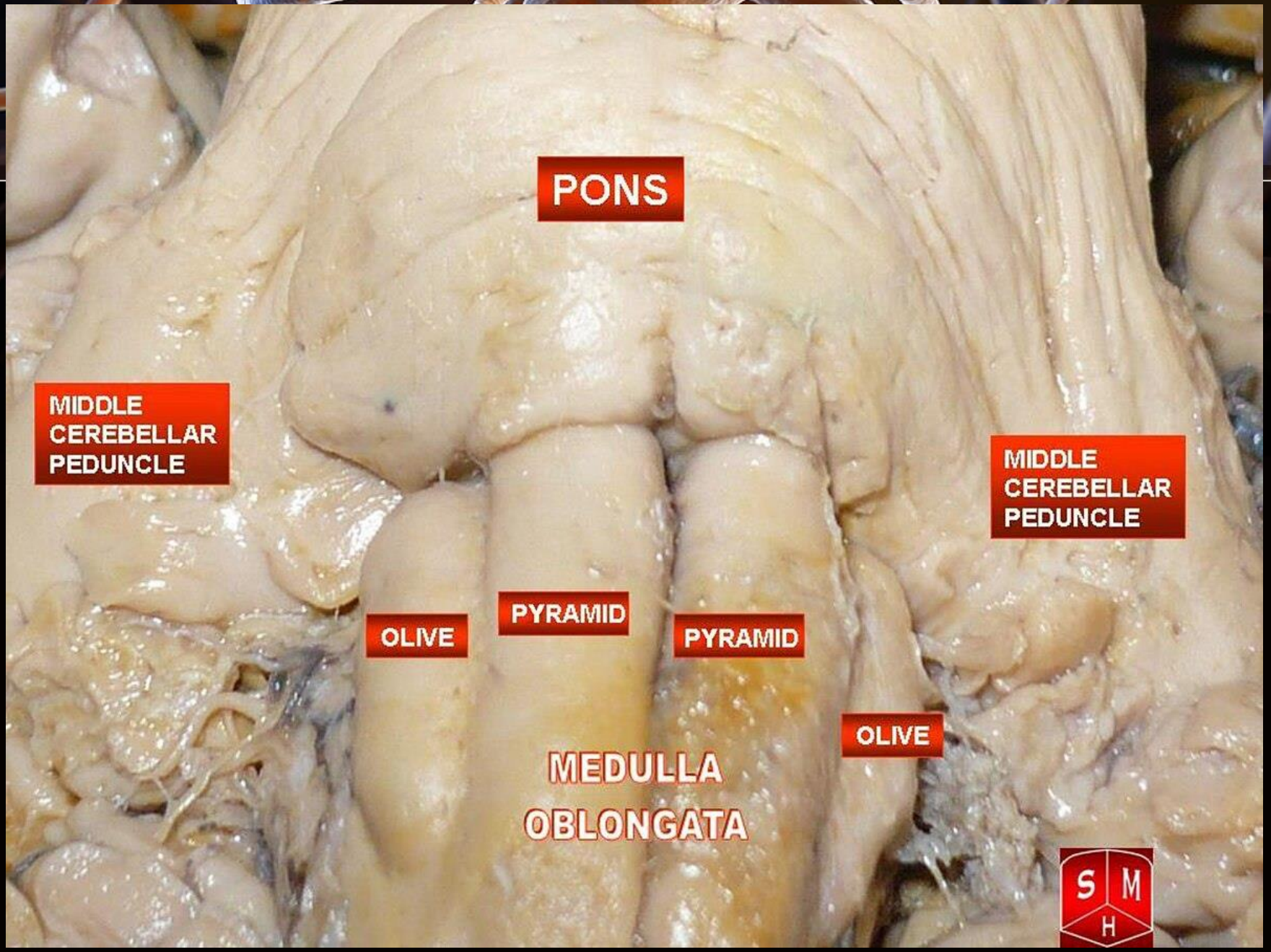
INTERNAL STRUCTURE OF THE BRAIN STEM

Dr AMAL ALBTOOSH

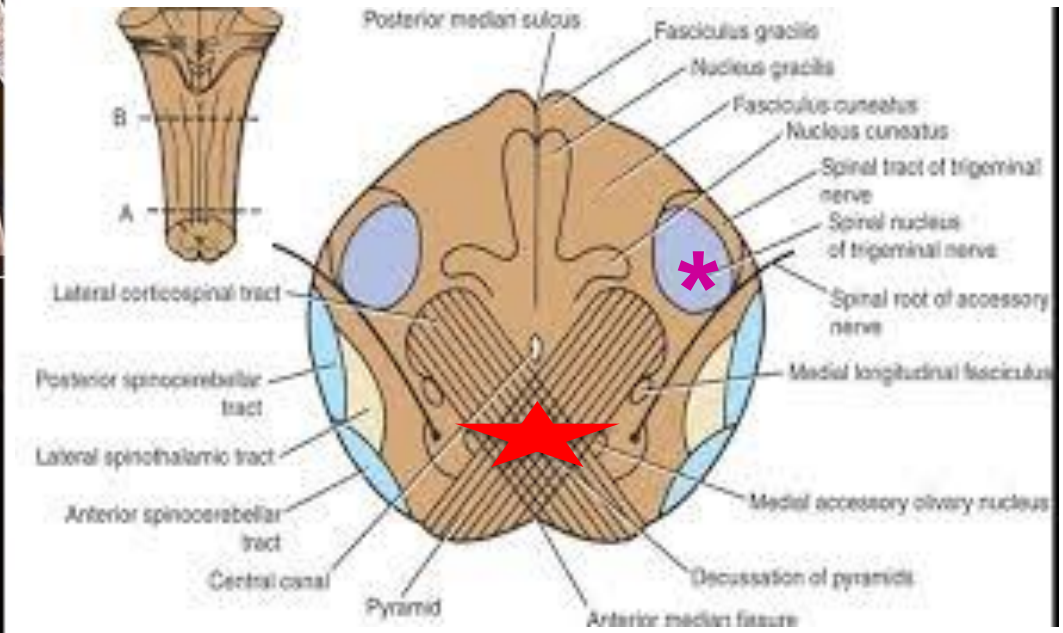
نصيحة.. إياكَ وأن تخاف شيئًا قبل حدوثه ، لا تتخيَّل ، واصرِف فِكرك وخوفك عن الغيبيات فهى فى عِلمِ الله ، واعلم أنَّ البلاء إذا نزل على العبد ينزل معه اللطف ، فإذا تصوَّرت البلاء قبل أن يقع فقد استقبلت البلاء بدون لُطفٍ وأهلكت روحك..

واجبٌ عليك أن تتيقَّن أنَّ لك ربٌ قيوم لا ينام ، فإطمئن به ، وتوكَّل عليه ، واستبشِر ، وتفاءل بالخير

