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# Examination of the Vestibulocochlear Nerve

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# Vestibulocochlear Nerve

The **vestibulocochlear nerve** (auditory vestibular nerve), known as the eighth cranial nerve, *transmits sound and equilibrium (balance) information from the inner ear to the brain.*

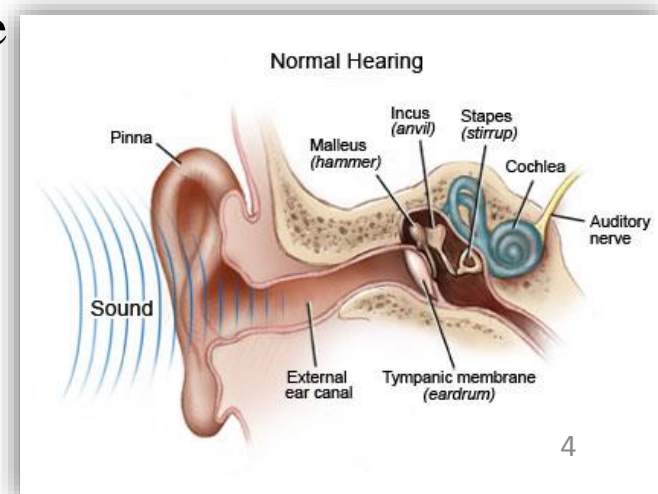
**This nerve consists of two distinct parts : vestibular nerve and cochlear nerve.** While the cochlear nerve is responsible for special sense of hearing, vestibular nerve is responsible for special sense of posture and equilibrium.

# Examination of the Cochlear Branch of vestibulocochlear Nerve

# Introduction and Principles

- The ear is the specialized sensory organ of hearing and balance. It comprises the conduction apparatus of the external and middle ears. The perceptive apparatus includes the cochlea with organ of corti and the auditory nerve.
- ***How Hearing Works?***
  1. Sound funnels into the ear canal and causes the eardrum to move.
  2. The eardrum vibrates with sound.
  3. Sound vibrations move through the ossicles to the cochlea.
  4. Sound vibrations cause the fluid in the cochlea to move.
  5. Fluid movement causes the hair cells to bend. Hair cells create neural signals which are picked up by the auditory nerve. Hair cells at one end of the cochlea send low pitch sound information and hair cells at the other end send high pitch sound information.
  6. The auditory nerve sends signals to the brain where they are interpreted as sounds.

<https://www.youtube.com/watch?v=eQEaiZ2j9oc>



# Introduction and Principle

## ➤ **Hearing loss, hard of hearing, and deafness**

- A person who is unable to hear as well as someone with normal hearing – hearing thresholds of 25 dB or better in both ears – is said to have **hearing loss**. Hearing loss may be mild, moderate, severe, or profound. It can affect one ear or both ears, and leads to difficulty in hearing conversational speech or loud sounds.
- **'Hard of hearing'** refers to people with hearing loss ranging from mild to severe. People who are hard of hearing usually communicate through spoken language and can benefit from hearing aids, cochlear implants, and other assistive devices. People with more significant hearing losses may benefit from cochlear implants.
- **'Deaf' people** mostly have profound hearing loss, which implies very little or no hearing. They often use sign language for communication.

# Types of Hearing Loss

There are four types of hearing loss; Conductive, Sensorineural, Mixed and Central. If any part of the hearing system is unable to function; the result is hearing loss.

1. **Conductive Hearing Loss**: Any problem in the outer or middle ear that prevents sound from being conducted properly is known as a conductive hearing loss.
2. **Sensorineural/nerve hearing loss**: results from damaged sensory cells (hair cells) in the cochlea and is usually permanent. Sensorineural hearing loss can be mild, moderate, severe or profound. Mild to severe sensorineural hearing loss can often be helped with hearing aids or a middle ear implant. Cochlear implants are often a solution for severe or profound hearing loss.
3. **Mixed hearing loss**: is a combination of a sensorineural and conductive hearing loss. It results from problems in both the inner and outer or middle ear. Treatment options may include medication, surgery, or hearing aids.
4. **Central hearing loss** : caused by a problem with the auditory nerve or sound centers. Sounds waves may travel through the ear but the nerve pathway is unable to send electrical impulses to the brain. As a result the hearing centers do not receive the signals correctly. Central hearing loss can be a result of a head injury or disease. A common symptom is the ability to detect sound but not being able to understand it.

