

CNS Block



Audiometry

**Done By;*

Ayan Saeed _ Samar Emad

★ Important Terminology★

★ *Air conduction;*

It's the transmission of sound waves through air to the auditory cortex via auditory nerve, involving outer, middle and inner ears.

- The sound is amplified 22 times when it is transmitted through air conduction by the tympanic membrane (17 times) and the ossicles (1.3 times). That is why, **air conduction is always better than bone conduction in a normal person.**

★ *Bone conduction;*

It's the transmission of sound waves through the bones of the skull to the cochlea and then through the auditory pathways to the auditory cortex.

★ *Masking Sound;*

It's the sound present in the background that interferes with the sound that we want to listen.

-if we will test one of the ears the masking sound should be in the other ear (masking sound will be provided to the left ear, if the right ear is tested).

★ *Pure tone;*

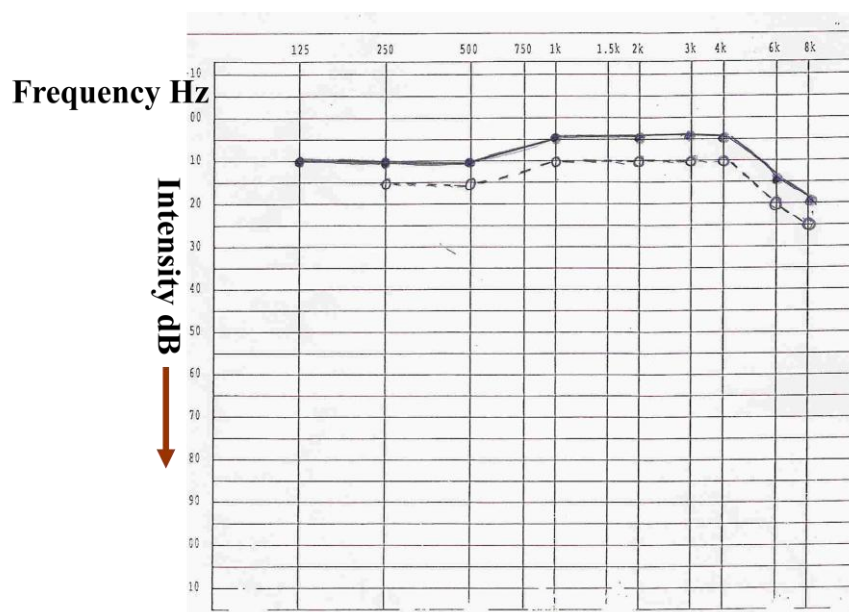
It's a single frequency tone with no harmonic content (no overtones). This corresponds to a sine wave.

★ *Audiogram;*

It's a chart of hearing sensitivity with the **frequency of sound plotted on the X- axis** and the **intensity of sound on the Y-axis**.

-Intensity (loudness) is the level of sound power measured in decibels

-frequency (pitch) is the number of sound waves per second measured in Hertz.



Hearing Tests and Pure Tone Audiometry

* tuning fork tests;

1- Rinne's Test:

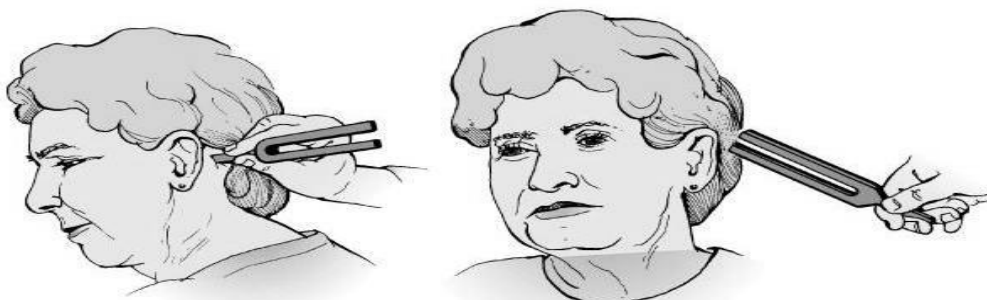
- This test compares the air conduction with the bone conduction.

-Equipment;

A 512 Hz tuning fork placed on the base of the **mastoid bone** first and then brought **in front of ear**

- Interpretation:.

- Normal subjects will **hear sound through air conduction twice as long as bone conduction**. They will still hear it in front of the ear when they can't hear anymore from the base of the mastoid bone.
- **conductive deafness**, bone **conduction will be better than air conduction**(when the subject stops hearing sound from the mastoid bone and brings the tuning fork in front of the ear, he will not hear any sound).
- **sensorineural deafness**, the **sound through air conduction is heard longer than bone conduction in affected ear**, but less than twice longer as is the case in normal subjects.



- The Weber's Test:

This test distinguishes between conductive and sensorineural deafness.

-Equipment;

A 512 Hz tuning fork placed on the **vertex of the subject**.

