



Anatomy Team
MED 439

Revised & Approved



MED439
KING SAUD UNIVERSITY

The Internal Structures of the Brainstem

CNS Block

Color index:

Content
Male slides
Female slides
Important
Doctors notes

Extra information, explanation

Don't forget to check the [Editing File](#)

Contact us:
Anatomy439@gmail.com

Objectives

At the end of the lecture, students should 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, mid and open medulla)
2. Pons (caudal and rostral).
3. Midbrain (superior and inferior colliculi).

Medulla oblongata

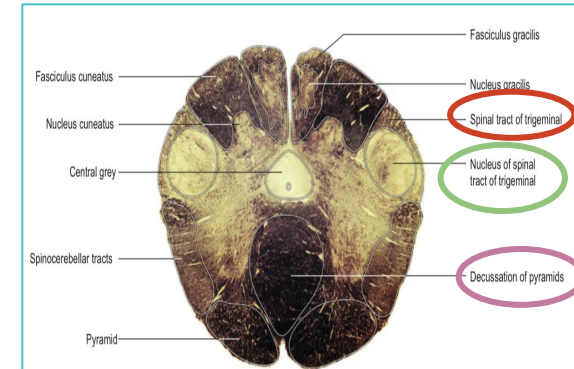
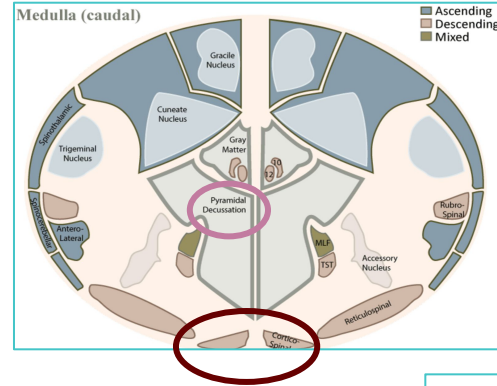
Caudal (Closed) Medulla

Traversed by the central canal

Motor decussation
(decussation of the pyramids)

Also called corticospinal decussation

Trigeminal sensory nucleus



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**.

it is a larger sensory nucleus.

The Nucleus Extends Through the whole length of the brainstem and upper segments of spinal cord and its continuation of the substantia gelatinosa of the 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. is formed of descending fibers that terminate in the trigeminal nucleus.

Med438:

how its sensory and descend?note :All CN V afferent sensory information enters the brainstem through the nerve itself located in the pons. Thus, to reach the spinal nucleus (which spans the entire brain stem length) in the Caudal Medulla those fibers have to "descend" in what's known as the Spinal Tract of the Trigeminal

Medulla oblongata

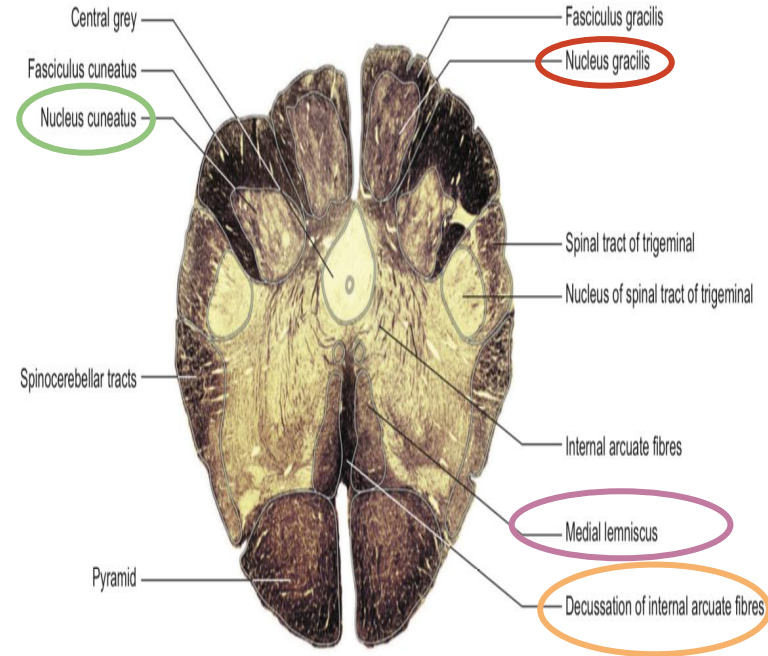
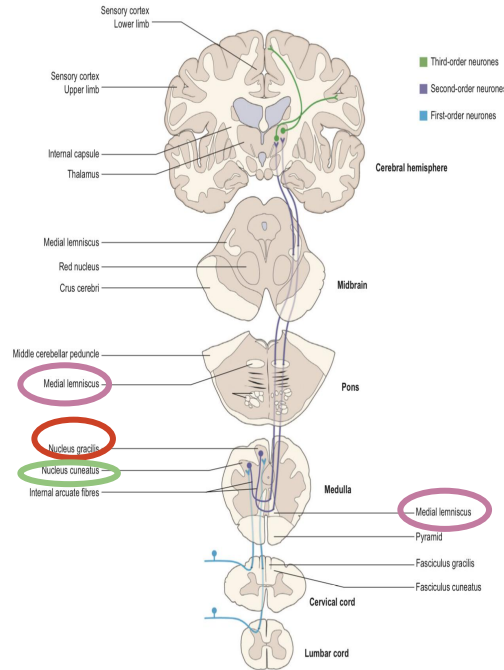
Mid medulla

