

# CNS

## Anatomy

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▶ number

8

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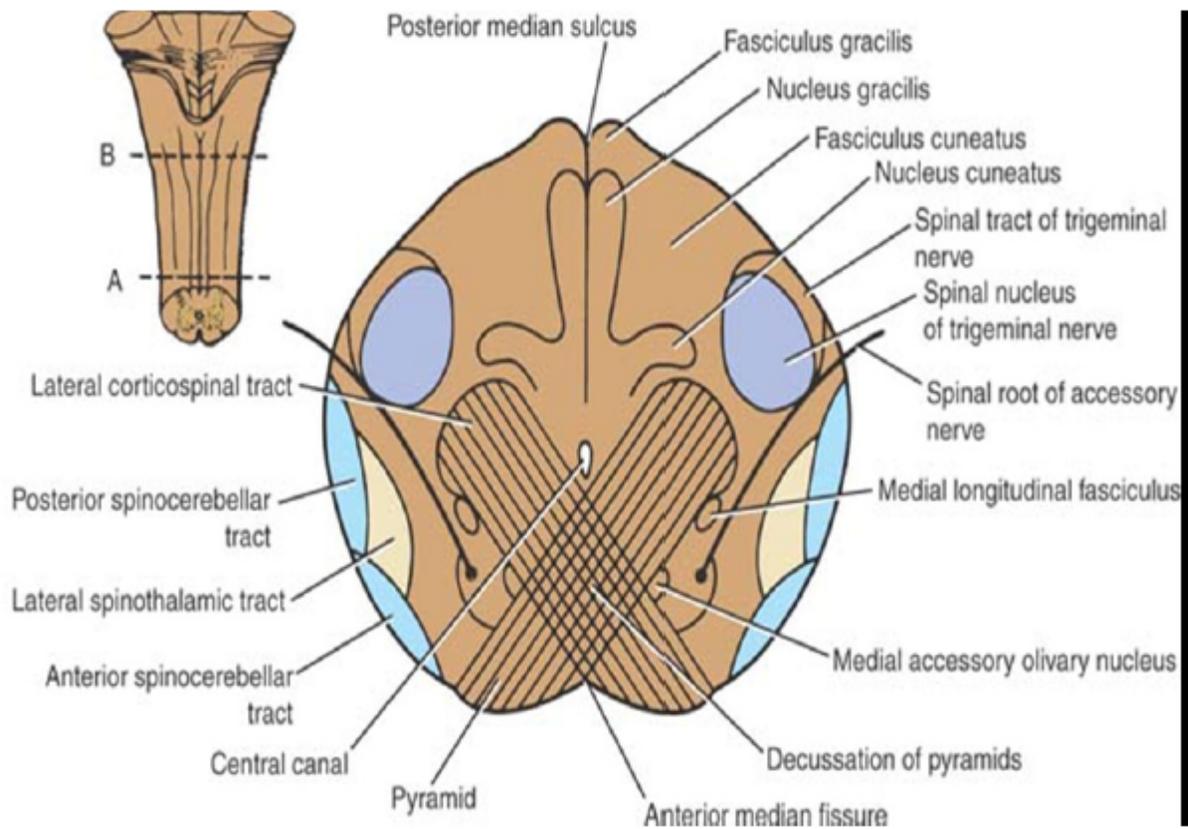
**Mohammad alsalem**

## بسم الله الرحمن الرحيم

Last time we talked about medulla oblongata , and we divided it into 4 sections from inferior to superior , the first one is level of pyramidal decussation ( also known as motor decussation) and the cavity in this level is central canal – we also divided medulla oblongata to closed (inferior part) and open (superior part) medulla oblongata – and as you can see in the figure below , anterior to central canal is decussation of the pyramids , posterior is posterior white column (fasciculus gracilis and fasciculus cuneatus) and nucleus gracilis(medial) and nucleus cuneatus (lateral) , and lateral to nucleus cuneatus is spinal nucleus of trigeminal nerve which is one of three sensory nuclei of trigeminal nerve , it is called spinal even though it starts from the level of C2 up to mid pontine area .

ALS of the spinal cord is unchanged on this level, also anterior and posterior spinocerebellar tracts are unchanged on this level.

