INTERNAL STRUCTURE OF THE BRAIN STEM

By

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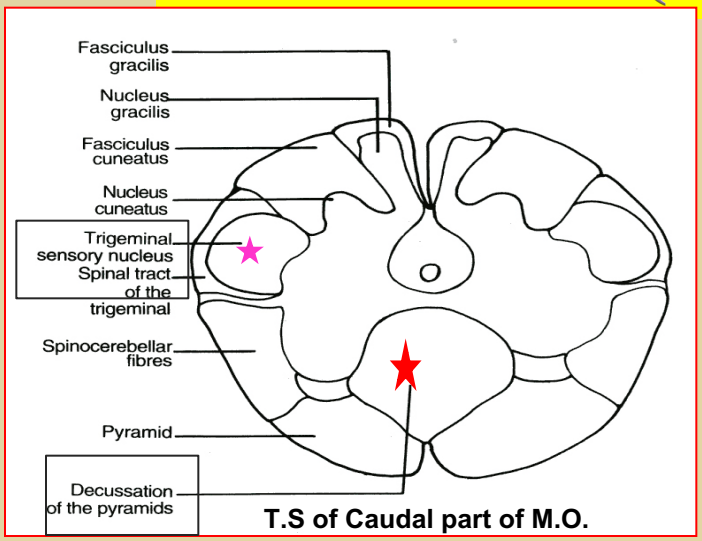
OBJECTIVES

By the end of the lecture, students will be able to :

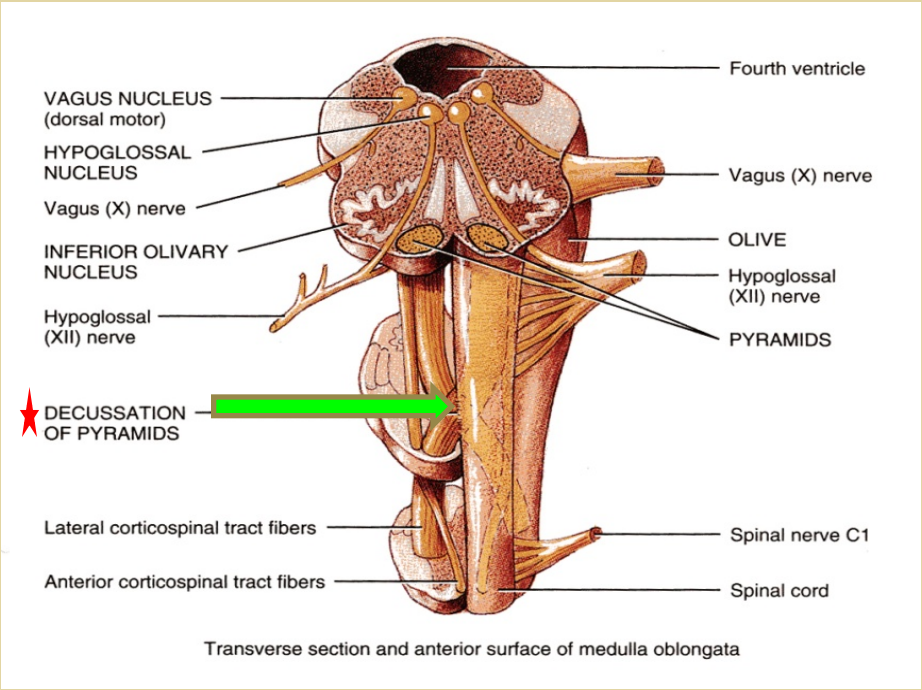
- ***Distinguish the internal structure of the components of the brain stem in different levels and the specific criteria of each level.***
- ***1. Medulla oblongata {closed (caudal), mid and open medulla (rostral)}.***
- ***2. Pons (caudal, mid "Trigeminal level" and rostral).***
- ***3. Mid brain (superior and inferior colliculi).***
- ***Describe in Breif the Reticular formation (structure, function and pathway).***

CAUDAL (closed) MEDULLA



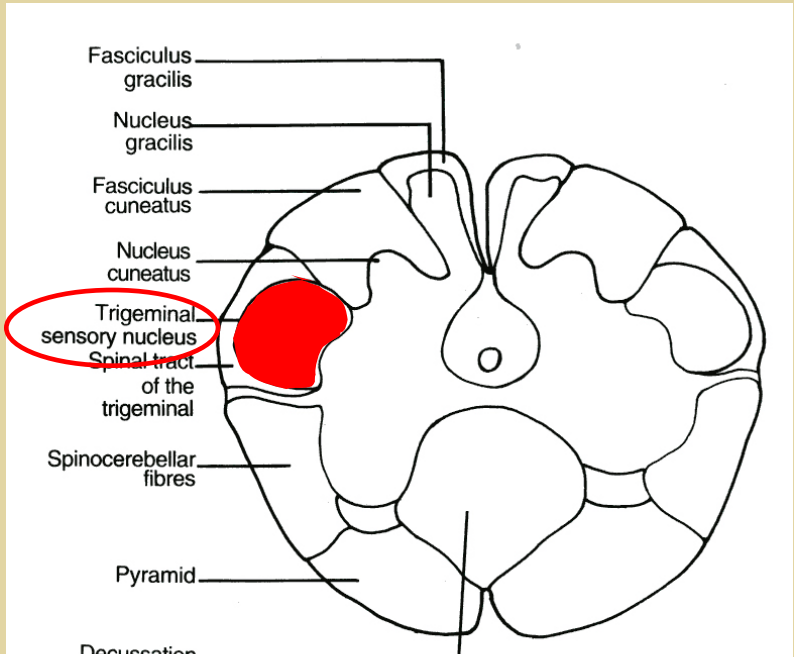
T.S of Caudal part of M.O.

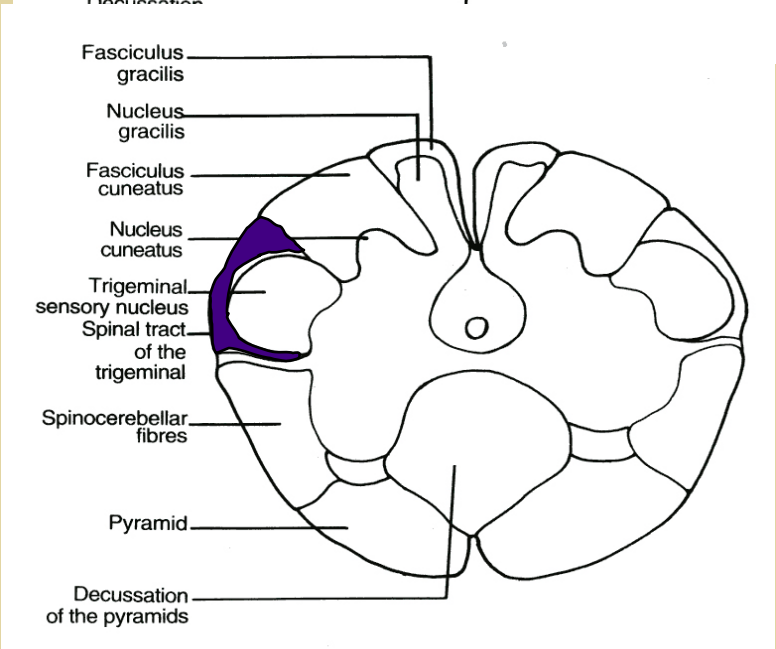
- 1. *Traversed by the Central Canal.*
- *Motor Decussation*.*
- *Spinal Nucleus of Trigeminal (Trigeminal sensory nucleus)* :*
  - *It is a larger sensory nucleus.*
  - *It is the brain stem continuation of the Substantia Gelatinosa of spinal cord.*



