

# CNS

## ANATOMY

8

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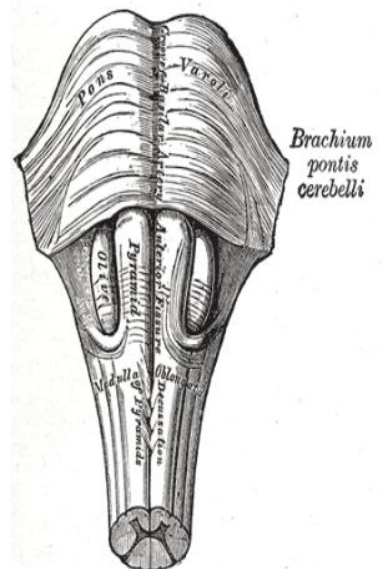


## Pons (the bridge)

The length of the pons is approximately 1 inch.

Anterior surface of the pons is convex.

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



### Gross appearance of the anterior surface of pons (Refer to figure 1)

- Basilar groove (midline). Contains basilar artery (important blood supply for the brain)
- Cranial nerve 5 (trigeminal) emerges from **anterolateral surface** (small motor (medial) and large sensory (lateral)). It emerges from the **mid-pontine area**.
- 6th 7th & 8th emerges at **pontomedullary junction** (from medial to lateral).

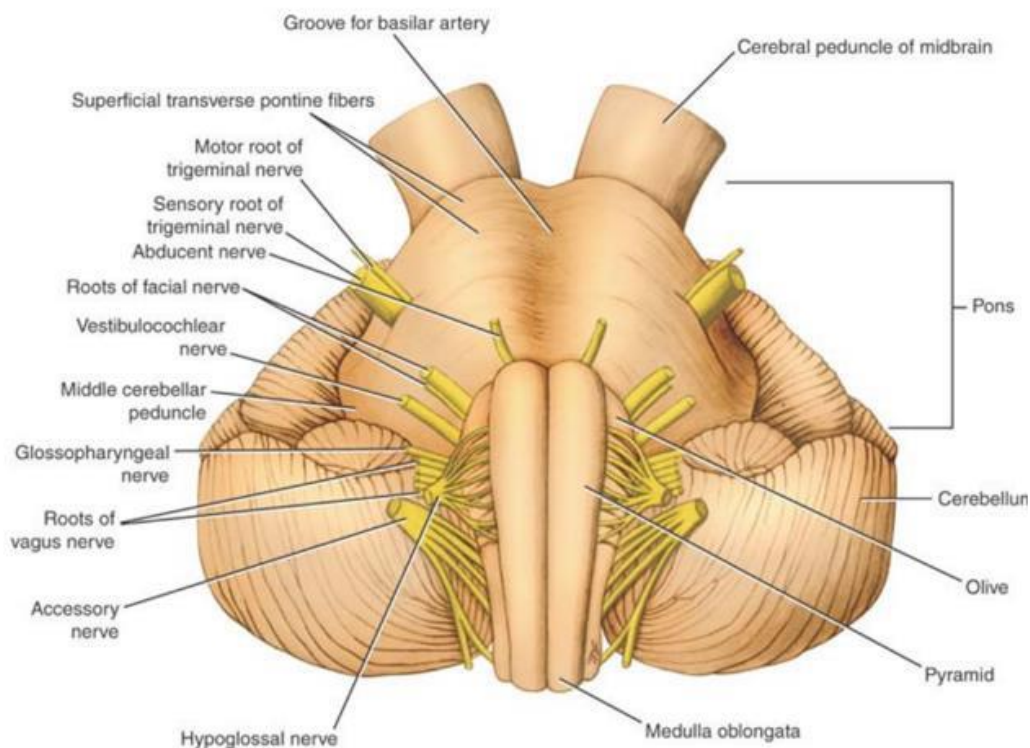


Figure 1. Anterior surface of pons

## Gross appearance of the posterior surface of pons (cerebellum removed) (refer to figure 2)

- The floor of the 4<sup>th</sup> ventricle can be seen. It is rhomboid-shaped (pons + medulla oblongata). However, if we are only talking about the pons, then the floor is triangular in shape (upper half of the floor). Collectively, the upper triangular half of the pons and the lower medullary half forms the **rhomboid fossa**.
- In the 4<sup>th</sup> ventricle floor (rhomboid fossa), the midline is made by a sulcus known as the **median sulcus**. Lateral to the midline, another sulcus can be seen, which is called the **sulcus limitans**. Between the median sulcus and the sulcus limitans is the **median eminence**, which forms the **facial colliculus** inferiorly.
- Vestibular area (lateral to sulcus limitans and superior to the facial colliculus) is related to underlying structure which is **vestibular nuclei**.
- Facial colliculus (inferior end of medial eminence) is related to **facial nerves** (not nuclei) more details later.

