



Central Nervous System

Sheet 8

Subject | Anatomy

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Correction | ...

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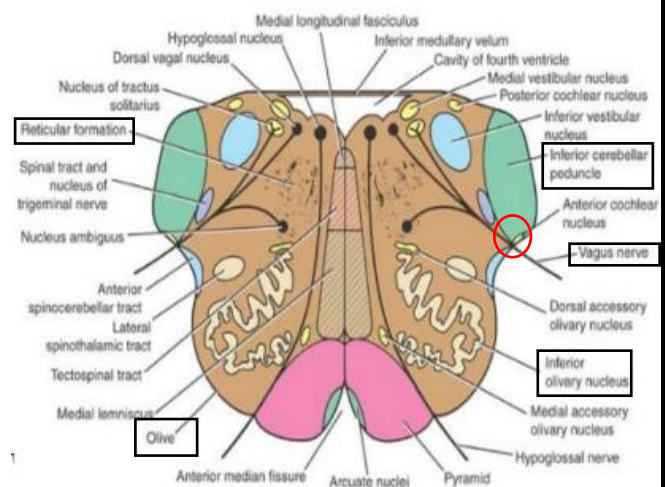
Now let's continue with the level of the olive:

-In previous lecture, we talked about the central gray mater which is found underneath the floor of the 4th ventricle, and it includes:

1. Hypoglossal nucleus
2. Dorsal vagal nucleus
3. Nucleus of tractus solitarius (solitary nucleus)
4. Vestibular nuclei (medial and inferior) (most lateral): of the 8th cranial nerve.

***Reticular formation:

- its found in the core of the brain stem. Remember Medullary reticulospinal tract which is a descending motor tract. Also vital centers are found in reticular formation. (Refer to dots in the figure)
- Deep in reticular formation, there is a nucleus called nucleus ambiguus



- Keep in mind that **vagus nerve** has many components, which is: 1. general sensory (To spinal nucleus of trigeminal) 2. parasympathetic fibers (from dorsal vagal nucleus) 3. special sensation which is taste (to solitary nucleus) 4. motor (for Ms. Of the larynx for example) (and motor nucleus of vagus is nucleus ambiguus, so it has cell body of LMN of vagus).

-Vagus nerve emerge through posterolateral groove (Red circle), which is found between inferior cerebellar peduncle and olive.

-**Nucleus ambiguous** isn't only motor for vagus nerve, but also it's a motor nucleus to cranial nerves: glossopharyngeal (#9) and cranial root of accessory nerve (#11). NOT only vagus nerve.

-**Nucleus ambiguous** is an elongated nucleus in the medulla oblongata that gives rise to the motor fibers of the glossopharyngeal, vagus, and accessory (cranial) nerves supplying striated muscle of the larynx and pharynx and soft palate.

-Note: accessory nerve (#11) have cranial and spinal root, nucleus Ambiguous gives motor component only to cranial root.

-This section is named according to inferior Olivary nucleus which form a bulge toward outside called olive as in the figure. The bulge near the midline is the **pyramid** and the bulge far away from the midline is **olive**.

-So olive is formed due to an underlying Olivary nuclear complex mainly Inf. Olivary nucleus, which is shaped like a crumpled bag (كيس متعرج), with its opening (mouth) found medially. It Has communications with spinal cord, cerebellum & cortex. Its Function is associated with voluntary muscle movement.

-Function of the olive in general is a motor function. Olive is strongly connected with cerebellum anatomicly, physiological, and pathologically, so lesions that effect olive, will effect the cerebellum and vice versa. Also regeneration of neurons of olive, leads to regeneration of neurons of the cerebellum.

-Remember that cerebellum is responsible mainly for motor coordination.

-Fibers that reach cerebellum will divid into 2 types of fibers:

1. Mossy fibers: like spinocerebellar tract.
2. Climbing fibers: From olive to cerebellum, for coordination of skeletal Ms. movement.