Transverse section and anterior surface of medulla oblongata

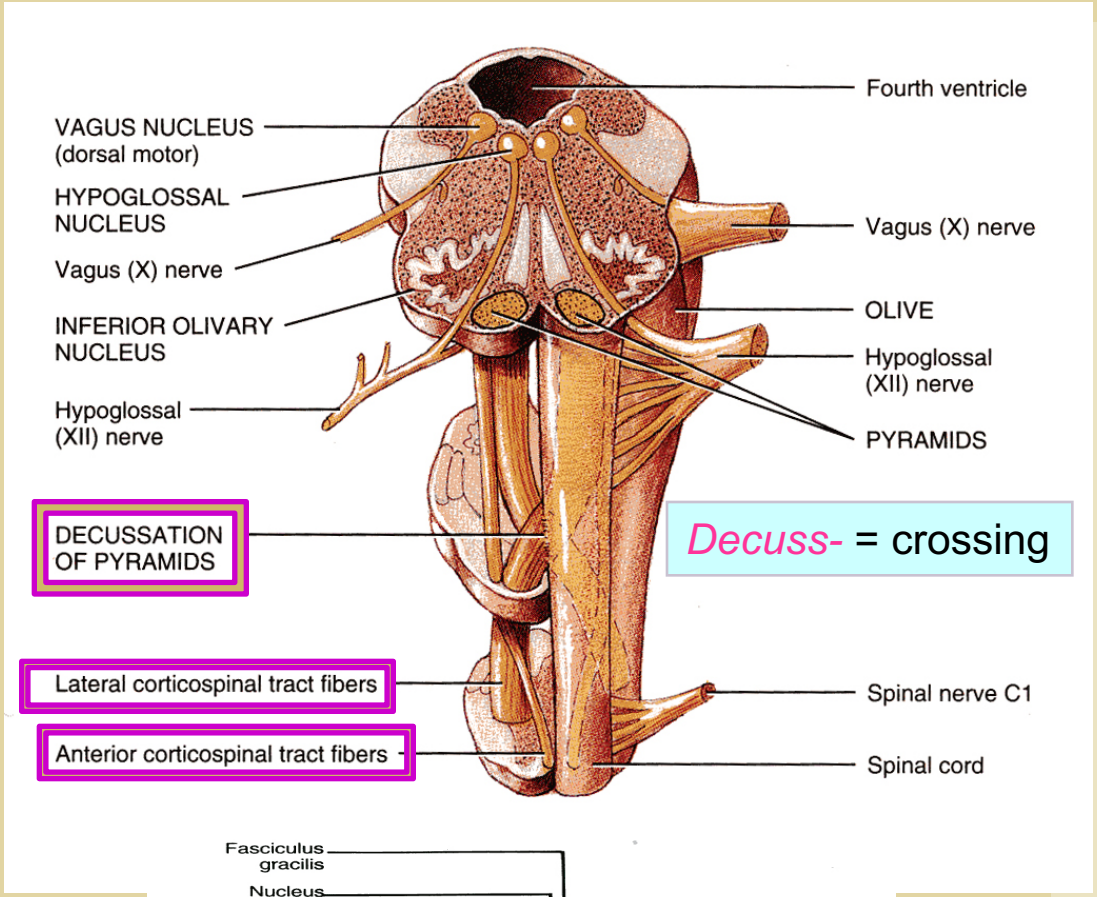
TRIGEMINAL SENSORY NUCLEUS & TRACT

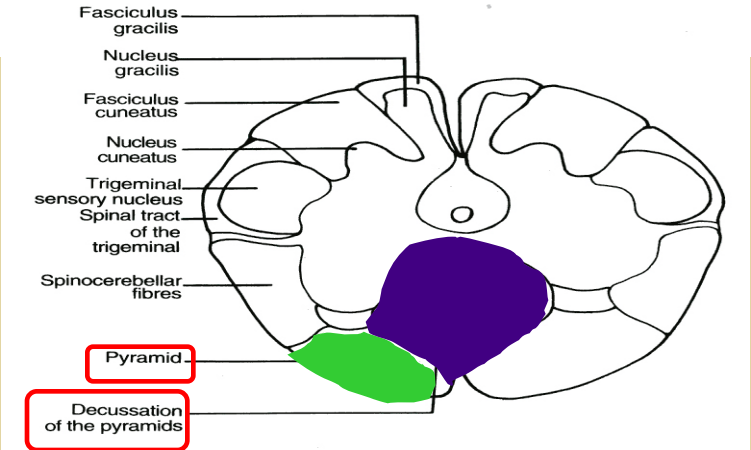




- ***The Nucleus Extends :***
- ***Through the whole length of the brain stem and upper segments of spinal cord.***
- ***It lies in all levels of M.O, medial to the spinal tract of the trigeminal.***
- ***It receives pain and temperature from face, forehead.***
- ***Its tract present in all levels of M.O. it is formed of descending fibers that terminate in the trigeminal nucleus.***

PYRAMIDAL DECUSSATION

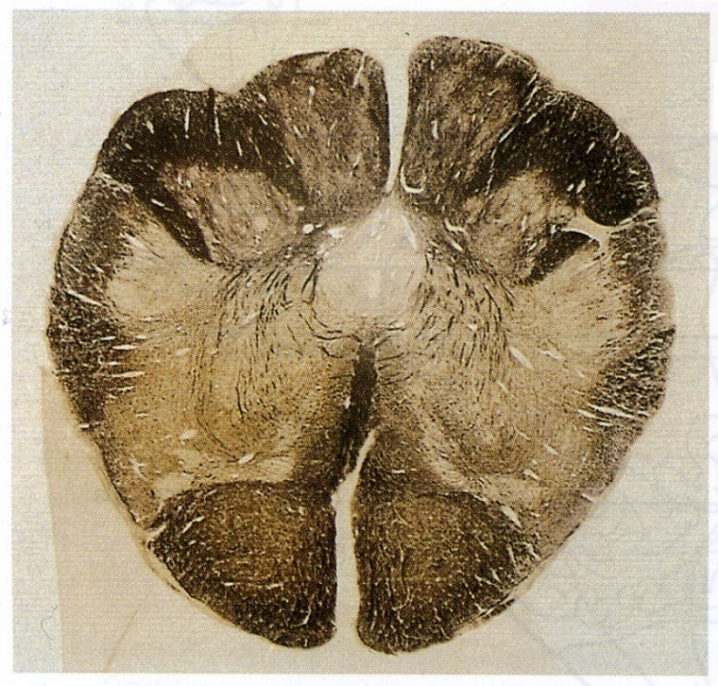


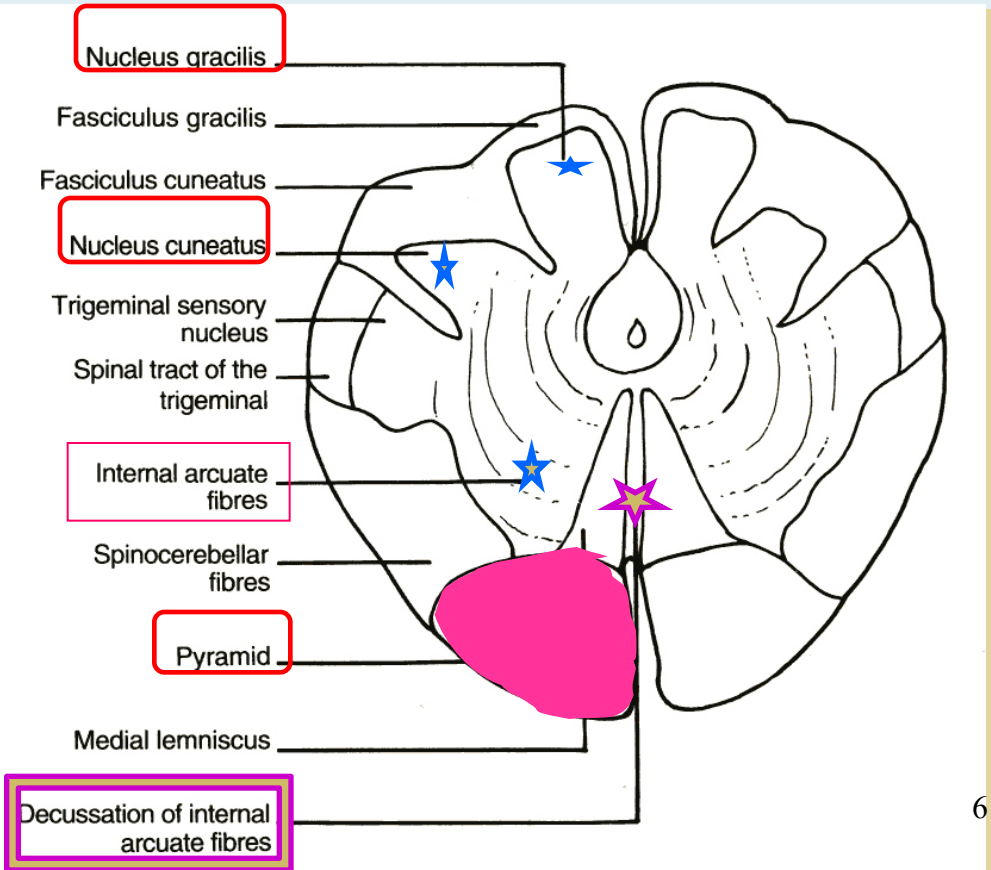


- *It is Motor Decussation.*
- *Formed by pyramidal fibers, (75-90%) cross to the opposite side*
- *They descend in the lateral white column of the spinal cord as the lateral corticospinal tract.*
- *The uncrossed fibers form the ventral corticospinal tract.*

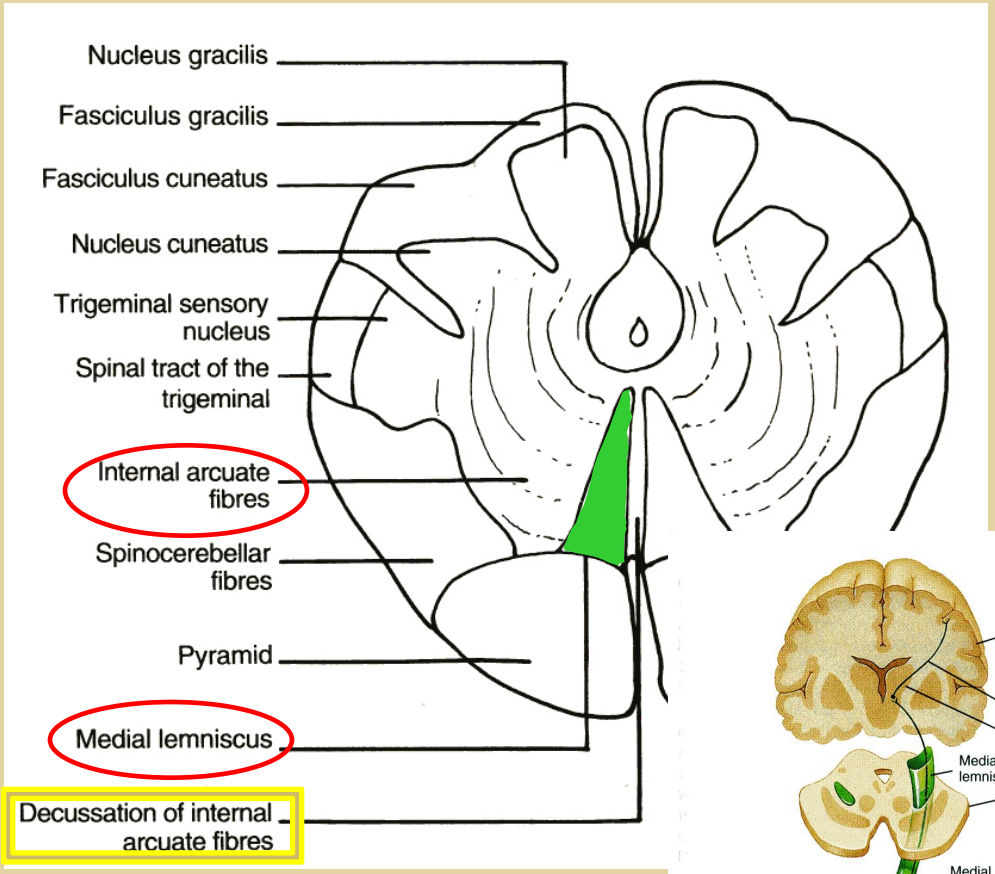
MID MEDULLA

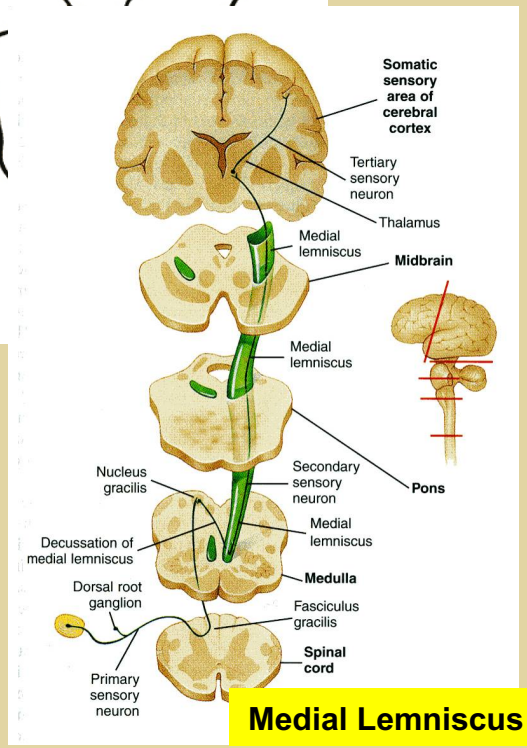
- *Traversed by Central Canal.*
- *Larger size Gracile & Cuneate nuclei, concerned with proprioceptive deep sensations of the body.*
- *Axons of Gracile & Cuneate nuclei form the internal arcuate fibers; decussating forming Sensory Decussation.*
- *Pyramids are prominent ventrally.*