# Causes of Hearing Loss

- ✓ **Age:** The tiny hairs get damaged and are less able to respond to sound waves.
- ✓ **Loud noise:** Exposure to loud noises damage the hair cells in the cochlea.
- ✓ **Infections:** During an ear infection, fluid can build up in the middle ear.
- ✓ **Perforated eardrum:** Depending on the size of the perforation, there may be a mild or moderate hearing loss.
- ✓ **Tumors:** eg. meningioma.
- ✓ **Trauma:** Injuries such as a skull fracture or a punctured eardrum can cause severe hearing loss.
- ✓ **Medications:** the aminoglycoside class of antibiotics (streptomycin), large quantities of aspirin, chemotherapy drugs, macrolide antibiotics (erythromycin) can cause hearing loss.
- ✓ **Genes:** Genetic hearing loss often begins with hearing loss diagnosed at birth.

# Before Examination (WIIPPPE)

- ✓ **W**ash your hands
- ✓ **I**ntroduce yourself (name and position)
- ✓ **I**dentify of patient (confirm name and date of birth)
- ✓ **P**ermission (consent and explain examination: “I’m going to examine your hearing using this tuning fork now, is that OK?”)
- ✓ **P**ain (especially over the mastoid)
- ✓ **P**osition (sitting comfortably)
- ✓ **E**xposure



# Hearing Tests



- Initial Otoscopic Examination



- Speech Test



- Rinne Test



- Weber Test



- Schwabach Test



- Audiometry

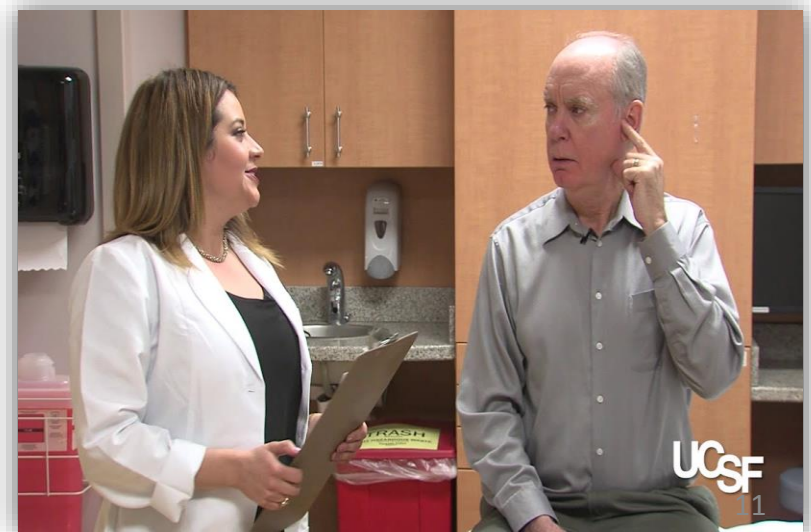
# Initial Otoscopic Examination

- ✓ Hold the otoscope in one hand and turn on the light.
- ✓ Gently insert the speculum into the ear.
- ✓ With the other free hand, gently pull up, out, and/or forward on patient's ear to straighten out the ear canal for easy viewing.
- ✓ Tympanic membrane is seen for:
  - Light reflection
  - Differentiation of its part
  - Mobility



