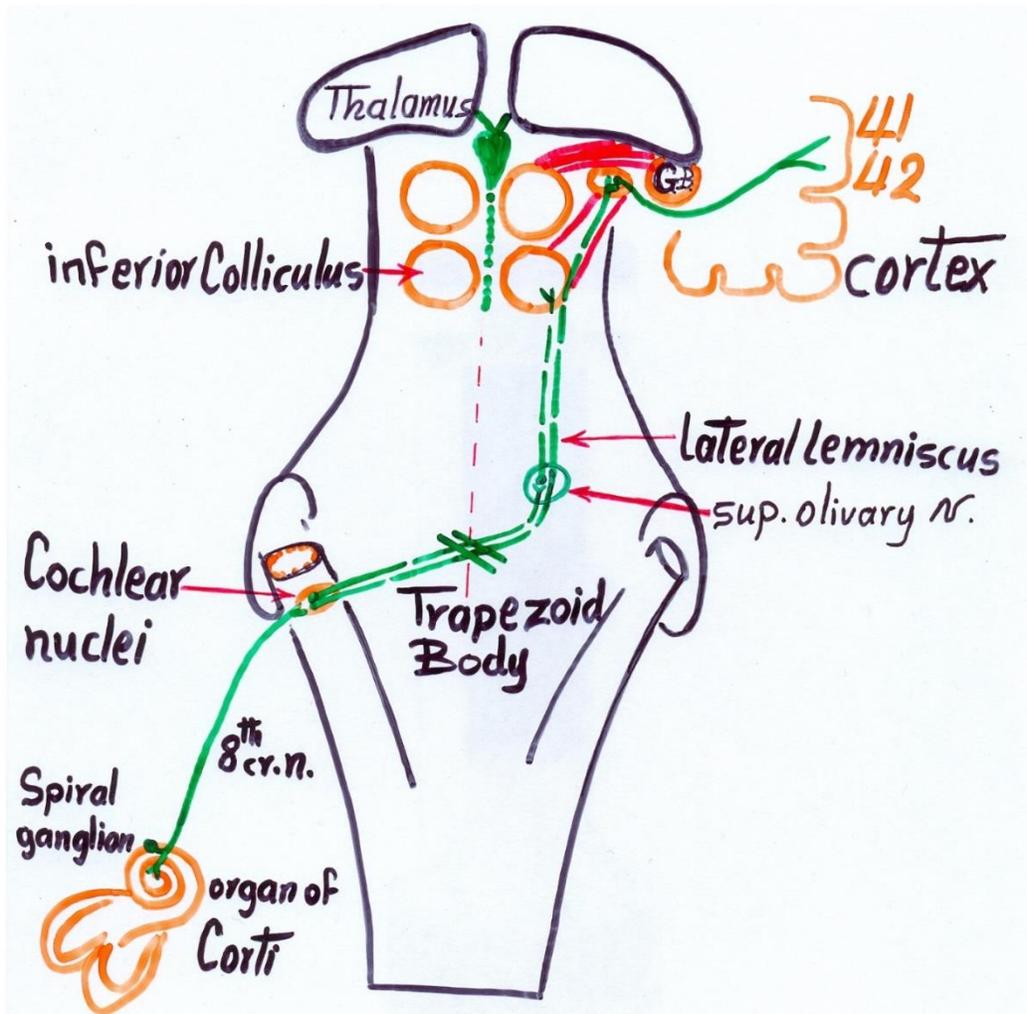
Connects the Habenular Nuclei in Both Sides