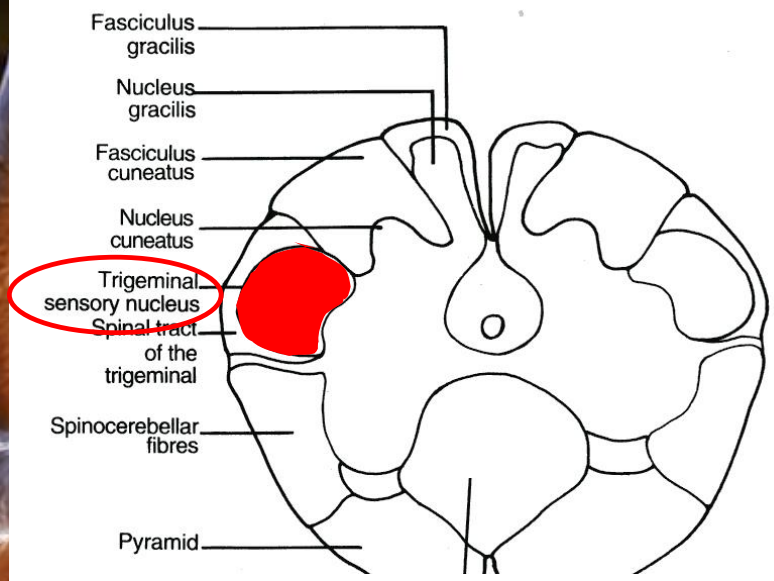

PONS
MIDDLE CEREBELLAR PEDUNCLE
MIDDLE CEREBELLAR PEDUNCLE
OLIVE
PYRAMID
PYRAMID
OLIVE
MEDULLA OBLONGATA
S
M
H

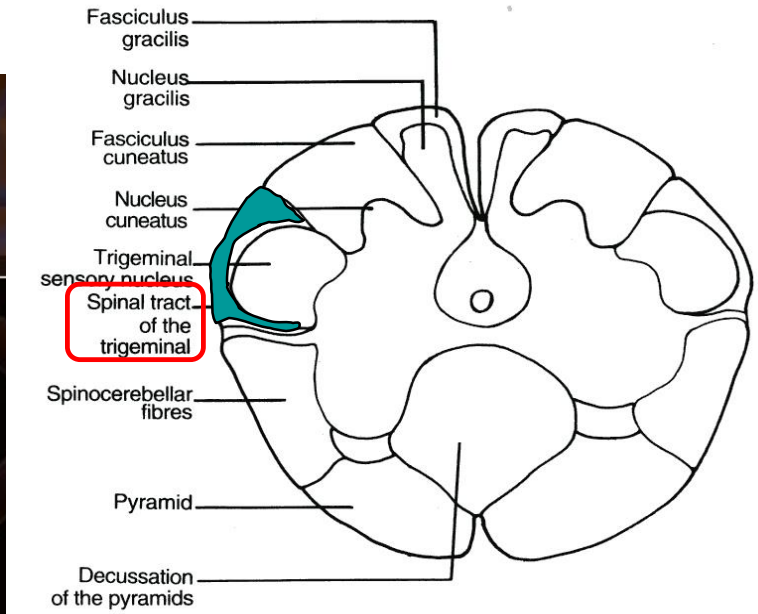
CAUDAL (closed) MEDULLA

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



TRIGEMINAL SENSORY NUCLEUS & TRACT

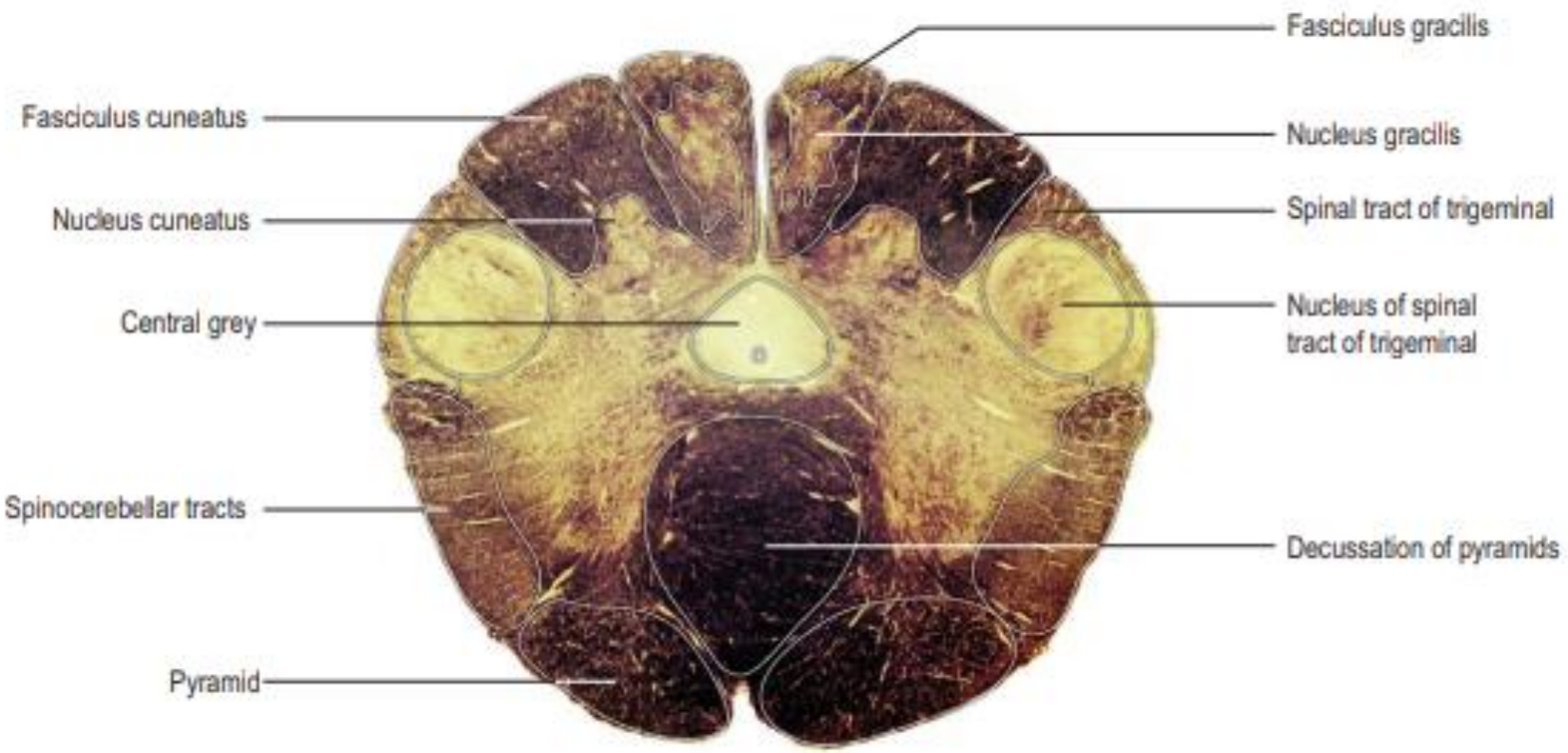


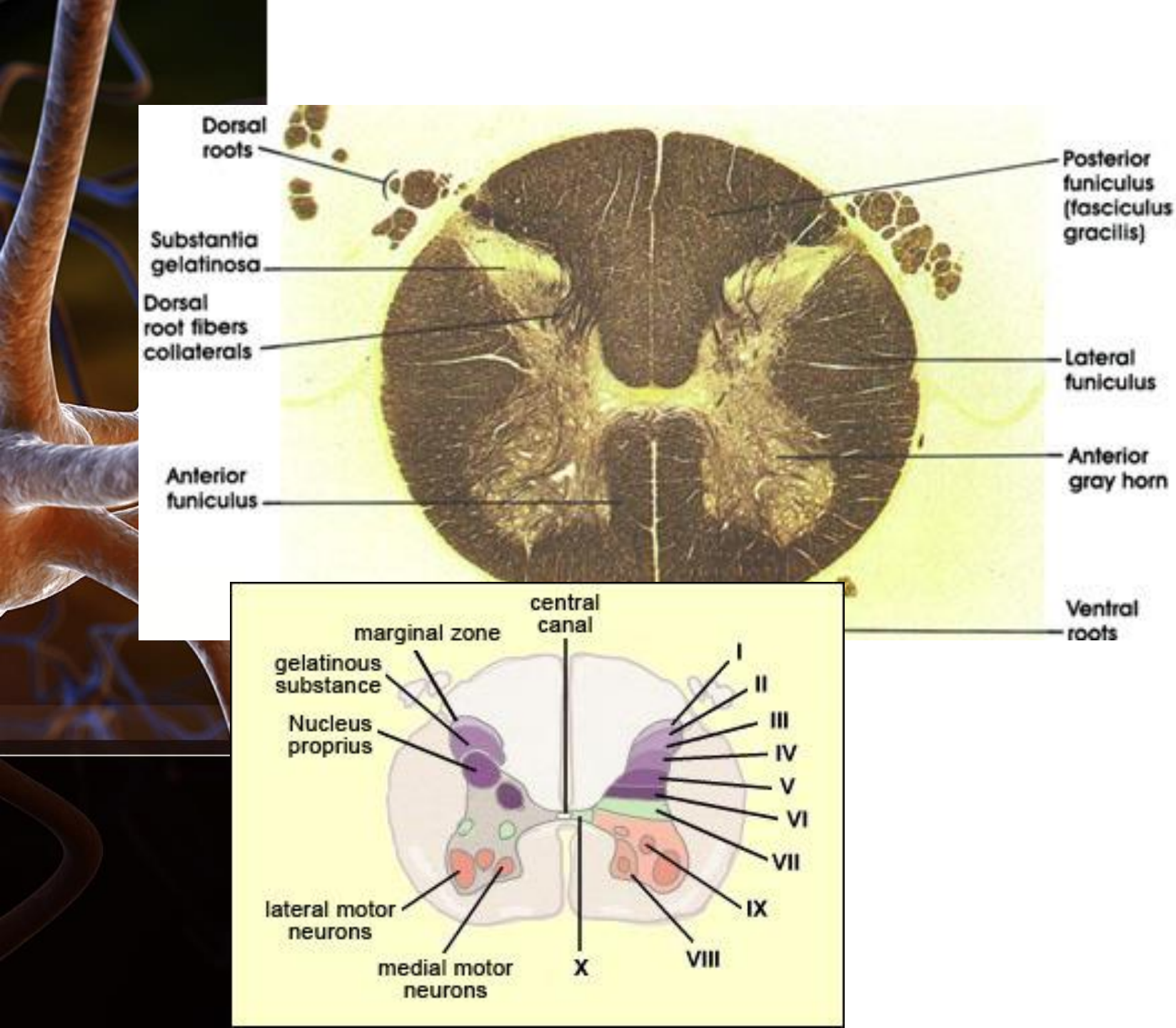


The Nucleus Extends :

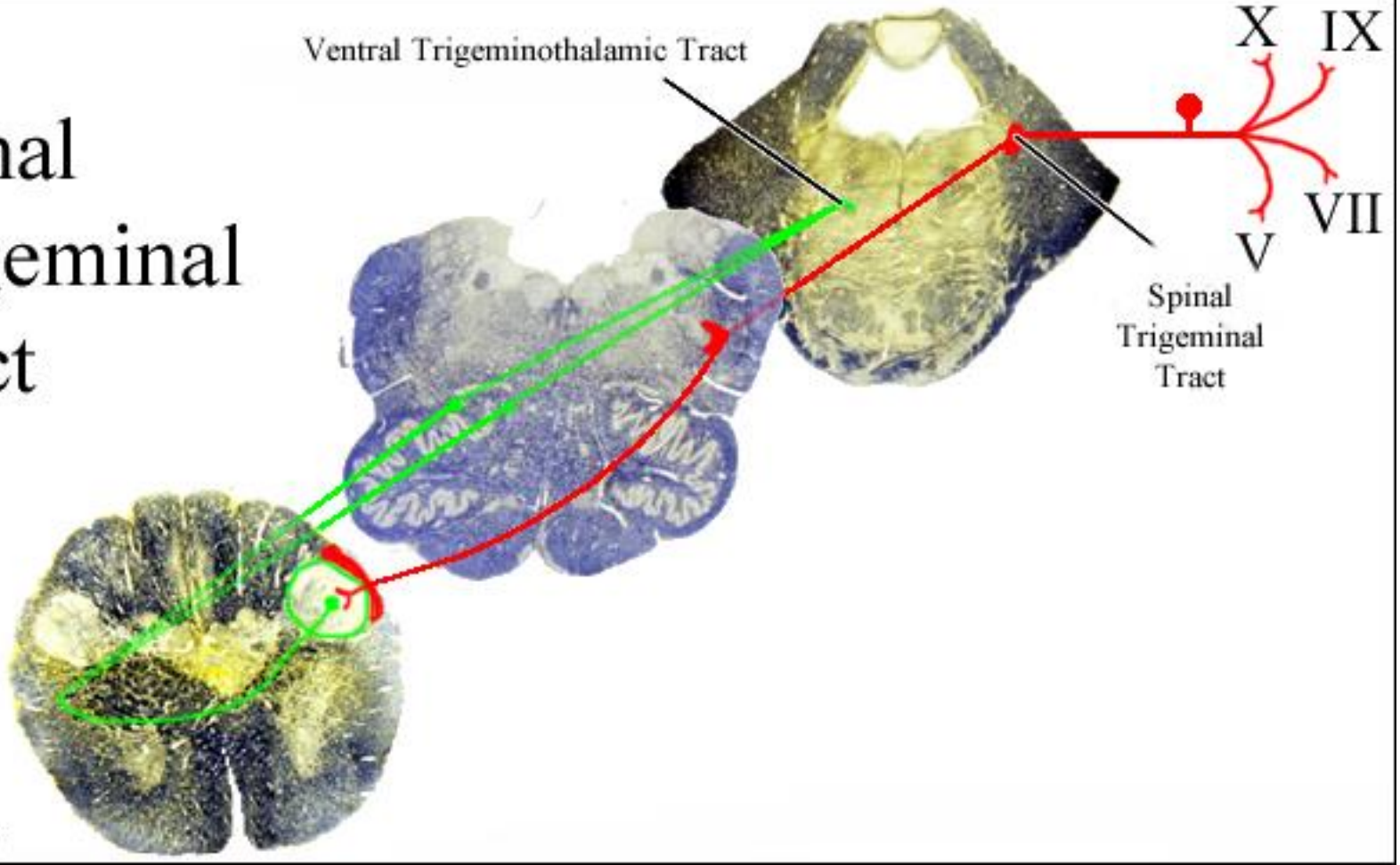
- Through the whole length of the brain stem and into upper segments of spinal cord.
- It lies in all levels of M.O, medial to the spinal tract of the trigeminal.
- Its tract present in all levels of M.O. is formed of descending fibers that terminate in the trigeminal nucleus.

CAUDAL (closed) MEDULLA

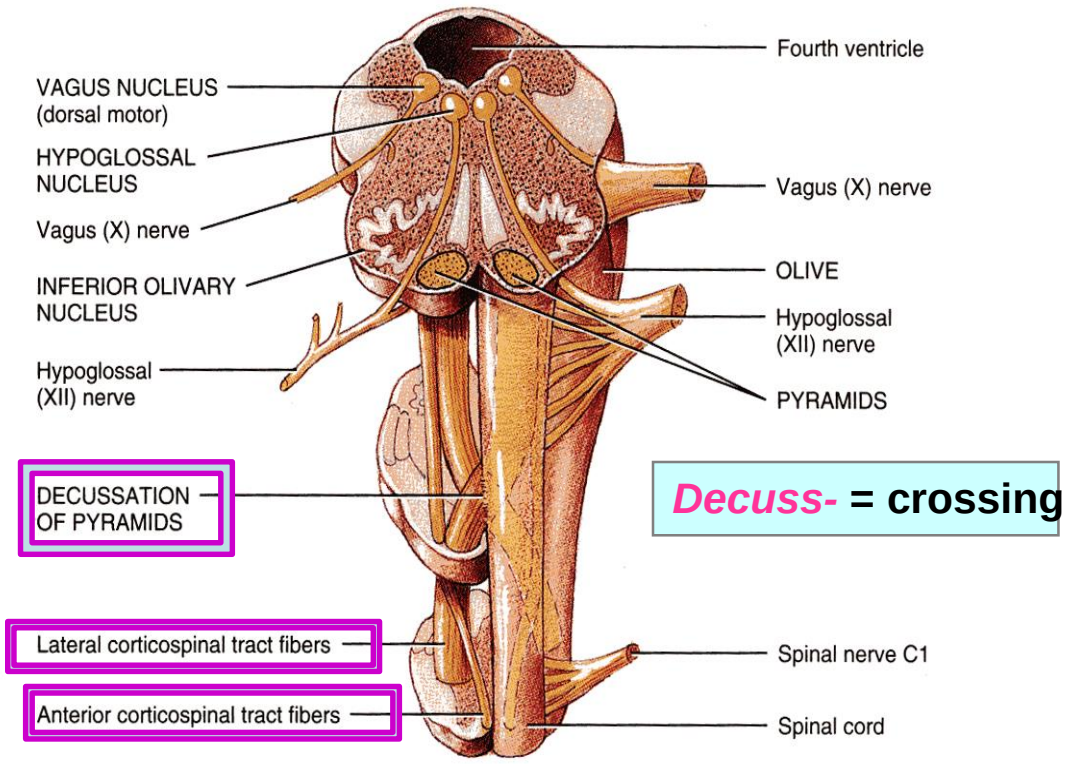



Dorsal roots
Substantia gelatinosa
Dorsal root fibers collaterals
Anterior funiculus
Posterior funiculus (fasciculus gracilis)
Lateral funiculus
Anterior gray horn
Ventral roots
central canal
marginal zone
gelatinous substance
Nucleus proprius
lateral motor neurons
medial motor neurons
I
II
III
IV
V
VI
VII
VIII
IX
X