Traversed by the central canal

Pyramids are prominent ventrally

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**



Formed by the crossed internal arcuate fibers which are called **Medial Lemniscus** after their crossing.

Lies adjacent to the middle line ventral to the central canal

Terminates in thalamus.

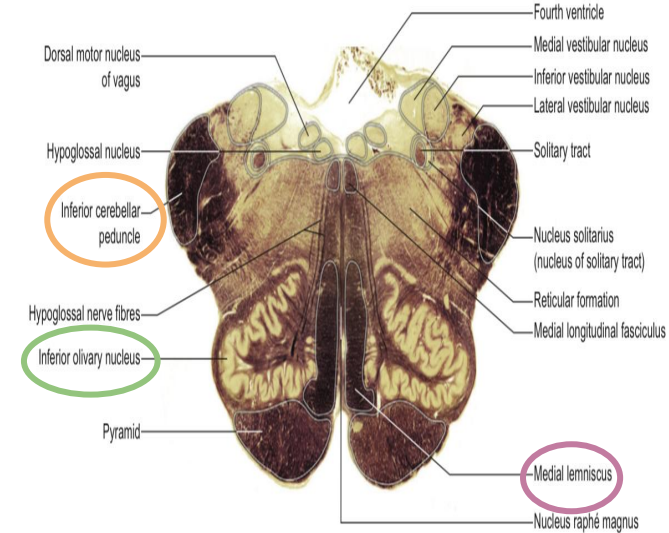
Concerned with proprioceptive deep sensation.

Medulla oblongata

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 lemniscus. Concerned with the control of movements.



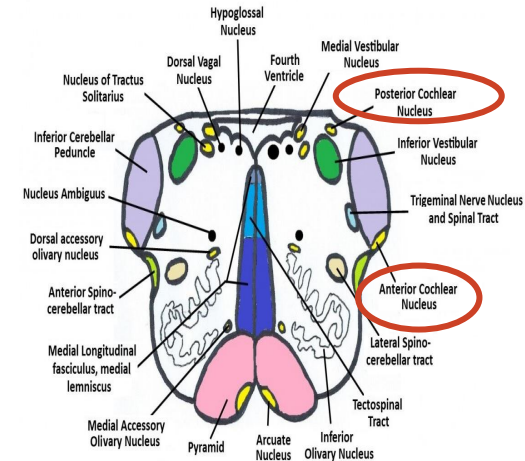
On the dorsal aspect

Lower part of the floor of the 4th ventricle.

The **Inferior Cerebellar Peduncle** is connecting the medulla oblongata with cerebellum.

Dorsal and ventral to the Inferior cerebellar peduncle lie the Cochlear nuclei (dorsal and ventral) : concerning with hearing

Note: the inferior cerebellar peduncle is found lateral on each side of the 4th ventricle.



Medulla oblongata

Rostral (Open Medulla) 1-Nuclei

(beneath the floor of the 4th ventricle except 1,2)

1

Cochlear nuclei

Dorsal and lateral to the Inferior cerebellar peduncle, lie the cochlear nuclei (dorsal and ventral):concerning with hearing.

3

Dorsal vagal nucleus

contains preganglionic parasympathetic fibers.