METATHALAMUS

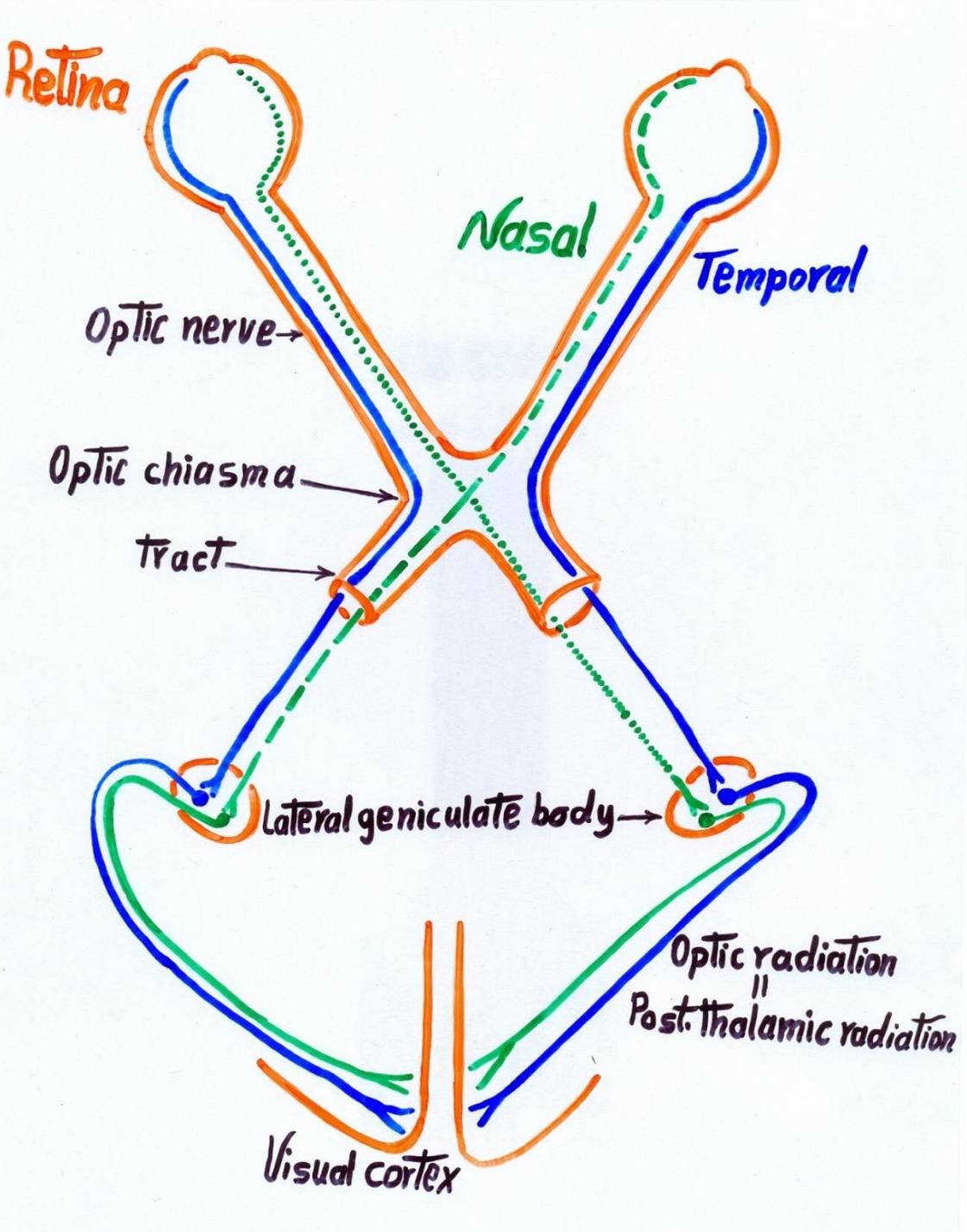
Formed by the Two Geniculate Bodies; medial and lateral geniculate bodies

They Form the Last Relay Station before The Cortex; along the hearing and visual pathway

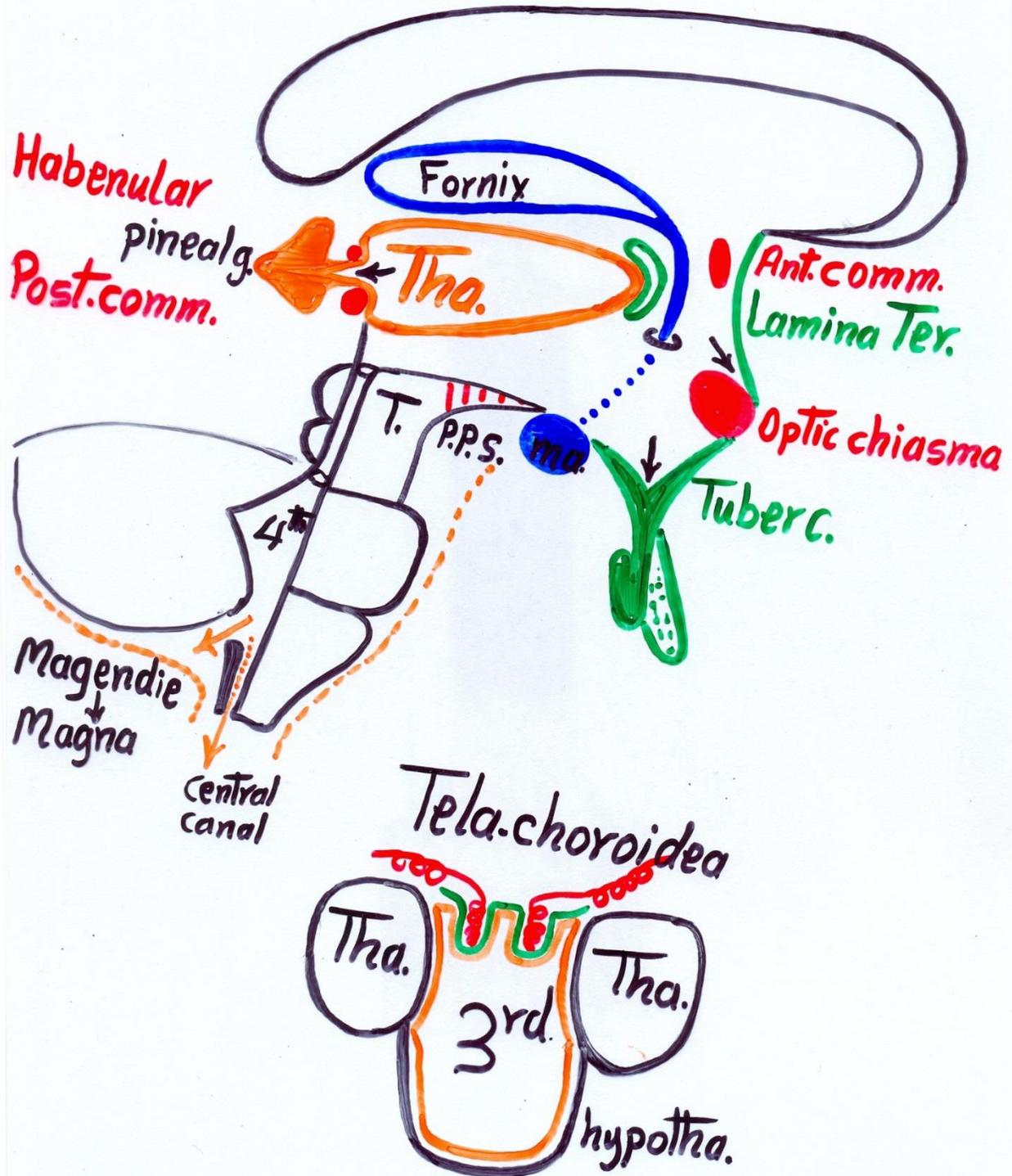
Medial geniculate gives the auditory radiation to the cortex