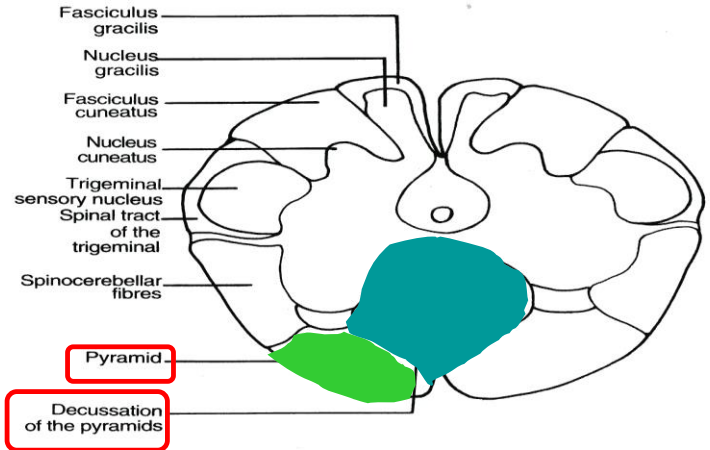
Spinal Trigeminal Tract



PYRAMIDAL DECUSSATION

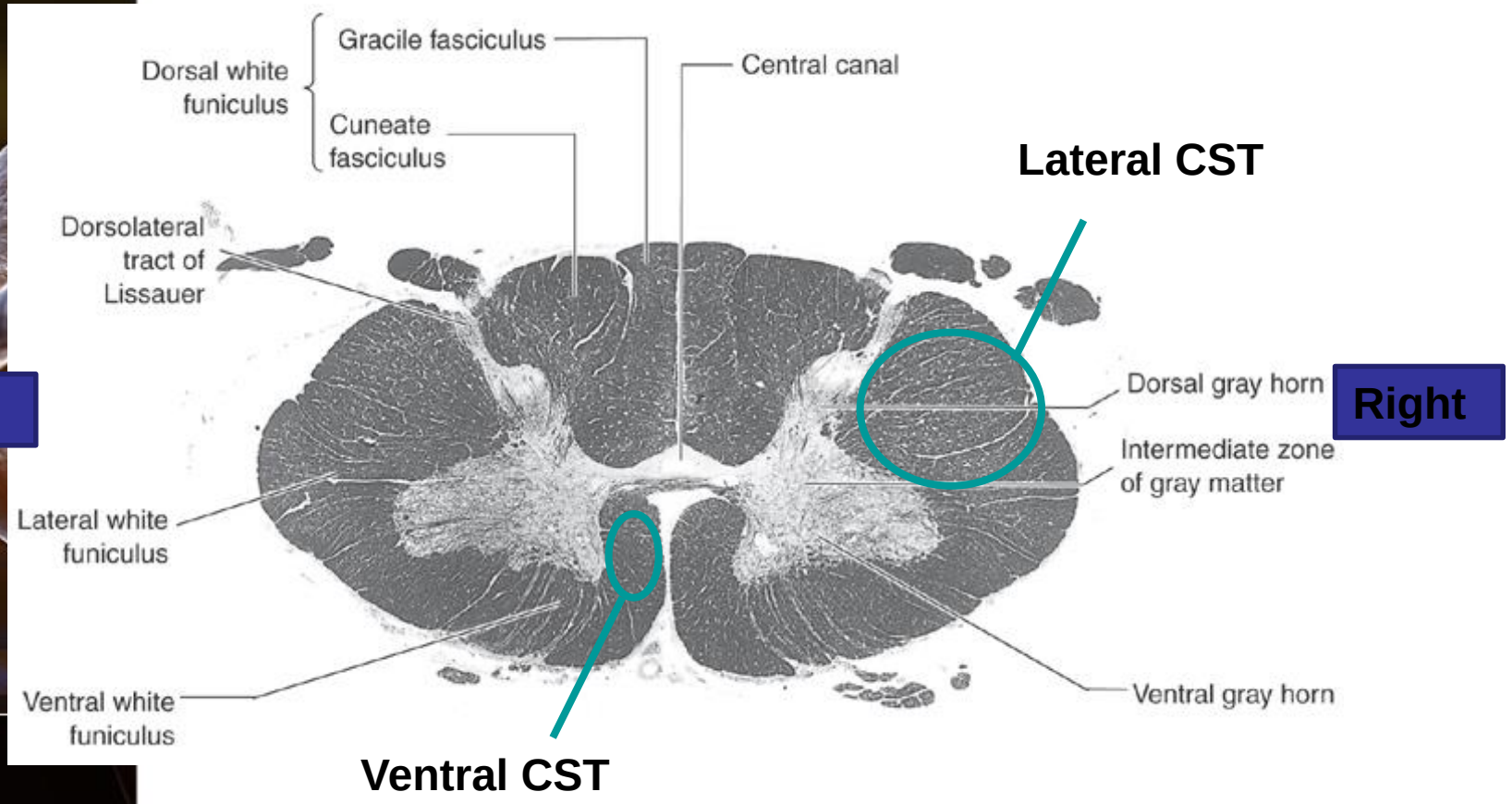


Decuss- = crossing



- *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.*

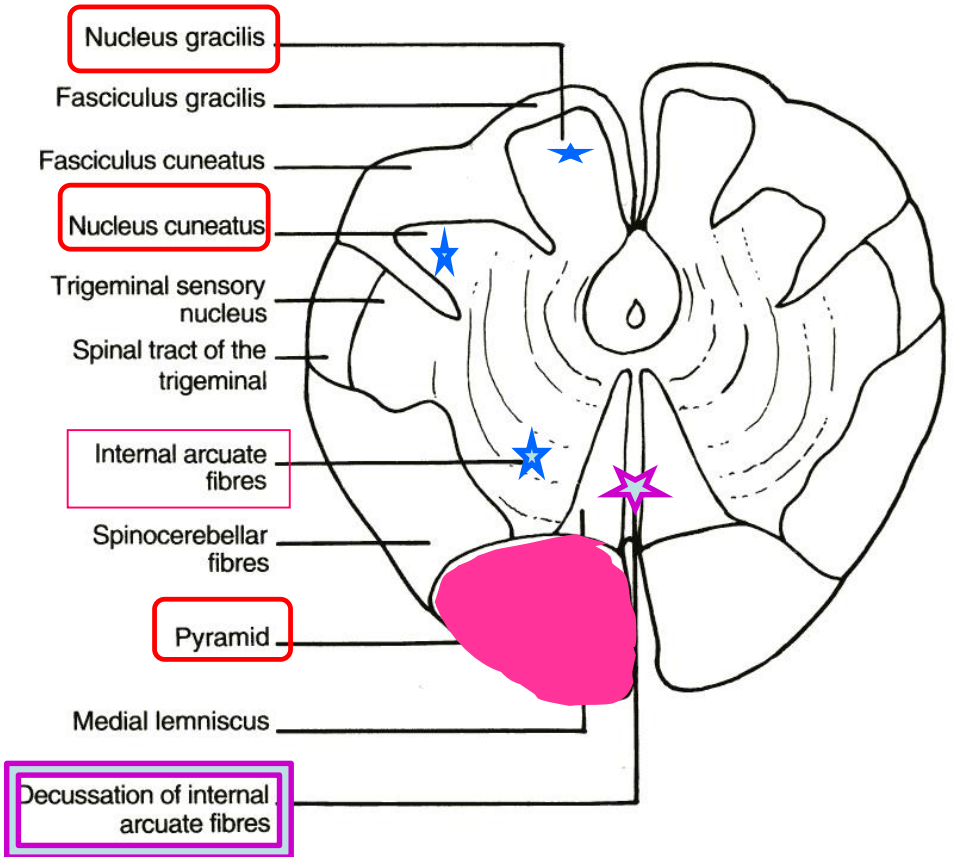
Pyramidal tract: CST in cervical cord



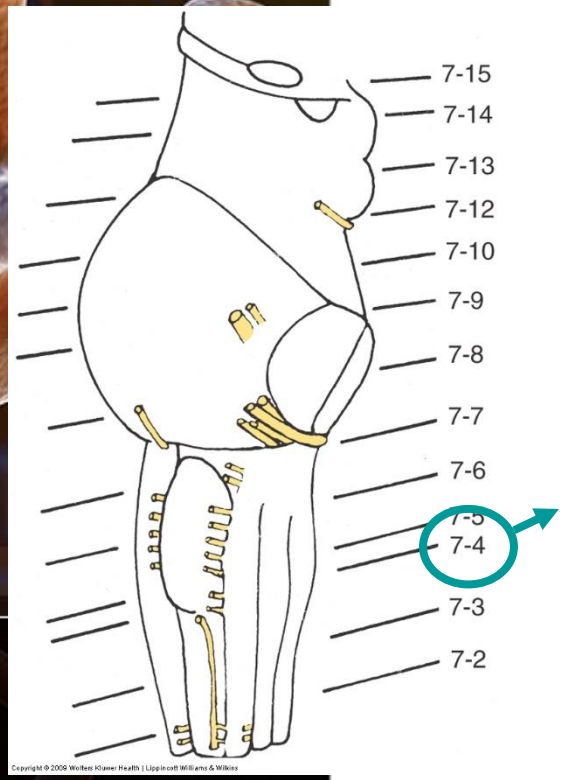
Both of these originated in the same side of the cortex. Which side?

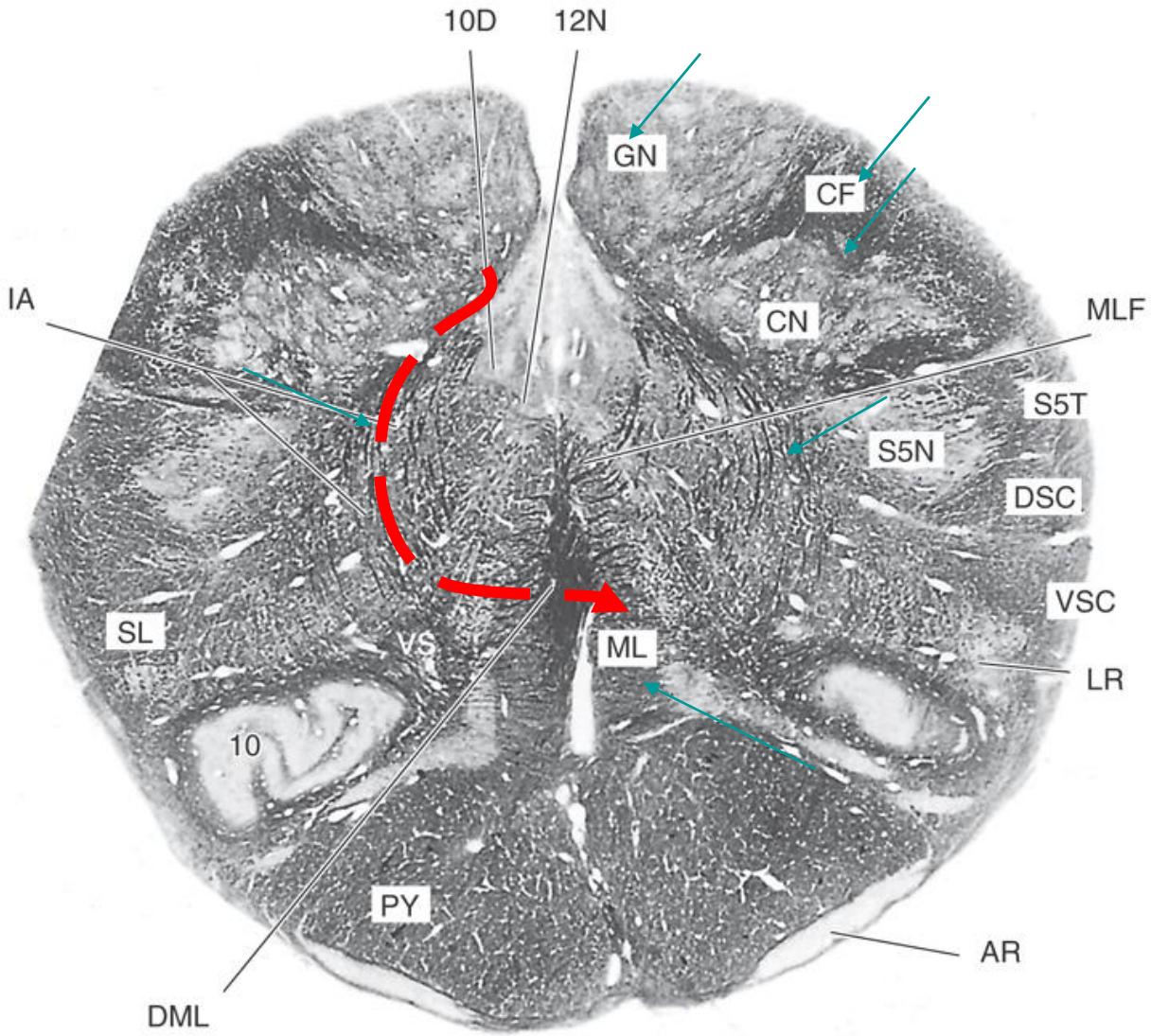
MID MEDULLA

- *Traversed by Central Canal.*
- *Larger size Gracile & Cuneate nuclei.*
- *Axons of Gracile & Cuneate nuclei form the internal arcuate fibers; Sensory Decussation.*
- *Pyramids are prominent ventrally.*