5

Nucleus Ambiguus

(motor nucleus)lies dorsal to olivary nucleus and gives motor fibers along 9th & 10th CN to Muscles of the pharynx, larynx & palate.

7

2

Inferior Olivary Nucleus

A convoluted mass of gray matter., lies posterolateral to the pyramids & lateral to the medial lemniscus. It is concerned with the control of movement.

4

Hypoglossal Nucleus

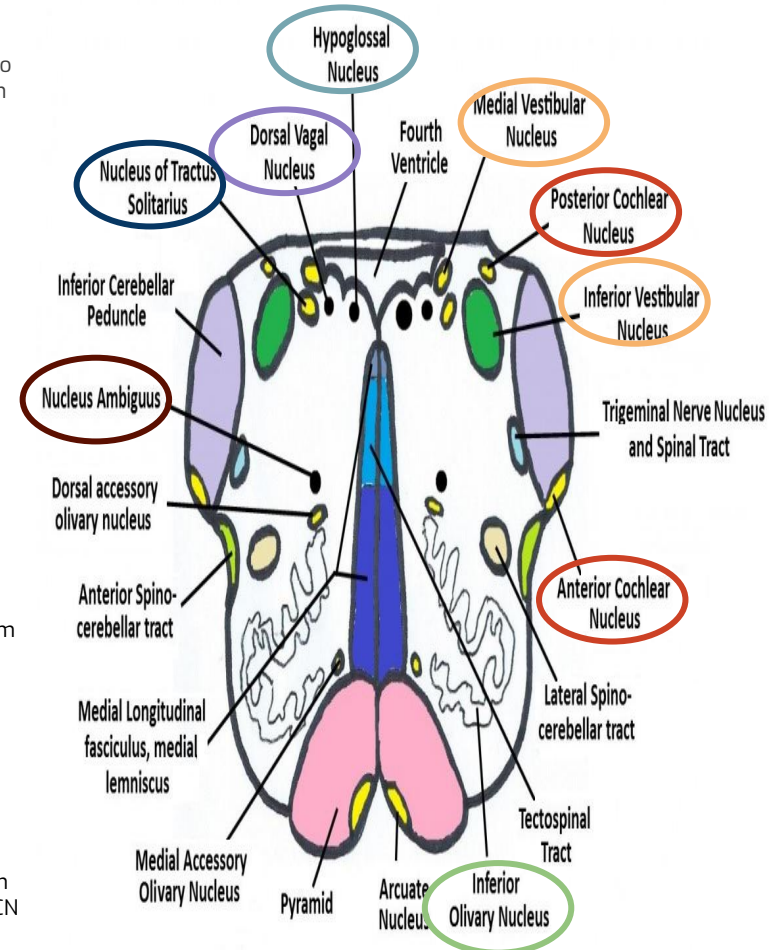
6

Vestibular nuclei complex

composed of medial, lateral, inferior & superior nuclei concerned with equilibrium

Solitary nucleus

(sensory nucleus) receive taste sensation from the tongue along the 7th, 9th 10th CN



Medulla oblongata

Rostral (Open Medulla) 2-Tracts

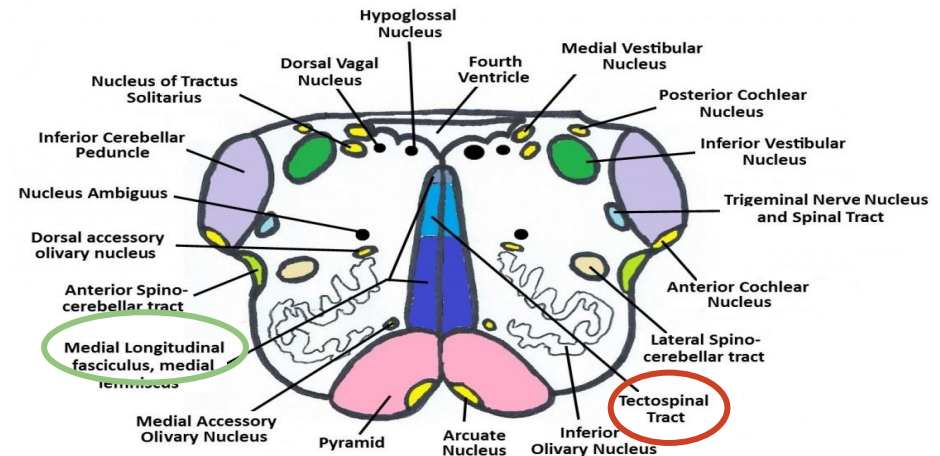
A. Medial longitudinal fasciculus:

It is important association tract

- Upwards: It links the vestibular nuclei with nuclei of extraocular muscles (3,4&6) as (vestibulo-ocular tract) to help coordination of eye movements with head movements.
- Downwards: It links vestibular nuclei with anterior horn 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.