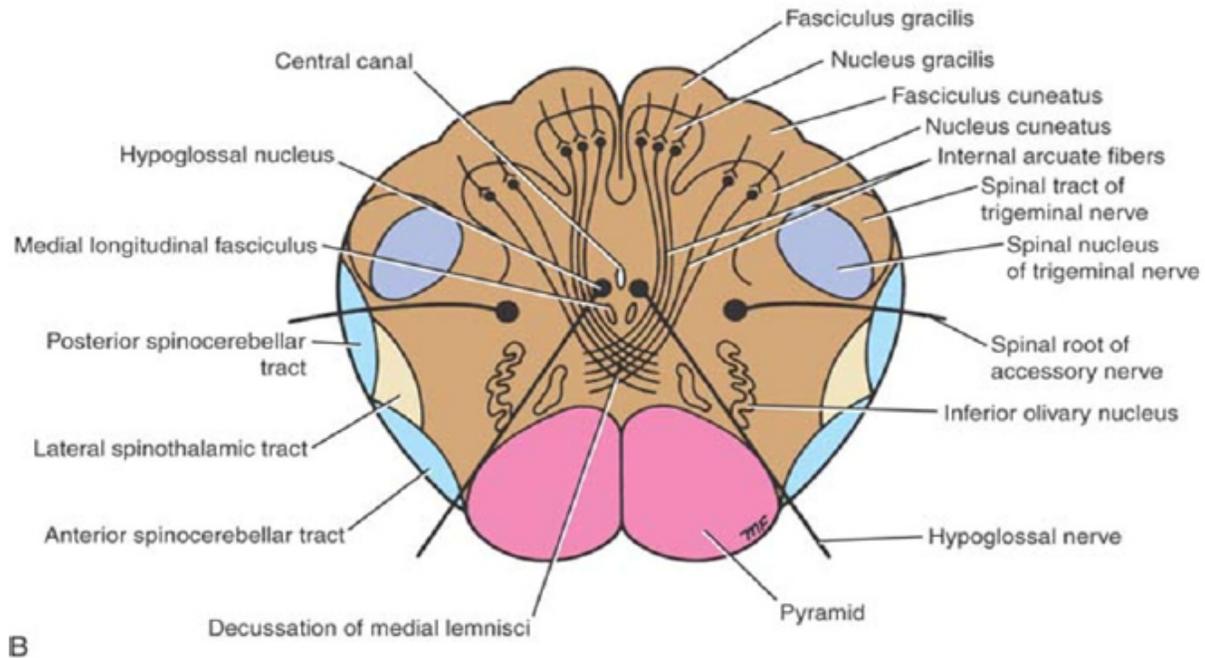
## Level of decussation of pyramids



Now let's see the section of the next higher level :

### Level of decussation of lemnisci:

## Level of sensory decussation



1-The cavity of this section is central canal → closed medulla

2- Posterior to central canal are nuclei of gracilis and cuneatus , behind them are fasciculus gracilis and cuneatus .

3- In these nuclei synapsis happens between 1<sup>st</sup> order neuron (from spinal cord) and 2<sup>nd</sup> order neuron ( from the nuclei ) , and internal arcuate fibers emerge and cross to contralateral side and this is the decussation .

The decussation (major sensory decussation) happens between the pyramids (anterior) and central canal (posterior) , and when these fibers go up we call them medial lemniscus .

The two pyramids are responsible for the bulge on anterior aspect of medulla oblongata close to the midline.

\*Note : we can't see olives on this level .

On either side of central canal is the hypoglossal nucleus (motor nucleus), so the hypoglossal nerve has one nucleus (pure motor) and supplies all muscles of the tongue except palatoglossal muscle.

Hypoglossal nucleus receives signals from cortex by corticonucleus tract from both sides except small portion of the nucleus which supplies genioglossal muscle , which receives from opposite side of the cortex.

Anterior to hypoglossal nucleus is MEDIAL LONGITUDINAL FASCICULUS which is a bundle of white matter from VESTIBULAR NUCLEI connecting motor nuclei of three cranial nerves moving the eyeball (3<sup>rd</sup>, 4<sup>th</sup>, and 6<sup>th</sup>) , and it descends to upper cervical segments (anterior horn of upper cervical segments) to coordinate between movement of head\ neck and eyeball movement.