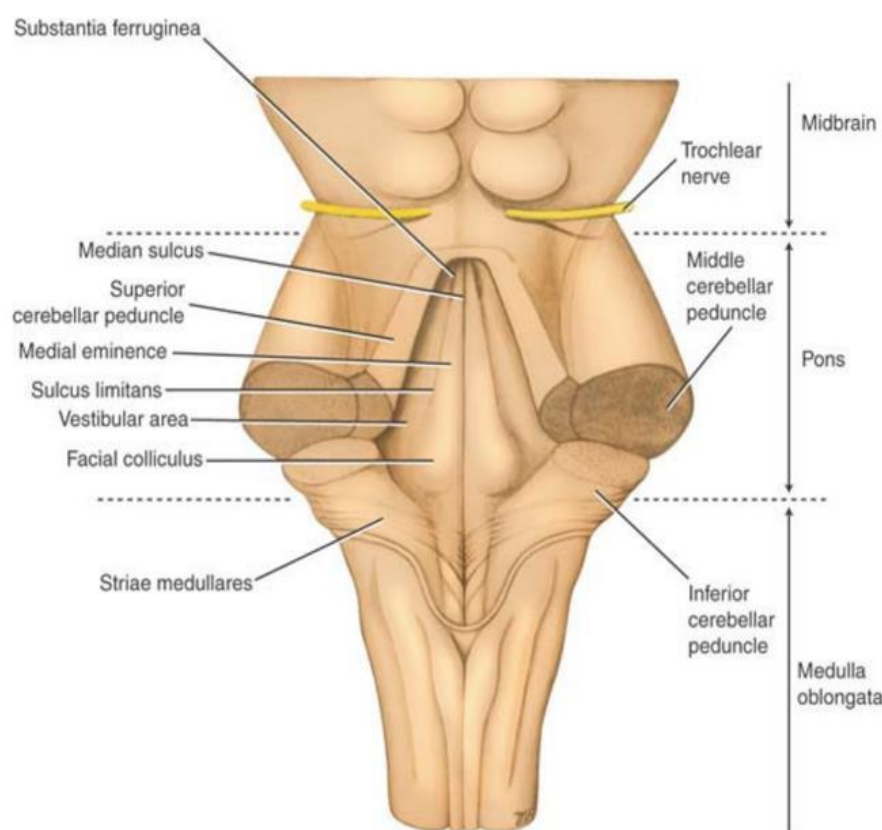


Figure 2 Posterior surface of pons (cerebellum removed)

In studying the pons, we will divide it to 2 sections. The first section will be “section of facial colliculus (caudal)” and the second section will be “section of trigeminal nuclei (cranial)”. However, before we investigate these two different sections, we need to know the internal structure of pons.

## Internal structure of pons

In the pons, there is the trapezoid body.

Anterior to the trapezoid body is the **basilar part**, which has the basilar groove most anteriorly. (contains basilar artery)

Posterior to the trapezoid body is collectively known as the **tegmentum**.

These three structures (basilar part, trapezoid body, and tegmentum) are important for differentiating the anterior-posterior direction of pons at its different levels.