# Speech Test

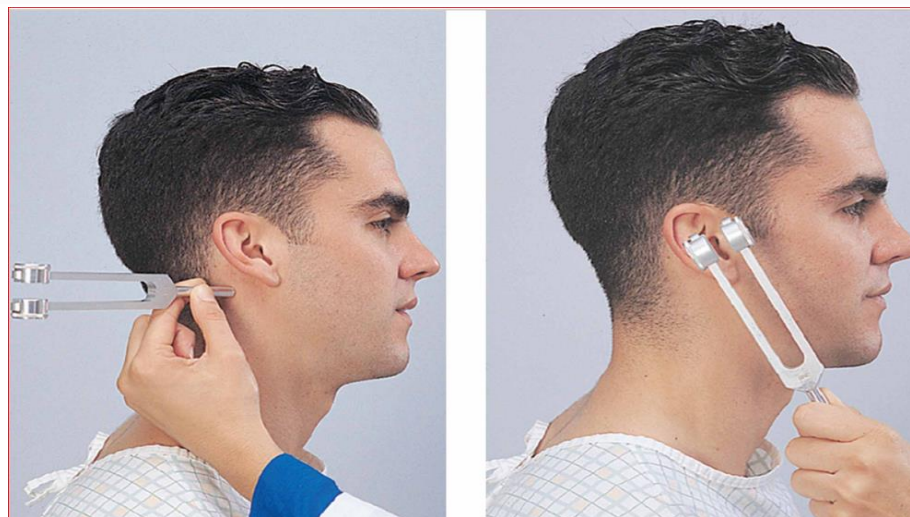
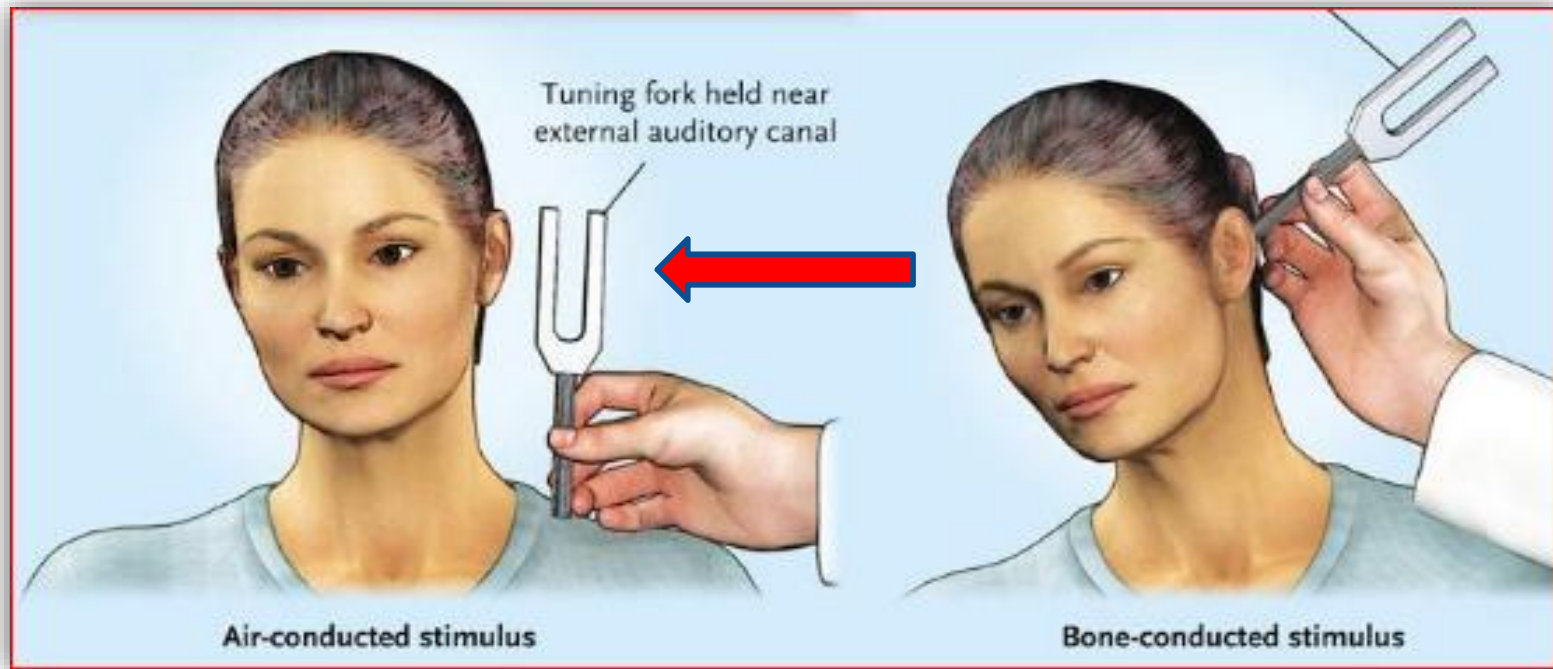
- ✓ Simplest of all
- ✓ Involves testing the ability to hear words without using any visual information.
- ✓ Patient should repeat 5 words spoken loudly at a distance of approx. 5 meter.
- ✓ The whispered voice test involves blocking one of patient's ears and testing hearing by whispering words at varying volumes.