Lateral geniculate gives the optic radiation to the cortex



3rd Ventricle



The Third Ventricle

It the cavity of the Diencephalon

Boundaries;

1-Roof; formed by the Telachoroidea of the third ventricle

2-Lateral Walls; formed by Thalamus and Hypothalamus

3-Floor; formed of four components;

- **Tuber Cinereum**
- **Mammillary bodies**
- **Posterior perforated substance**
- **Tegmentum of the midbrain**

4-Posterior Wall; formed by the Pineal gland and its stalk

The pineal stalk has two laminae with the pineal recess in between

5-Anterior Wall; formed by three components;

- **Anterior commissure**
- **Lamina terminalis**
- **Optic chiasma**

Communication of the lateral ventricle

1-with the Lateral Ventricle through the interventricular foramen

2-with the Fourth Ventricle through the cerebral aqueduct

Recesses of the Third Ventricle

1-pineal recess

2-infundibular recess

3-suprachiasmatic recess

Circulation of the cerebro-spinal fluid [CSF]

Formation; by the Tela choroidea and ependymal lining

Circulation;

The CSF Formed in the Lateral Ventricle passing through the Interventricular foramen of Monro to reach the Third Ventricle

The CSF in the third ventricle descends through the Cerebral Aqueduct to reach the fourth ventricle

The CSF in the Fourth Ventricle Passes in Two Ways;

- **1-small amount descends in the Central Canal of the spinal cord**
- **2-most of the fluid passes to the Subarachnoid Space through three foramina ; the two foramina of Luschka and foramen of Magendie**

Drainage; by the Arachnoid Granulation, which drain the CSF into the dural venous sinuses

Functions of the CSF;

- **Protection from external trauma**
- **Nourishes the CNS** **-Removes metabolite**

Subarachnoid Cisterns

The subarachnoid space expands to form the subarachnoid cisterns

Examples; interpeduncular cistern, pontine cistern, superior cistern, Cerebellomedullary cistern and lumbar cistern

Function of the cisterns;

- **Provides more protection to the vital parts of the CNS**
- **Promotes the circulation of the CSF by pulsation of the arteries in the cisterns**

Blood Supply of the Brain

The brain is supplied by Three Cerebral Arteries:

Anterior, Middle and Posterior cerebral arteries

MIDDLE CEREBRAL ARTERY

Origin;

- **From the end of the internal carotid artery , below the anterior perforated substance**

Course;

- **It runs laterally in the stem of the lateral sulcus , then backwards on the insula**

End; on the insula

Branches;

A -Cortical Branches to;

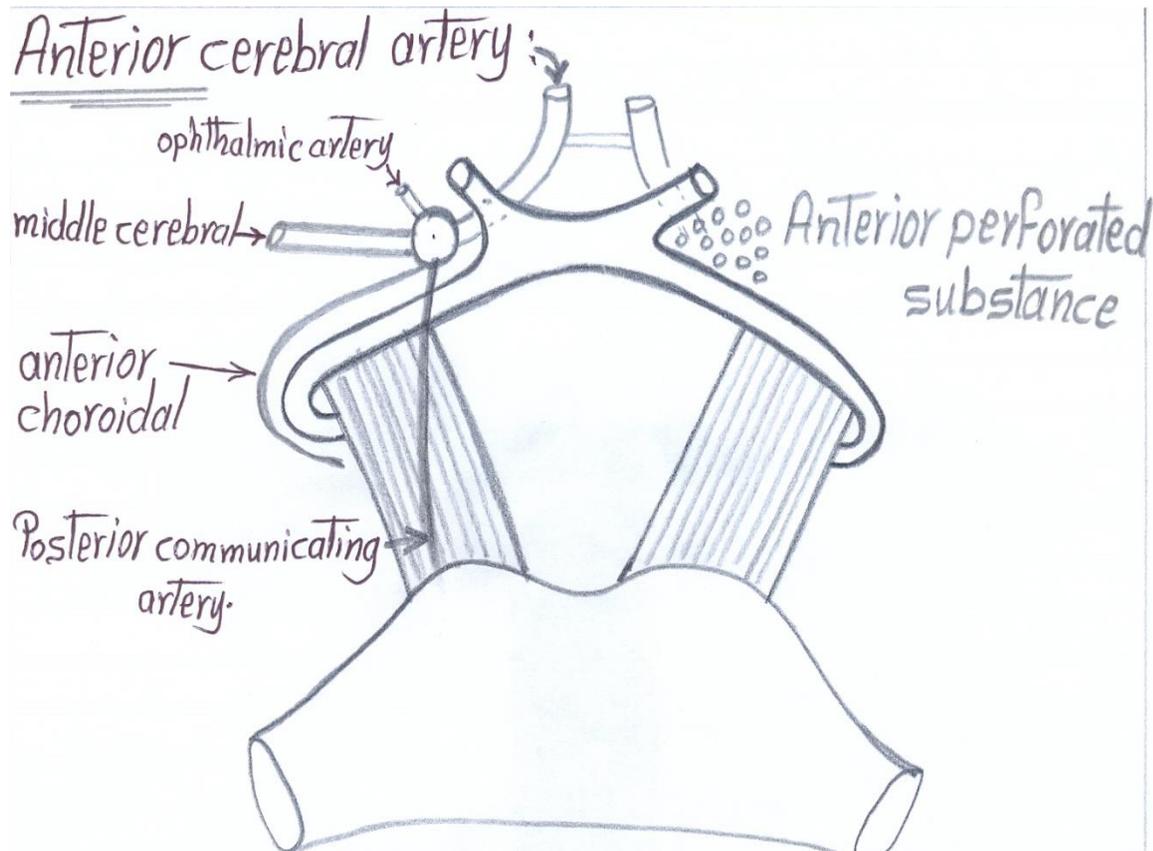
- **1-lateral half of the orbital surface**
- **2-temporal pole**
- **3-superolateral surface of the frontal and parietal lobes except a narrow strip at the superomedial border**
- **4-superior and middle temporal gyri**
- **5-insula**