SENSORY DECUSSATION

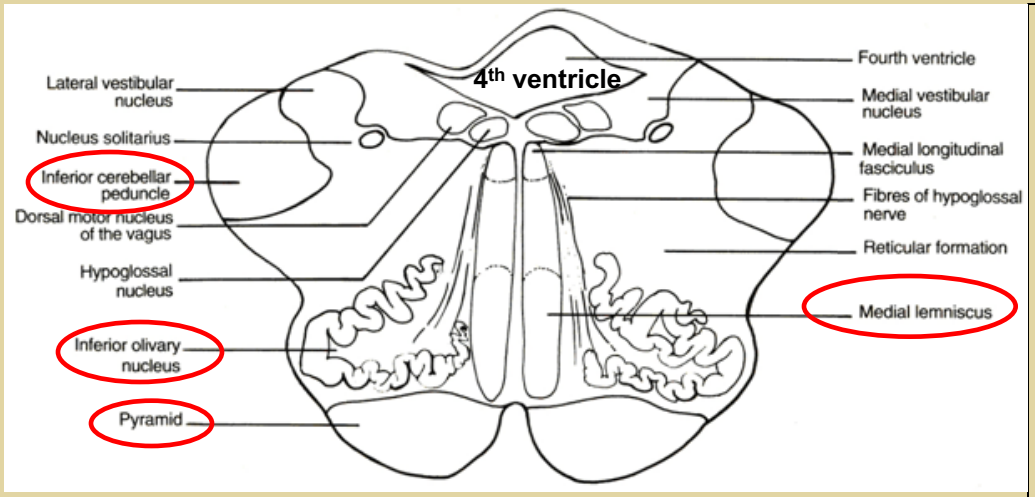


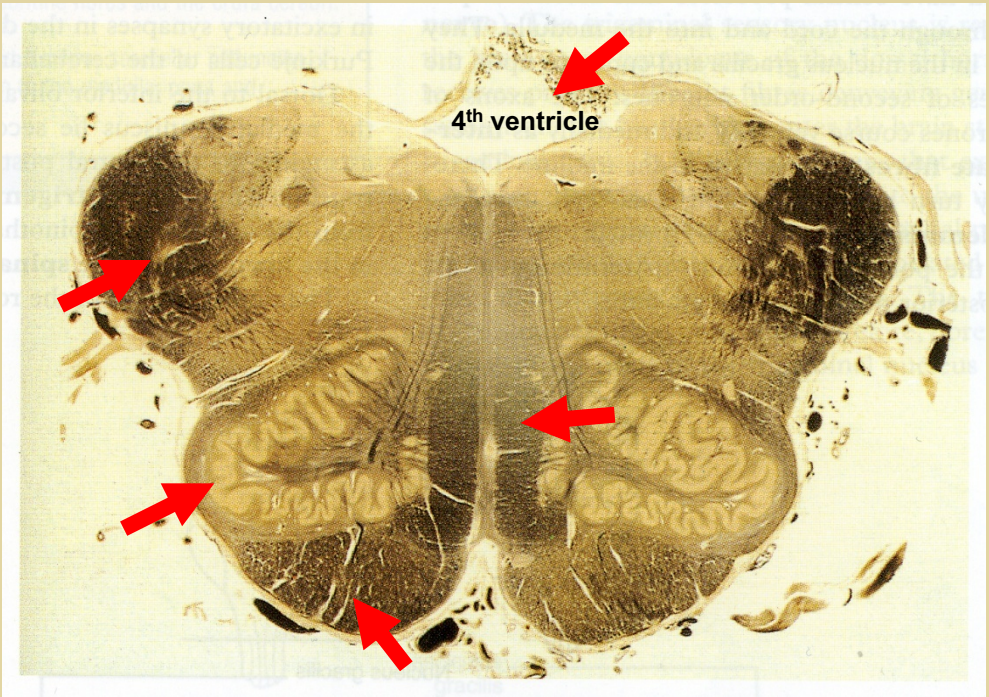


Medial Lemniscus

- *Formed by the crossed internal arcuate fibers*
- ***Medial Leminiscus:***
  - *Composed of the ascending internal arcuate fibers after their crossing.*
  - *Lies adjacent to the middle line ventral to the central canal*
  - *Terminates in thalamus.*
  - *Concerned with proprioceptive deep sensation.*

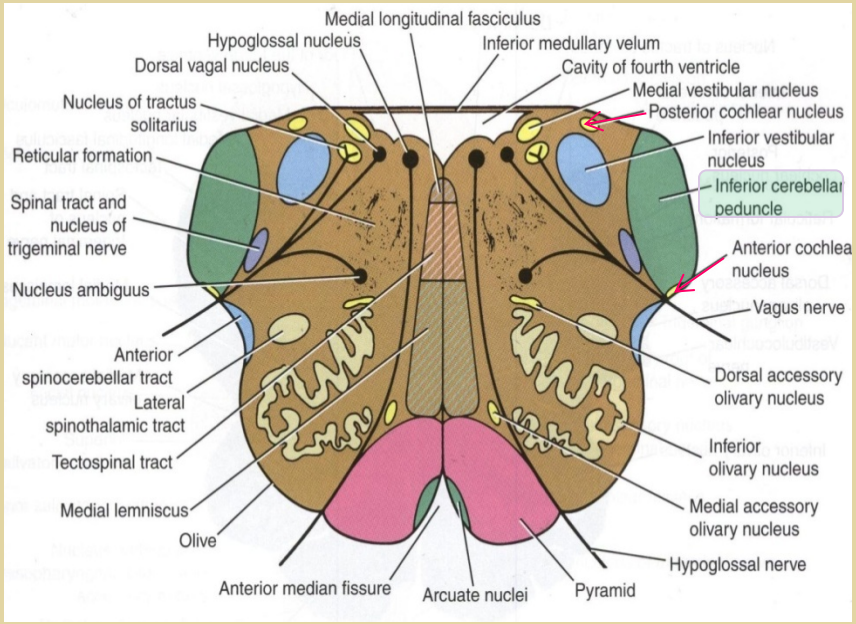
ROSTRAL (open) MEDULLA

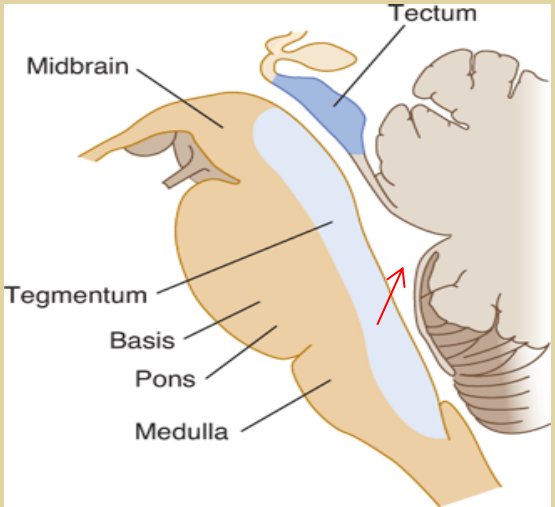




- **On the ventral aspect :**
- The pyramid is clear,
- Medial lemniscus on either sides of middle line dorsal to the pyramid
- Inferior Olivary Nucleus:
  - **A convoluted mass of gray matter., lies posterolateral to the pyramids & lateral to the medial leminiscus.**
  - **It is concerned with the control of movements.**

