



Anatomy Team
MED 439

Revised & Approved



MED439
KING SAUD UNIVERSITY

The 8th Cranial Nerve

CNS Block

Contact us:
Anatomy439@gmail.com

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

Color index:

Content
Male slides
Female slides
Important
Doctors notes

Extra information, explanation

Objectives

At the end of the lecture, students should be able to:

- List the nuclei related to vestibular and cochlear nerves in the brain stem.
- Describe the type and site of each nucleus.
- Describe the vestibular pathways and its main connections.
- Describe the auditory pathway and its main connection.

8th CN: VestibuloCochlear

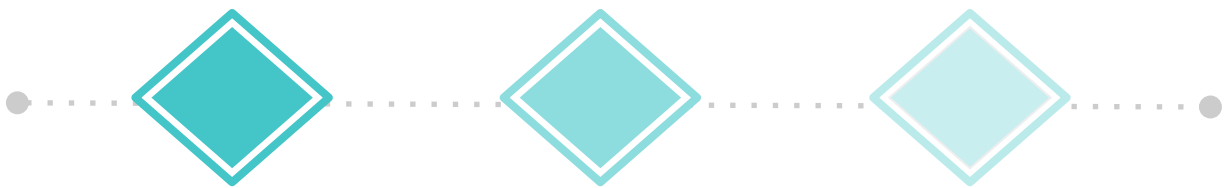
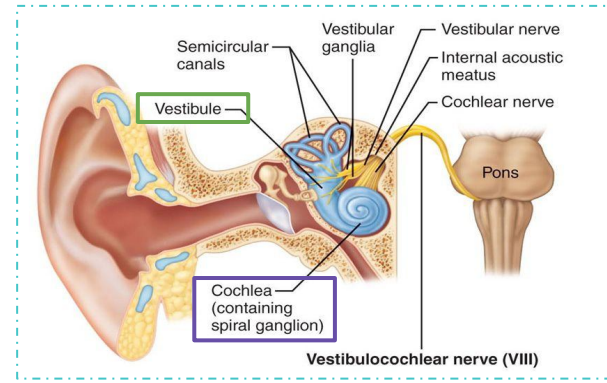
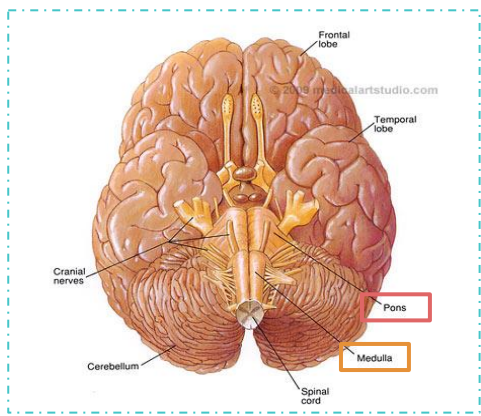
According to the females slides

- Type: Special sensory (SSA)
- located: In **pons** & **medulla**.
- Receiving: Special afferent sensation, hearing & equilibrium from inner ear.
- Conveys: Impulses from inner ear to nervous system

Components

1 Vestibular part:
Conveys impulses associated with body posture, balance and coordination of head & eye movements.

2 Cochlear part:
Conveys impulses associated with hearing.



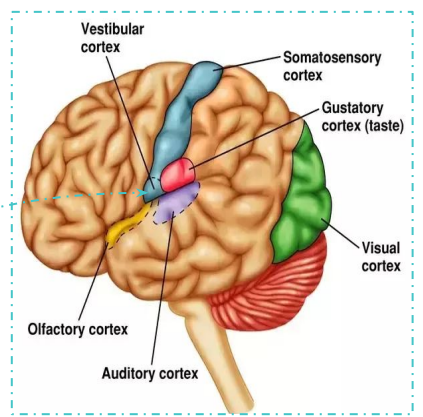
Vestibular & cochlear parts leave the ventral surface of brain stem through the pontomedullary sulcus at cerebellopontine angle (lateral to facial nerve)

Run laterally in posterior cranial fossa

Enter the internal acoustic meatus along with 7th nerve.