Accessory nerve (xi) has cranial root and spinal root :

Spinal root from upper 5 segments (accessory nucleus in anterior horn) enters foramen magnum to go to cranial cavity and it meets cranial root of accessory nerve.

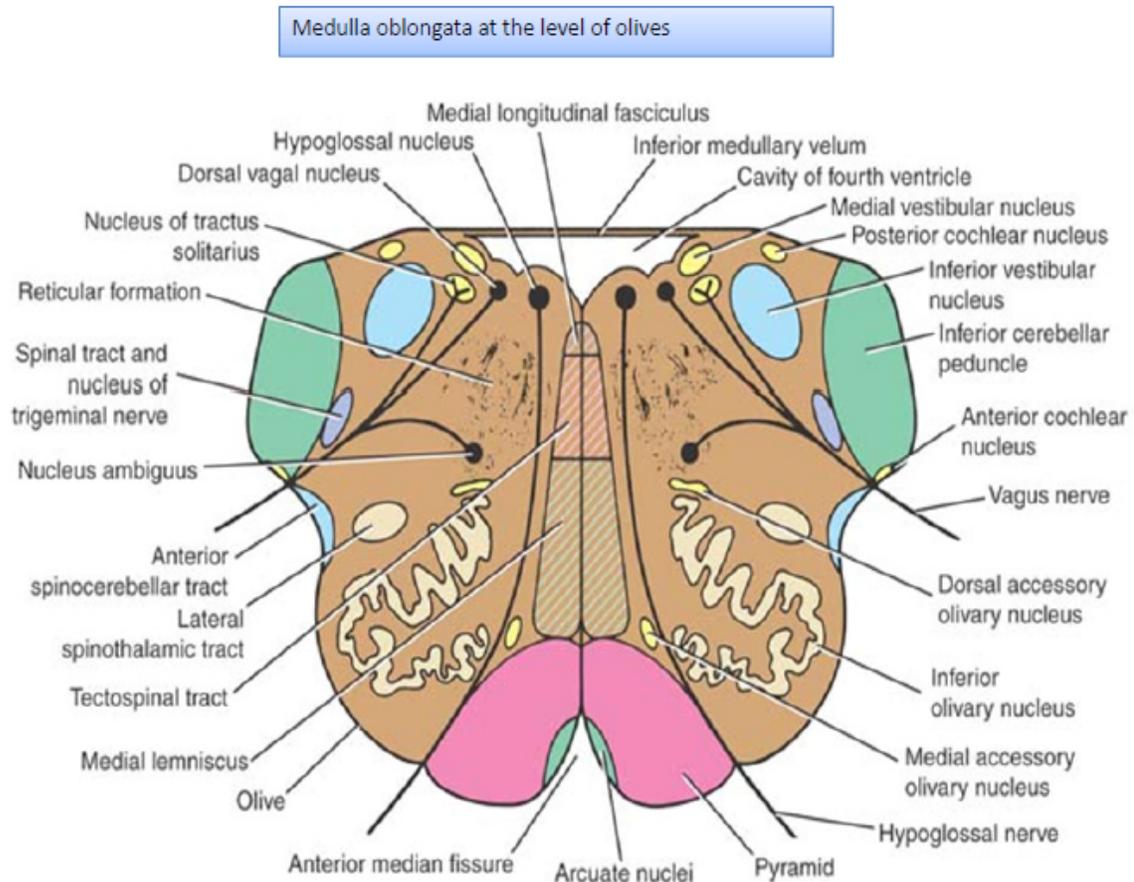
The nucleus in this level is a motor nucleus of accessory nerve but it's not exclusive for this nerve only , in fact it is a motor nucleus for cranial nerves number 9 \ 10 and 11, and we call it nucleus ambiguus.

\*\*cranial root of accessory emerges from nucleus ambiguus to unite with spinal root of accessory , but they divide after that immediately.

ALS is unchanged on this level also, but here it starts to form spinal lemniscus with spinotectal tract.

\*note : sometimes we can see a small part of inferior olivary nucleus but we don't consider it the level of the olives.

## The third level is the level of olives :



1-The cavity of this section is inferior part of 4<sup>th</sup> ventricle (open medulla), behind it is the cerebellum.