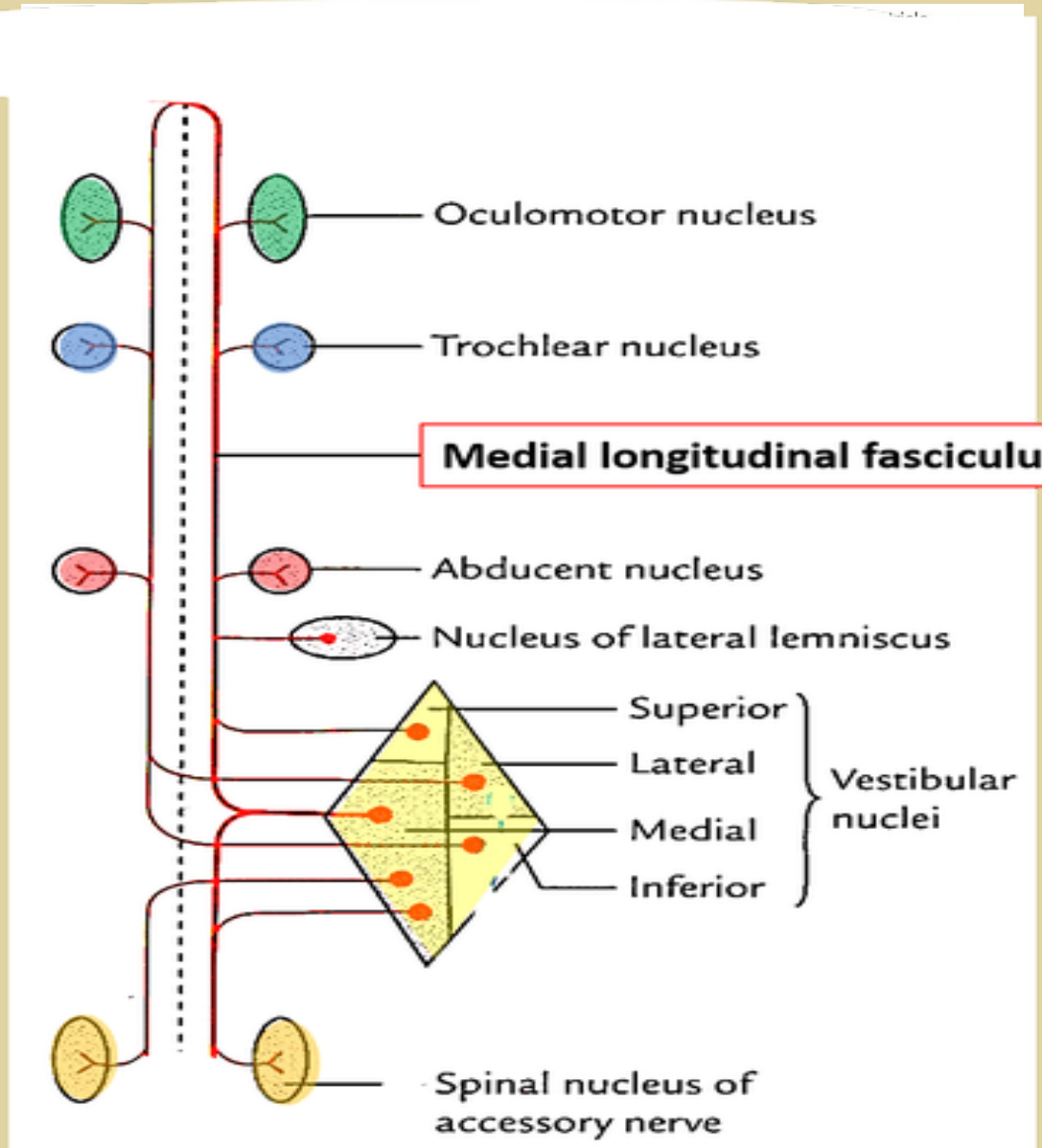
ROSTRAL (open) MEDULLA





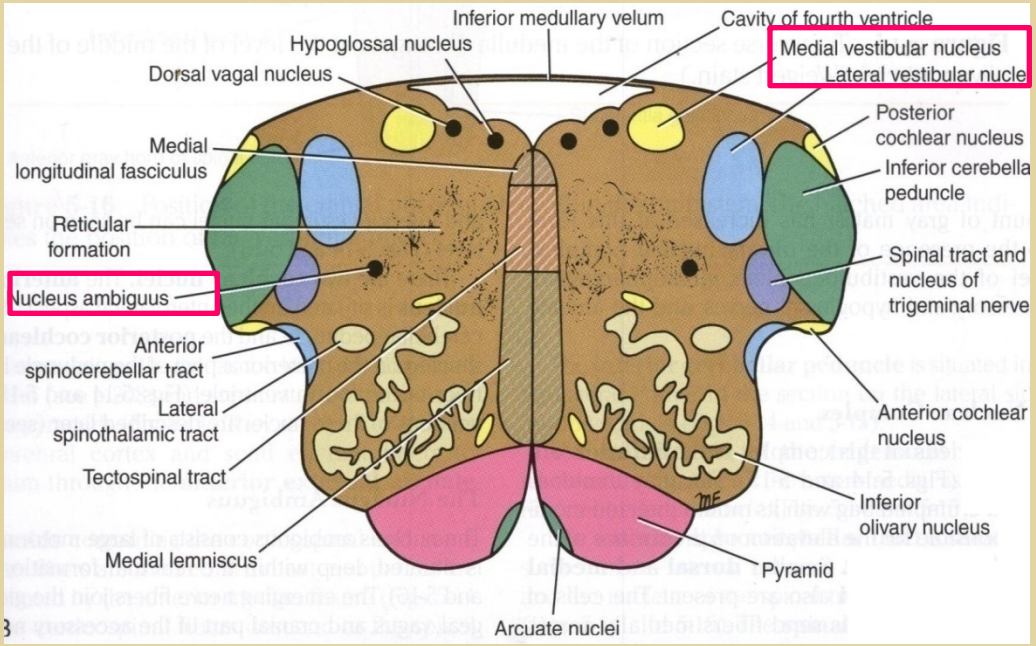
- **Its dorsal surface :**
  - **Forms the Lower part of the floor of the 4th ventricle.**
- **The Inferior Cerebellar Peduncle is, connecting M.O. with cerebellum.**
- **Cochlear nuclei (dorsal and ventral); concerning with hearing.**

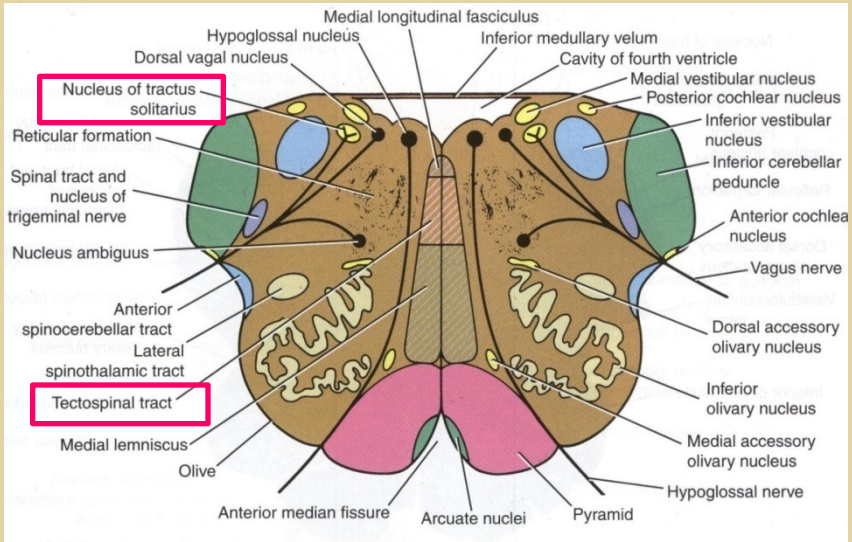
ROSTRAL (open) MEDULLA



- **Beneath the floor of 4th ventricle lie :**
- *1. Hypoglossal Nucleus.*
- *2. Dorsal vagal nucleus contains preganglionic parasympathetic fibers.*
- **3. Medial longitudinal fasciculus, it is important association tract;**
- *Upwards :*
- *It links the vestibular nuclei with nuclei of extraocular ms.(3,4&6) as (vestibulo-ocular tract) to help coordination of eye movements with head movements.*
- *Downwards :*
- *It links vestibular nuclei with anterior horne cells of spinal cord (cervical & upper thoracic segments) as (vestibulo-spinal tract)---so, the neck & trunk move with head movements, so* maintaining balance of the body trunk and head.

ROSTRAL (open) MEDULLA

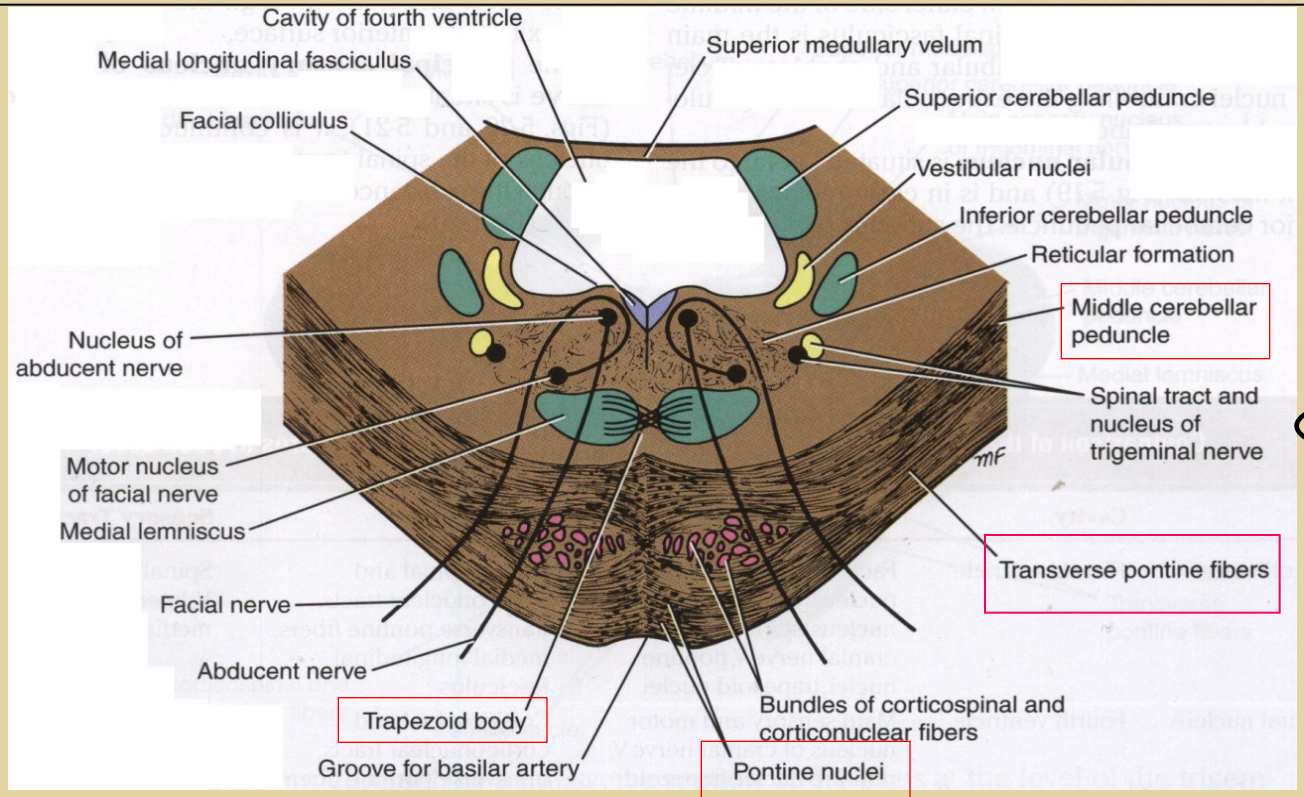


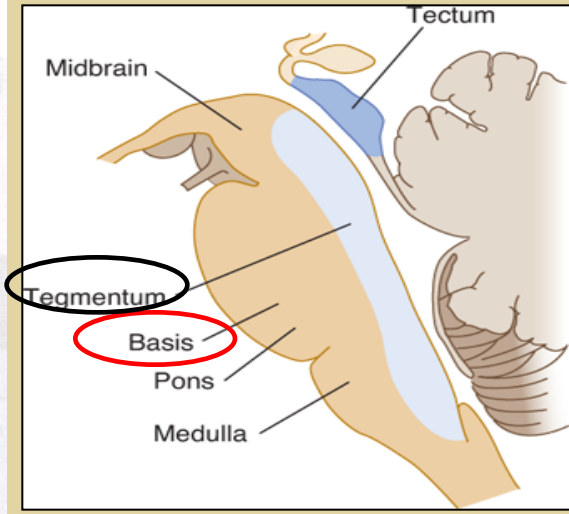


- *4. Vestibular nuclei complex : concerned with equilibrium.*
- *5. Nucleus Ambiguus: (motor nucleus) : gives motor fibers along glossopharyngeal N. & vagus N. to Ms. of the pharynx, larynx & palate.*
- *6. Solitary nucleus (sensory nucleus) : receives taste sensation from the tongue along the facial (VII), glossopharyngeal (IX) and vagus (X).*
- *7. Tectospinal tract : lies between tectum of midbrain and spinal cord* (involved in **head movements in response to visual and auditory stimuli**).