Vestibular area (In both slides)

- Located in the lower part of postcentral gyrus (head area).
- Responsible for conscious awareness of vestibular sensation.

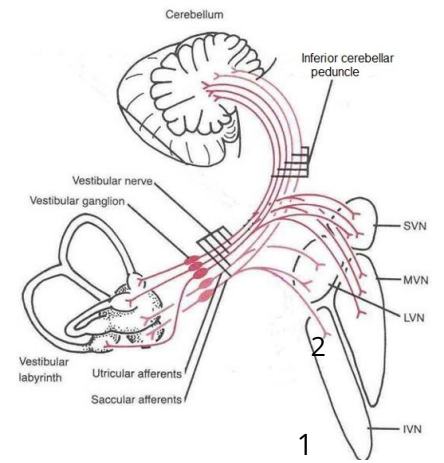


1st: Vestibular Nerve

According to the females slides

1st order neurons:
The cell bodies are located in the vestibular ganglion within the internal auditory meatus.

Vestibular nuclei belong to special somatic afferent column in brain stem.



Dr's note:
After the fibers

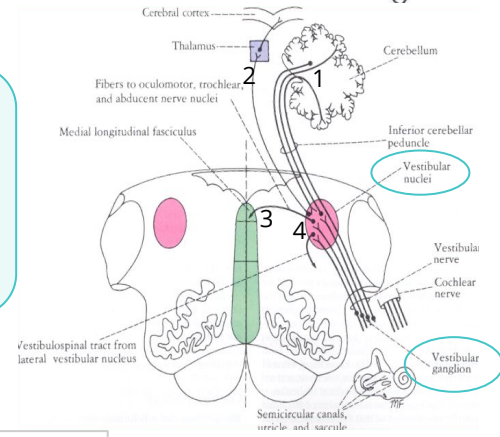
The Peripheral processes
(vestibular nerve fibers)

Make dendritic contact with hair cells of the membranous labyrinth (inner ear).

The central processes
(form the vestibular nerve)
"Efferent Fibres"

1- Mostly end up in the lateral, medial, inferior and superior vestibular nuclei (2nd order neurons) of the rostral medulla, located beneath the lateral part of the floor of 4th ventricle

2- Some fibers go to the cerebellum through the inferior cerebellar peduncle



The efferents from the vestibular nuclei project:

1- Ipsilateral
Flocculonodular lobe of cerebellum (vestibulo-cerebellar tract) (For Balance) through inferior cerebellar peduncle.

2- Bilaterally
To ventral posterior nucleus of thalamus, which in turn project to the cerebral cortex (For conscious awareness).

3- Bilaterally
To motor nuclei of cranial nerves (vestibulo-ocular tract) through medial longitudinal fasciculus (For coordination of head and eye movements).

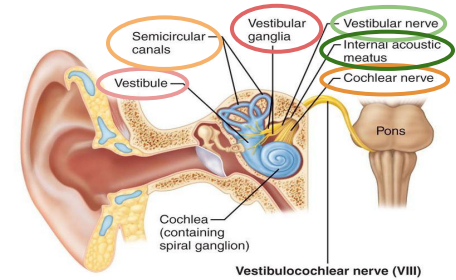
4- To Motor neurons of the spinal cord
As lateral (ipsilateral) directly & medial vestibulospinal (bilateral) tracts through MLF (for control the posture).