- Posterolateral in this section is Inf. Cerebellar peduncle (ICP) which connects medulla oblongata with cerebellum. (one of the structures that cross ICP is posterior spinocerebellar tract>>Mossy fibers).

- Corticospinal tract gives branches to the olive, they are involved in voluntary movement and from olive to spinal cord (olivospinal tract which is motor).

- A reminder: Cavity of the section is 4th ventricle with its floor related to medulla and roof related to cerebellum.

-Solitary nucleus receive **taste sensation** from facial, glossopharyngeal and vagus nerve.

-Vestibular complex, at which in this section appear medial and lateral vestibular nucleus. But when you switch to the next section above which is the section Just inferior to the pons there is a minimal difference here.

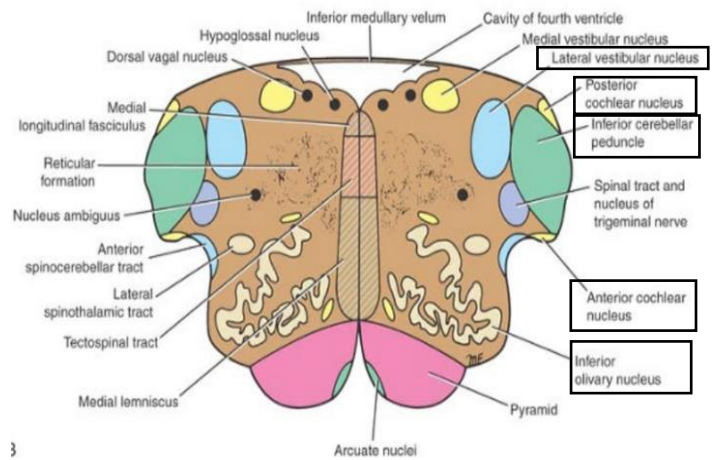
Fourth: Level Just Inferior to the Pons.

-No major changes at this level, its very similar to previous section.

-cavity of the section is 4th ventricle.

-The differences in this section are:

- I. **Lateral vestibular nucleus** replaced the **inferior vestibular nucleus**. (Remember that vestibular nerve (#8) is related to balance)
- II. Inferior cerebellar peduncle is found in the posterolateral corner. Inner ear has vestibule (related to balance) and cochlea (القوقعة) innervated by vestibulocochlear nerve (#8), so keep in mind that it has 2 components, vestibular and cochlear. Cochlear part has 2 nuclei, ventral and dorsal cochlear nucleus (Ant. And Post. to inferior cerebellar peduncle).



*** Now the next main object is **Pons** :

- Its found superior to medulla oblongata and inferior to midbrain.

-Pons in latina means **Bridge**: which is found between cerebrum and cerebellum, which is an important part of cerebro-Ponto-Cerebellar pathway>>>How does this connection form? From Rt. cerebral hemisphere, pons and Lt. Cerebellar hemisphere.

-Pons is 1 inch in length (2.54cm), its anterior aspect have a groove called **basilar groove**, through which basilar artery pass.

-Between pons and medulla oblongata there is a groove called **pontomedullary junction**. Which is for emergence of 3 cranial nerves: abducent (6th) (closest to midline) , facial (7th) and vestibulocochlear (8th) nerve (arranged from midline to later).

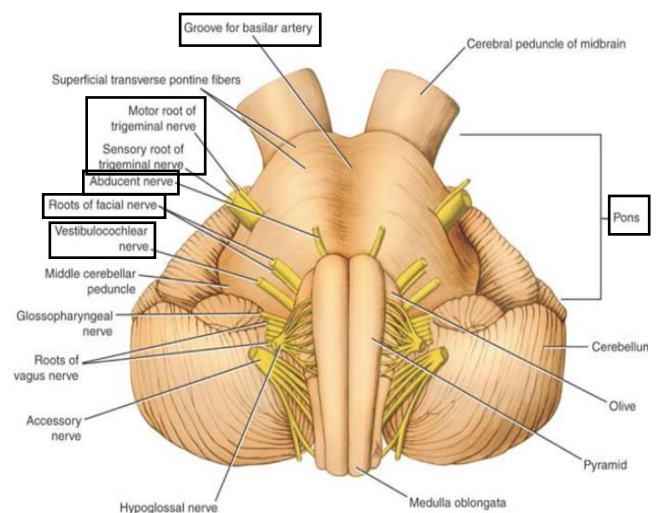
-Pons is divided into 2 sections:

1. Caudal section (Inferior) (Level of fascial colliculus)
2. Cranial section (superior) (level of trigeminal nuclei, because the biggest cranial nerve is the trigeminal nerve which originate from the mid pontine area)

- Recap: Gross appearance of the anterior surface of Pons: (Refer to figure)

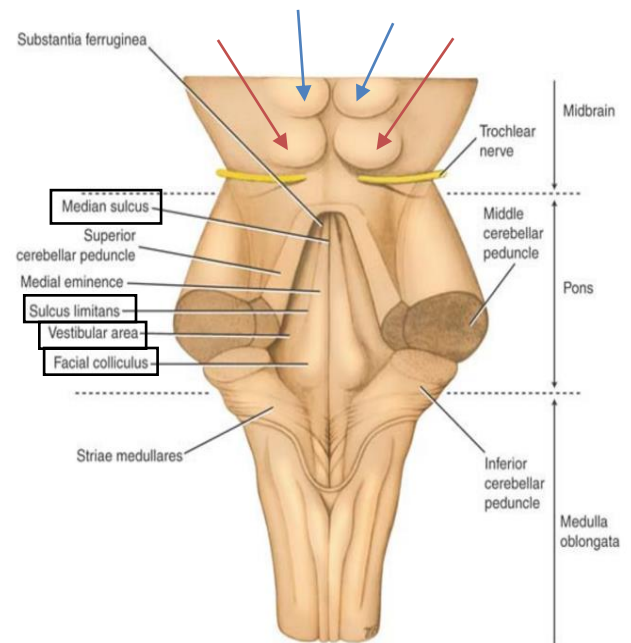
- I. Basilar groove (midline)..lodges basilar artery.
- II. 5th nerve emerges from anterolateral surface (small motor (medial) and large sensory (lateral)).
- III. 6th 7th & 8th emerges at pontomedullary junction (Medial→Lateral).

- Note: Trigeminal Nerve have a big sensory root and small motor root.



- The following figure indicate posterior view of brain stem (cerebellum is removed):

- There is upper half of the floor of the 4th ventricle (Rhomboid in shape), that's why its floor is called **rhomboid fossa**. In the floor, there are 2 ball-like structures which are called facial colliculi found on either sides of the midline which is called median sulcus. Also you can indicate sulcus limitans in the figure.
- Vestibular triangle(lateral to sulcus limitans) is related to underlying structure which is vestibular nuclei.
- Facial colliculus(inferior end of medial eminence) is related to facial nerves.
- Pons in this view is triangular in shape.
- Identify inferior colliculus(Auditory reflexes) (red arrows) and superior colliculus (visual reflexes)(Blue arrows)