B. Tectospinal tract:

Between tectum of midbrain and spinal cord involved in head movements during visual and auditory tracking. (Head movement in response to visual and auditory stimuli)



The Pons

Anterior part (Basis Pontis) & **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).

Divided into

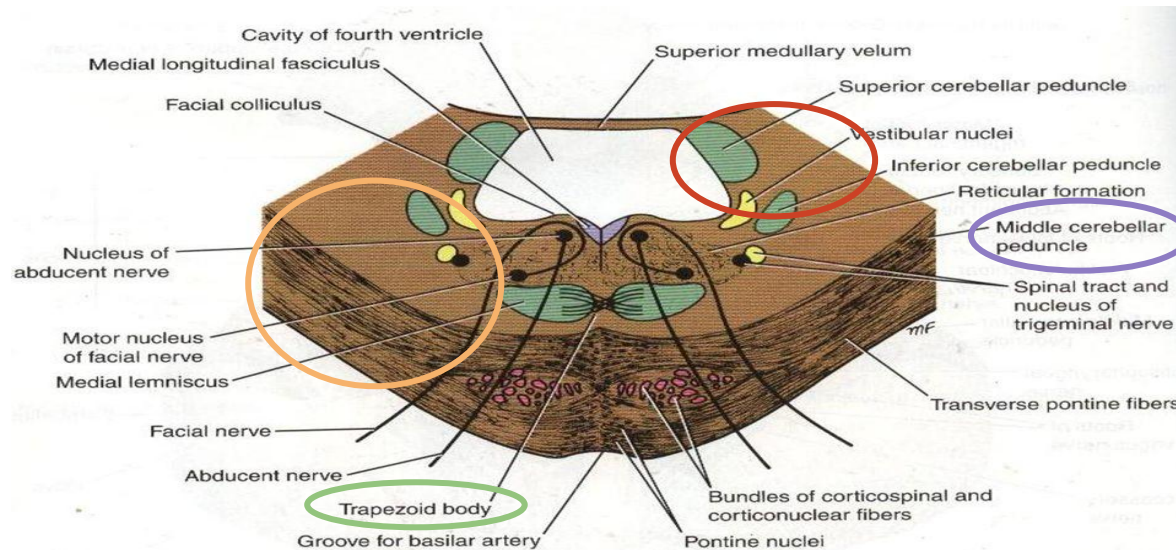
The ventral portion (In all levels of Pons):

Is marked by numerous transversely oriented fascicles of pontocerebellar fibers that originate from scattered cell groups, the pontine nuclei, and that pass to the contralateral side of the cerebellum through the **middle cerebellar peduncle**.

Note:

Trapezoid body is an **internal transverse pathway** found in the caudal pons.

It carries auditory **decussating** fibers from the ventral cochlear nuclei on one side of the brainstem to the superior olivary nuclei on the other.



The Pons

Caudal part of the Pons

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.