### What is the trapezoid body?

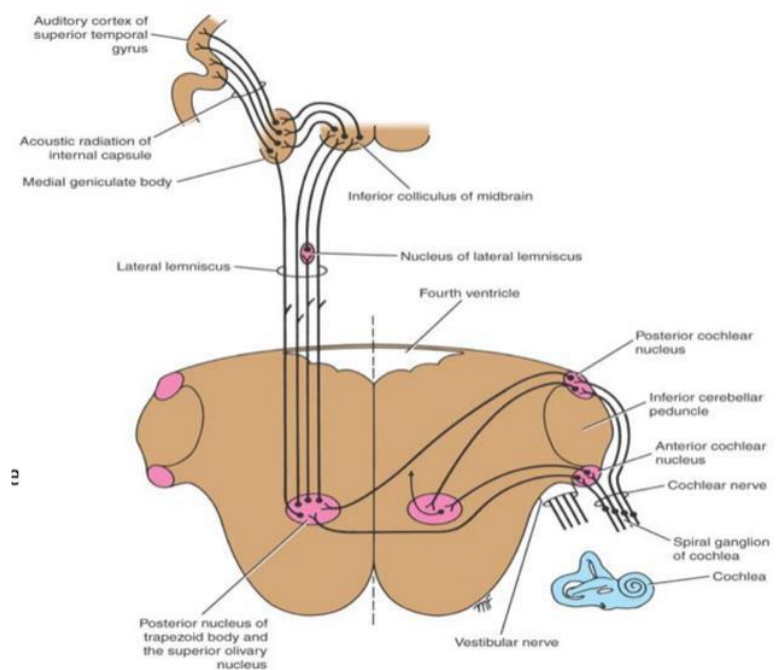
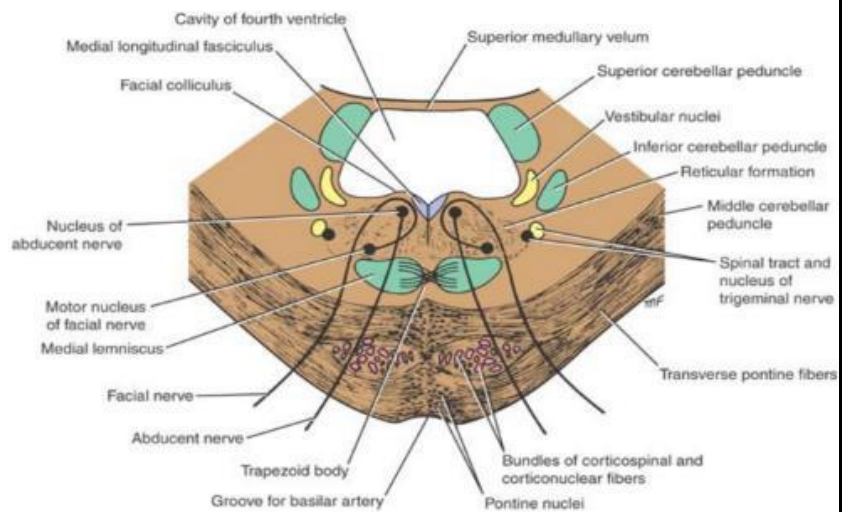
Trapezoid body is part of the acoustic pathway (Auditory pathway)

The acoustic pathway starts from the cochlea in inner ear, from which the cochlear nerve (part of vestibulocochlear nerve) which has its cell body in the spiral ganglion of cochlea, goes to the brainstem (it pass through pontomedullary junction) to reach the anterior and posterior cochlear nuclei. Where synapse with 2<sup>nd</sup> order neuron occurs. Most of the 2<sup>nd</sup> order neurons decussates at the midline (contralateral) (some stay ipsilateral)

These fibers that cross the midline are known as the **trapezoid body**.

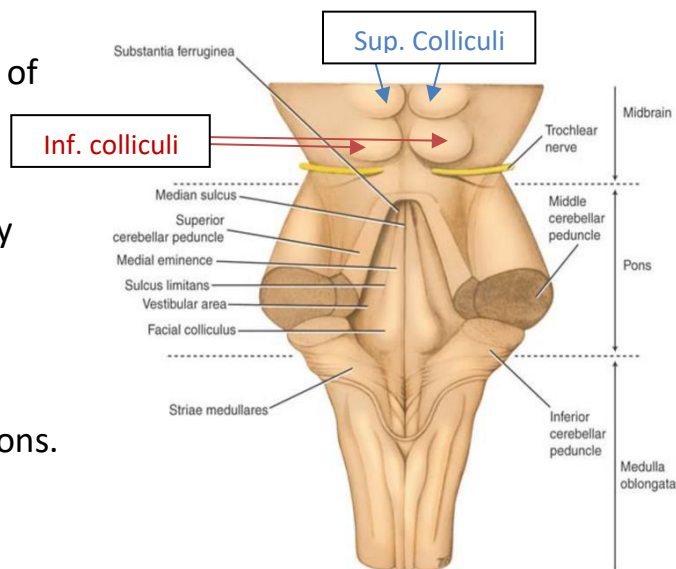
From the trapezoid body, these fibers ascend in what is known as the **lateral lemniscus**. These fibers will reach the inferior colliculus (In posterior aspect of midbrain/part of tectum), then they will go to the medial geniculate