# Rinne Test

- Rinne test aims to compare air conduction to bone conduction.
- Start with striking the tuning fork ( 256 or 512 Hz) against your knee/elbow or hard surface like a table.
- Place the base of the vibrating tuning fork on the mastoid process until the subject no longer feels the vibration. Then place the vibrating tips about 1cm from the subject's external auditory meatus.
- ***Normally***, the subject hears the vibrating tuning fork in air after bone conduction is over ( positive or normal ).
- ***In conductive hearing loss:*** patient does not hear the vibration in air after bone conduction is over ( Negative or abnormal ).
- ***Rinne test can only detect a conductive hearing loss.***

# Rinne Test





# Weber Test

- To perform Weber's test strike the fork against your knee or elbow, then place the base of the fork in the midline, high on the patient's forehead.
- It is important to make the patient's head steady with your other hand so that reasonably firm pressure can be applied.
- Then ask the patient: "Do you hear the sound louder in one ear than the other?" . If so, in which ear it is louder?
- If the patient is unclear, you may ask if they hear it "everywhere." Be careful not to ask the question in a misleading manner.
- ***Normally***, the sound is heard equally at both sides.
- ***In conductive hearing loss:*** the sound is louder in the impaired ear because masking effect of environmental noise is absent on the diseased side.
- ***In nerve hearing loss :*** sound is louder in normal ear.

# Weber Test



# Examination of the Cochlear Nerve

To summarize :

Method	Weber's test	Rinne's test
<b>Technique</b>	Base of the vibrating tuning fork placed on vertex	Base of the vibrating tuning fork placed on the mastoid process until the subject is no longer hearing it, then held in air next to the ear
<b>Normal</b>	Hears equally on both sides	Hears vibration in air after bone conduction is over
<b>Conductive hearing loss (one ear)</b>	Sound louder in the diseased ear because masking effect of environment noise is absent in the diseased side	Vibration in air not heard after bone conduction is over
<b>Nerve hearing loss (one ear)</b>	Sound louder in normal ear	Vibration heard in air after bone conduction is over as long as nerve deafness is partial



# Schwabach Test

- In Schwabach test, the vibrating tuning fork is placed on the subject's mastoid process then on that of the examiner.
- ***In normal hearing*** ( assuming that both of the examiner and subject have normal hearing), ***the sound will be lost equally.***
- ***In conductive hearing loss*** : the patient hears the vibration for a longer period than the examiner.
- ***In nerve hearing loss*** : the patient feels the vibration of the fork for a shorter period or not at all.

# Examples of results encountered in tuning fork tests

*L ear*                      *R ear*

+      Rinne      +  
         ↑  
         Weber  
N      Schwabach      N



Normal hearing  
on both sides

*Good(L)*                      *Bad(R)*

+      Rinne      -  
                         →  
                         Weber  
N      Schwabach      ↑



Conductive  
hearing loss on  
the right side

*Good(L)*                      *Bad(R)*

+      Rinne      +  
                         ←  
                         Weber  
N      Schwabach      ↓



Nerve hearing loss  
on the right side

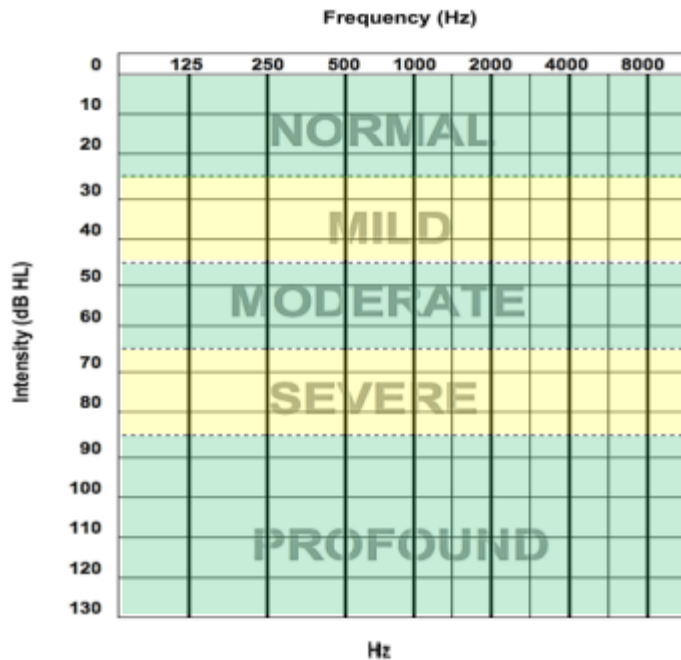
# Audiometry

- **Audiometry** is a device for measuring the auditory acuity by providing the subject with pure tones of various frequencies ( 125, 250, 500, 750, 1000, 2000, 4000, 6000, and 8000)Hz through earphones and bone conduction piece.
- At each frequency the threshold intensity is determined and plotted on a graph as a percentage of normal hearing.
- The audiometry also determines whether the defect in hearing results from a lesion on the external auditory canal or middle ear (conductive hearing loss) or from a defect in the cochlea or its nerve ( nerve hearing loss).
- Normally air conduction of sounds is more efficient than bone conduction but when there is a conductive hearing loss, the reverse is the case.