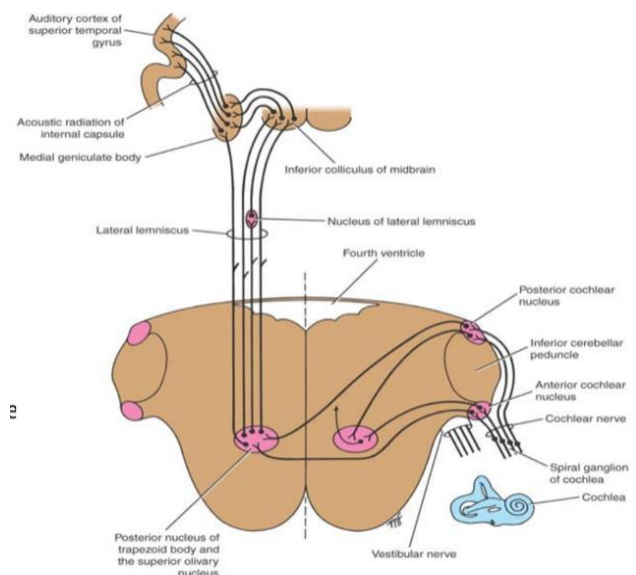
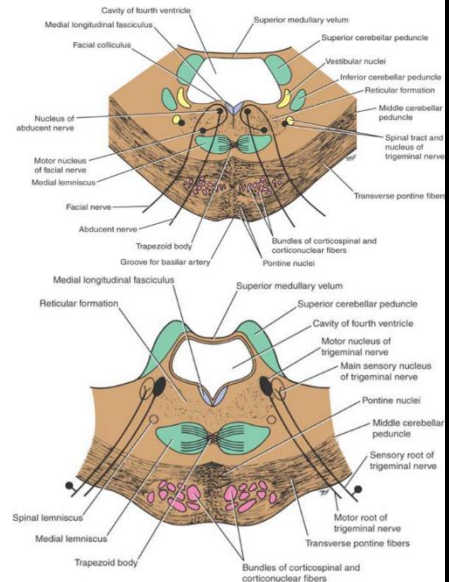
***Internal structure of Pons:

- In caudal and cranial sections, 4th ventricle is the cavity of the section. In these sections, you can see the floor of the 4th ventricle which is related to brain stem, and the roof related to cerebellum

- In both sections, there is a trapezoid body. **Basilar part**(basilar A. pass by it) is found anterior to trapezoid body. **Tegmentum** is found posterior to trapezoid body

-Trapezoid body is part of acoustic pathway (Auditory pathway):

1. which starts from cochlea in inner ear inside petrous part of temporal, from which cochlear nerve (part of vestibulocochlear) goes to brain stem(it pass through pontomedullary junction) to reach Ant. And Post. cochlear nuclei, at which synapse with 2nd order neuron occur (part of fibers crosses the midline)>>> Group of fibers that crosses the midline are called the trapezoid body.
2. Then the **lateral lemniscus**, or so-called **acoustic lemniscus**, ascends till it reaches the inferior colliculus(In posterior aspect of midbrain/part of tectum), then to Medial Geniculate Body within the thalamus and finally to the auditory part of cortex.



-Note: Trapezoid body is made up of fibers derived from the cochlear nuclei.

First: Level Through caudal part (facial colliculi) (Inferior)

-Structures found underneath the floor of the 4th ventricle:

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-Note: Posterior to medial lemniscus, there is motor nucleus of facial nerve.

- Note: there are 3 cerebellar peduncle: (Refer to figure below)

1. Inf. Cerebellar peduncle (connect medulla oblongata and cerebellum)
2. Middle cerebellar peduncle (connect pons and cerebellum)
3. Superior cerebellar peduncle (connect Midbrain and cerebellum)

-Middle cerebellar peduncle is found outside, whereas Sup. And Inf. Cerebellar peduncles are found inside. a section in medulla there is inf. Cerebellar peduncle.

-Fibers of middle cerebellar peduncle are formed by Cerebro-Ponto-Cerebellar pathway.

-NOW back to the section in previous page, you can see all these peduncles. (red brackets in figure).

-Now, basilar part which is found anterior to trapezoid body:

- It contain scattered pontine nuclei, which is part of the cerebro-ponto-cerebellar pathway. Corticospinal Fibers in the pons don't form a nice well organized bundle due to scattered pontine nuclei, so fibers become scattered. Also, there is a point of intersection between the descending corticospinal tract and the horizontal cerebro-ponto-cerebellar tract.