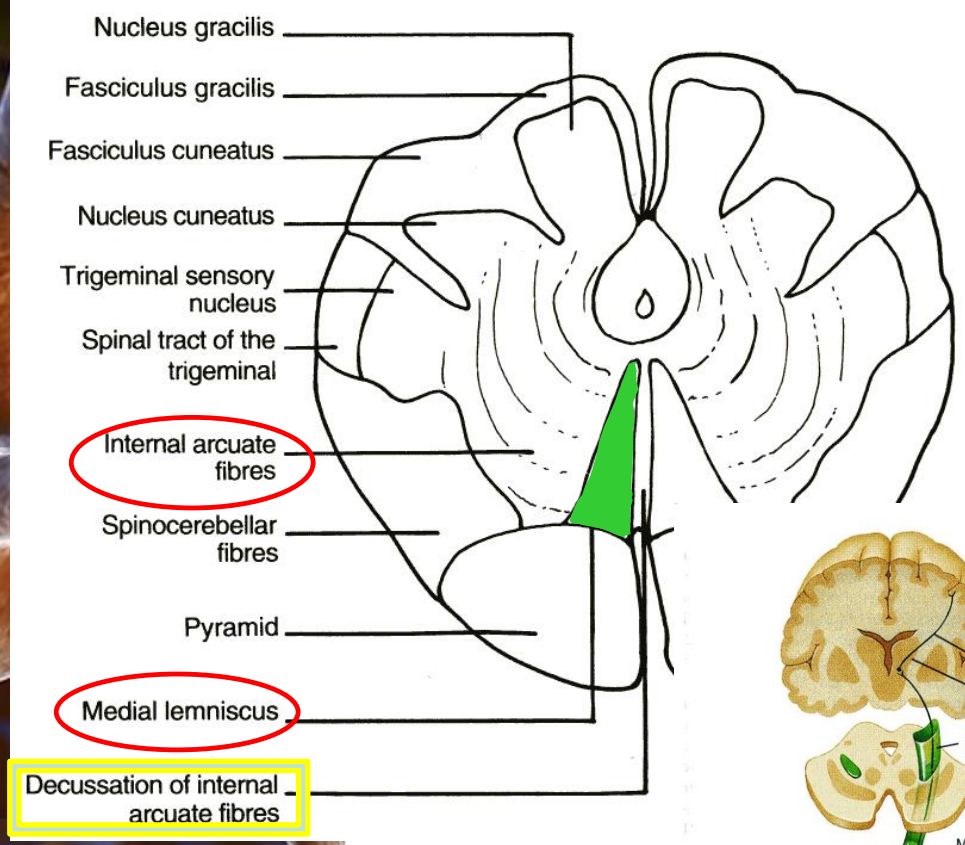


The Dorsal Column/Medial Lemniscus System

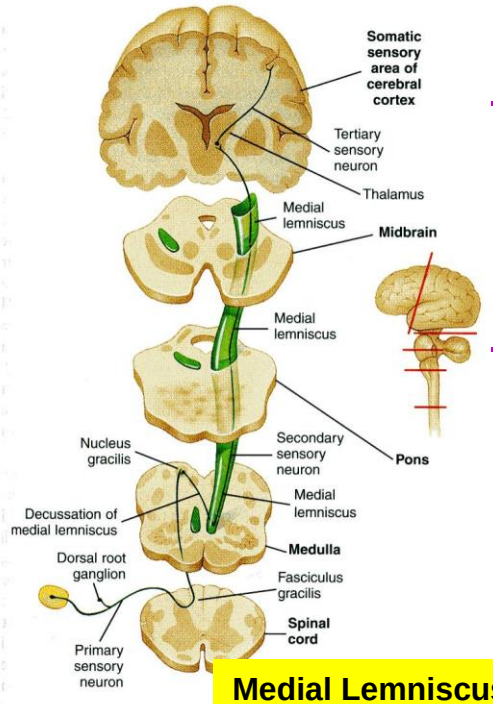




SENSORY DECUSSATION

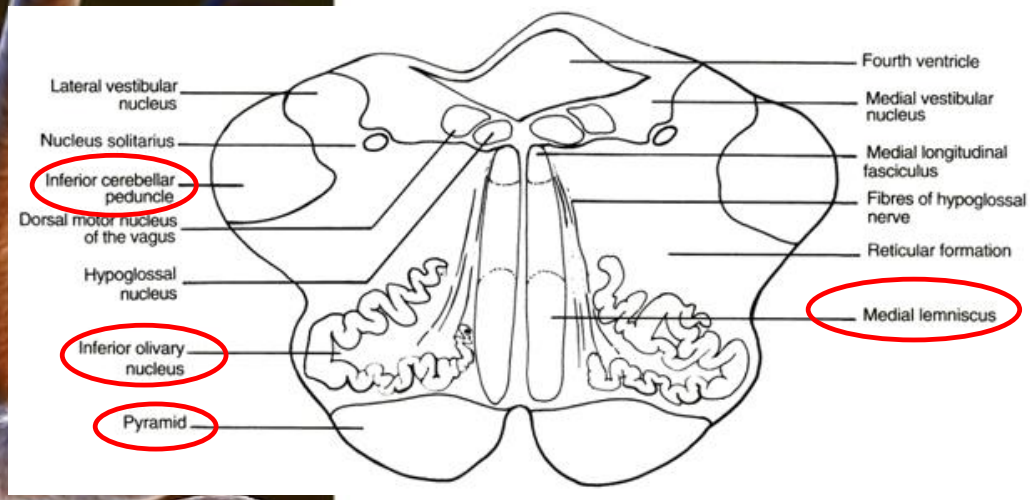


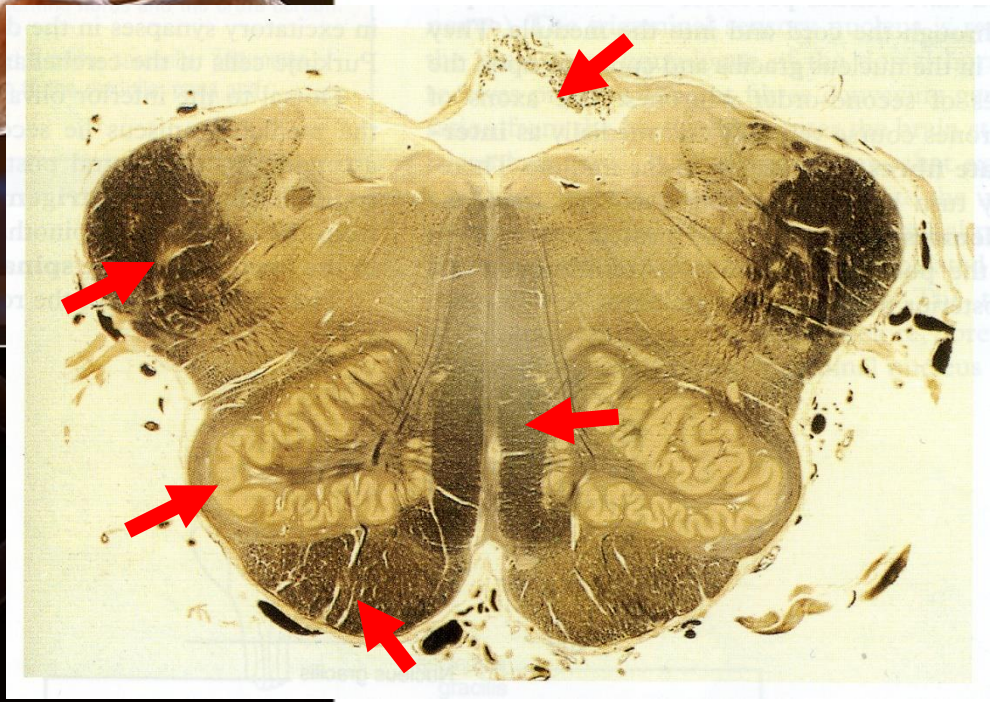
- *Formed by the crossed internal arcuate fibers*
- *Medial Leminiscus:*
  - *Composed of the ascending internal arcuate fibers after their crossing.*
  - *Lies adjacent to the middle line ventral to the central canal*
  - *Terminates in thalamus.*



Medial Lemniscus

ROSTRAL (open) MEDULLA

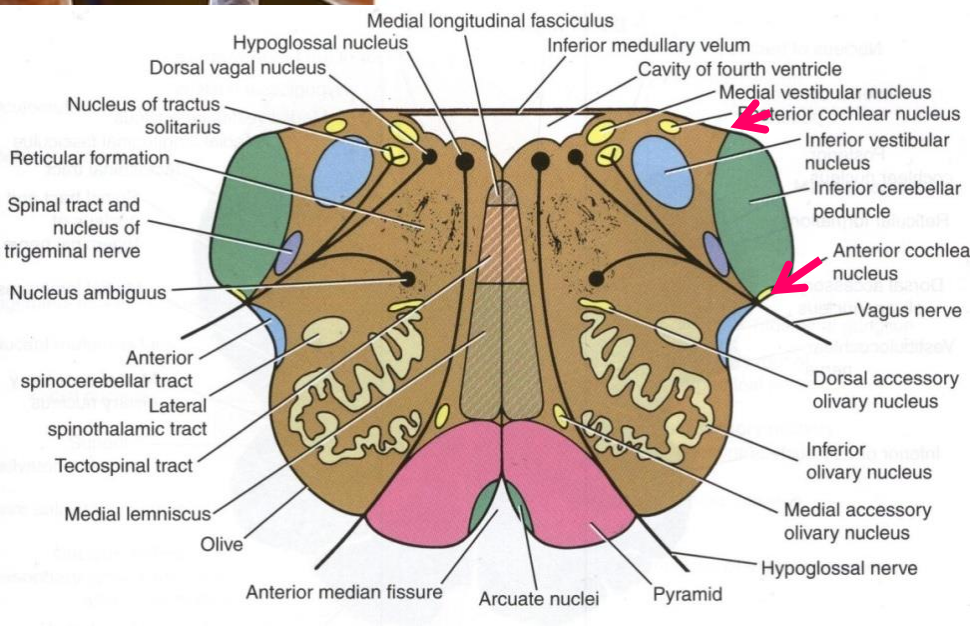




On the ventral aspect :

- The pyramid is clear, with 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.

ROSTRAL (open) MEDULLA

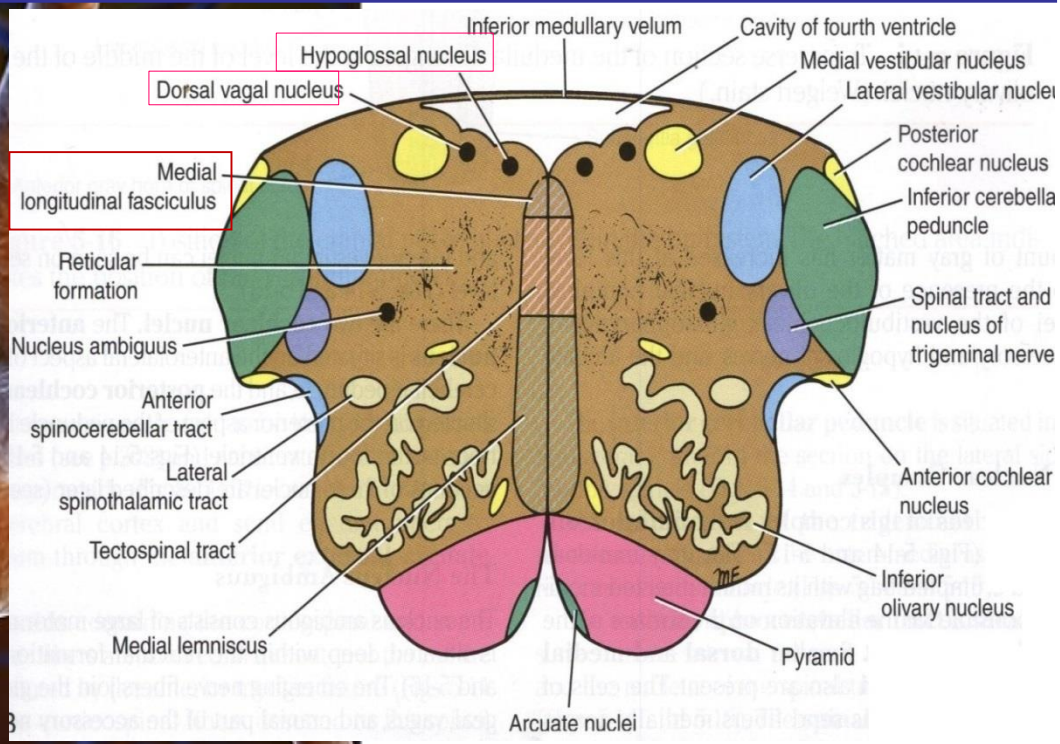


Its dorsal surface forms:

- Lower part of the floor of the 4th ventricle.