body within the thalamus, and finally they will project to the auditory part of cortex (temporal lobe)



Remember in previous lectures we said that all sensations must pass through the thalamus before reaching the cortex. Rule still applies here.

Returning to this figure on the right for a second, we can see in the posterior aspect of midbrain (the tectum), the **superior colliculi** (related to visual pathway) and the **inferior colliculi** (related to the auditory pathway).



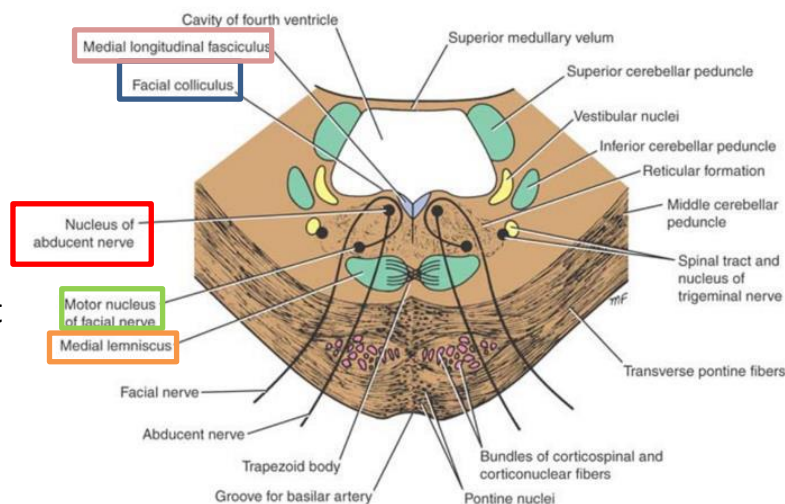
Now let's get into the first section of the pons.

### Level through caudal part (facial colliculus) (inferior)

Cavity seen in the section is the 4<sup>th</sup> ventricle.

**1. The Tegmentum:** (everything posterior to the trapezoid body)

The **medial lemniscus** is the most anterior part of the tegmentum (just posterior to the basilar part).



The **medial longitudinal fasciculus (MLF)**, which was explained in the

last lecture in the medulla oblongata, can be seen beneath the floor of the fourth ventricle on either side of the midline.

Part of the reticular formation is found in the core of the pons in the tegmentum.

The spinal nucleus of trigeminal nerve (also from previous lecture) can be found on the **anteromedial aspect** of the inferior cerebellar peduncle. And it is lateral to the motor nucleus facial nerve.

Part of the superior cerebellar peduncle and middle cerebellar peduncle can be seen.

**Note** there are 3 cerebellar peduncles (Refer to figure 2 in pg 2)

1. Inferior 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 on the outside, whereas the superior and inferior cerebellar peduncles are found to the inside. That is why all three can be found in the same section.

Nuclei of the 6<sup>th</sup>, 7<sup>th</sup>, and 8<sup>th</sup> cranial nerves can be seen.

1. The **abducent nuclei** is found just underneath the floor of the fourth ventricle.
2. The **motor facial nuclei** are found directly posterior to the **medial lemniscus**. The fibers of the motor facial nuclei have an unusual pathway. The fibers move posteriorly and turn (do a U-turn) around the **abducent nuclei**, then they emerge from the ponto-medullary junction. This turn is responsible for the formation of the facial colliculus.
3. Part of the vestibular nuclei found in the lateral aspect of the floor of 4<sup>th</sup> ventricle

## 2. The basilar part (anterior to the trapezoid body)

Notice the **basilar groove** most anteriorly.