Floor of 4<sup>th</sup> ventricle → medulla oblongata

Roof of 4<sup>th</sup> ventricle → cerebellum

2- Posterolateral in this section is INFERIOR CEREBELLAR PEDUNCLE (ICP) which connects medulla oblongata with cerebellum. (one of the structures that cross ICP is posterior spinocerebellar tract).

3- There are many olivary nuclei on this level (OLIVARY NUCLEAR COMPLEX), the biggest one is INFERIOR OLIVARY NUCLEUS, which is the cause of the bulging in the olive (its shape resembles crumpled bag with its opening directed medially).

The function of inferior olivary nucleus is motor, and has a connection with cerebellum and cerebrum. There are fibers emerging from it that go to cerebellum by ICP, their name is climbing fibers.

\*note: Fibers that go to cerebellum are divided into climbing fibers and Mossy fibers.

\*note: Spino-olivary tract is very similar to spinocerebellar tract and is considered an alternative pathway from spinal cord to cerebellum.

4- Corticospinal tract gives branches to the olive, they are involved in voluntary movement and from olive to spinal cord (olivospinal tract which is motor (not important)).

\*note: neurodegenerative diseases that affect olive will always affect the cerebellum so symptoms are overshadowed clinically.

Now let's talk about the midline structures in this section:

1-Medial lemniscus which is posterior to the pyramids and very close to the midline (lemniscus not fasciculus because fibers are elongated in shape and not rounded in the cross-section) which goes up until it reaches VPL in thalamus(one of the ventrobasal complex nuclei).

\*note: VPM which is one of ventrobasal complex nuclei, is concerned with face and taste sensory pathway.

2- posterior to medial lemniscus is tectospinal tract (extrapyramidal tract) which is very important in visual-spinal reflex (superior colliculus takes signals from visual pathway and spinotectal tract , then it sends signals through tectospinal tract to upper cervical segments).

\*note: withdrawal reflex is different from spinovisual reflex. Withdrawal reflex is the sudden and immediate withdrawal movement of the limb after the harm signals reach the spinal cord. On the other hand, spinovisual reflex is when you move your head and eyes to see your limb after the harm signals reach the superior colliculus by tectospinal tract.

3-posterior to tectospinal tract is medial longitudinal fasciculus which is underneath the floor of 4<sup>th</sup> ventricle.

Now let's talk about nucleus ambiguus :

Nucleus ambiguus (which is deep in reticular formation) is a motor nucleus to 3 cranial nerves (glossopharyngeal 9<sup>th</sup> \ vagus 10<sup>th</sup> \ cranial root of accessory nerve 11<sup>th</sup>).

\*note: lower part of nucleus ambiguus is the part that supplies cranial root of accessory nerve.

\*note: cranial nerves 10<sup>th</sup> \11<sup>th</sup> supply muscles of soft palate, pharynx, larynx and palatoglossus.

\*note: reticular formation is in the core of brain stem (medulla oblongata, pons and may extend to midbrain).

Also on this level we can see Central gray matter:

Underneath the floor of 4<sup>th</sup> ventricle, contains 4 structures from medial to lateral:

- 1- Motor nucleus of hypoglossal nerve: fibers of hypoglossal nerve emerge between pyramids and olives. (notice that 9<sup>th</sup> \10<sup>th</sup> \11<sup>th</sup> pass between olive and ICP)
- 2- Dorsal vagal nucleus (which is parasympathetic nucleus of vagus): if we cut vagus nerve we will see motor, sensory, parasympathetic, special sensory and visceral fibers. This nucleus gives parasympathetic supply to as long as distal third of transverse colon, after that level the sacral parasympathetic supply takes over.  
\*note: only cranial and sacral nerves gives parasympathetic supply to the body.
- 3- Nucleus of tractussolitarii (solitary nucleus) (sensory): takes fibers from vagus nerve (not only from vagus), it's function is special sensation (taste) and visceral sensation.

Innervation of the tongue:

Anterior 2\3	Posterior 1\3
1- Lingual and trigeminal nerve (general sensory) 2- Facial nerve (chorda tympani) (taste)	Glossopharyngeal nerve (special sensory and general sensory)

\*note: in infratemporal fossa there is a connection between lingual nerve and chorda tympani (facial).

\*\*important: what is the connection between vagus nerve and taste? there are taste fibers on epiglottis which are from vagus nerve.