- The Inferior Cerebellar Peduncle is connecting M.O. with cerebellum.
- (dorsal and ventral) to the Inferior cerebellar peduncle lie the Cochlear nuclei

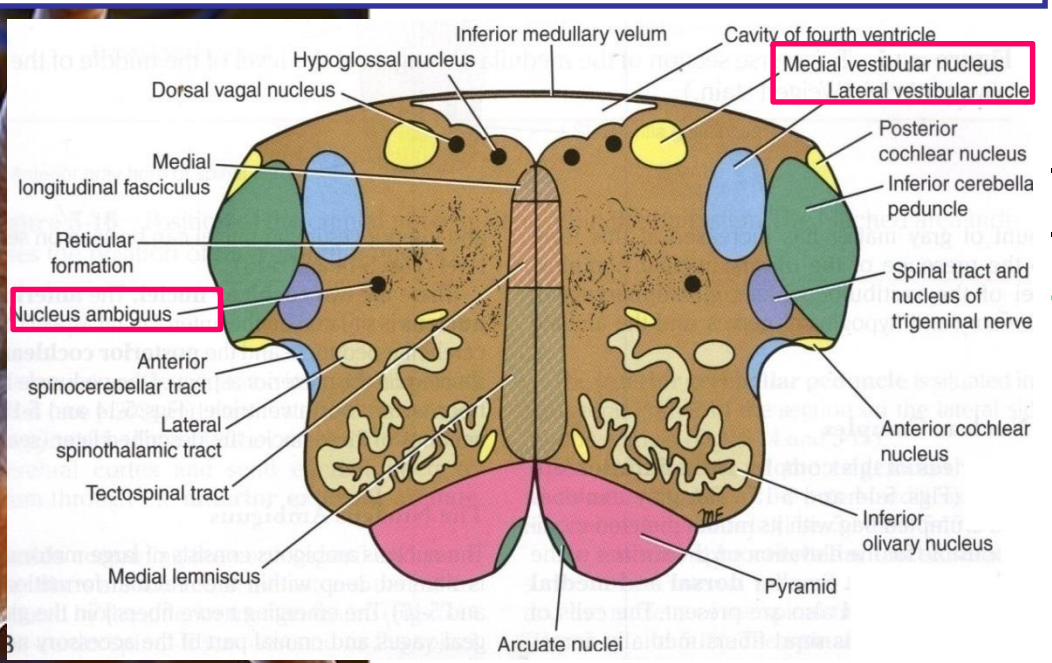
ROSTRAL (open) MEDULLA

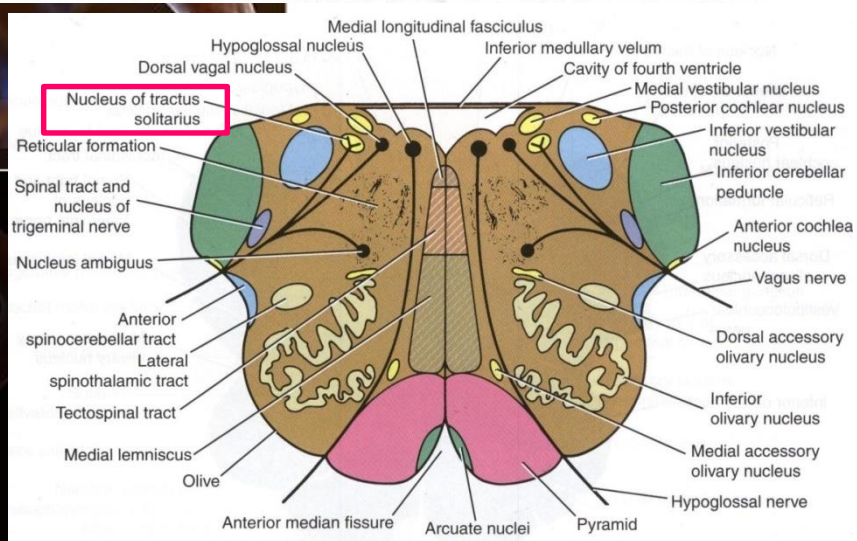


Beneath the floor of 4th ventricle lie :

- ✓ ***1. Hypoglossal Nucleus.***
- ✓ ***2. Dorsal Nucleus of Vagus lateral to the hypoglossal nucleus.***
- ✓ **3. Medial longitudinal fasciculus, it is important association tract, *lies* close to the midline, ventromedial to the hypoglossal nucleus.**

ROSTRAL (open) MEDULLA





4. Vestibular nuclei complex

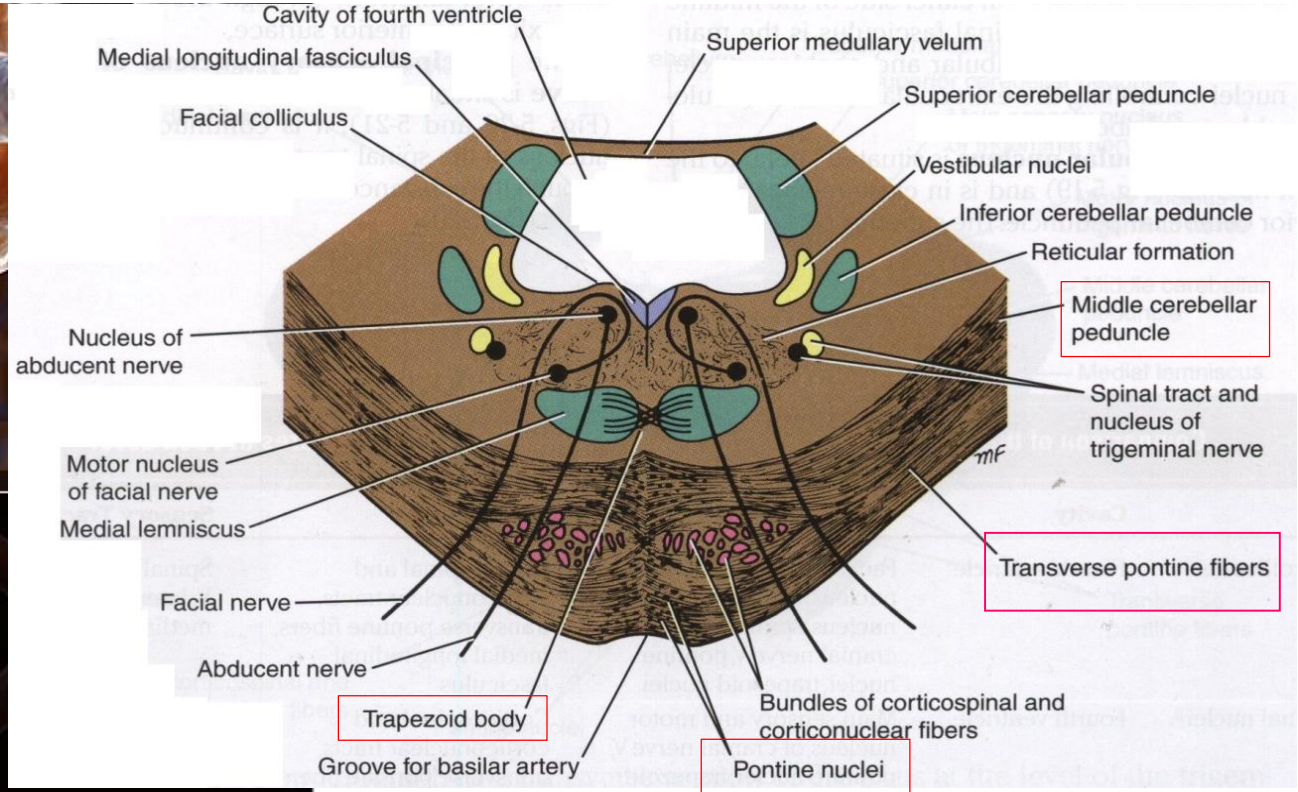
5. Nucleus Ambiguus: (motor nucleus) : lies dorsal to olivary nucleus gives motor fibers along glossopharyngeal N. & vagus N.

6. Solitary nucleus (sensory nucleus) : lies ventrolateral to dorsal nucleus of vagus.

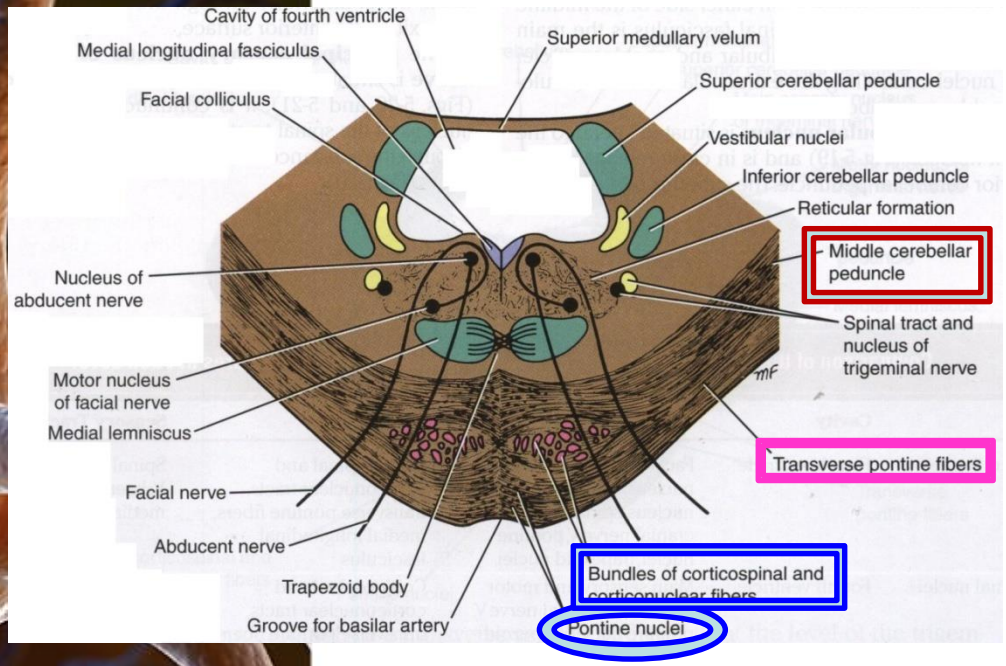
7. Tectospinal tract : between tectum of midbrain and spinal cord (involved in head movements during visual and auditory tracking).

CAUDAL PART OF THE PONS

- **Divided into an anterior part (Basis Pontis) & a posterior part (Tegmentum) by the Trapezoid Body (consists of acoustic fibres from cochlear nuclei to ascend into midbrain as lateral lemniscus and terminate in inferior colliculus).**
- **The ventral portion :** 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 massive **middle cerebellar peduncle.**



CAUDAL PART OF THE PONS

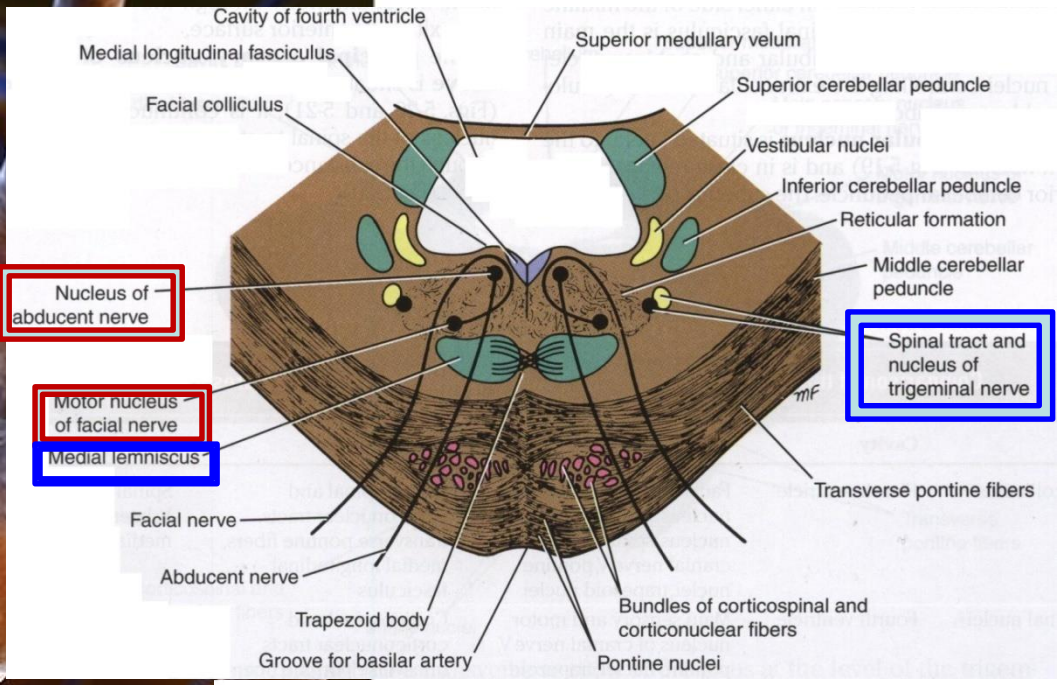


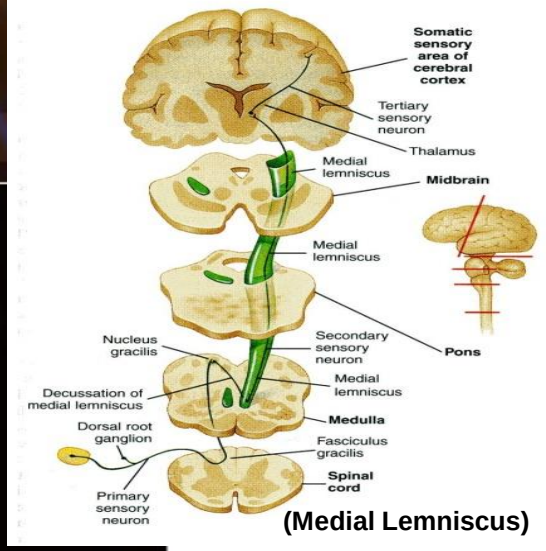
1. Pontine Nuclei:

- *Are 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 the medial lemniscus

- become separated from the pyramid and displaced dorsally.