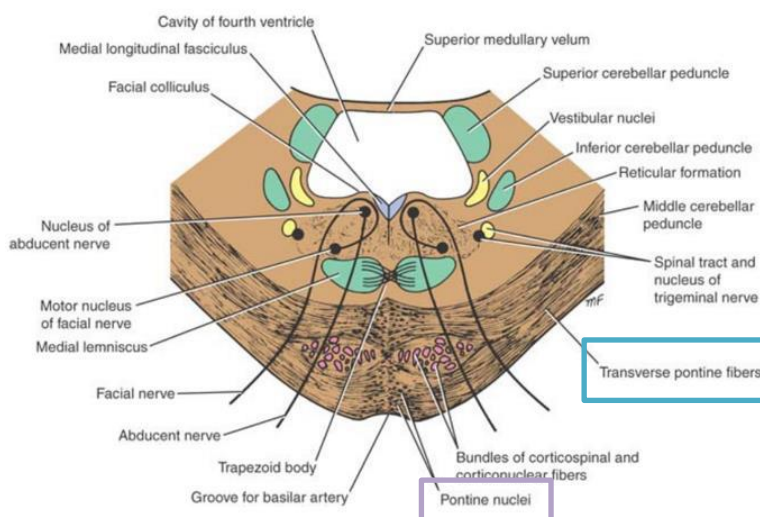
Transverse fibers, known as **transverse pontine fibers**, form the middle cerebellar peduncle which will reach the cerebellum posteriorly.

This pathway is known as the **cerebro-ponto-cerebellar pathway**, which means that it connects the cerebrum with the cerebellum. This pathway is

very important because the cerebellum receives information from the spinal cord about the muscle-joint sense (position of body) and because the cerebellum must also receive information about the **intended movement** (which is generated in the higher centers in the cortex) in order for the cerebellum to coordinate the skeletal muscles movement. Fibers in this pathway descend from the cerebrum to the pons, then they move in a transverse fashion (**transverse pontine fibers**) to the cerebellum.

Within the cerebro-ponto-cerebellar pathway **pontine nuclei** are where synapse occurs.

Bundles of corticospinal tract fibers are scattered due to the presence of the **pontine nuclei**.



## Nuclei of the facial nerve:

### 1. Superior salivatory nucleus/ Salivatory lacrimal nucleus (Parasympathetic nuclei)

It gives parasympathetic supply to the submandibular and sublingual glands (salivatory) but **NOT** parotid gland. It also supplies the lacrimal gland (lacrimatory). Parotid by Glossopharyngeal nerve.

It is located posterolateral to the main motor nucleus. (discussed above)

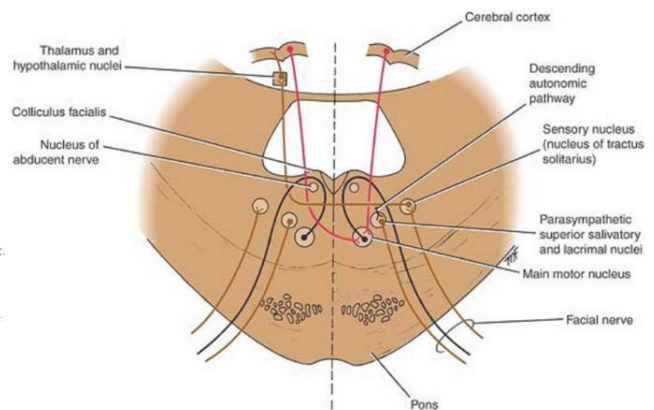
### 2. Part of the nucleus of tractus solitarius (sensory nucleus of facial nerve)

Located posterolateral to the parasympathetic nucleus of facial nerve.

It receives taste sensation from the anterior 2/3 of the tongue.

Superior salivatory: receives from the hypothalamus.

Lacrimal nucleus: receives from Hypothalamus (emotional) and sensory nuclei of the trigeminal (reflex).