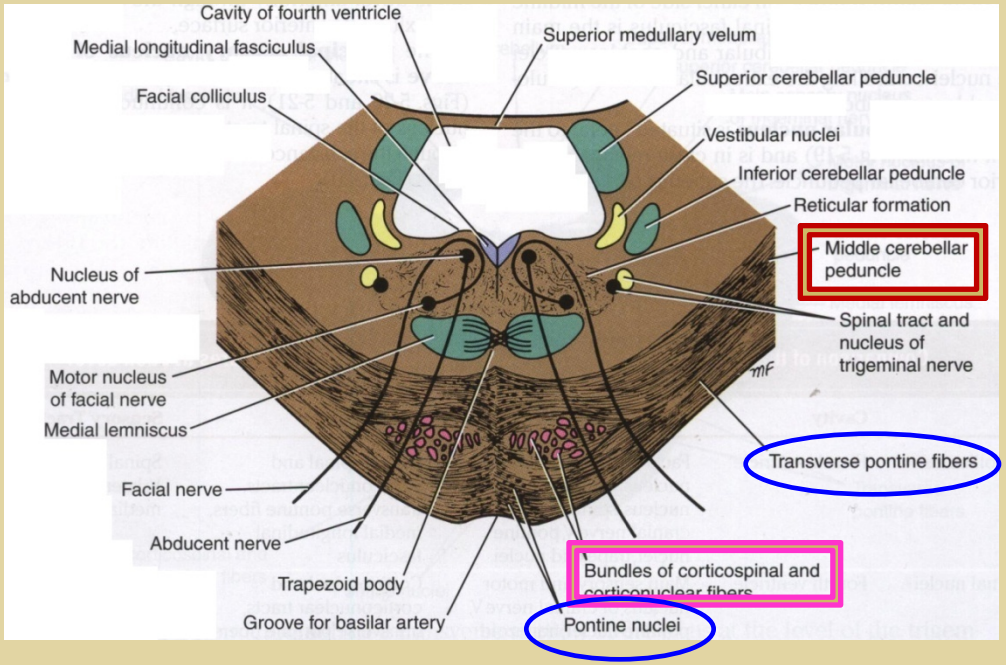
THE PONS

- **It is divided into an anterior part (Basis Pontis) & a posterior part (Tegmentum) by the Trapezoid Body (consists of crossed acoustic fibres from cochlear nuclei to ascend into midbrain as lateral lemniscus and terminate in inferior colliculus).**
- **The ventral portion (In all Levels of Pons) :** is marked by numerous transversely oriented fascicles of **pontocerebellar fibres** that originate from scattered cell groups, the **pontine nuclei,** and that pass to the contralateral side of the cerebellum through the **middle cerebellar peduncle.**



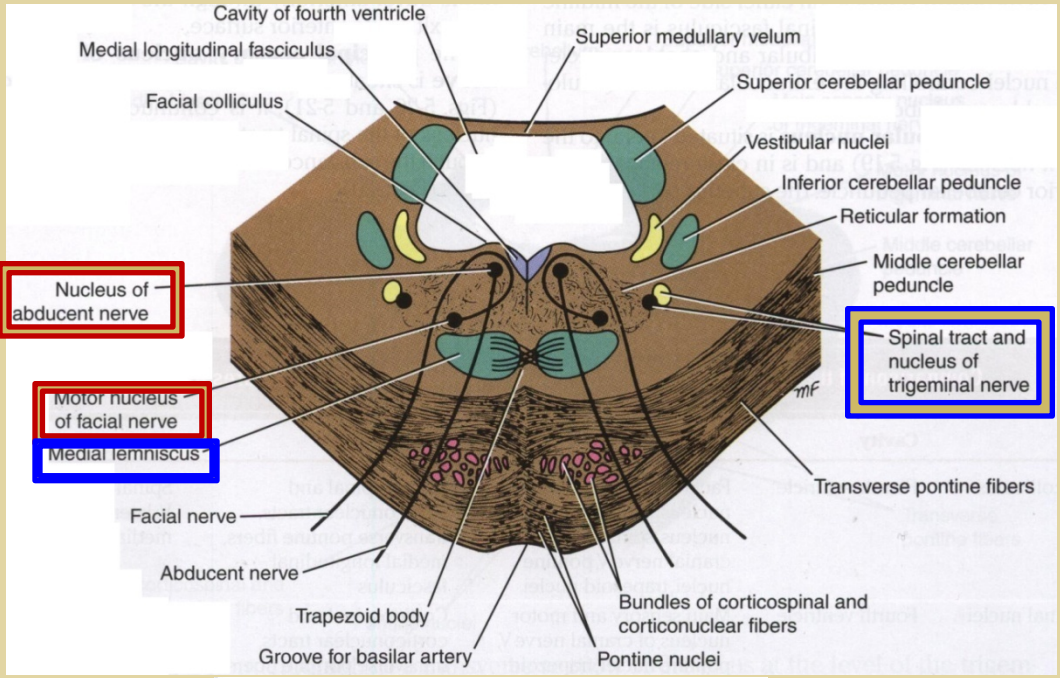


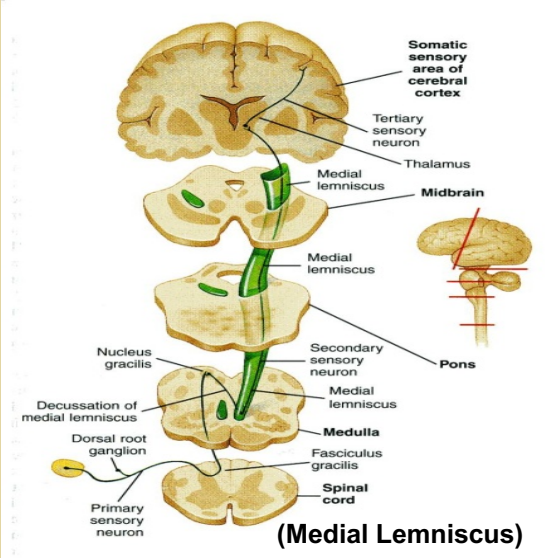
CAUDAL PART OF THE PONS



1. *Pontine Nuclei:*
   - *Small masses of nerve cells, receive cortico pontine fibers. Their axons form the transverse pontocerebellar fibers which pass to the contralateral side of the cerebellum through Middle Cerebellar peduncles.*
2. *Bundles of corticospinal & corticonuclear fibres (Pyramidal fibres)*

CAUDAL PART OF THE PONS





(Medial Lemniscus)

3. The ascending fibres of **Medial lemniscus**

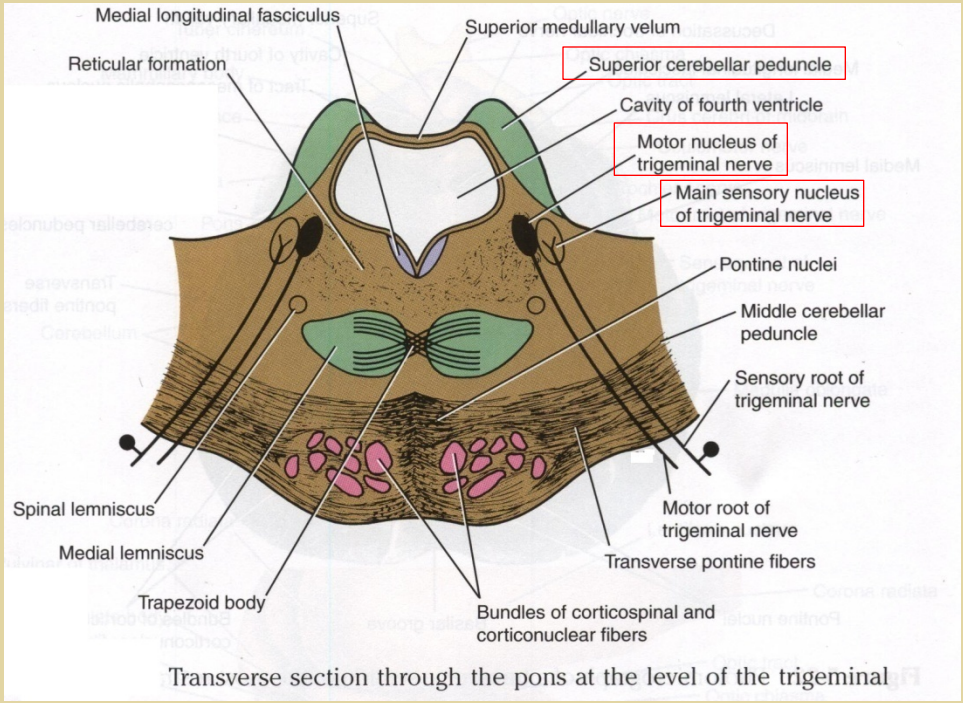
- become separated from the pyramid and displaced dorsally.
- *The Medial Lemniscus rotates 90 degrees and lies almost horizontally.*