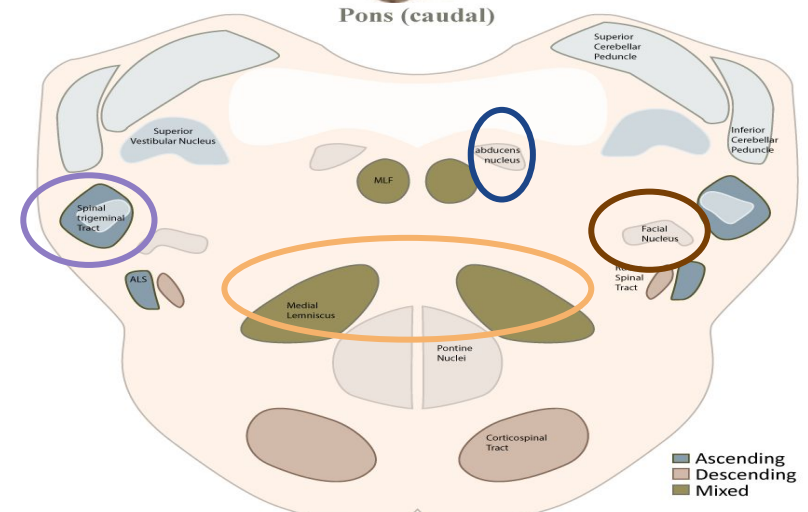
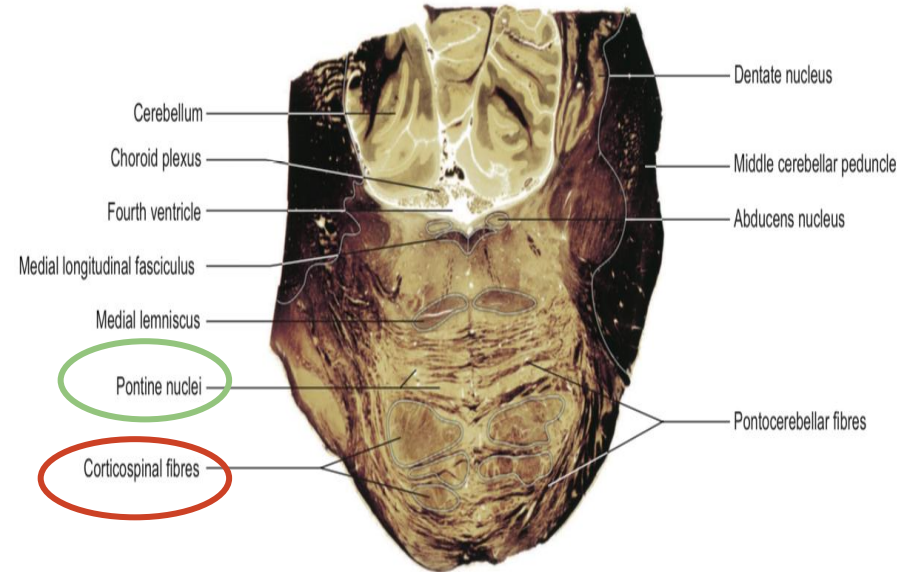
Bundles of **corticospinal** & corticonuclear fibres (Pyramidal fibres)

The ascending fibres of the Medial lemniscus become separated from the pyramid and displaced dorsally, rotates 90 degree and lies horizontally.

Spinal tract & nucleus of Trigeminal.

Deep origin of cranial nerve nuclei:

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



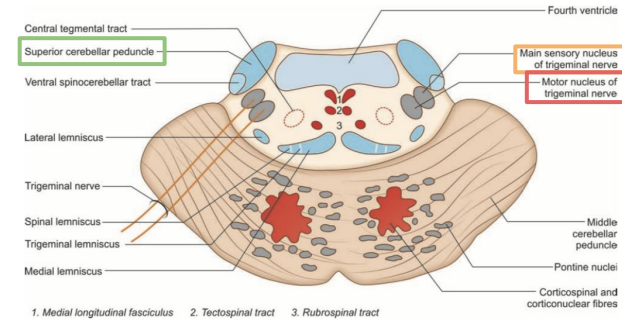
The Pons

Mid pons (At the level of the trigeminal nerve) :