1st: Vestibular Nerve

According to the male slides

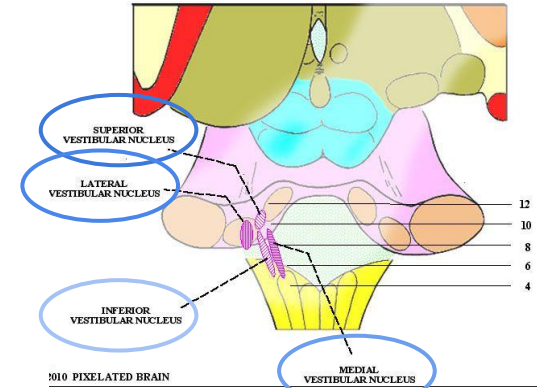
FIRST ORDER NEURONS:

- Cells of **Vestibular ganglion** located in Internal Auditory Meatus.
- Axons make dendritic contacts with hair cells in **vestibule & semicircular canals**.
- Both **cochlear & vestibular nerves** meet & emerge through **internal auditory (acoustic) meatus** to cranial cavity.
- Vestibular & cochlear parts enter pons through pontocerebellar (cerebellopontine) angle (lateral to facial nerve).



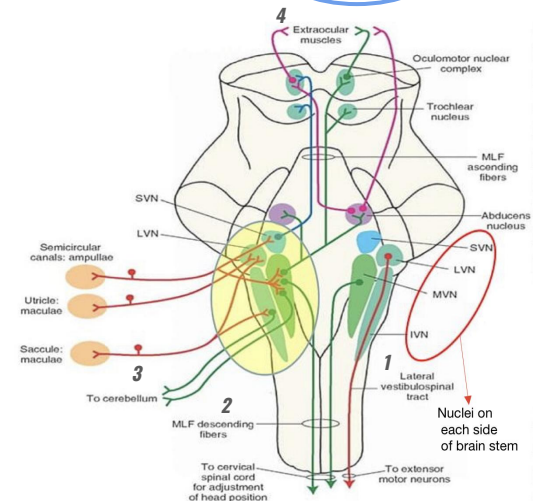
SECOND ORDER NEURONS:

- Cells of **Superior, Lateral, Medial & Inferior Vestibular Nuclei** in medulla & pons.
- Vestibular nuclei belong to special somatic afferent column in brain stem.



Axons of vestibular nuclei may:

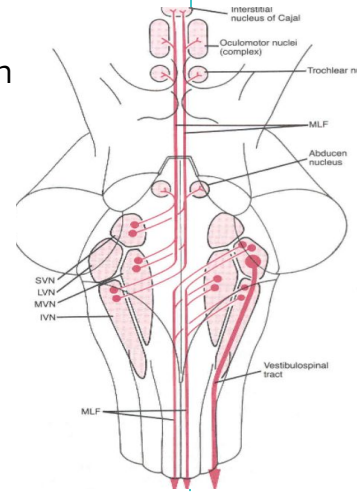
1. Descend as **lateral vestibulospinal** tract to anterior horn cells of spinal cord.
2. Join medial longitudinal fasciculus & descend as **medial vestibulospinal** tract to anterior horn cells of spinal cord.
3. Pass through **inferior cerebellar peduncle** to flocculonodular lobe of cerebellum.
4. Cross midline & ascend to **ventral posterior nucleus of thalamus** then to vestibular area in cerebral cortex.



Medial Longitudinal Fasciculus:

Vestibulospinal Tracts:

- Extends through out the brain stem and formed of both descending & ascending fibers
- Projects bilaterally



- Vestibulospinal fibers influence the activity of spinal motor neurons concerned with the control of body posture and balance.

Has two components:

The ascending component (vestibulo-ocular)

Establishes connections with the nuclei of the Oculomotor, Trochlear & Abducent nerves (motor nuclei for extraocular muscles) for coordination of head & eye movements.

The descending component

- Extends into the spinal cord as the medial vestibulospinal tract, for control the body posture.
- To anterior horns cells for control of body posture & balance.

Two tracts

Lateral arises from lateral vestibular (Deiter's) nucleus, descends ipsilaterally

Medial is the descending part of the medial longitudinal fasciculus, projects bilaterally.