4. Spinal tract & nucleus of Trigeminal.

5. *Cranial nerve nuclei :*

- *Abducent nucleus*
- *Facial motor nucleus*

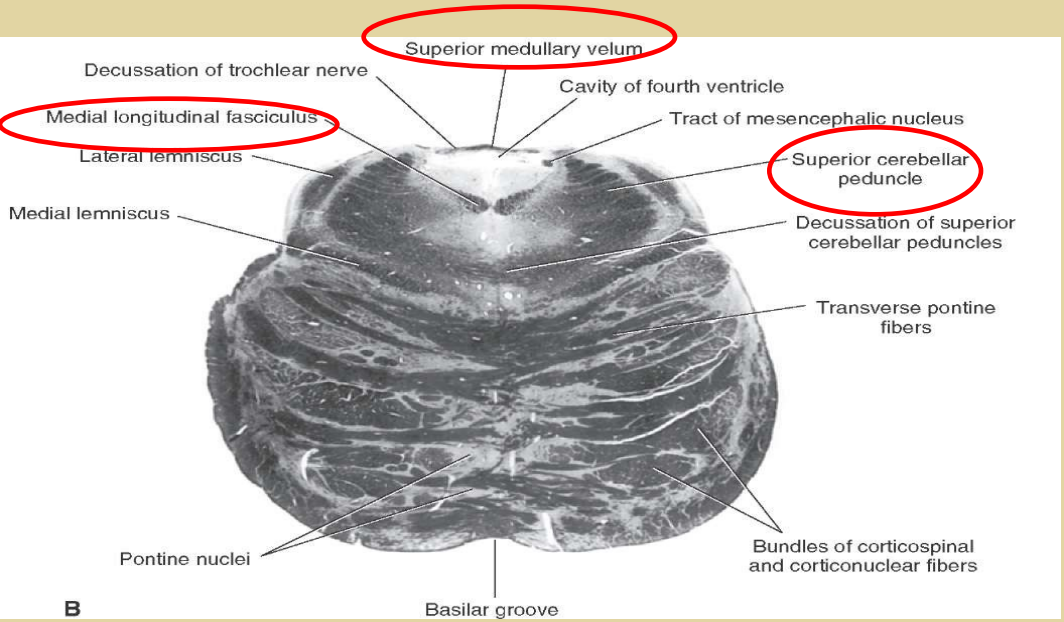
AT THE LEVEL OF THE TRIGEMINAL NERVE



Transverse section through the pons at the level of the trigeminal

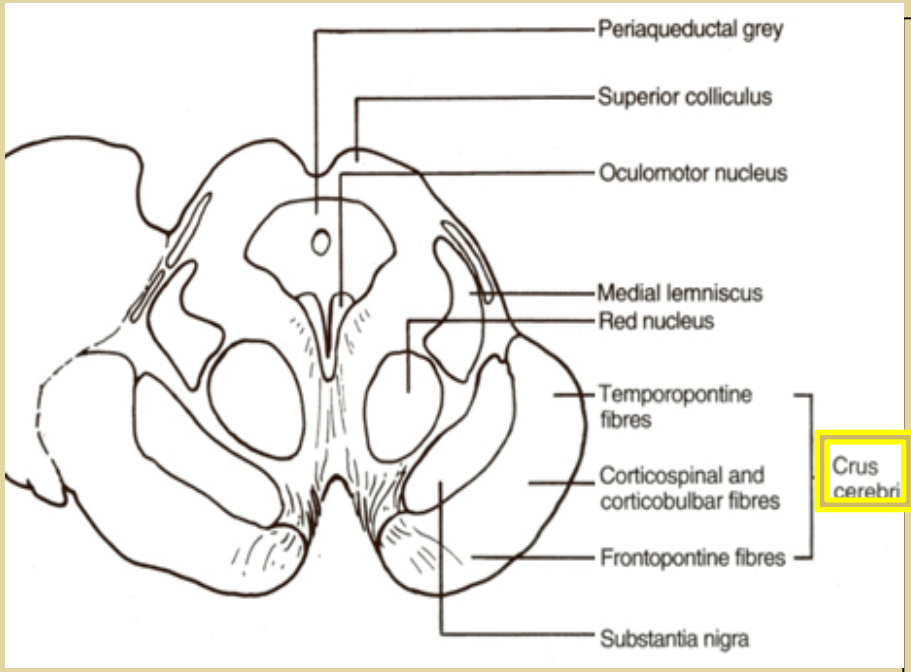
- ***Motor nucleus of the trigeminal nerve:*** *Lies in the lateral part of the floor of the 4th ventricle.*
- ***Main sensory nucleus of the trigeminal nerve:*** *it lies lateral to the motor nucleus.*
- ***Superior cerebellar peduncles*** *form the lateral boundary of the 4th ventricle*

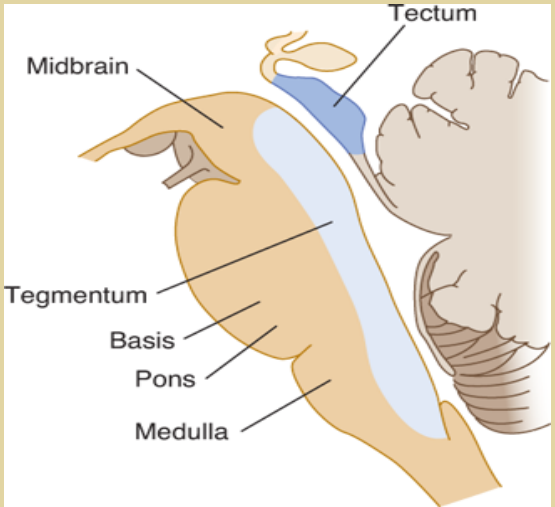
ROSTRAL PONS



- ***Superior cerebellar peduncles.***
- ***Superior Medullary Velum:***
  - *Passes between the two peduncles & forms the roof of the 4th ventricle.*
- ***Medial longitudinal fasciculus:***
  - *Lies close to the midline beneath the floor of the 4th ventricle.*

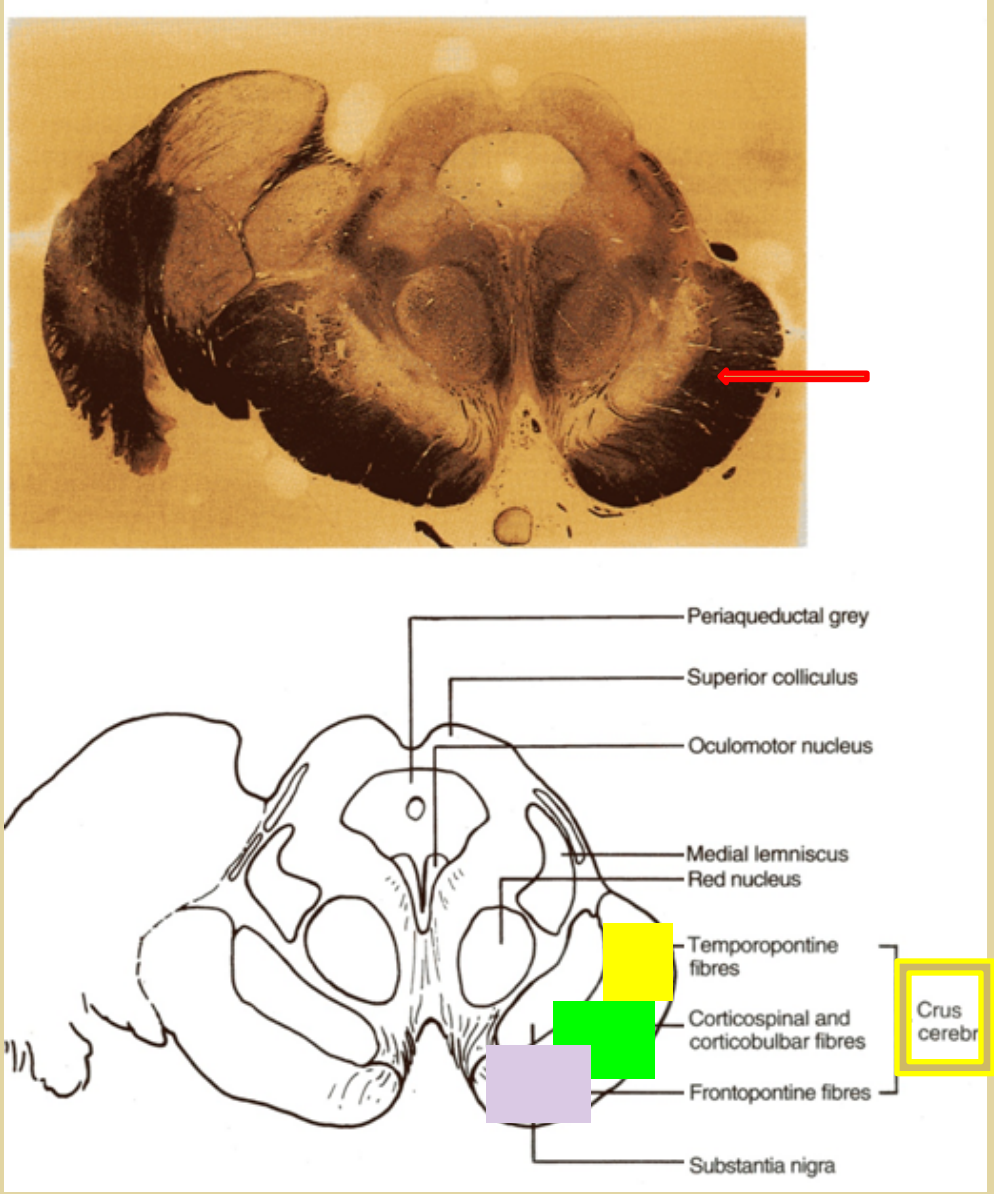
MIDBRAIN





- *It is divided into :*
- *a dorsal part (Tectum) of 4 colliculi ; and*
- *a ventral part (Tegmentum) at the level of the cerebral aqueduct.*
- *The cerebral aqueduct is surrounded by a pear shaped periaqueductal (central) gray matter.*
- *The most ventral part of the tegmentum is the massive fibrous mass (Crus Cerebri);* **Present in both levels of colliculi.**