## 2. Level through cranial part (trigeminal nuclei)

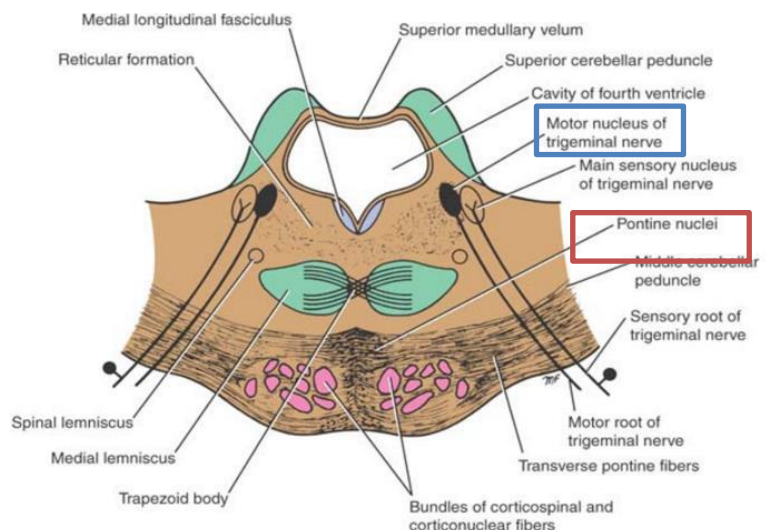
This is the midpontine area.

Cavity seen in this section is the 4<sup>th</sup> ventricle.

### 1. The tegmentum

Inferior cerebellar peduncle not visible. Only superior and middle cerebellar peduncles can be seen.

The spinal lemniscus & lateral lemniscus (not on this level) can be seen on the lateral extremity of the medial lemniscus.



Motor nucleus of trigeminal nerve can be seen.

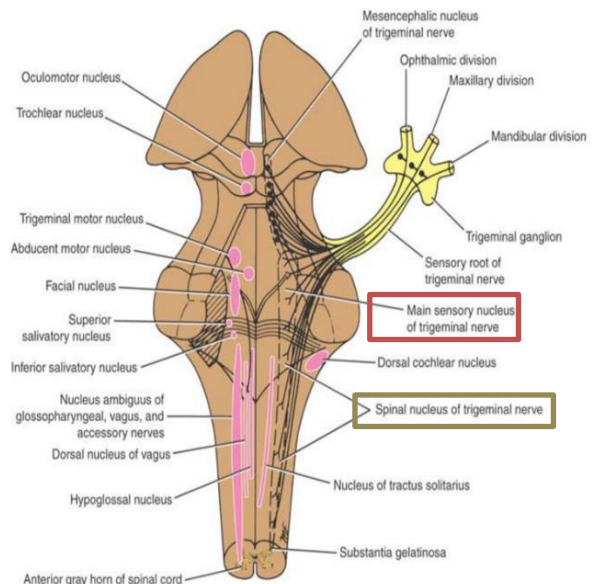
Lateral to it is the **main/principle sensory nucleus**.

Notice that the spinal nucleus of trigeminal nerve cannot be seen in this section. It is located inferiorly.

The **spinal nucleus of trigeminal nerve** extends from the lowest part of medulla oblongata all the way to the caudal part of pons (inferior part of pons).

At the level of the cranial part of pons, the spinal nucleus of trigeminal nerve cannot be seen. However, the **principle/main sensory nucleus of trigeminal nerve** can be seen instead.

Remember in the previous lecture we said that the spinal nucleus of the trigeminal nerve is similar in its function to the ALST, which senses pain, temperature, and crude touch. And the main sensory nucleus of trigeminal nerve is like the DCMLT, which senses discriminative touch.



## 2. The basilar part

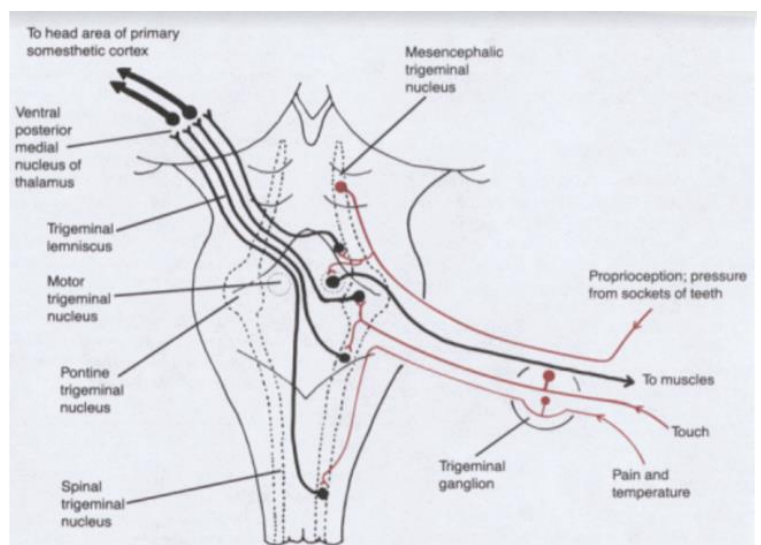
Similar to the previous level. No change from previous level.