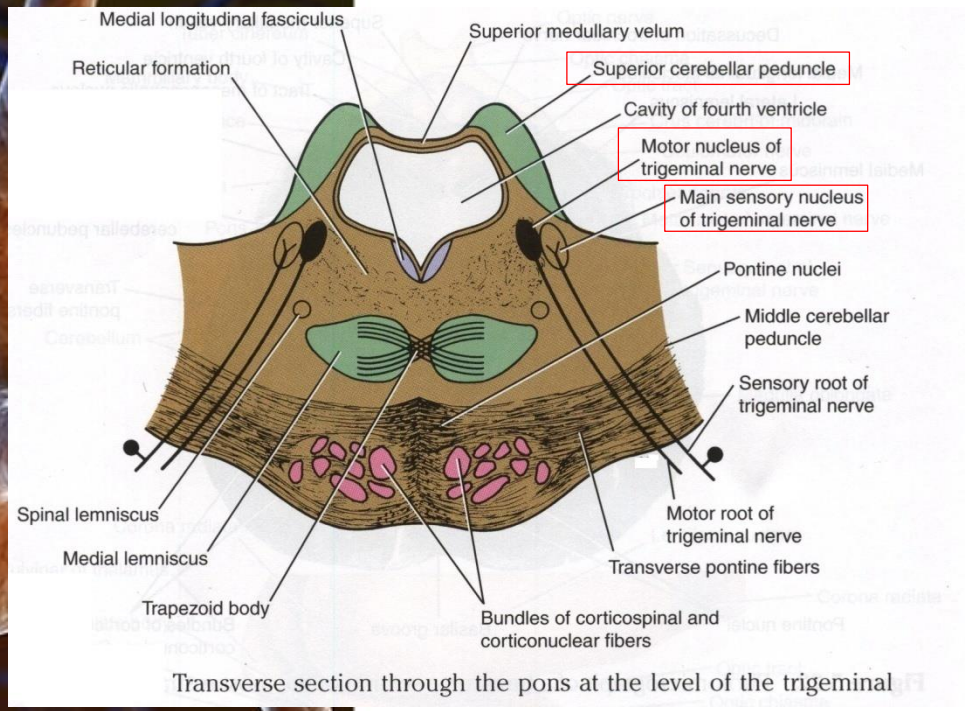
⊡ ***The Medial Lemniscus rotates 90 degrees and lies almost horizontally.***

4. It contains **spinal tract & nucleus of Trigeminal.**

5. *Deep origin of* ***cranial nerve nuclei :***

- ***Abducent nucleus***
- ***Facial motor nucleus***

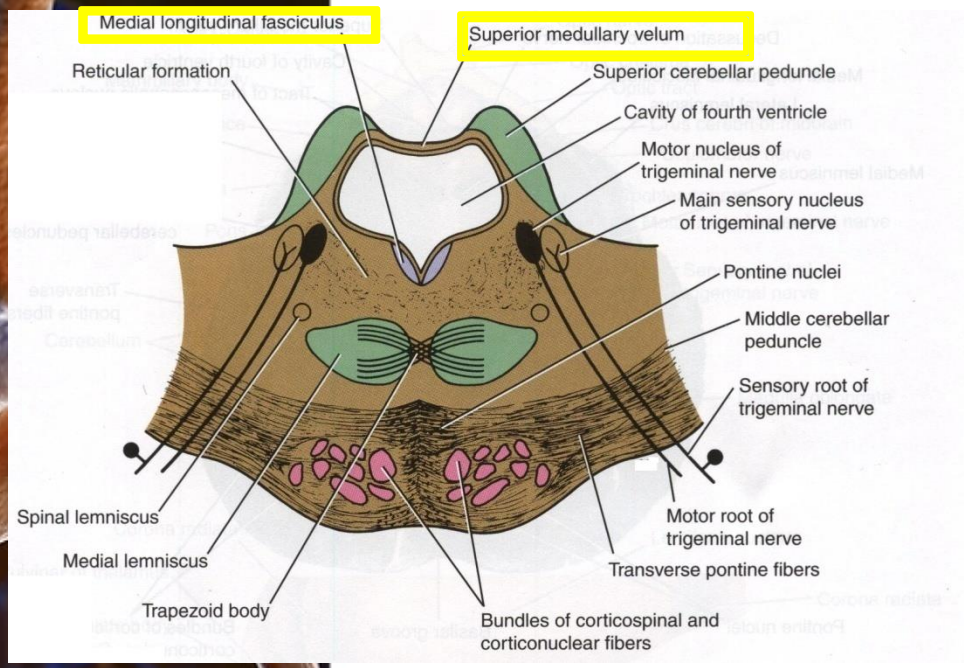
AT THE LEVEL OF THE TRIGEMINAL NERVE



Transverse section through the pons at the level of the trigeminal

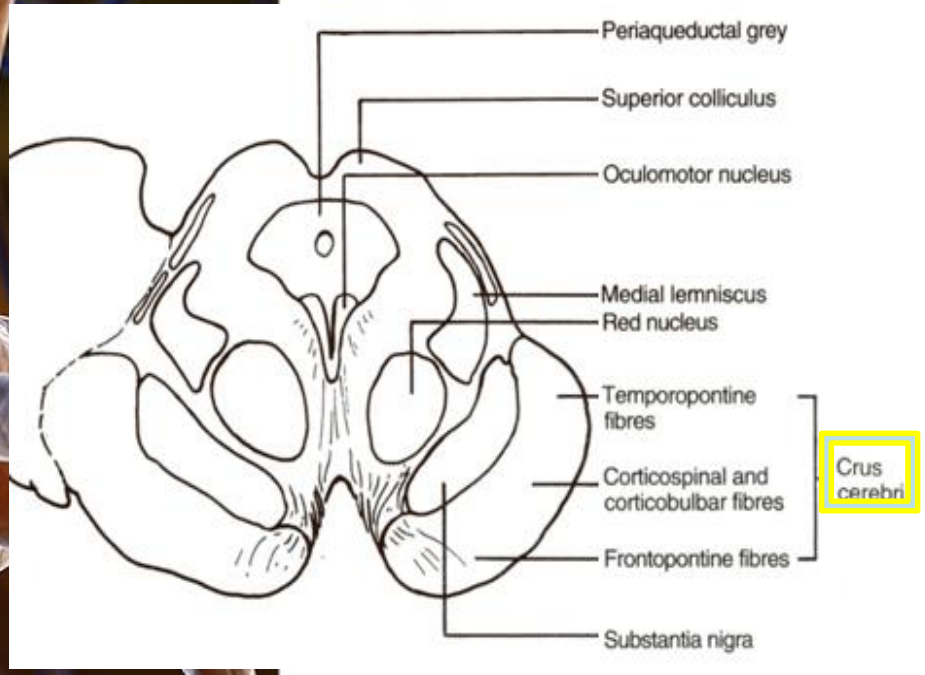
- ***Motor nucleus of the trigeminal nerve:*** ***Lies in the lateral part of the floor of the 4th ventricle.***
- ***Main sensory nucleus of the trigeminal nerve:*** ***Reaches its maximum extent in the pons and it lies lateral to the motor nucleus.***
- ***Superior cerebellar peduncles*** ***form the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

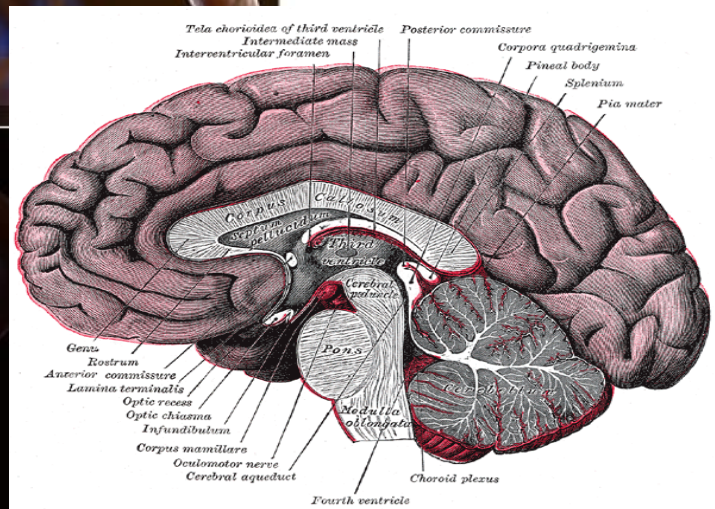
ROSTRAL PONS



- ***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



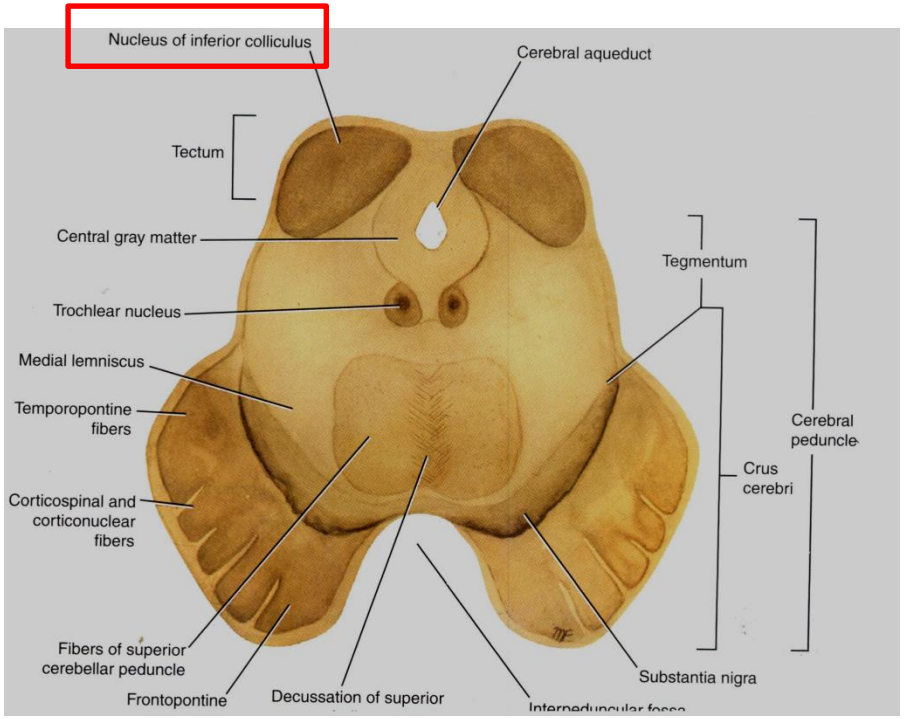


It is divided into :