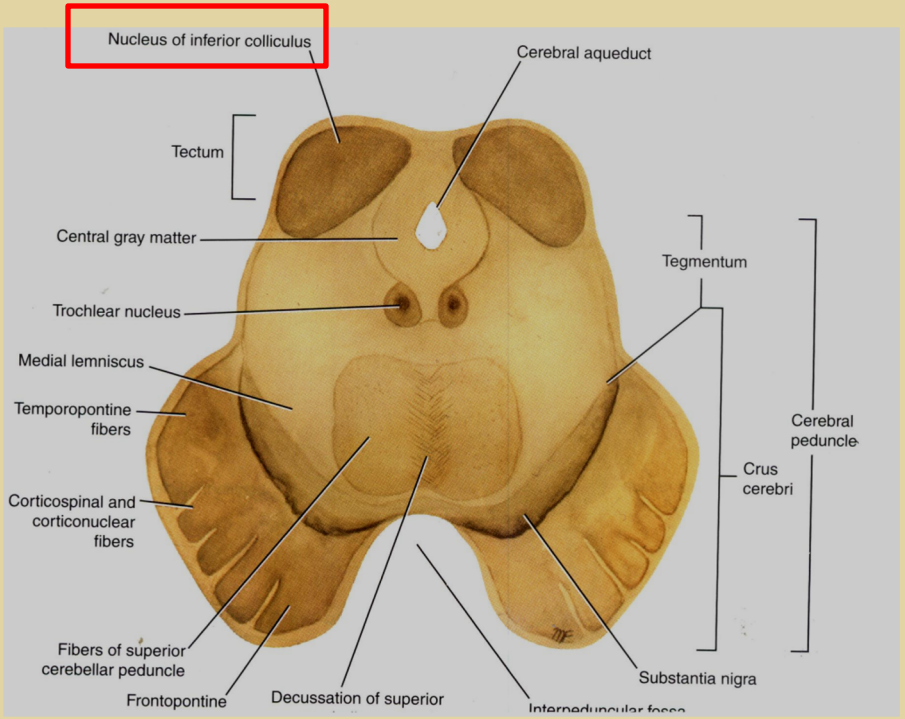
CRUS CEREBRI



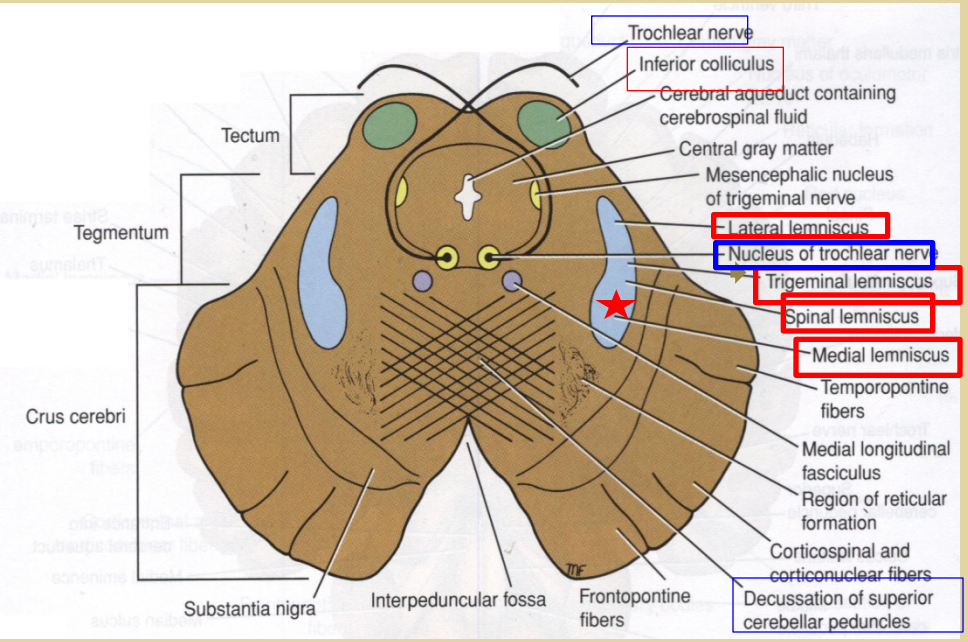
- Present in both levels of colliculi.
- It is a massive mass ventral to the substantia nigra.
- It consists entirely of descending cortical efferent fibers (Frontopontine, Corticospinal & corticobulbar and Temporopontine Fibres) to the motor cranial nerve nuclei and to anterior horn cells of spinal cord.
- Involved in the coordination of movement.

INFERIOR COLLICULUS Level

- *Inferior colleculus is a large nucleus of gray matter.*
- *It is part of the auditory pathway.*
- *It receives fibers from the lateral lemniscus.*
- *Its efferent fibers pass to the thalamus*



INFERIOR COLLICULUS Level



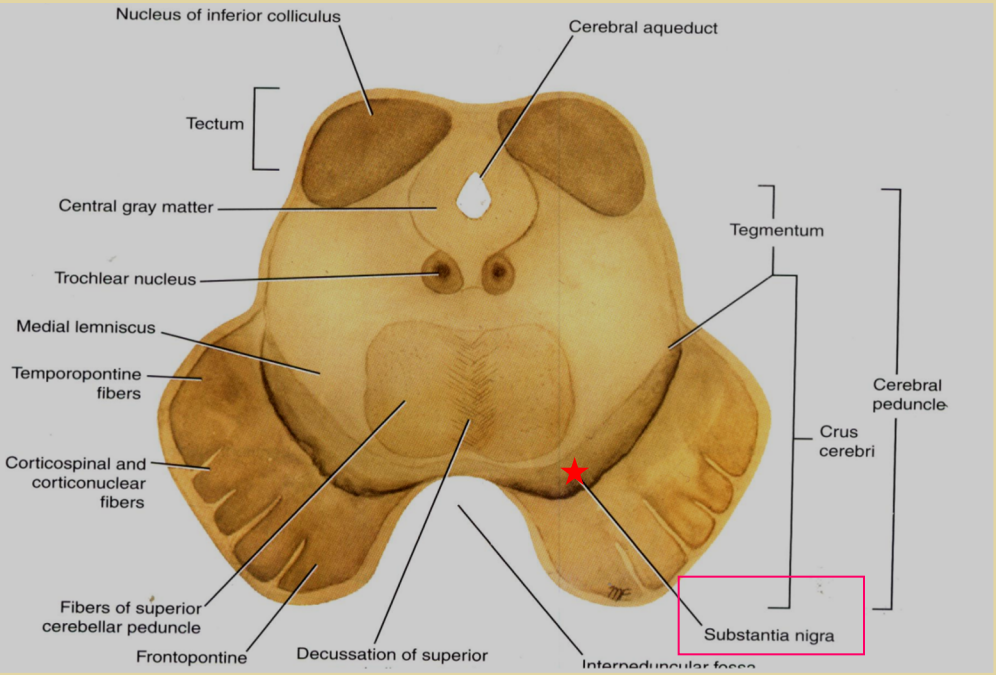
1. *Trochlear nucleus:*
   - *lies in the central gray matter close to the median plane.*
   - *The fibers of the trochlear nerve decussate and emerges from posterior surface of midbrain.*

2. *Decussation of the superior cerebellar peduncles lies in the mid line.*

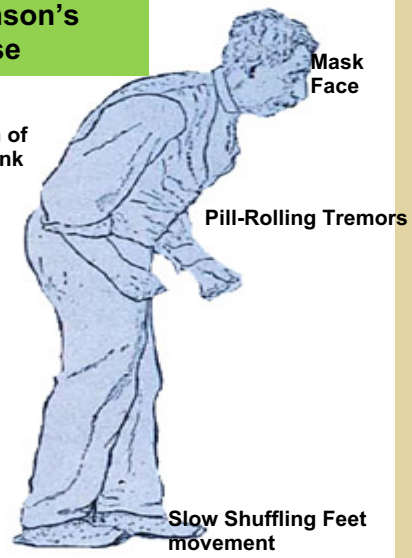
3. *Ascending Leminisci :*

- *Composed Of:* ★
  - *Medial lemniscus.*
  - *Spinal (Lateral & anterior spinothalamic tracts)*
  - *Trigeminal (Lateral & medial).*
  - *Lateral lemniscus.*

INFERIOR COLLICULUS Level



Parkinson's disease



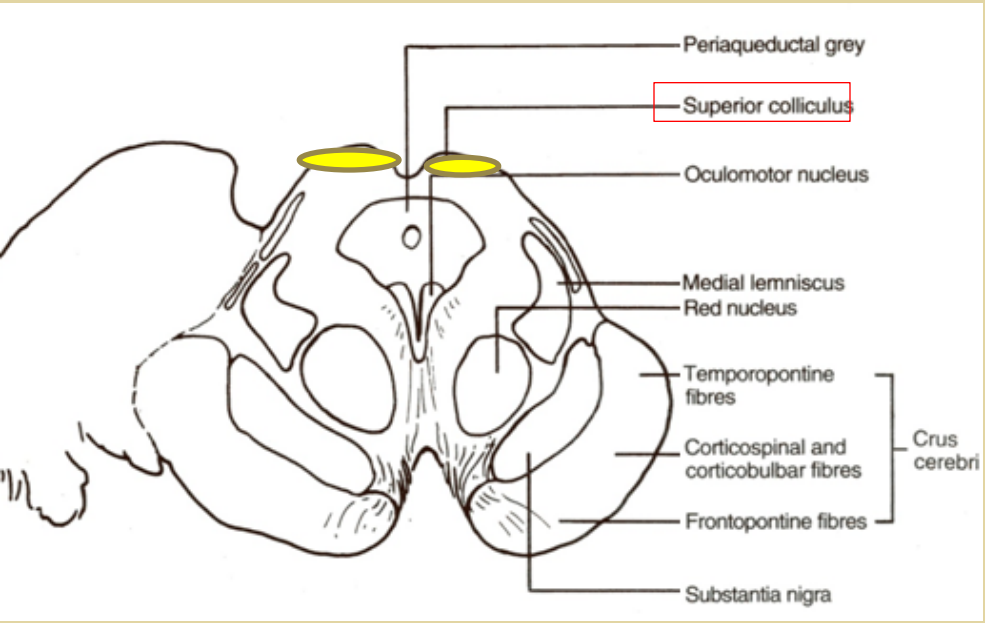
4. Substantia nigra :

- *Occupies the most ventral part of the tegmentum.*
- *It is a mass of pigmented, melanin neurones.*

It projects to the basal ganglia (responsible for voluntary movements). Its degeneration is associated with Parkinson's disease.