***Facial nerve Nuclei:

-Facial nucleus of parasympathetic component is called parasympathetic superior salivatory and lacrimal nuclei: (superior salivatory nucleus, OR, salivatory lacrimatory nucleus)

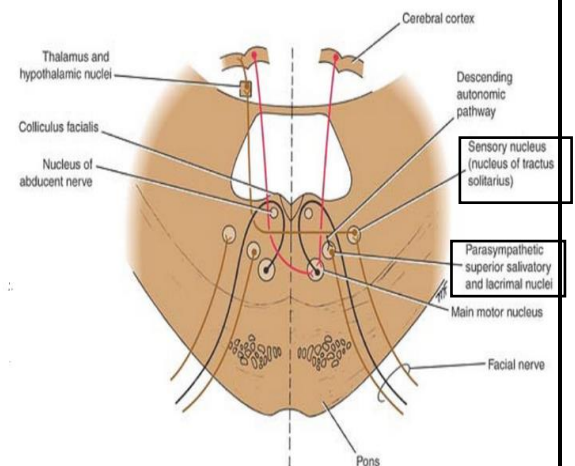
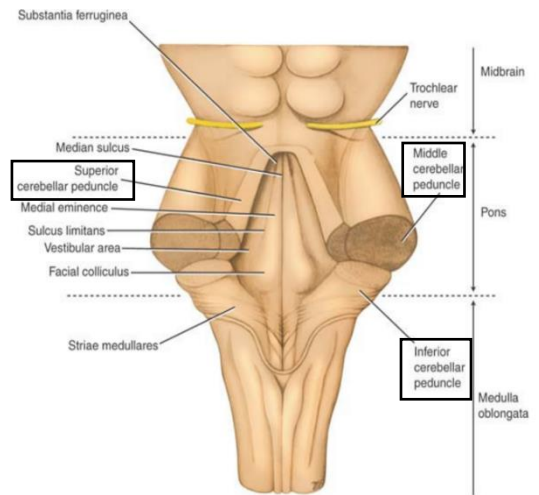
- It give parasympathetic supply to the submandibular and sublingual glands (salivatory) but **NOT** parotid gland (it only pass by it without supply – its supplied by glossopharyngeal). Also it give supply to lacrimal gland (lacrimatory).
- This nucleus receive fibers from higher centers mainly from hypothalamus. Part responsible for **salivary gland** is controlled by hypothalamus only. While the **lacrimal part** is controlled by hypothalamus (emotional part, where people tears due to emotions of sadness...) and Sensory nuclei of trigeminal by facial N. (related to reflexes not emotion, like when dirt enter your eyes, it result tear production).

Note: Hypothalamus is a connector between 3 systems: limbic system (emotions), endocrine system and autonomic nervous system.

-Other components of facial nucleus is for taste which is sensory nucleus of tractus solitarius. (facial nerve supply Ant. 2/3 of tongue for taste sensation)

-spinal nucleus of trigeminal for general sensory component of facial nerve.

-We have already explained motor component in previous page.



Second : Level through cranial part (Through mid pontine area) (superior) (Trigeminal nuclei)

-Cavity of this level is 4th ventricle.

-Identify middle cerebellar peduncle.

- At this level, there is superior cerebellar peduncle. (NO inf. Cerebellar peduncle)

- Basilar part doesn't change. You can identify trapezoid body, cerebro-ponto-cerebellar pathway and bundles of corticospinal tract(scattered).

-Medial longitudinal fasciculus is underneath the floor of 4th ventricle and close to midline.

-Nuclei of trigeminal nerve at this level:

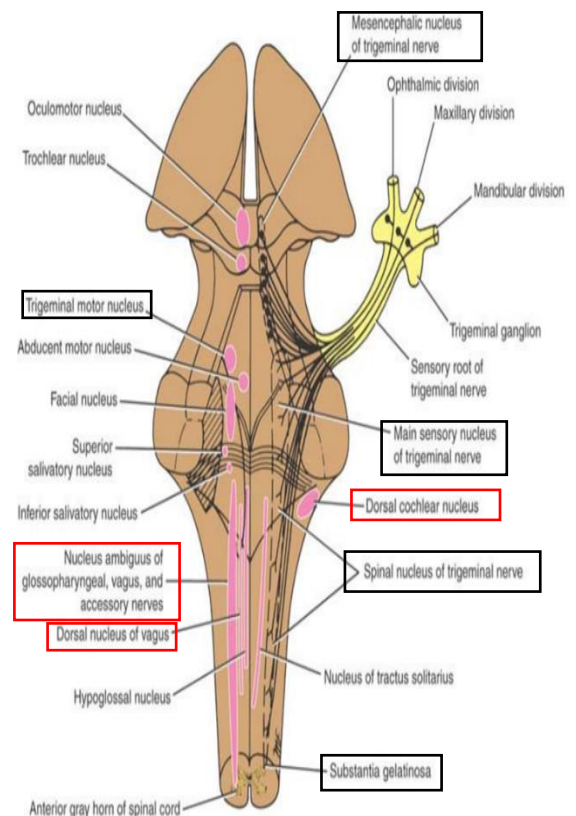
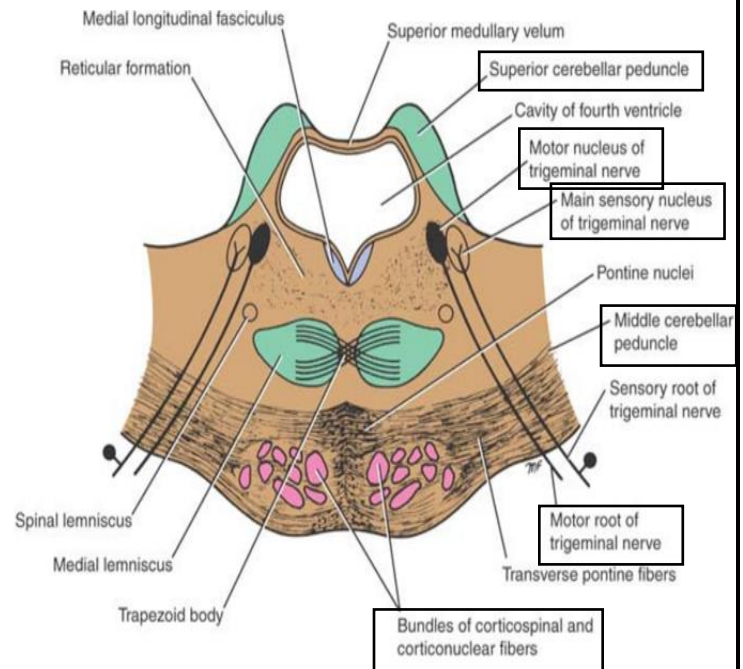
1. Motor nucleus of Trigeminal (medial)
2. Main sensory nucleus of trigeminal (lateral) (This nuclei replaces spinal nucleus of trigeminal at this level)

-Fibers close to midline are medial lemniscus, but the one far away from midline are fibers of spinal lemniscus. (***)Spinal lemniscus include 3 tracts: Anterior and lateral spinothalamic (ALS) and spinotectal tract)

- This figure indicates trigeminal nerve, which has 1 motor and 3 sensory nuclei:

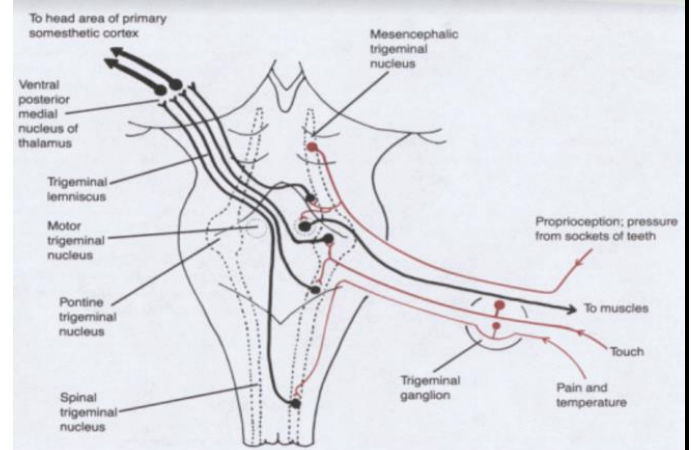
- 3 sensory nuclei have longitudinal extension. The lowest one is spinal nucleus which extends from substantia gelatinosa in spinal cord up to mid pontine area where it is replaced with main sensory nucleus. And the nucleus found in the midbrain is mesencephalic nuclei.
- REMEMBER, nuclei are divided according to **modality** into:
 1. Spinal nucleus: Pain and Temperature
 2. Main sensory nucleus: Crude touch
 3. Mesencephalic: Proprioception
- Motor nucleus is close to midline (Rt. and Lt.)