B -Central Branches, named striate branches & supply;

- **1-caudate nucleus**
- **2-thalamus**
- **3-internal capsule**
- **4-lentiform nucleus**

- 5-external capsule
- 6-claustrum and extreme capsule

The Longest and most Lateral of the striate branches, is more Liable to injury and hemorrhage and named Charcot's Artery of Hemorrhage



ANTERIOR CEREBRAL ARTERY

Origin;

- From the end of the internal carotid artery , below the anterior perforated substance

Course;

- Passes medially to the median longitudinal fissure , then it ascends around the corpus callosum

End; at the posterior end of the corpus callosum

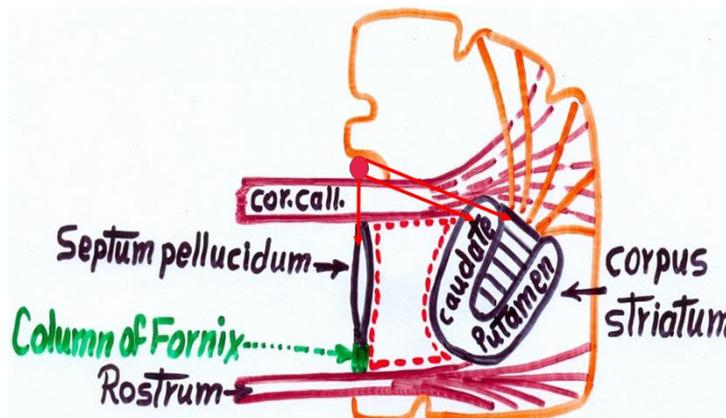
Branches;