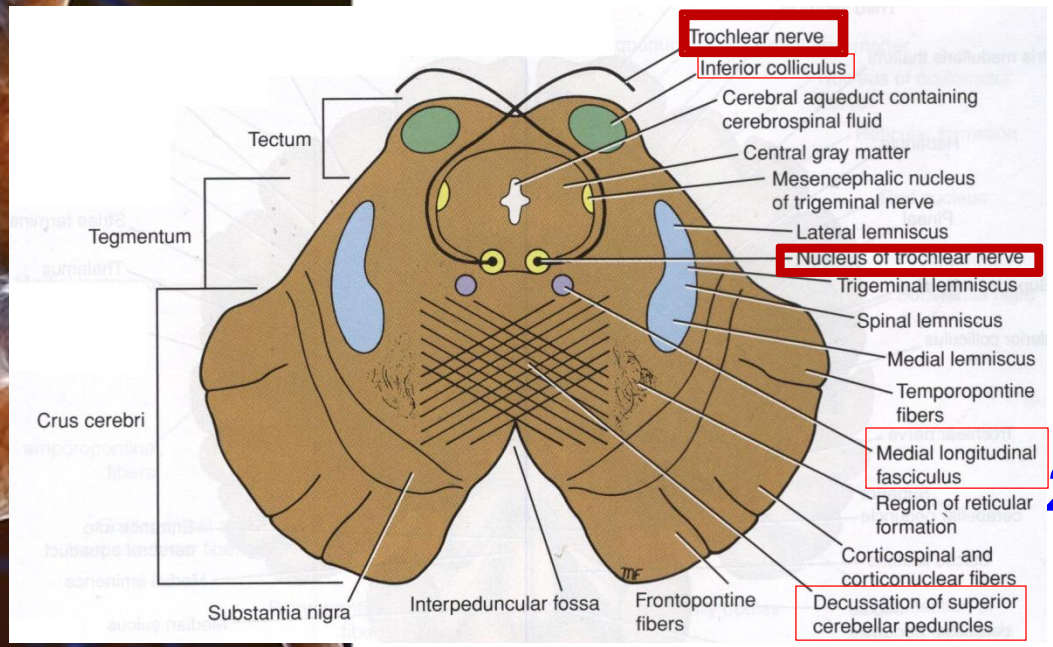
- ***a <u>dorsal part</u> (Tectum) and***
- ***a <u>ventral part</u> (Tegmentum) at the level of the <u>cerebral aqueduct.</u>***
- ***The cerebral aqueduct is surrounded by a pear shaped periaqueductal (central) gray matter.***
- ***The <u>most ventral part</u> of the <u>tegmentum</u> is the massive fibrous mass (Crus Cerebri).***

INFERIOR COLLICULUS Level

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

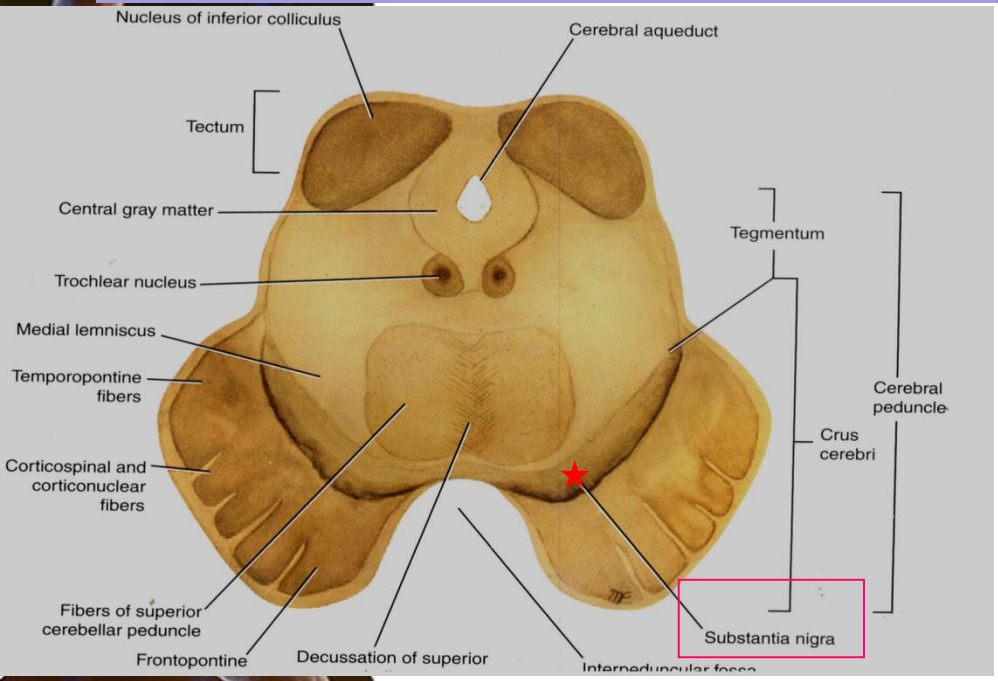


INFERIOR COLLICULUS Level



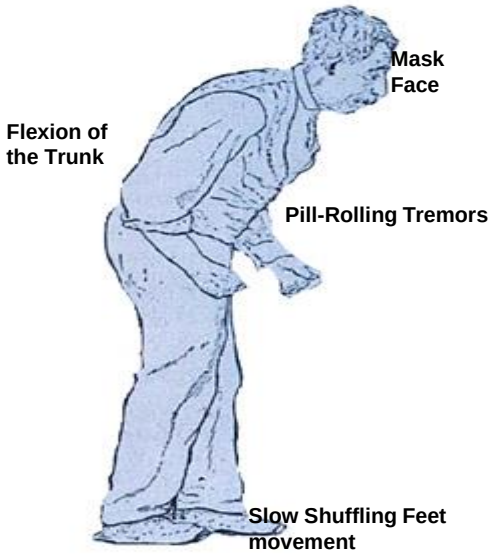
1. ***Trochlear nucleus:***
   - ***lies in the central gray matter close to the median plane just posterior to the medial longitudinal bundle.***
   - ***The fibers of the trochlear nerve decussate in the superior medullary velum.***
2. ***Decussation of the superior cerebellar peduncles in the mid line.***

INFERIOR COLLICULUS Level

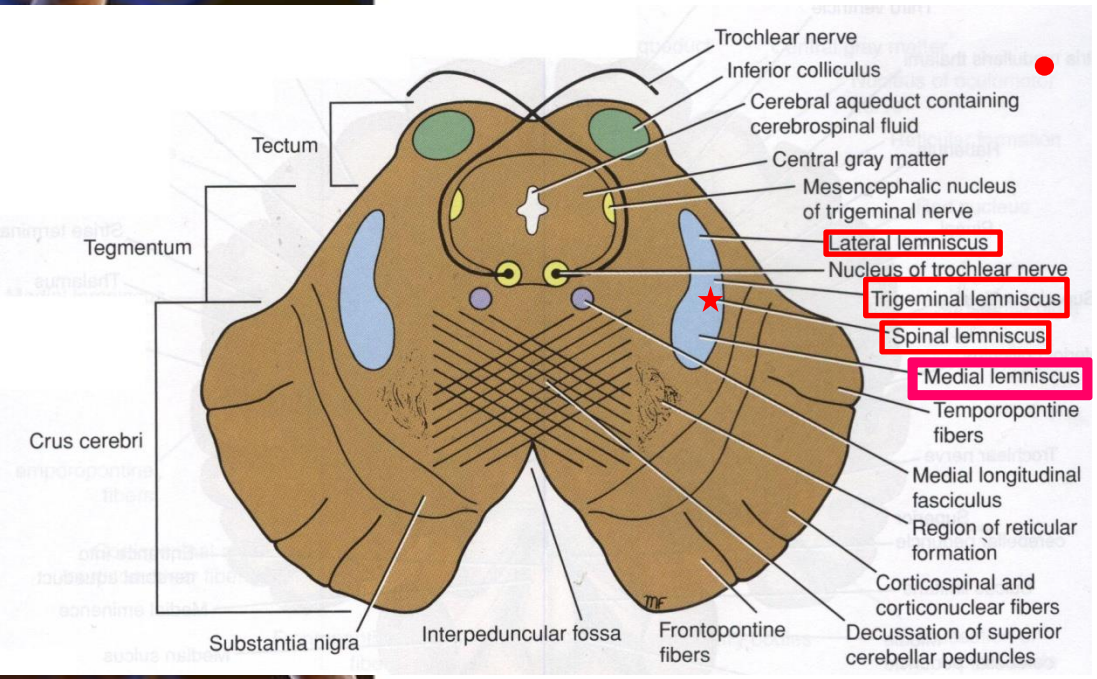


3. Substantia nigra :

- *Occupies the most ventral part of the tegmentum.*
- *It consists of pigmented, melanin containing neurones.*
- *It projects to the basal ganglia. Its degeneration is associated with Parkinson's disease.*

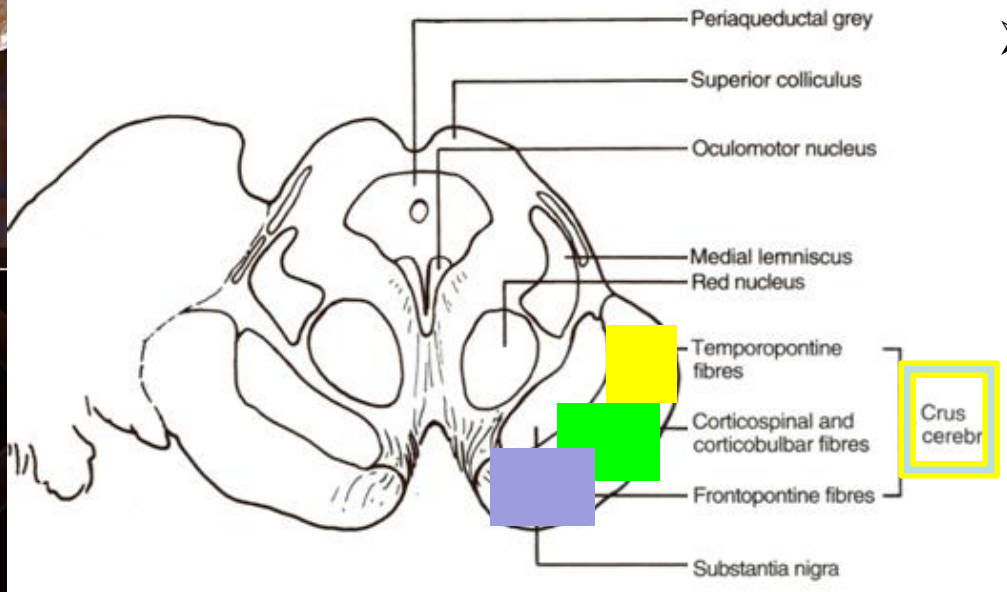


ASCENDING LEMINISCI



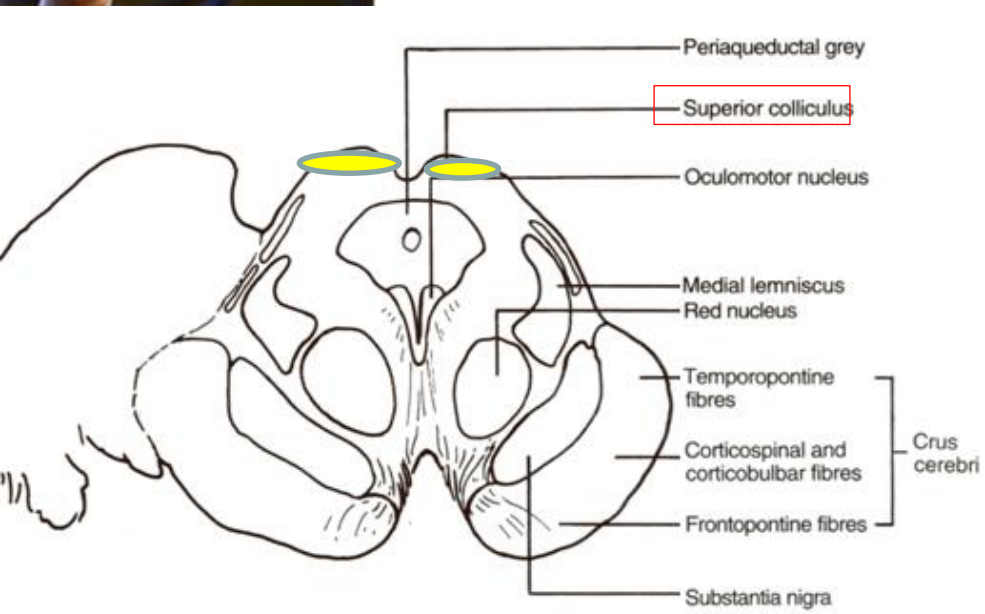
- ***Composed Of:***
  - ***Medial lemniscus.***
  - ***Spinal* (Lateral & anterior spinothalamic tracts)**
  - ***Trigeminal* (Lateral & medial).**
  - ***Lateral lemniscus.***