- In the figure, identify nucleus ambiguus, dorsal vagal nucleus and nucleus of tractus solitarius which appear in multiple sections (check red brackets in figure).



***Trigeminal system:

- It's similar to spinal system (ALS and PCML), in Trigeminal system there are sensory nuclei in which each one has a specific modality.
- These Nuclei receive 1st order neuron which synapse with 2nd order. Then 2nd order fibers leaving from sensory nuclei, (mainly from main sensory and spinal nucleus of trigeminal), crosses the midline and then as they ascend>>>they form trigeminal lemniscus, it ascend to thalamus to reach ventral posteromedial nucleus (VPM) which is smaller than VPL. VPM also receive Taste sensation by fibers from nucleus tractus solitarius.
- In the case of mesencephalic nuclei, its mainly responsible for reflexes, so it doesn't send fibers to higher centers a lot.



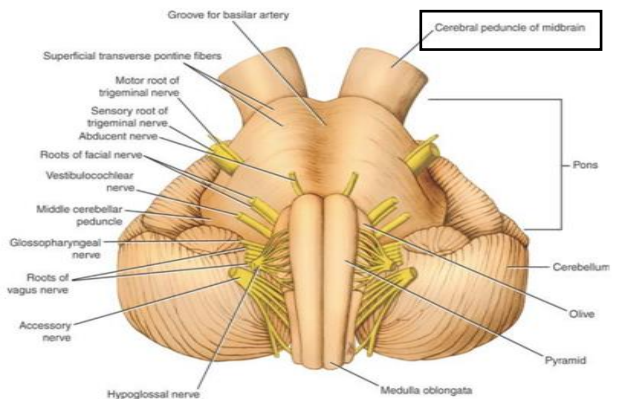
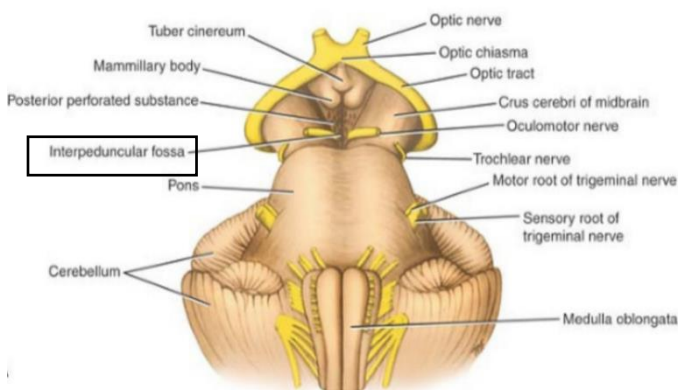
***Now our next main subject is Midbrain:

-Superior part of brain stem above pons. It lies between the diencephalon and the pons

-There is 2 peduncles, called Cerebral peduncle(NOT cerebellar). Between cerebral peduncles there is interpeduncular fossa (Oculomotor nerve #3 originate from this fossa)

Note: Trochlear N. is the only one that originate from the posterior aspect of brain stem.