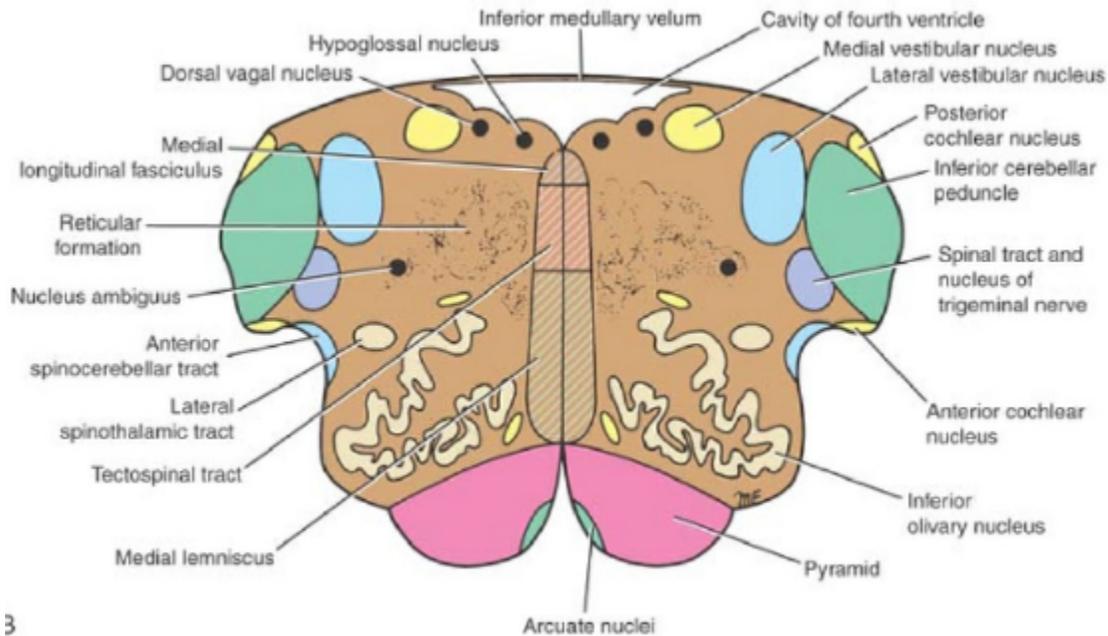
When vagus nerve gets out of skull by jugular foramen (9<sup>th</sup> and 11<sup>th</sup> use jugular foramen also) it will face 2 ganglia: inferior vagal ganglia and superior vagal ganglia, the cell body of taste and visceral sensory are in inferior vagal ganglia (glossopharyngeal is the same), superior vagal ganglia contains cell body of general sensation.

\*note: jugular foramen is between superior and inferior vagal ganglia.

- 4- Inferior vestibular nucleus (medial vestibular nucleus): sensory nucleus for vestibular nerve which is part of vestibulocochlear nerve 8<sup>th</sup> (important for balance), which leaves the cavity of inner ear then internal acoustic meatus then brain stem (pontomedullary junction), cell body in scarpa ganglia which is relay station in the groove between ICP and olive. Emergence of vestibulocochlear nerve: from vestibular nucleus to 1- cerebellum 2- medial longitudinal fasciculus 3- down on spinal cord 4- some people think it may project on cerebral cortex (vpl then cortex).

Now let's talk about 4<sup>th</sup> and last level of medulla oblongata:

### Level just inferior to Pons:



3

- 1- No major changes.
- 2- Most upper level in medulla oblongata
- 3- Lateral vestibular nucleus replaces inferior vestibular nucleus
- 4- Cochlear nuclei become visible on anterior(ventral) and posterior(dorsal) of ICP (relay station for cochlear nerve the second part of cranial nerve vestibulocochlear nerve 8<sup>th</sup>).