CRUS CEREBRI



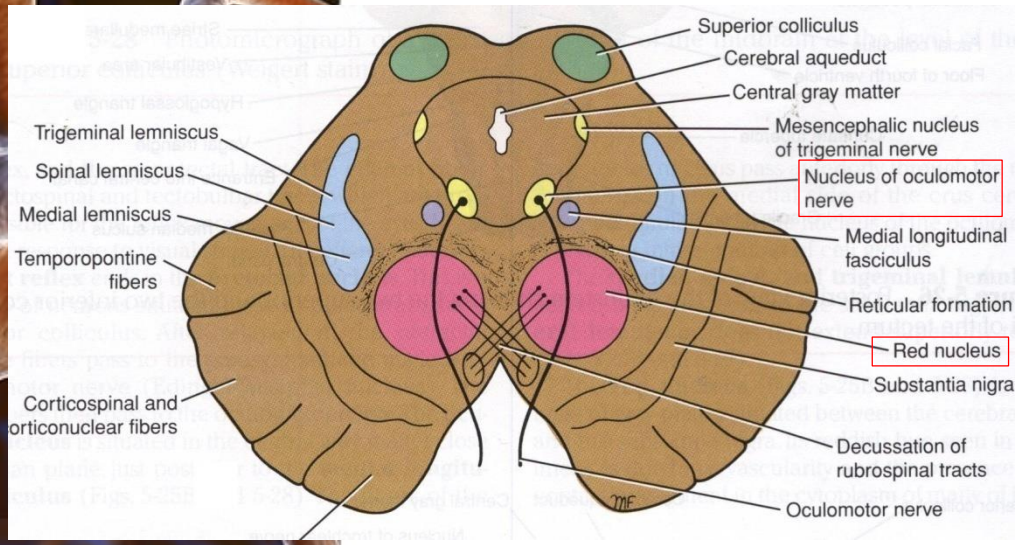
- It is a massive mass <u>ventral</u> to the <u>substantia nigra</u>.
- It consists entirely of descending cortical efferent fibers (Frontopontine, Corticospinal & corticobulbar and Temporopontine Fibres) to the <u>motor cranial nerve nuclei</u> and to <u>anterior horn cells.</u>
- Involved in the coordination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

SUPERIOR COLLICULUS Level



- A large nucleus of gray matter that lies beneath corresponding elevation.
- 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, as in following a moving object or altering the direction of the gaze.

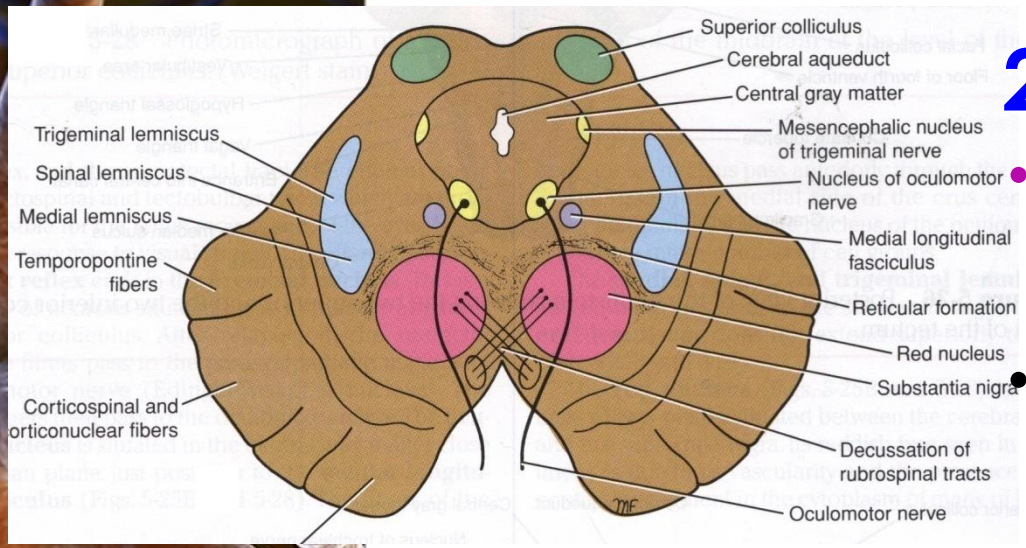
SUPERIOR COLLICULUS Level



1. Oculomotor nucleus:

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

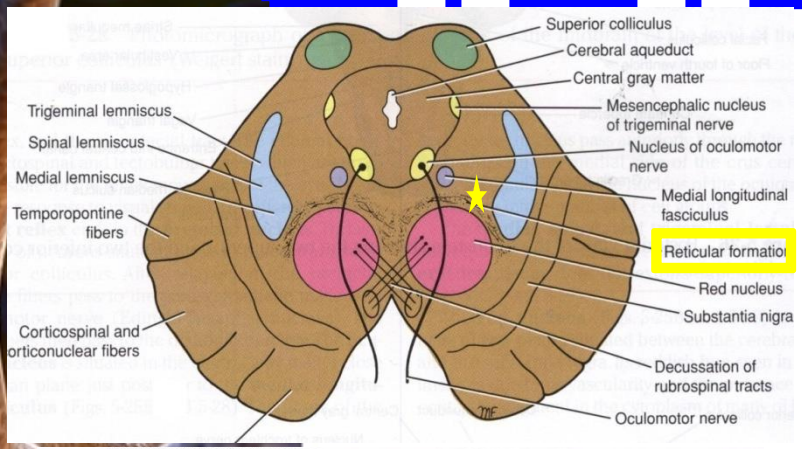
SUPERIOR COLLICULUS Level

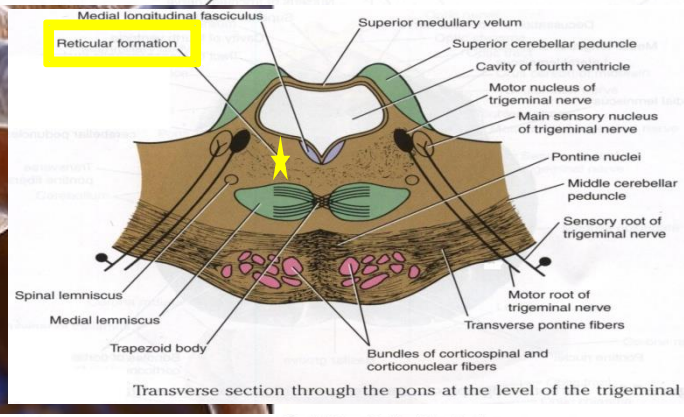


2. Red nucleus :

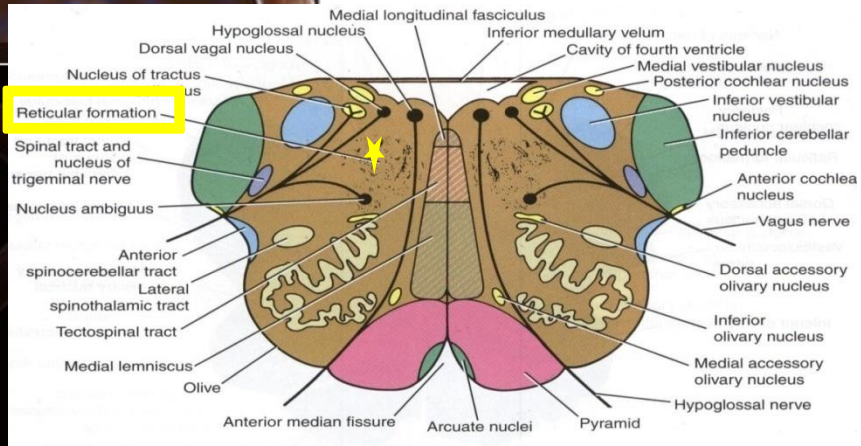
- A rounded mass of gray matter that lies in the central portion of the tegmentum.
- Its red coloration is due to its vascularity and the presence of an iron containing pigment in the cytoplasm of its neurons.
- It is involved in motor control.

RETICULAR FORMATION





Transverse section through the pons at the level of the trigeminal



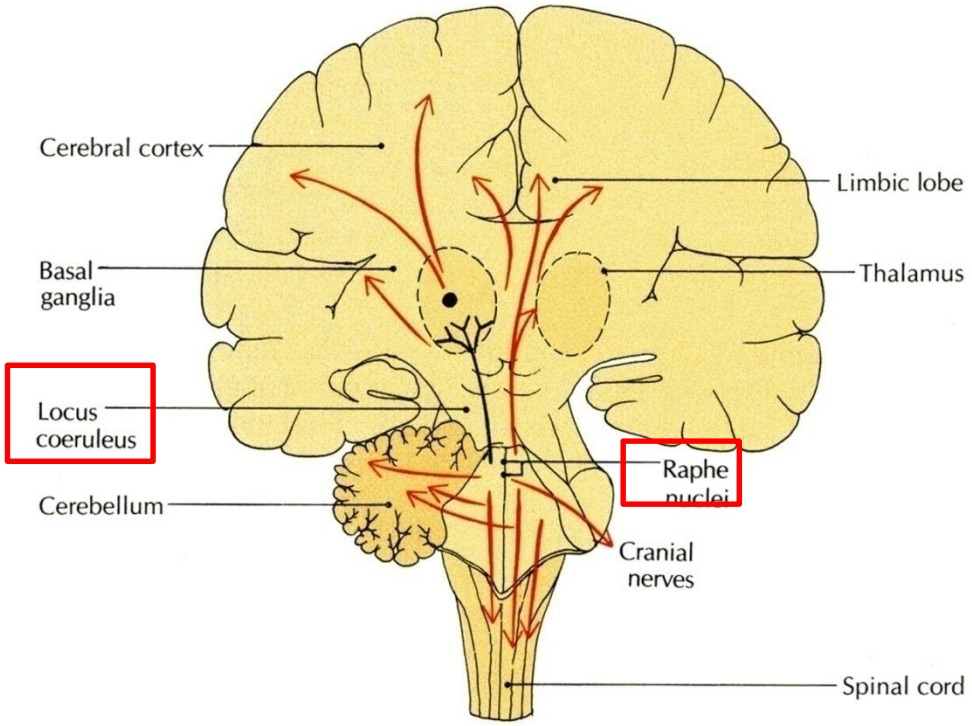
- It is a complex matrix of nerve fibers & small groups of nerve cells that extends throughout the brain stem.
- It has a number of important functions i.e. Respiratory and Cardio-vascular centers are located in the medullary and caudal pontine reticular formation.

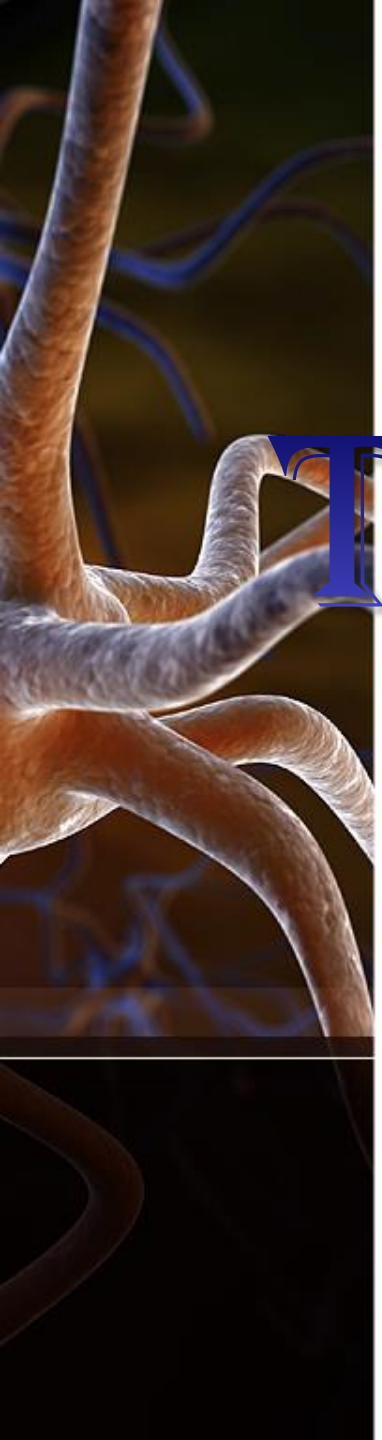
Raphe Nuclei:

- ✓ Midline reticular nuclei.
- ✓ They are serotonergic.
- ✓ Its ascending fibers to the cerebral cortex are involved in the mechanisms of sleep.
- ✓ Its descending fibers to the spinal cord are involved in the modulation of Pain.

Locus Ceruleus:

- ➢ Pigmented neurons that lie in the tegmentum of the caudal midbrain & rostral pons
- ➢ It is the main noradrenergic cell group of the brain.
- ➢ Helps in arousal and sleep-wake cycles.





Thank You