Midbrain ant. View

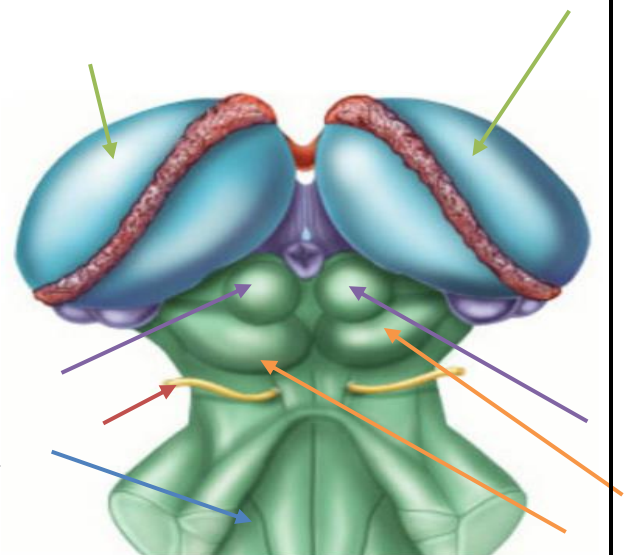


***Posterior aspect of midbrain:

-Identify Trochlear nerve (Red arrow), Rhomboid fossa (blue arrows), and thalamus (green arrow)

-It also have tectum (Corpora quadrigemina – the largest nuclei), which is composed of 4 ball-like structures:

1. 2 superior colliculi (related to visual reflexes) (purple arrows)
2. 2 inferior colliculi (related to auditory reflexes) (orange arrows)



Note: Trochlear nerve emerges below the level of inf. Colliculus as in the figure.

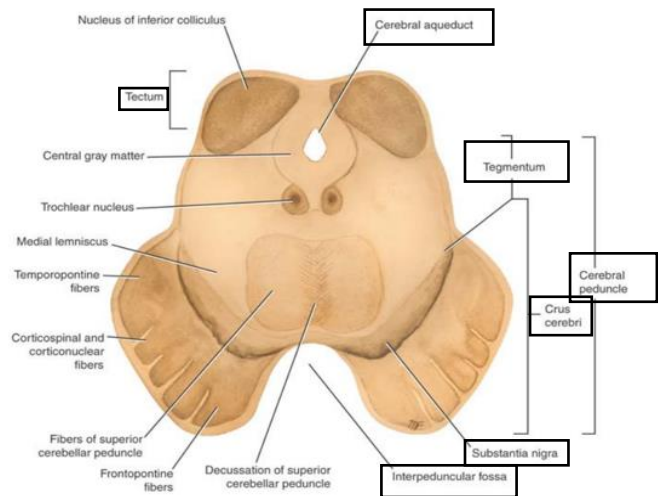
***Midbrain is divided into 2 levels:

1. Level of superior colliculus
2. Level of inferior colliculus

-Cerebral aquaduct is the cavity of the midbrain. It links 3rd ventricle above with 4th ventricle below.

-Refer to figure:

- Take cerebral aquaduct as a reference point.
- Area anterior to cerebral aquaduct is called cerebral peduncle (NOT cerebellar)
- Area posterior to cerebral aquaduct is called tectum (4 colliculi)
- Cerebral peduncle is divided by substantia nigra into 2 parts.
- Area anterior to Substantia Nigra is called crus cerebri (by which corticospinal fibers pass)
- Area posterior to Substantia Nigra is called tegmentum.



Substantia nigra is situated between the tegmentum and crus cerebri

Note: The difference between Sup. And Inf colliculi level, is the presence of red nucleus in superior level. (it will be explained in next lectures)

Note: All fibers must pass through thalamus to project to cortex, even auditory and visual pathway. (Refer to figure)

- On posterior aspect of thalamus, there are geniculate bodies (Medial and lateral). Medial geniculate (Red arrow) is specific for auditory system and lateral geniculate body (purple arrow) is specific for visual system.
- Medial geniculate body, fibers leaving it project to auditory cortex in temporal lobe
- Lateral geniculate body, fibers leaving it project to visual cortex in occipital lobe.
- Again, sup. Colliculi is for visual reflexes and inf. Colliculi is for auditory reflexes.
- So, connecting Inf. Colliculus with medial geniculate, form Inferior Brachium.
- And connection Sup. Colliculi with lateral geniculate, form Superior Brachium.