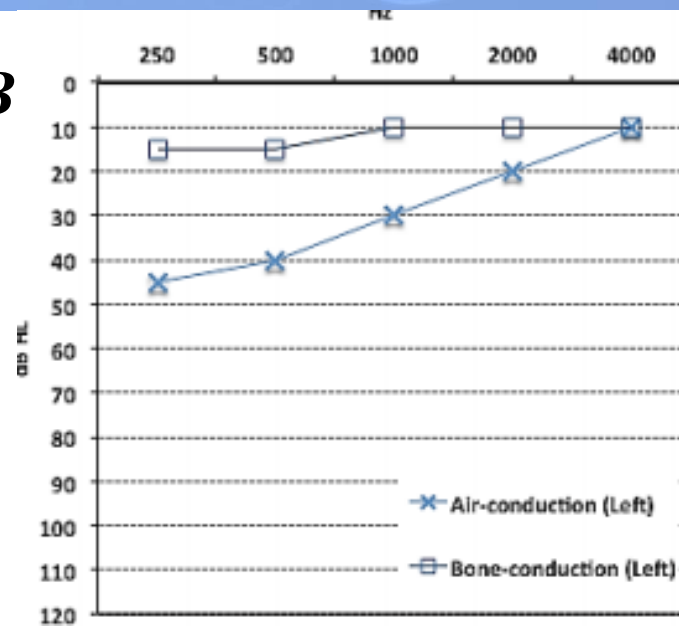


# Audiometry

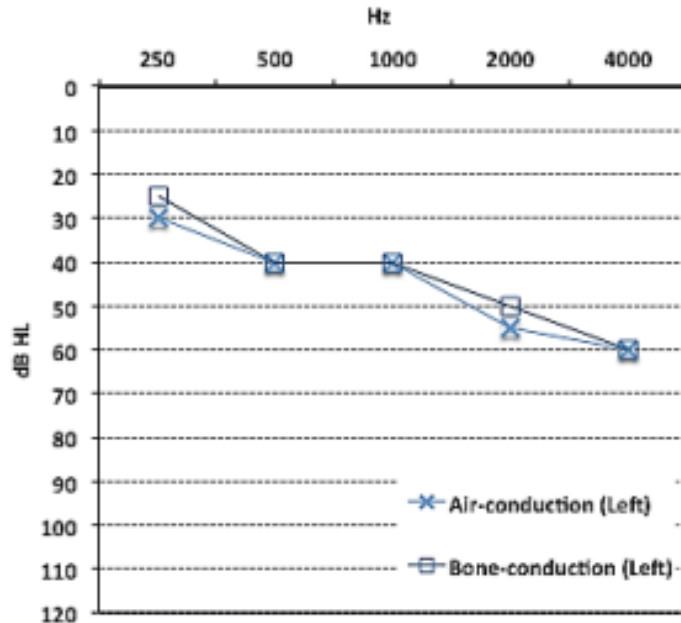
**A**



**B**



**C**



**A.** Pure tone audiogram (x-axis = frequency; y-axis = intensity).

**B.** Audiogram of a patient with conductive hearing loss.

**C.** Example of audiogram of a patient with nerve hearing loss.

# Examination of the Vestibular Branch of vestibulocochlear Nerve

# Examination of Vestibular Nerve

- Perform the **oculocephalic reflex** or dolls eye movement : The oculocephalic reflex, a form of the vestibulo-ocular reflex, is tested by holding the eyes open and rotating the head from side to side or up and down. These maneuvers obviously should not be performed in cases of head injury or other cases of suspected cervical spine trauma unless complete cervical spine films are normal. The reflex is present if the eyes move in the opposite direction of the head movements, and it is therefore sometimes called doll's eyes.

See the link : <https://www.youtube.com/watch?v=5dvqpxUGfcg>

- Perform **caloric test** : the caloric reflex test (sometimes termed 'vestibular caloric stimulation') is a test of the vestibulo-ocular reflex that involves irrigating cold or warm water or air into the external auditory canal.

These two tests are usually carried out in special laboratory and not usually done.



*“When you lose your vision, you lose contact with things; when you lose your hearing, you lose contact with people.”*

*Helen Keller*