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

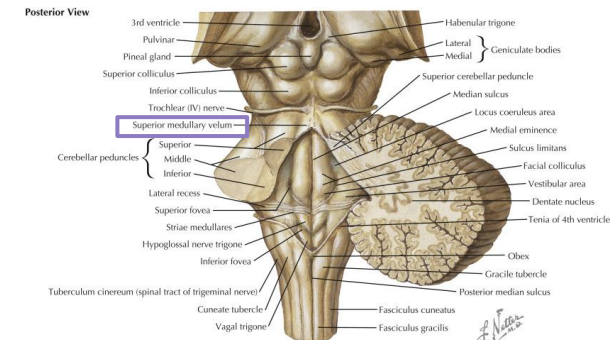


Rostral Pons

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

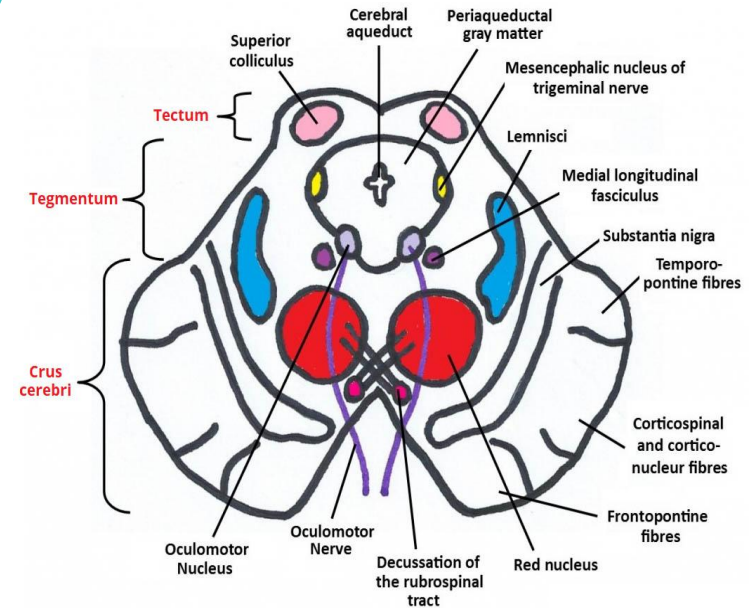
Divided into :

Ventral part (**Tegmentum**)

At the level of the cerebral aqueduct . The most ventral part of the tegmentum is the massive fibrous mass (**Crus Cerebri**)

By the The **cerebral aqueduct** which is surrounded by a pear shaped **periaqueductal (central) gray matter**.

Dorsal part (Tectum**)** of 4 colliculi



Midbrain

Inferior Colliculus Level :

- **Inferior colliculus** 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

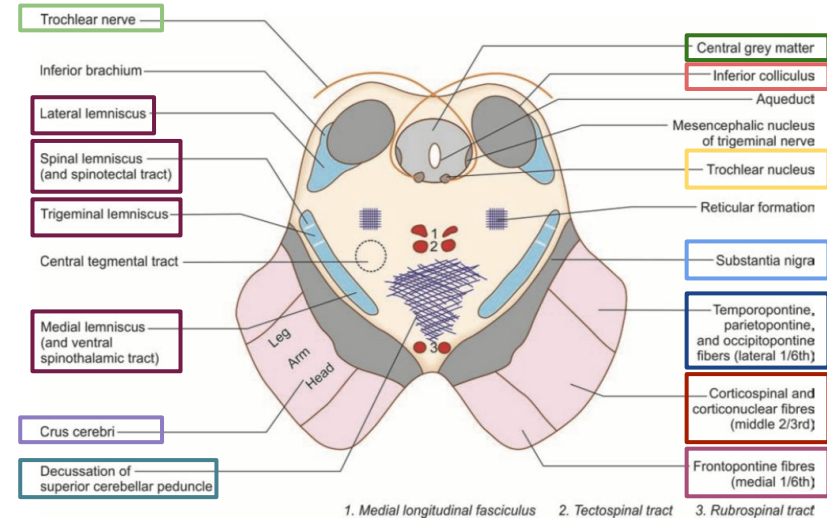
1- Trochlear nucleus: lies in the **central gray matter** close to the median plane. The fibers of the **trochlear nerve** decussate and emerge from posterior surface of midbrain.

2- Decussation of the superior cerebellar peduncles lies in the midline.

3- Ascending Lemnisci : composed of Medial, lateral & Spinal lemniscus (Lateral & anterior spinothalamic tracts), and Trigeminal (Lateral & medial).

4- Substantia nigra : Occupies the most ventral part of the tegmentum. It consists of a pigmented, melanin neurons . It projects to the basal ganglia (basal ganglia is responsible for voluntary movements). **Its degeneration (Pars Compacta) is associated with Parkinson's disease.**

5- Crus cerebri : 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 . Present in both levels of colliculi.**



Note:

Both **Frontopontine and Temporopontine** tracts terminate in pons

Note:

The corticospinal tract will start to divide in the **pontine** level and large portion of it will **decussate (75-90% remember?)** and form the pyramid in the medulla.