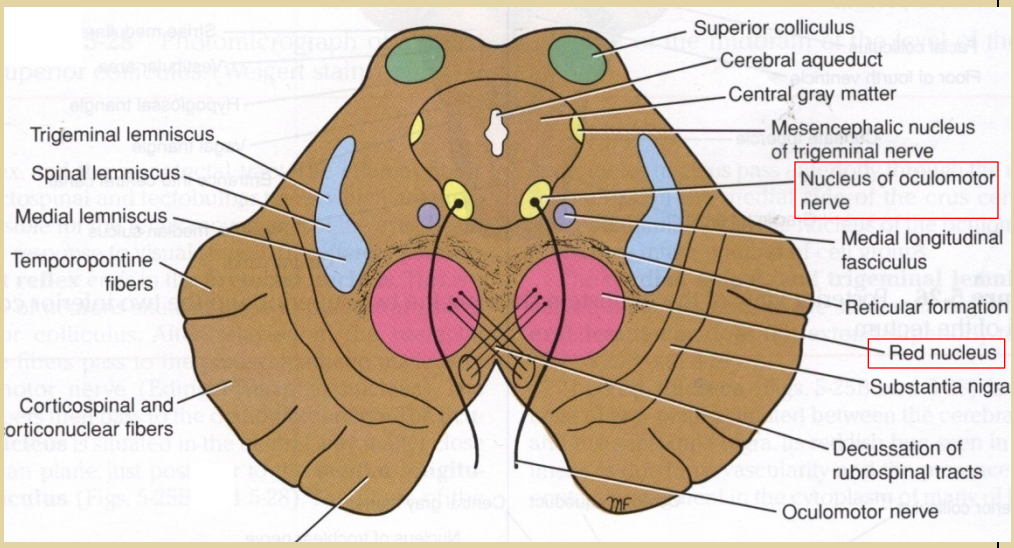
5. Crus cerebri

SUPERIOR COLLICULUS Level



- A large nucleus of gray matter.
- It forms part of the visual reflexes.
- Its efferent fibers go to the anterior horn cells & to cranial nuclei 3, 4, 6, 7 & 11).
- It is responsible for the reflex movements of the eyes, head and neck in response to visual stimuli.

SUPERIOR COLLICULUS Level

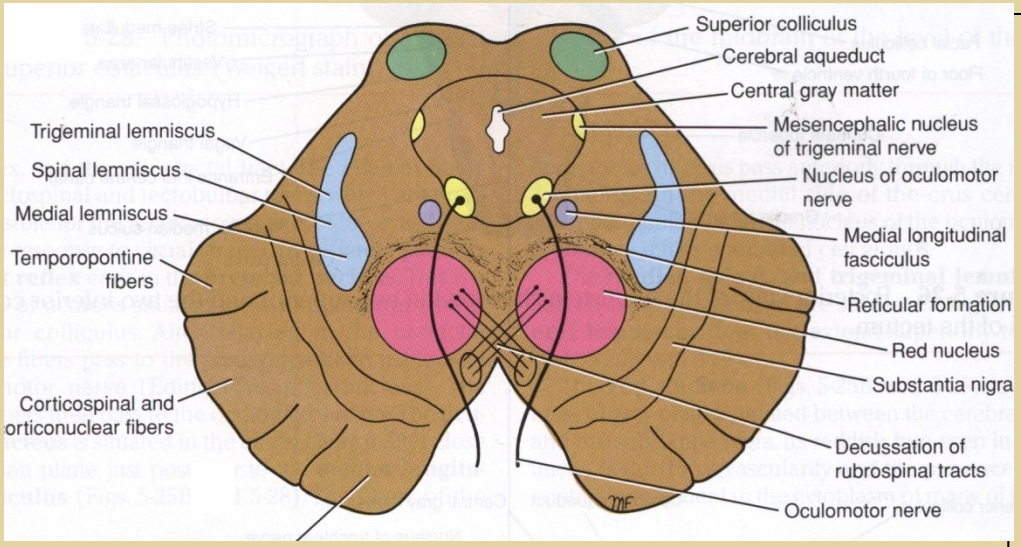


1. Oculomotor nucleus:

- *Situated in the central gray matter.*
- *The fibers of the oculmotor nerve passes anteriorly through the red nucleus to emerge on the medial side of the crus cerebri*

  (In interpeduncular fossa).

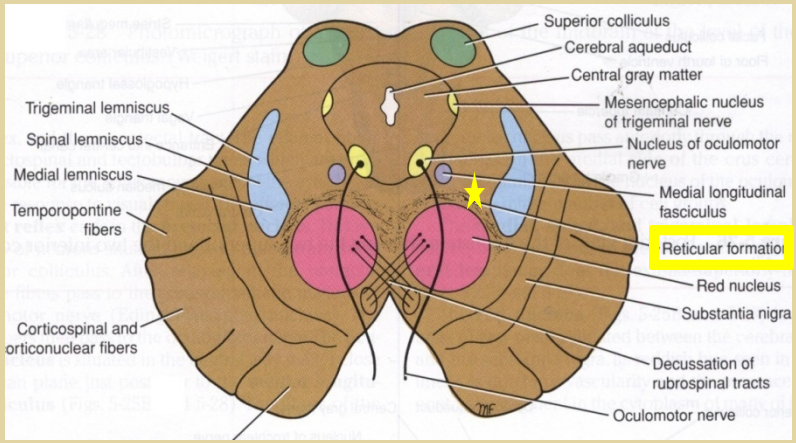
SUPERIOR COLLICULUS Level

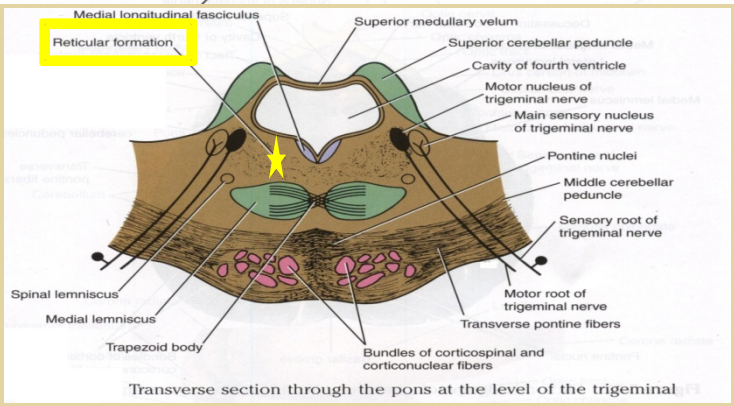


2. Red nucleus :

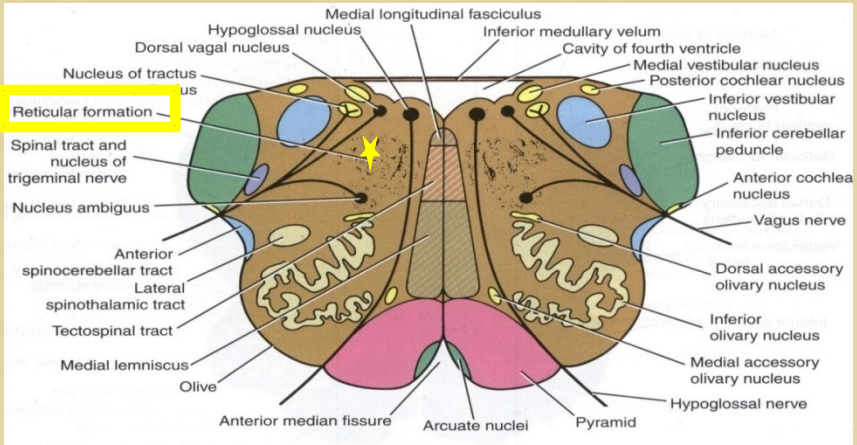
- A rounded mass of gray matter that lies in the central portion of the tegmentum.
- Its red coloration is due to its vascularity and the presence of an iron containing pigment in the cytoplasm of its neurons.
- It is involved in motor control.

RETICULAR FORMATION



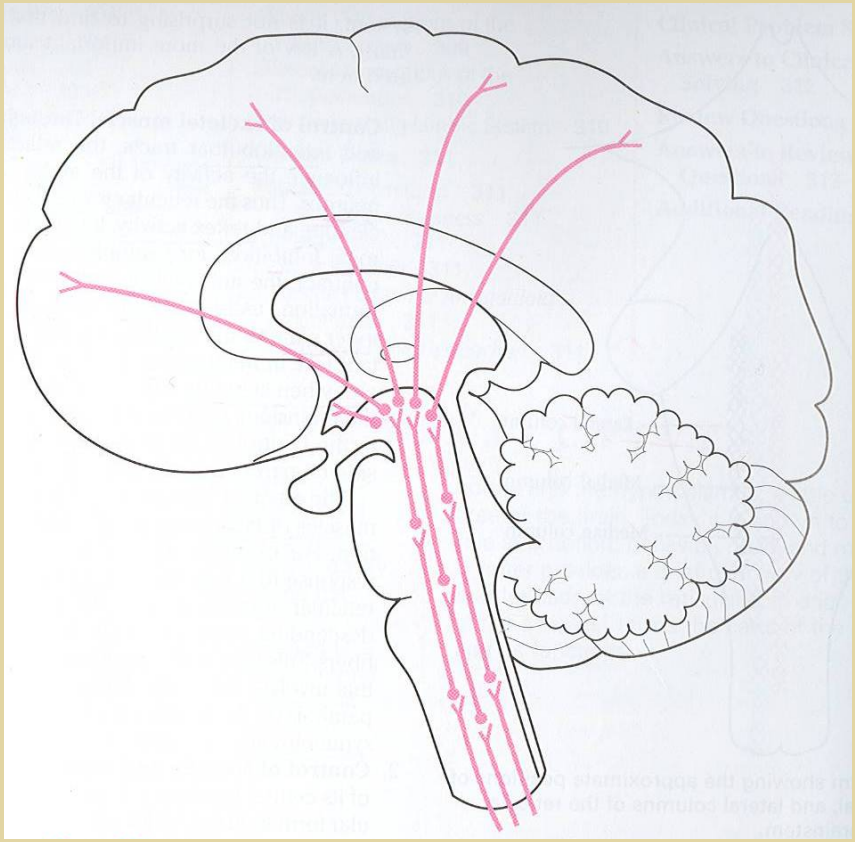


Transverse section through the pons at the level of the trigeminal



- It is a complex matrix of nerve fibers & groups of nerve cells that extends throughout the brain stem.
- It has a number of important functions i.e. Respiratory and Cardio- vascular control.

RETICULAR TRACTS



- **Reticulo spinal tracts:**
  - **Descending fibres**
    Influence a muscle tone & posture
- **Reticular Activating system:**

  Ascending fibers through the thalamus ;then

  to the cerebral cortex for activation of awake.

THANK YOU