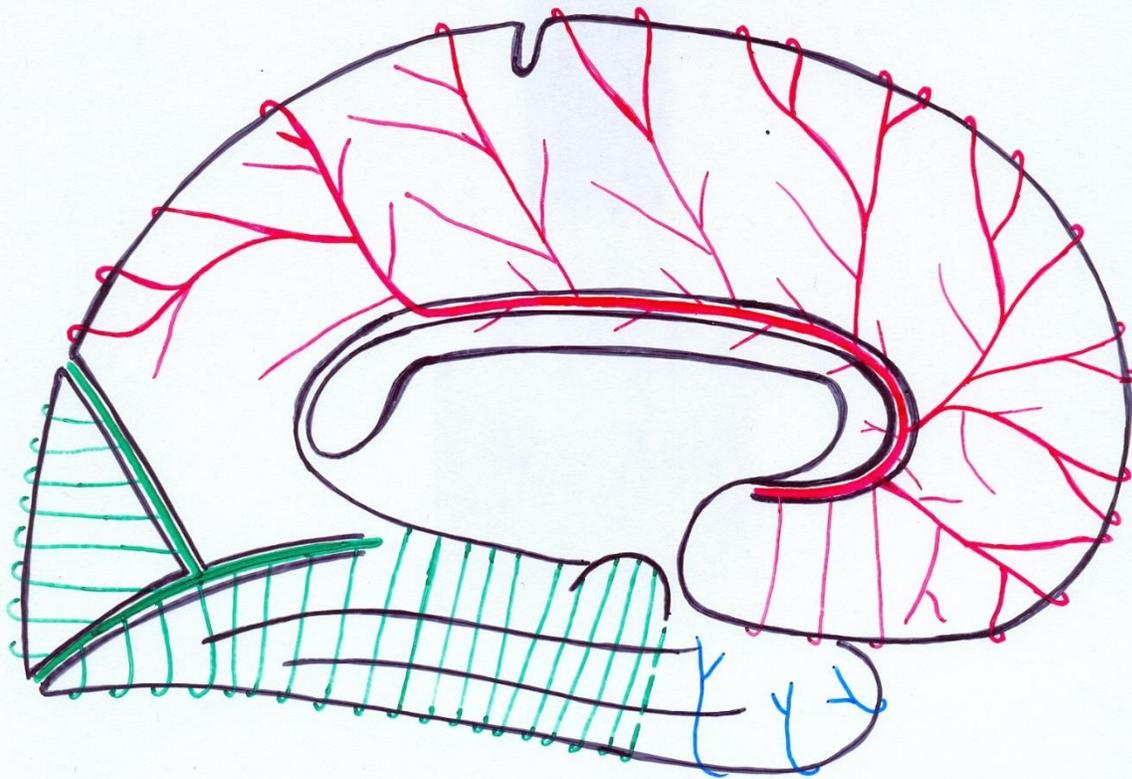
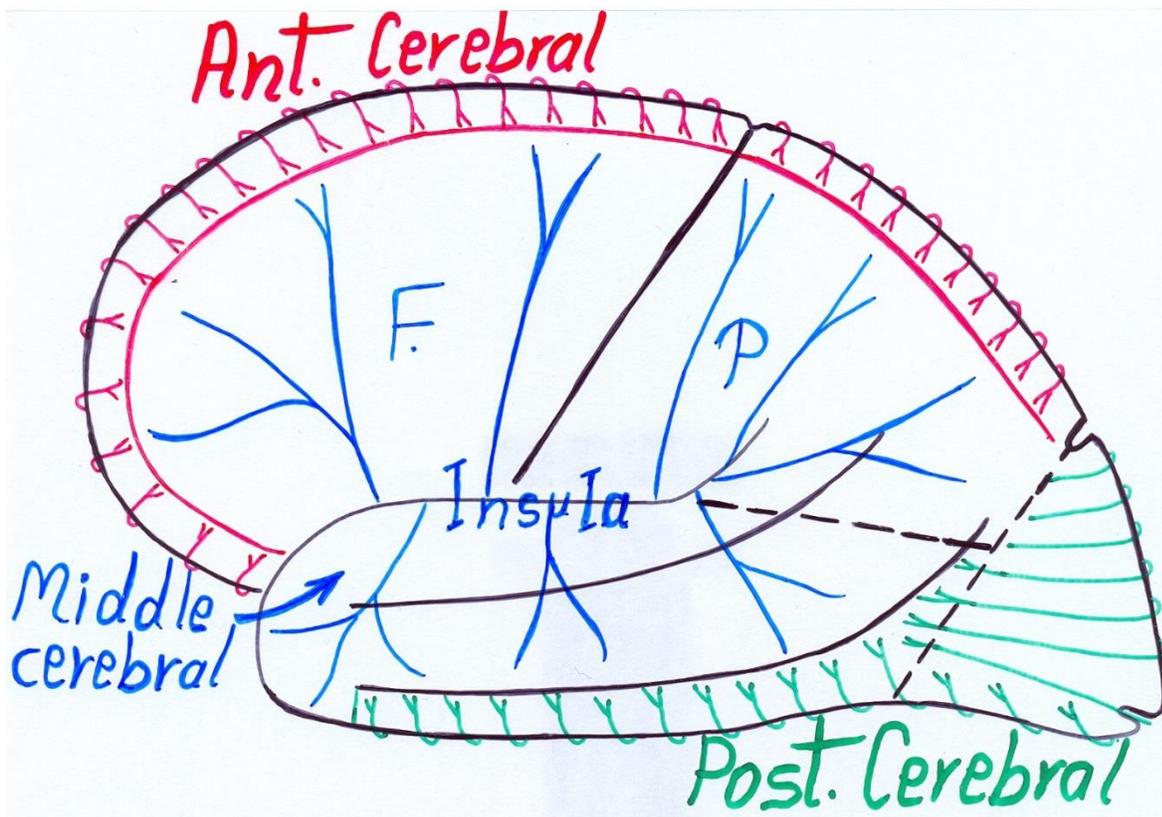
A -Cortical Branches to;

- 1-medial half of the orbital surface
- 2-medial surface of the frontal and parietal lobes
- 3- narrow strip on the upper part of the lateral surface of the frontal and parietal lobes
- 4-corpor callosum

B -Central Branches to;

- Optic chiasma , lamina terminalis , hypothalamus and septum pellucidum
- Head of caudate , internal capsule and Lentiform nucleus





POSTERIOR CEREBRAL ARTERY

Origin;

- From the end of the basilar artery

Course;

- Passes backwards on the side of the midbrain to reach the calcarine sulcus

End; in the calcarine sulcus

Branches;

A -Cortical Branches to;

- 1-occipital lobe
- 2-inferior surface of the temporal lobe except the polar area
- 3-inferior temporal gyrus except the polar area

B -Central Branches to;

1-thalamus 2-hypothalamus 3-subthalamus

4-epithalamus 5-metathalamus 6-midbrain

7-posterior choroidal branches to the Tela choroidea of the 3rd ventricle, body of the lateral ventricle and inferior horn of the lateral ventricle

Blood supply of the internal capsule:

A -striate branches of the middle cerebral artery form the main supply of the capsule

B -contribution from the following arteries;

- 1-anterior cerebral supplies the anterior limb
- 2-posterior communicating supplies the genu
- 3-choroidal arteries [anterior and posterior choroidal] supply the posterior limb

Anterior Choroidal Artery

Origin;

From the end of the internal carotid artery

Distribution;

- **Supplies the internal capsule**
- **Gives branches to the inferior horn of the lateral ventricle**

Venous Drainage of the Brain

The brain is drained by two groups of veins; superficial and deep veins

I - Superficial = External = Cortical Veins;

- **Drain into the dural venous sinuses**

II - Deep Veins; Two Veins:

Internal cerebral and Basal veins

A – Internal Cerebral Vein:

Beginning;

At the interventricular foramen by union of Four Veins;