2nd: Auditory pathway

According to the male slides

First order neuron

- Cells of **spiral ganglion** in the cochlea. Axons form **cochlear nerve**.
- Cochlear nerve makes dendritic contact with hair cells of Organ of Corti (in Cochlear Duct).
- Both cochlear & vestibular nerves meet & emerge through internal auditory (acoustic) meatus to cranial cavity.
- Vestibular & cochlear parts enter pons through pontocerebellar (cerebellopontine) angle (lateral to facial nerve)

Second order neuron

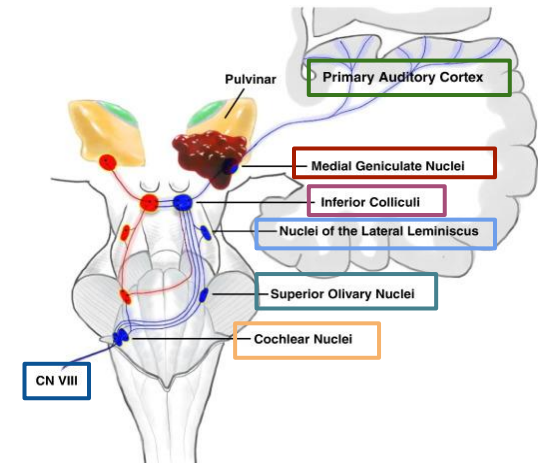
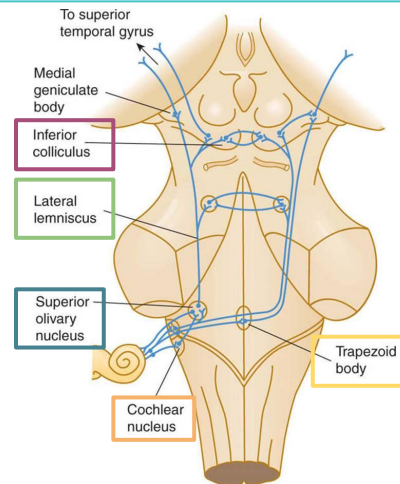
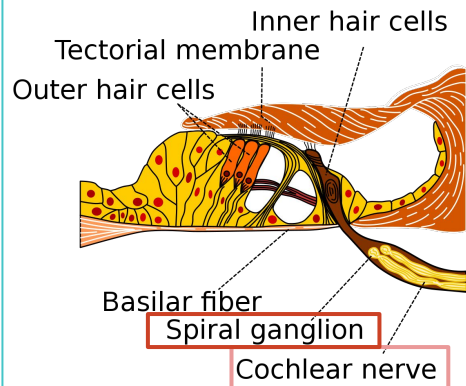
- Cells of dorsal & ventral cochlear nuclei in pons
- **Cochlear nuclei** belong to special somatic afferent column in brain stem.
- On ascending, most of axons decussate in the **trapezoid body** & form **lateral lemniscus**.
- Some fibers end in **Superior Olivary Nucleus** & **Nucleus of Lateral Lemniscus**.
- Superior Olivary Nucleus & Nucleus of Lateral Lemniscus: modulate transmission of auditory information to cochlear nerve by:
 1. Sending inhibitory fibers through **vestibulocochlear nerve** ending in **organ of corti**.
 2. Establishing connection with motor neurons supplying tensor tympani & stapedius muscle.

Third order neuron

- **Cells of inferior colliculus** (midbrain)
- Both colliculi are interconnected by commissural fibers.

Fourth order neuron

- **Cells of medial geniculate nucleus** (thalamus).
 - Axons form **auditory radiation** that pass through retrolenticular part of internal capsule.
 - Auditory radiation ends in **primary auditory cortex** (superior temporal gyrus) which is connected to auditory association cortex
- N.B.: Representation of cochlea is bilateral at all levels above **cochlear nuclei**.