**Trigeminal system:** (contains the last lemniscus in the body)

Remember that the trigeminal nerve has its cell body of the 1<sup>st</sup> order neuron in the trigeminal ganglia, which is found in the cranial cavity on the tip of the petrous portion of the temporal bone. The trigeminal system is **sensory** to the **head and neck area**. Whereas the spinal systems (ALST & DCMLT) are sensory to the rest of the body.

Pathway of trigeminal system:

Sensory 1<sup>st</sup> order neurons of trigeminal nerve have the cell bodies in the **trigeminal ganglia**. The 1<sup>st</sup> order neurons synapse in the **main/principle nucleus** and the **spinal nucleus of trigeminal nerve**. The 2<sup>nd</sup> order neurons arising upon the synapsis with the nuclei **cross the midline**. Once these 2<sup>nd</sup> order neurons cross the midline, they form a lemniscus called the **trigeminal lemniscus**.



There is a third nucleus where sensory 1<sup>st</sup> order neurons of trigeminal nerve can synapse at known as the **mesencephalic trigeminal nucleus**. However, 2<sup>nd</sup> order



neurons arising from this nucleus are not involved in the trigeminal lemniscus. This nuclei is mainly responsible for reflexes (e.g. periodontal ligament reflex). The trigeminal lemniscus is moving towards the thalamus, where they will synapse with the **ventropostomedial (VPM) nucleus**. The VPM nucleus is mainly responsible for head and neck sensation and taste.

## Midbrain (superior part of brainstem)

It lies between the diencephalon and the pons.

There are 2 peduncles called **cerebral peduncles** (NOT cerebellar).

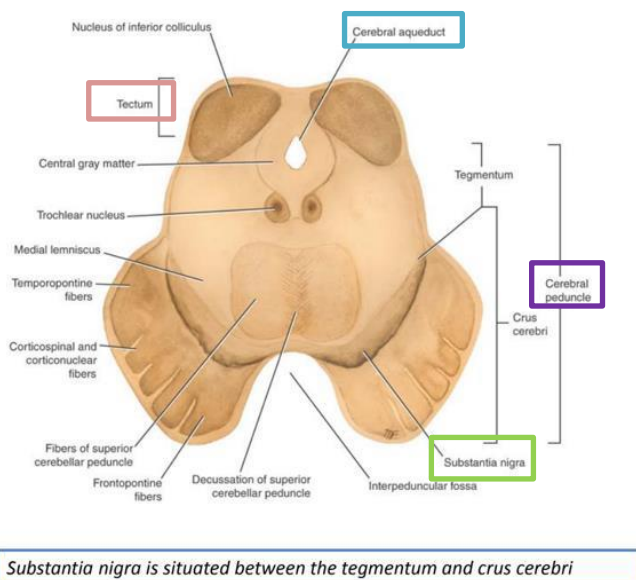
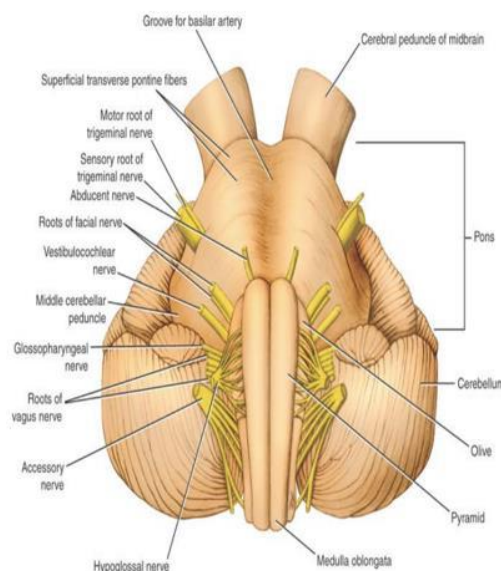
Between the two cerebral peduncles there is the **interpeduncular fossa** (Oculomotor nerve #3 originate from this fossa).