Now let's start new subject which is the Pons

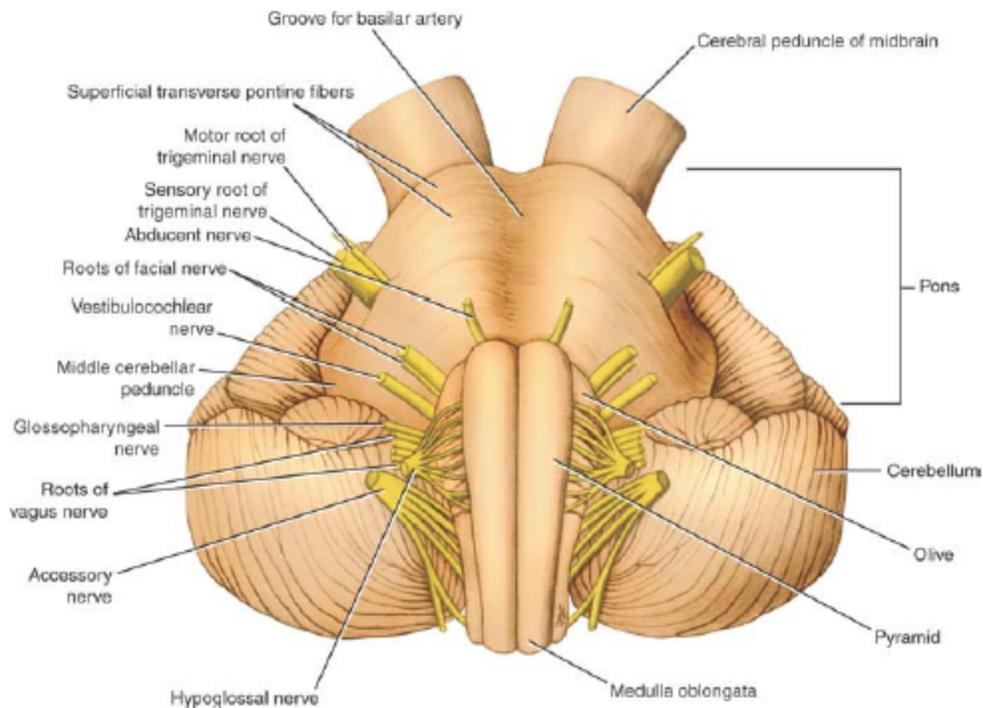
## PONS

As you can see in the figure there is basilar groove anteriorly through which the basilar artery passes.

Pons means bridge → bridge between cerebrum and cerebellum.

Pontomedullary junction from which 3 cranial nerves emerge (most lateral one is vestibulocochlear nerve).

# Pons – anterior view



We will study pons on two levels: caudal (facial colliculus) and cranial (mid pontine area (trigeminal)).

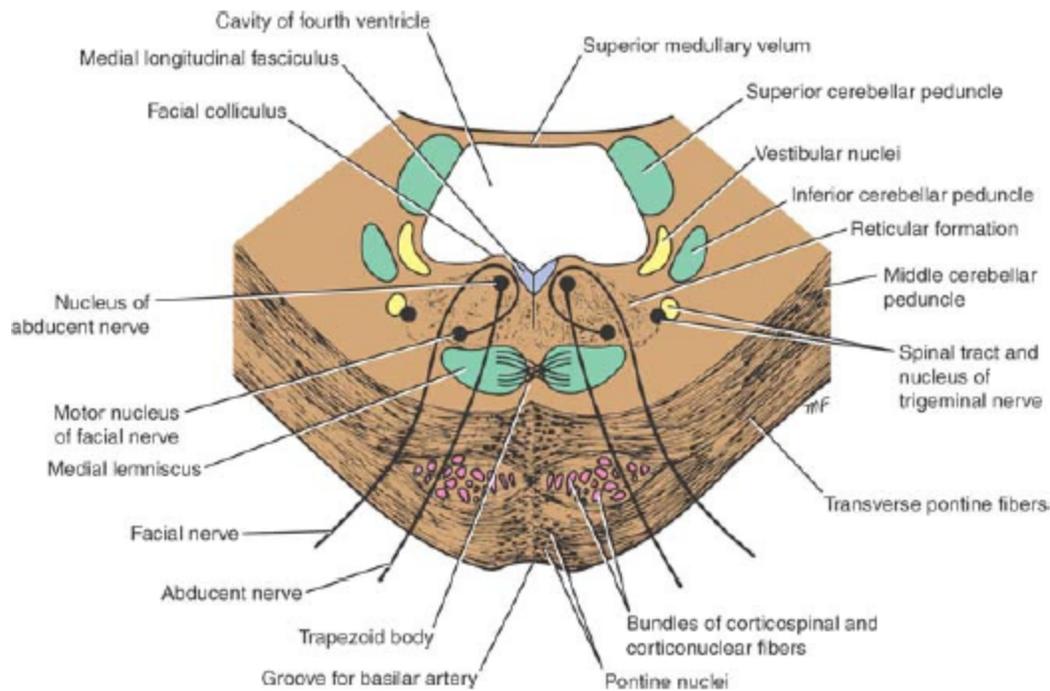
On the level of facial colliculus we will see nuclei of facial nerve.