1-Septal vein

2-Fornix vein

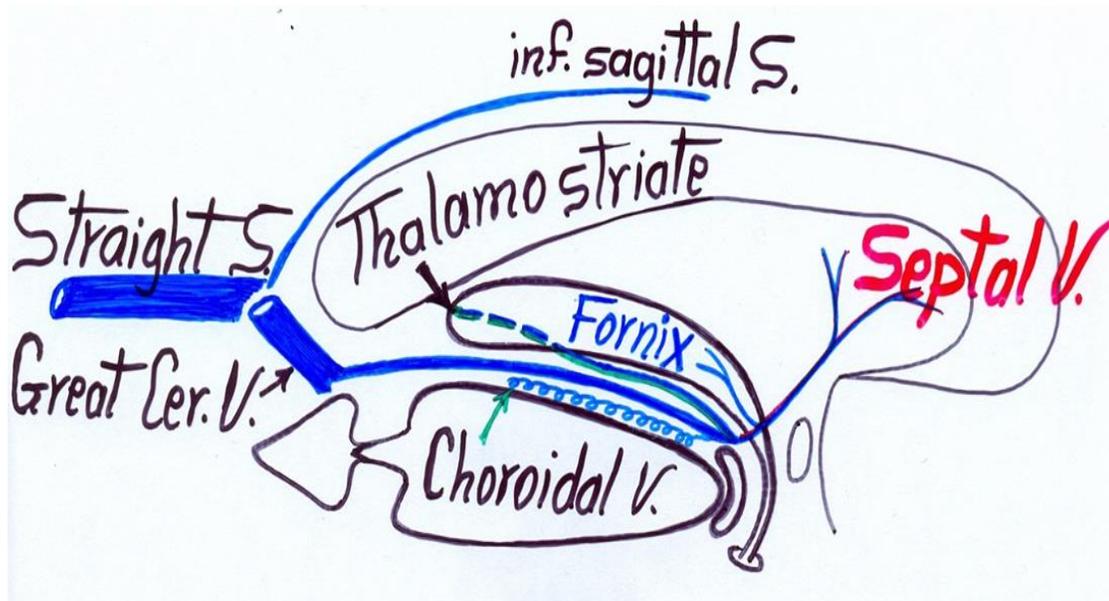
3-Thalamostriate vein

4-Choroidal vein

Course and End Internal Cerebral Vein;

It runs backwards in the Tela choroidea of the third ventricle to end below the splenium by joining its fellow to form the great cerebral vein

The Great Cerebral Vein Ends In the Straight Sinus



B – Basal Vein;

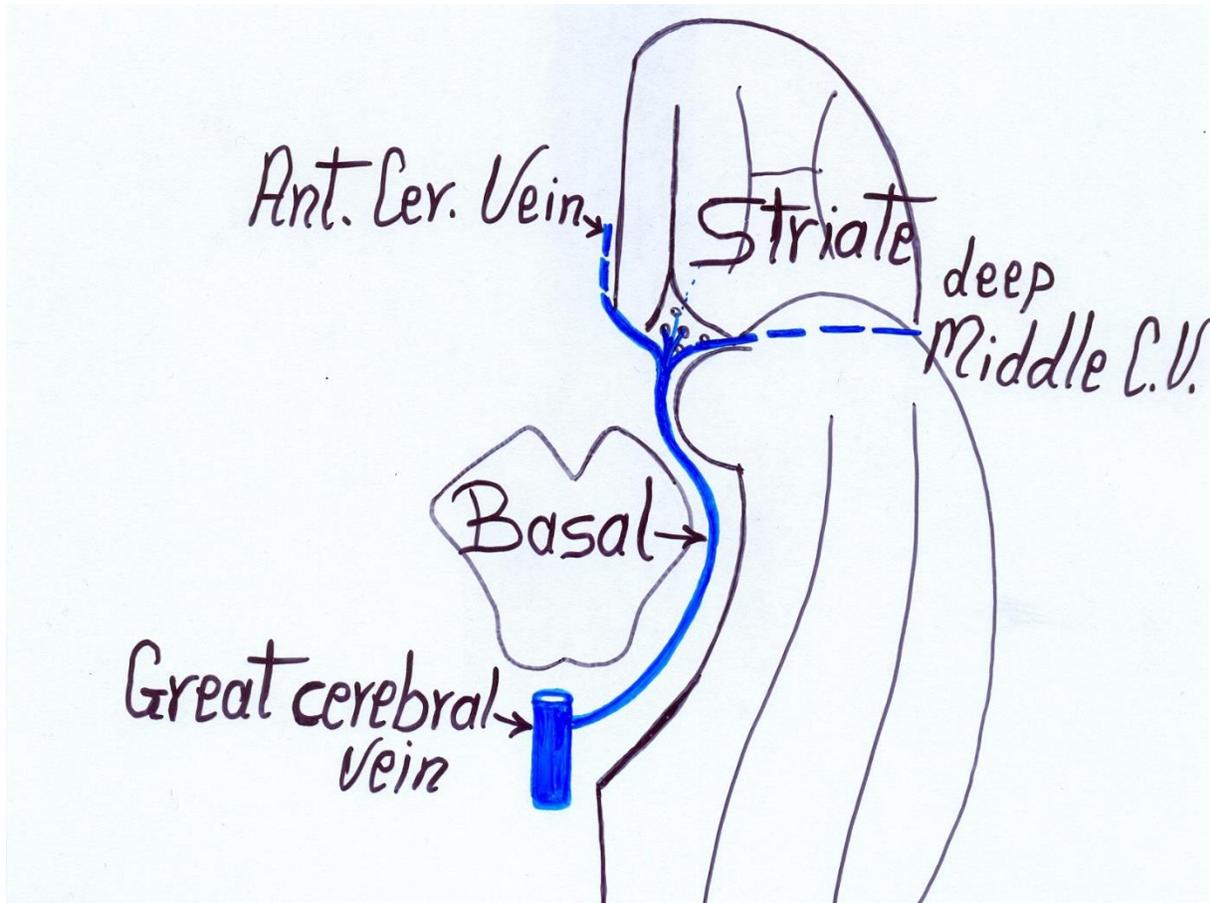
Beginning; below the anterior perforated substance by union of three veins which are ;