2nd: Auditory pathway

According to the females slides

1

It is multisynaptic pathway

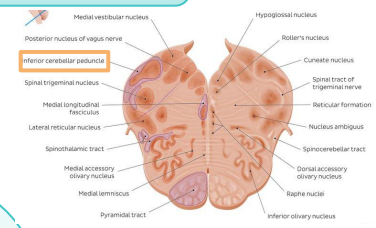
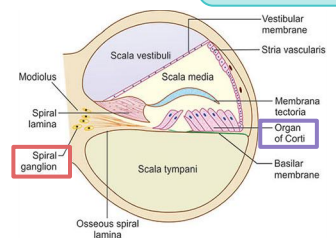
2

There is several locations between medulla and thalamus where axons may synapse and not all the fibers behave in the same manner

3

Representation of cochlea is bilateral at all levels above cochlear nuclei, so Hearing is bilaterally represented.

The cell bodies (first order neuron)

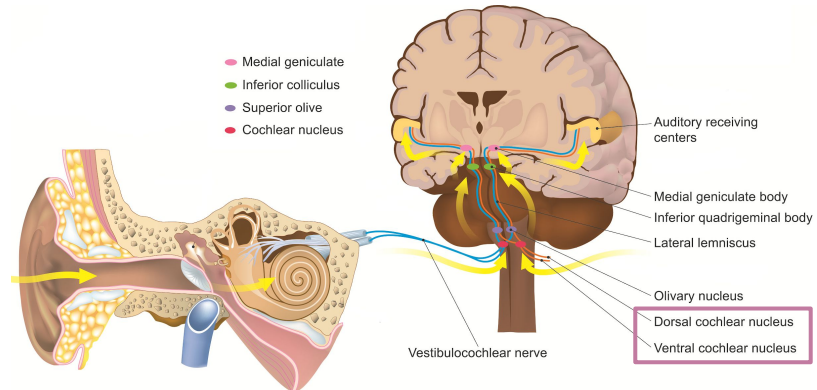


Are located in the **spinal ganglion** within the cochlea (organ of corti in the inner ear).

The Peripheral processes

The central processes (cochlear nerve fiber)

Make **dendritic contact** with **hair cells** of the **organ of Corti** within the cochlear duct of inner ear.



Terminate in the **dorsal and ventral cochlear nuclei (2nd order neurons)**, which lie close to the **inferior cerebellar peduncle (ICP)** in open rostral medulla.

2nd: Auditory pathway Cont...

According to the females slides

From the **cochlear nuclei** (2nd order neurons) fibres ascend into the pons, where:

Most fibers cross the midline in trapezoid body and terminate in

The **nucleus of trapezoid body** (1)

The **contralateral superior olivary nucleus** (2)

Some fibers run ipsilaterally and terminate in

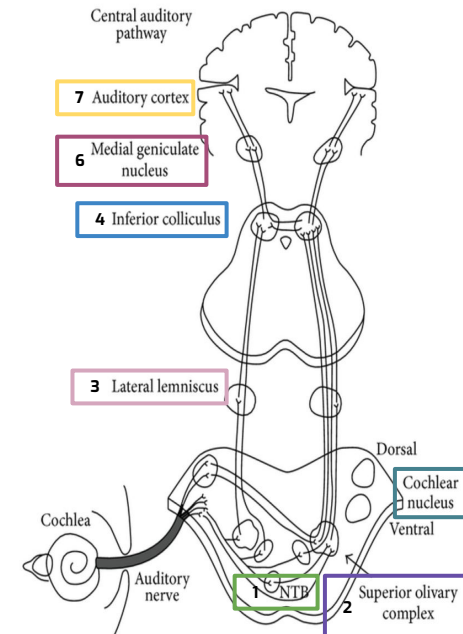
The **superior olivary nucleus** (2)

From the **superior olivary nuclei**, ascending fibers comprise the **lateral lemniscus** (3) containing both

Crossed (mainly) cochlear fibres

Direct (few) cochlear fibres

which runs through **tegmentum of pons** and terminate in the **inferior colliculus** (4) of the midbrain (3rd order neurons)



Dr's note:

#Remember : superior colliculi for vision reflex
Inferior colliculi for auditory pathway

2nd: Auditory pathway Cont...