\*note: on both levels the cavity is the 4<sup>th</sup> ventricle.

\*\*we divide pons anteroposteriorly into tegmentum (posterior part) and basal part (anterior part).

Posterior to trapezoid body is called tegmentum, and anterior to trapezoid body is called basilar or basal part (contains pontine nuclei and corticospinal tract).

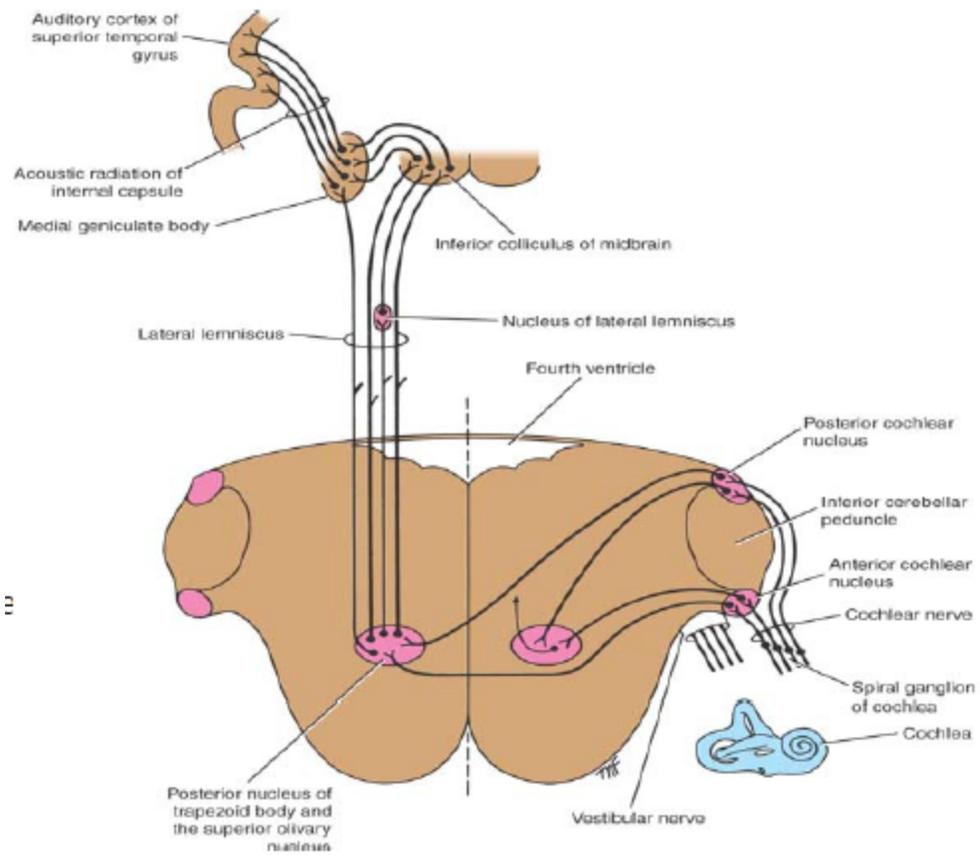
Trapezoid body is part of the acoustic (auditory) pathway that is made up of fibers derived from cochlear nuclei.



### Auditory pathway:

Fibers relay in posterior and anterior cochlear nuclei and then mainly cross trapezoid body to contralateral side, then ascend up (as lateral lemniscus) to inferior colliculus of midbrain then to medial geniculate body (which is part of the thalamus) then project on cortex of temporal lobe (primary auditory area).

\*note: synapse in this pathway happens in many areas (cochlear nuclei \ trapezoid body \ nucleus of lateral lemniscus) and that's why we call it polysynapse.



**THE END**