1-Anterior cerebral vein

2-Striate veins

3-Deep middle cerebral vein

The Course and End; the basal vein runs backwards on the side of the midbrain to END in the Great Cerebral Vein



Parts of the Corpus Callosum

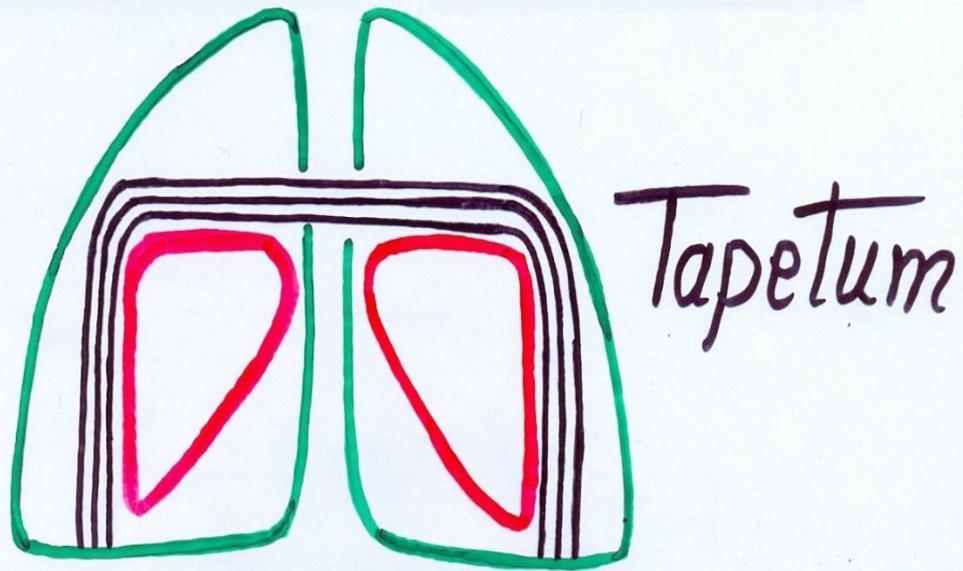
The corpus callosum has 7 parts:

- | | | |
|-------------------|------------------|-------------------------|
| 1-Splenium | 2-Trunk | 3-Genu |
| 4-Rostrum | 5-Tapetum | 6- two Forcepses |

Tapetum:

The fibers connecting the inferior surfaces of the cerebral hemispheres

Coronal S.