According to the females slides

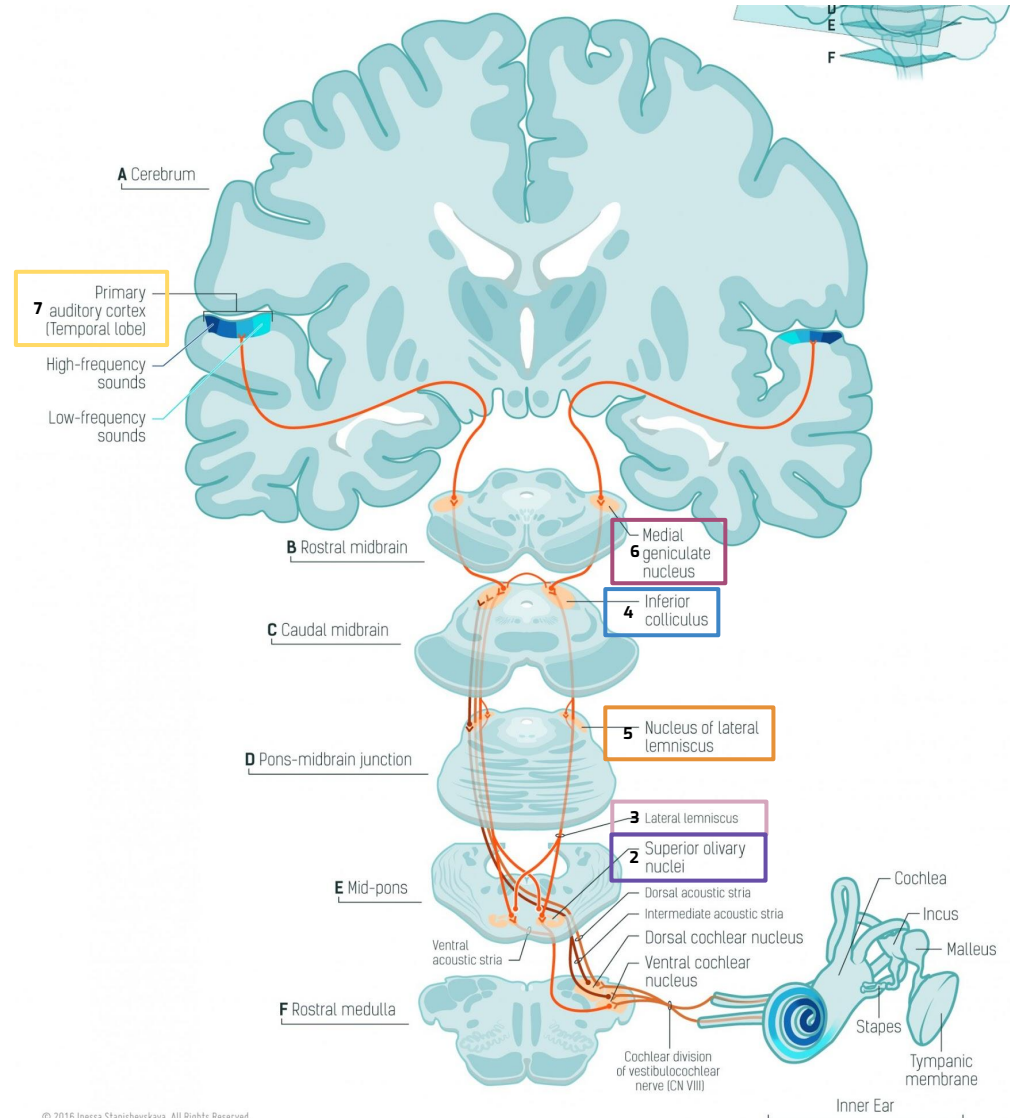
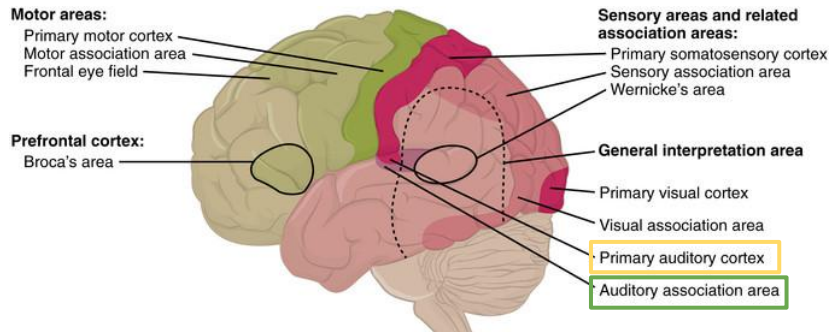
Some axons within lateral lemniscus terminate in small **nucleus of the lateral lemniscus (5)**