The cavity of the midbrain is known as the **cerebral aqueduct**. The cerebral aqueduct is the passageway between the 3<sup>rd</sup> (superiorly) and 4<sup>th</sup> ventricle (inferiorly).

Posterior to the cerebral aqueduct is the **tectum**. The tectum consists of 4 colliculi, 2 superior colliculi and 2 inferior colliculi (refer to page 4)

Anterior to the cerebral aqueduct is collectively known as the **cerebral peduncle**.

The cerebral peduncle is divided by the **substantia nigra** to **crus cerebri** (anterior) and **tegmentum** (between cerebral aqueduct and substantia nigra)



## Posterior view of midbrain

In this view, the 4 colliculi of the tectum can be seen.

The **trochlear nerve (CN4)** is the only cranial nerve that arises posteriorly. It arises from the posterior aspect of the midbrain.

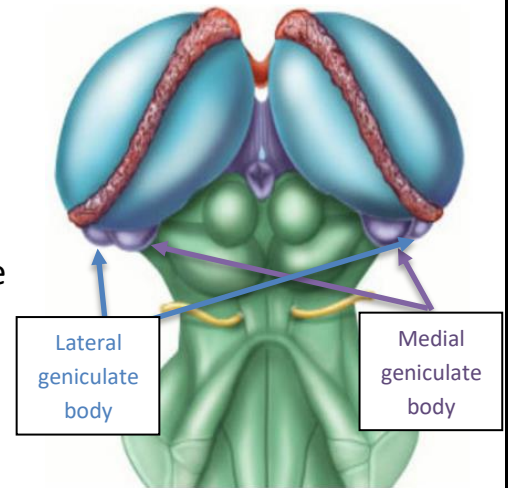
Supplies superior oblique muscle of the eye.

In the figure on the right, the two thalami can be seen. They are divided into right and left thalami by the 3<sup>rd</sup> ventricle. Third ventricle is connected to the fourth ventricle by cerebral aqueduct.

The thalami are egg-shaped and contain multiple nuclei. It contains the **medial geniculate body** (part of the auditory pathway) and **lateral geniculate body** (part of the visual pathway).

Superior brachium (brachium=الذراع) connects the superior colliculus with the lateral geniculate body. (connecting the visual with visual)

Inferior brachium connects the inferior colliculus with the medial geniculate body.



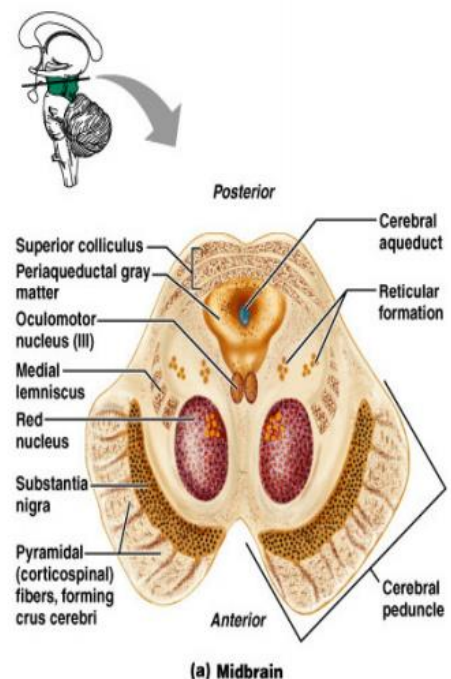
It is important to be able to recognize the midbrain in a cross-section.

Notice the left and right crus cerebri with the interpeduncular fossa between them.

The cavity of the midbrain is the cerebral aqueduct.

**Substantia nigra** can be seen, which is a very important structure for the motor system.

Substantia nigra is anatomically located in the midbrain. However, it is related to the **basal nuclei functionally**. It is responsible for initiating movements. (more details in next lecture)



Good luck <3