Midbrain

Superior Colliculus Level :

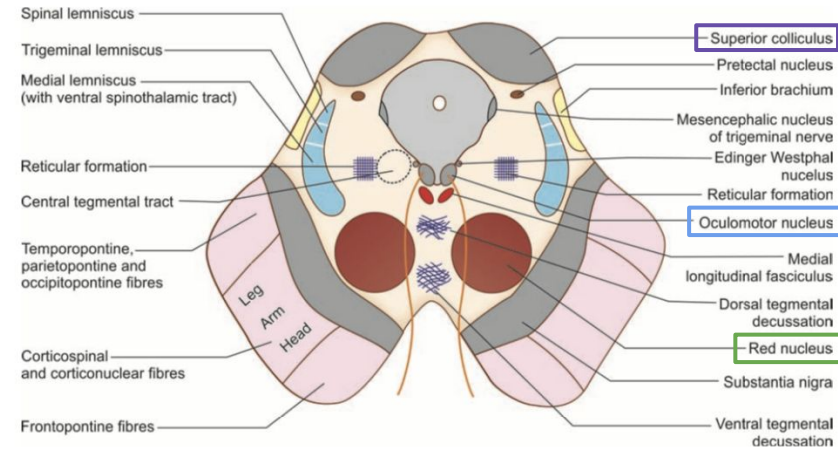
Superior colliculus is a large nucleus of gray matter that lies beneath corresponding elevation.

- 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**

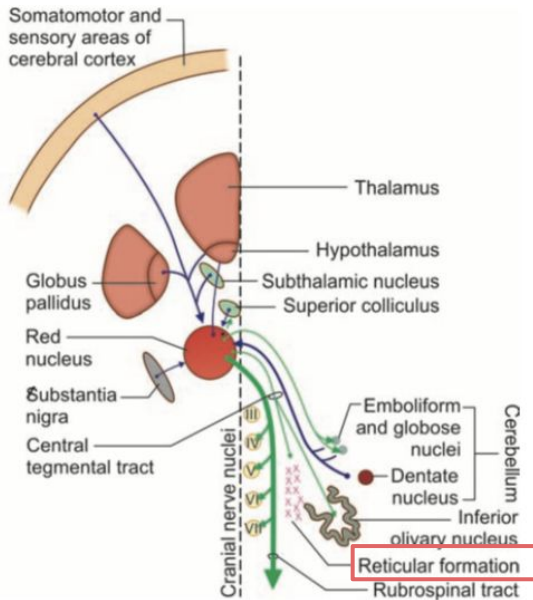
1- Oculomotor nucleus: Situated in the central gray matter. The fibers of the oculomotor nerve pass anteriorly through the **red nucleus** to emerge on the medial side of the crus cerebri (**In interpeduncular fossa**)

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



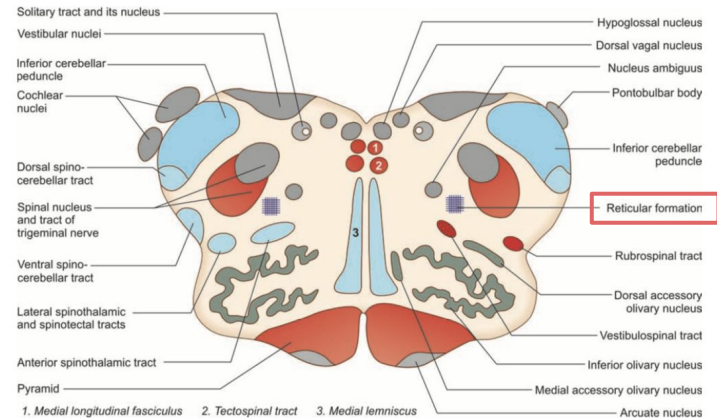
Reticular Formation

Reticular tracts

- 1. Reticulospinal tracts:** Descending fibres influence a muscle tone & posture
- 2. Reticular Activating system:** Ascending fibers through the thalamus, then to the cerebral cortex for **activation of awake**

- It is a complex matrix of nerve fibers & groups of nerve cells that extends throughout the brainstem.

- It has a number of important functions i.e. Respiratory and Cardiovascular centers.



Q1: Which part of the Medulla contain the inferior olivary nucleus?

A: Closed medulla

B: Mid medulla

C: Dorsal rostral medulla

D: Ventral rostral medulla

Q2: Which one of the following tracts link the vestibular nuclei with nuclei of the extraocular muscle?

A: Upward medial longitudinal fasciculus

B: Downward medial longitudinal fasciculus

C: Tectospinal tract

D: Corticospinal tract

Q3: Which of the following nuclei contains the preganglionic parasympathetic fibers?