The inferior colliculi project to **medial geniculate nuclei (6)** (4th order neurons) of thalamus

The axons originating from the medial geniculate nucleus (auditory radiation) pass through sublenticular part of the internal capsule to the **primary auditory cortex** (Brodmann's areas 41, 42) **(7)** located in the dorsal surface of the superior temporal gyrus (Heschl's gyrus)

→ The region surrounding the primary auditory cortex is known as the **auditory association cortex** or **Wernicke's area** (Brodmann's areas 22)

→ Wernicke's area is related to **recognition and processing of language by the brain.**



Other Functions of some nuclei

According to the females slides

01

Superior olivary nucleus

Sends olivocochlear fibers to end in organ of Corti through the vestibulocochlear nerve. These fibers are inhibitory in function and serve to modulate transmission of sound to the cochlear nerve.

02

Superior olivary nucleus & the nucleus of the lateral lemniscus

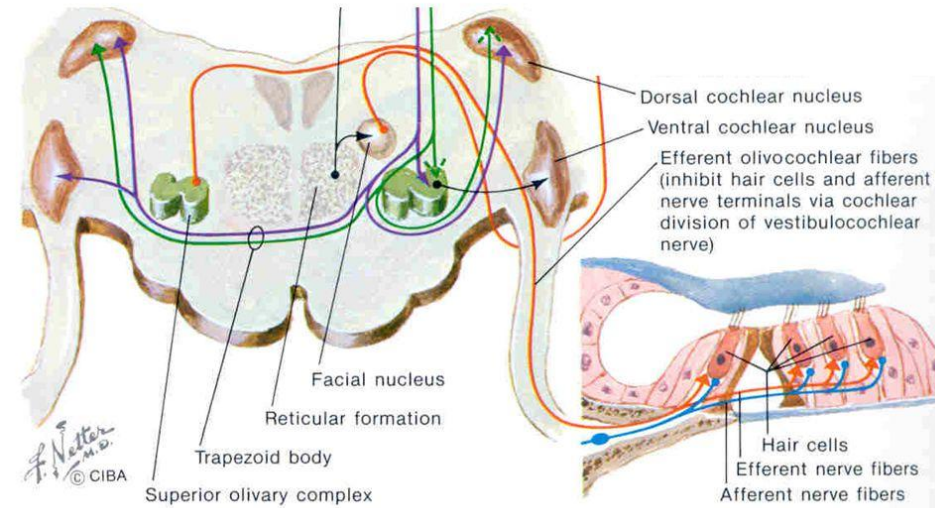
Establish reflex connections with motor neurons of trigeminal and facial motor nuclei mediating contraction of tensor tympani and stapedius muscles as they reduce the amount of sound that gets into the inner ear in response to loud noise.

03

Inferior colliculus

establish reflex connections with motor neurons in the cervical spinal segments (via tectospinal tract) for the movement of head and neck in response to auditory stimulation.

Olivo-Cochlear Efferent Neurons



Lesion of vestibulocochlear nerve produces deafness (disturbance of cochlear nerve functions), tinnitus, vertigo, dizziness, nausea, nystagmus, **loss of balance and ataxia** (disturbance vestibular nerve function)

Complete Deafness
Of the affected ear is essentially only caused by damage to the middle ear, cochlea, or auditory nerve.