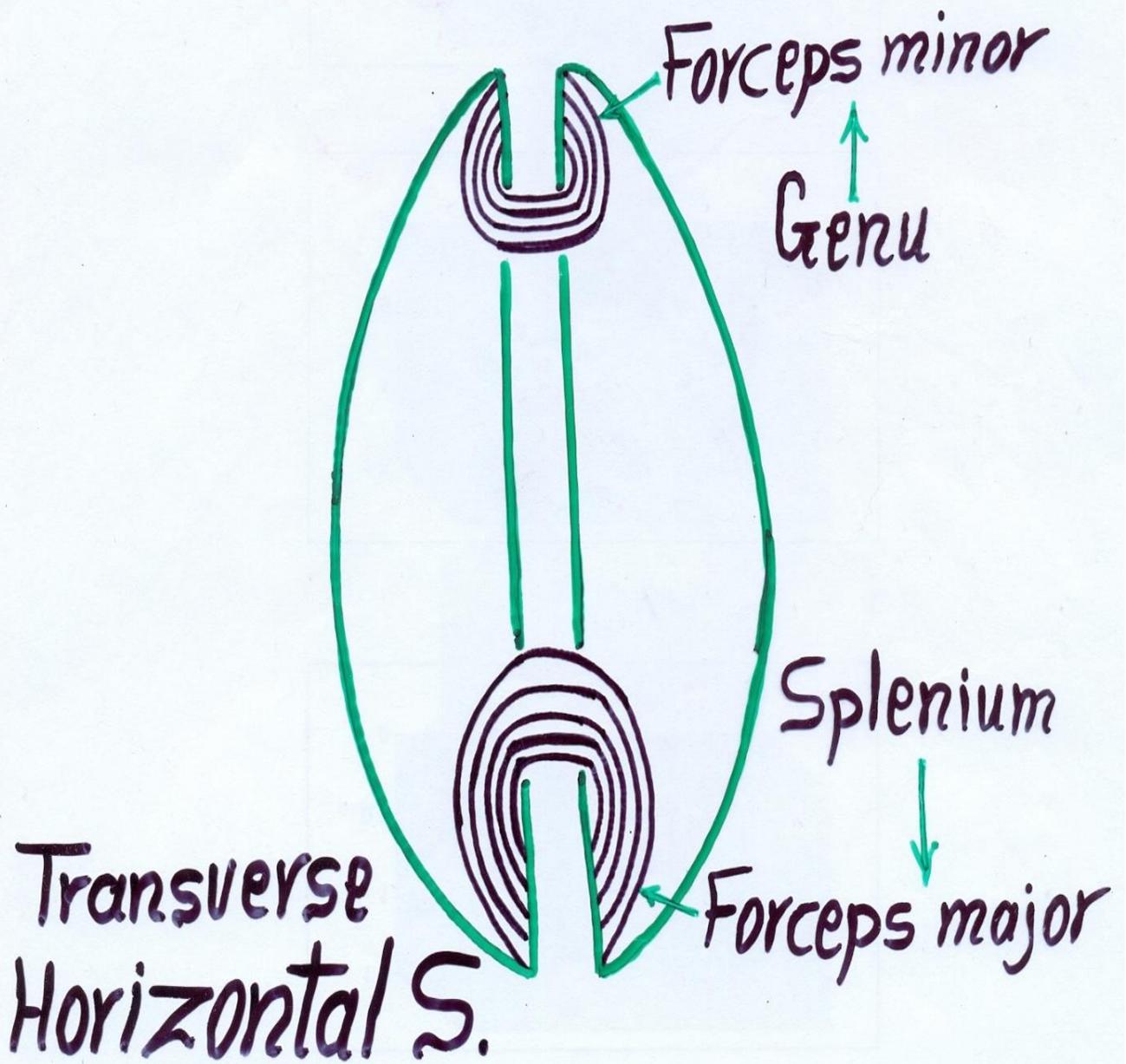


Forceps Minor:

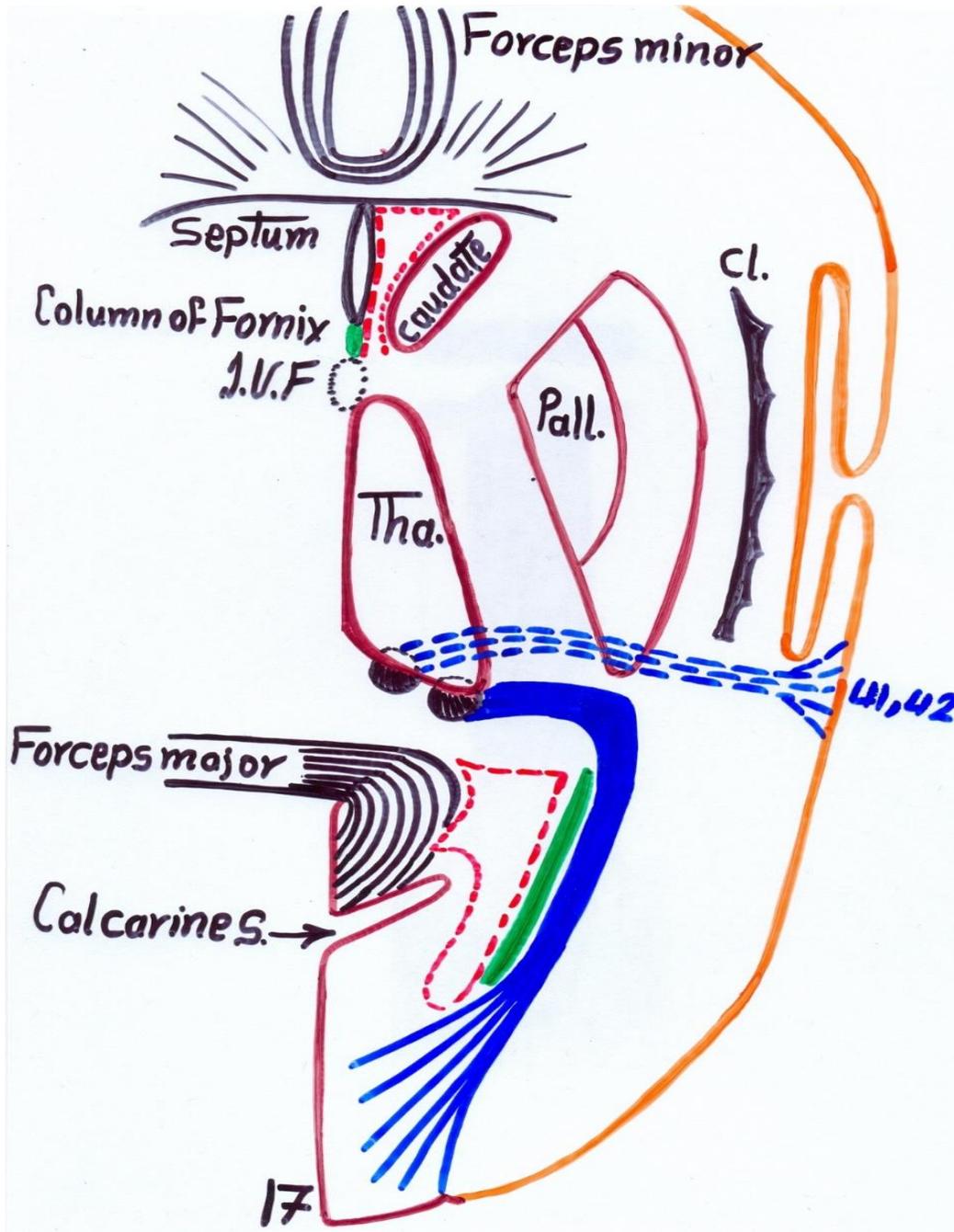
The part of the genu which connects the medial surfaces of the frontal lobes of the two hemispheres

Forceps Major:

The part of the splenium which connects the medial surfaces of the occipital lobes of the two hemispheres



Horizontal section of the cerebral hemisphere



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