A: Vestibular nuclei complex

B: Dorsal vagal nucleus

C: Solitary nucleus

D: Hypoglossal nucleus

Q4: The caudal part of the pons contains the nuclei of which cranial nerve?

A: X

B: V

C: VI

D: VIII

Q5: Nucleus gracilis & cuneate are located in?

A: Caudal pons

B: Mid medulla

C: Rostral medulla

D: Caudal medulla

Q6: What is the function of the tectospinal tract?

A: Head movements due to a visual or auditory stimulus

B: Links vestibular nuclei to anterior horn cells

C: Balance

D: Support the function of the corticospinal tract

Answer key:
1 (D) , 2 (A) , 3 (B) , 4 (C) , 5 (B) , 6 (A)

Q7: The ventral part of midbrain is known as :

A: Tegmentum

B: Tectum

C: cerebral aqueduct

D: Crus cerebri

Q8: Composed of Medial, Lateral, Spinal and Trigeminal lemniscus :

A: Trochlear nucleus

B: Substantia nigra

C: Ascending lemnisci

D: Oculomotor nucleus

Q9: It is involved in motor control:

A: Trochlear nucleus

B: Oculomotor nucleus

C: Reticular tracts

D: Red nucleus

Q10: It is part of the auditory pathway :

A: Superior colliculus

B: Inferior colliculus

C: Oculomotor nucleus

D: Red nucleus

Q11: Motor nucleus of the trigeminal nerve lies in the part of the floor of the 4th ventricle :

A: Medial

B: Lateral

C: Lower

D: Upper

Q12: Lies close to the midline beneath the floor of the 4th ventricle :

A: Medial longitudinal fasciculus

B: Superior medullary velum

C: Superior cerebellar peduncles

D: None of them

Answer key:

7(A) , 8(C) , 9(D) , 10(B) , 11(B) , 12(A)

SAQ

Q1: Enumerate the nuclei located in the rostral medulla?

Q2: What is the name of the structure that contains acoustic fibers and separate between the basis pontis and the tegmentum of the Pons?

Q3: Enumerate the descending cortical efferent fibers of the Crus cerebri .

Q4: What is the disease that is associated with the degeneration of substantia nigra ?

Answers

1 : Inferior olivary nucleus, Cochlear nuclei, Hypoglossal nucleus, Vestibular nuclei complex, Nucleus ambiguus and Solitary nucleus

2 : Trapezoid body

3 : Frontopontine, Corticospinal & corticobulbar and Temporopontine Fibres

4: Parkinson's disease

Team leaders

Rayan jabaan
Abeer Awwad

A special thanks to Mohamed Alquhidan

Reviser

Norah Alasheikh

Organizer

Shaden Alsaiedan

Note taker

Mohammed Aldehaim

Team Members

- Alaa Assulmi
- Albandari Alanazi
- Aljoud Algazlan
- Afnan Almohsen
- Arwa Alqahtani
- Aseel Alshehri
- Asma Alamri
- Bodoor Almubarak
- Deemah Alotaibi
- Fatimah Saad
-  Ghada Alabdi
- Ghaida Alassiry
- Joud Alnujaidi
- May Barakah
- Norah Alasheikh
- Nouf Alsubaie
- Raghad Alasiri
- Raghad Soaeed
- Renad Alosaimi
- Sara Alharbi
- Sarah Almuqati
- Sarah Alqahtani
- Shaden Alsaiedan
- Shahad Almezel
- Shayma Alghanoum
- Sumo Alzeer

- Abdullah Alburikan
- Abdullah Aldosari
- Abdulaziz Alghuligah
- Abdulaziz Alkraida
- Abdulaziz Alomairy
- Abdulaziz Alrabiah
- Abdulaziz Alsuhaim
- Abdulrahman Almugren
- Ahmed Alkhayatt
- Bader Alrayes
- Basel Fakeeha
-  Fahad Alajmi
- Faisal Alotaibi
- Fayez Altabbaa
- Feras Alqaidi
- Hadi Alhems
- Hesham Alsqabi
- Mohammed Aldehaim
- Mohamed Alquhidan
- Mohammed Beyari
- Mubarak Alanazi
- Musab Alamri
- Nawaf Alghamdi
- Osama Alharbi
- Raed Alnutaifi
- Saad Aldohaim
- Saleh Algarni