Clinical notes

Rostral to the cochlear nuclei
The representation of cochlea is essentially bilateral at all levels. So, Lesions anywhere along the pathway usually have no obvious effect on hearing, producing weakness of hearing in both ears but mostly in the opposite ear.

Acoustic neuroma
Benign tumour of 8th nerve leads to compression of the nerve leading to attacks of dizziness, and profound deafness and ataxia

MCQ

Q1: The third order neurons of the auditory pathway are found in:

A: Thalamus

B: Midbrain

C: Pons

D: Cerebral cortex

Q2: The vestibular nuclei are connected to the oculomotor neuron through:

A: Lateral lemniscus

B: Medial longitudinal fasciculus

C: Vestibular nerve

D: Lateral vestibulospinal tract

Q3: The primary auditory cortex is located in:

A: Superior frontal gyrus

B: Inferior frontal gyrus

C: Superior temporal gyrus

D: Inferior temporal gyrus

Q4: The fourth order neurons of the auditory pathway are:

A: Cells of spiral ganglion in the cochlea

B: Cells of dorsal and ventral cochlear nuclei

C: Cells of inferior colliculus

D: Medial geniculate nuclei

Q5: Both cochlear & vestibular nerves enter pons through:

A: Inferior cerebral peduncle

B: Anterolateral olivary sulcus

C: Pontocerebellar angle

D: Basilar sulcus

Q6: Vestibular nuclei belong to ___ column in brain stem :

A: Special somatic afferent

B: Special somatic efferent

C: Special visceral afferent

D: Special visceral efferent

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

MCQ

Q7: Cells of vestibular ganglion located in:

A: External auditory meatus

B: Internal auditory meatus

C: Pontocerebellar junction

D: Inferior colliculus

Q8: Vestibulo-ocular tract responsible for:

A: Conscious awareness

B: Control body posture

C: Coordination of head & eye movement

D: Balance

Q9: Vestibular area in the cerebral cortex located in:

A: Lower part of postcentral gyrus

B: Upper part of precentral gyrus

C: Superior temporal lobe

D: Upper part of postcentral gyrus

Q10: Vestibular & cochlear parts leave the ventral surface of brain stem through the

A: Pontomedullary sulcus

B: Internal acoustic meatus

C: Cerebellar peduncle

D: Medial vestibulospinal tract

Q11:area is related to recognition and processing of language by the brain

A: Vestibular

B: Primary auditory

C: Wernick's

D: Visual association

Q12: vestibule cochlear nerve type is

A: Motor

B: Sensory

C: Parasympathetic

D: Mixed

Answer key:
7(B) , 8(C) , 9(A) , 10(A) , 11(C) , 12(B)

SAQ

Q1: Vestibular Cortex/Area Responsible for?

Q2: The difference between the lateral & medial tracts?

Q3: vestibular nuclei belong to Which column in brain stem ?

Q4: what is the vestibulocochlear nerve components ?

Answers

1 : conscious awareness of vestibular sensation.

2 : A) Lateral arises from lateral vestibular (Deiter's) nucleus, descends ipsilaterally.
B) Medial is the descending part of the medial longitudinal fasciculus, projects bilaterally.

3 : special somatic afferent

4: 1- vestibular part 2- cochlear part

Team leaders

Rayan jabaan
Abeer Awwad

A special thanks to Mohamed Alquhidan

Reviser

Abdulaziz Alkraida

Organizer

Abdulaziz Alghuligah

Note taker

Asma Alamri

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
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- Feras Alqaidi
- Hadi Alhemsy
- Hesham Alsqabi
- Mohammed Aldehaim
- Mohamed Alquhidan
-  Mohammed Beyari
- Mubarak Alanazi
- Musab Alamri
- Nawaf Alghamdi
- Osama Alharbi
- Raed Alnutaifi
- Saad Aldohaim
- Saleh Algarni