- Interpretation:

-If the **hearing is normal**, the sound is heard equally in both ears.

-The sound is heard better in the affected or diseased ear in a subject with **conductive deafness** because of the loss of masking effect of the environment and all the receptors for hearing in the affected ear are free to hear the sound.

-The sound is obviously heard better in the normal ear than the affected ear in a subject with **sensorineural deafness** because the cochlea and the neural pathway is intact on the normal side.



**Pure tone Audiometry :-*

Audiometry is the testing of hearing ability, involving thresholds and differing frequencies.

**degrees of hearing loss:-*

Given below are the ranges of hearing thresholds for a given frequency of sound that determine the severity of hearing loss in a subject tested by audiometry:-

<i>Degree of hearing loss</i>	<i>Range of hearing threshold</i>
Normal hearing	0-25 dB
Mild hearing loss	26-40 dB
Moderate hearing loss	41-55 dB
Moderate-severe hearing loss	56-70 dB
Severe hearing loss	71-90 dB
Profound hearing loss	>90 dB

-types of hearing loss (deafness):-

- 1-Conductive hearing loss
- 2-Sensorineural hearing loss
- 3-Mixed hearing loss

1-Conductive Hearing loss (deafness):-

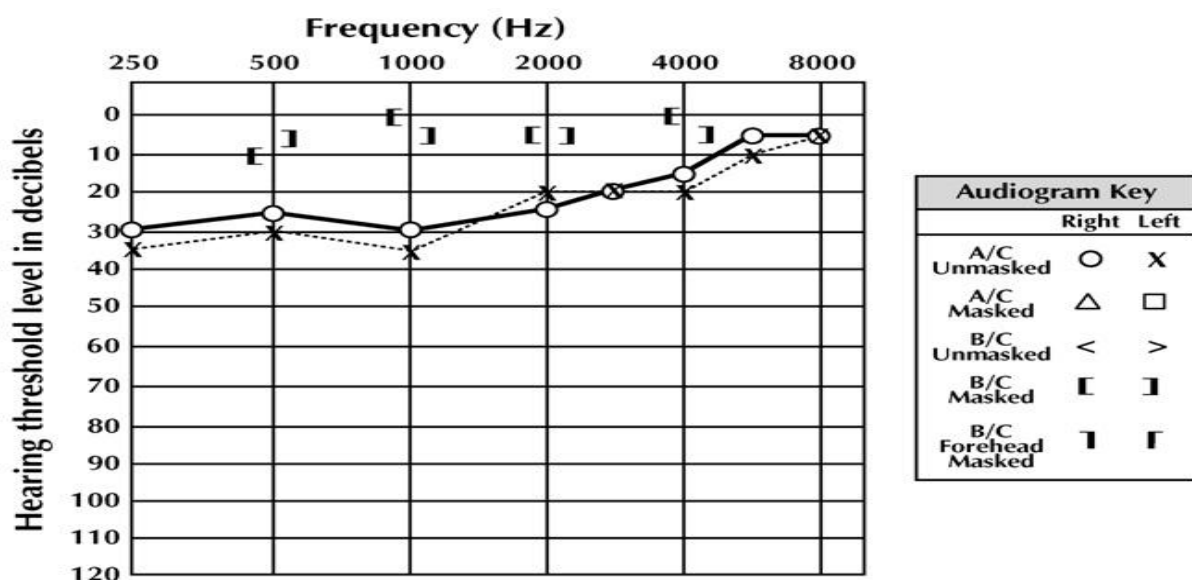
-Conductive deafness reduces the effective transmission of sound through air conduction, but it does not affect the bone-conduction because it bypasses the outer or middle ear and in the conductive deafness, the problem is either in the outer or in the middle ear. So bone conduction becomes better than air conduction due to the loss of amplification of sound in all cases of conductive deafness.

*** The causes of conductive deafness include:-**

1-wax in the ear canal, ruptured tympanic membrane.

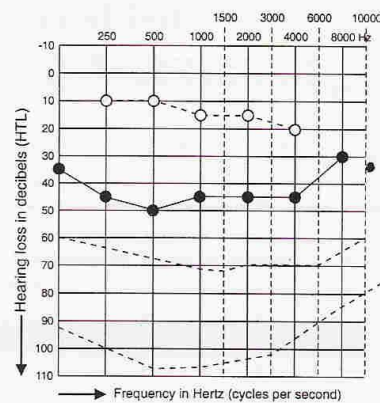
2- fluid in the middle ear system (**otitis media**).

3- fixation of the footplate of stapes to the oval window (**Otosclerosis**).



In the above audiogram, bone conduction is better than air conduction, so it is a case of **Conductive deafness**. Most likely cause of conductive deafness in this case is **Otosclerosis**, as we can see the two curves for air conduction and bone conduction are merging with each other at higher frequencies.

*the audiogram is showing conductive deafness, caused by Otosclerosis

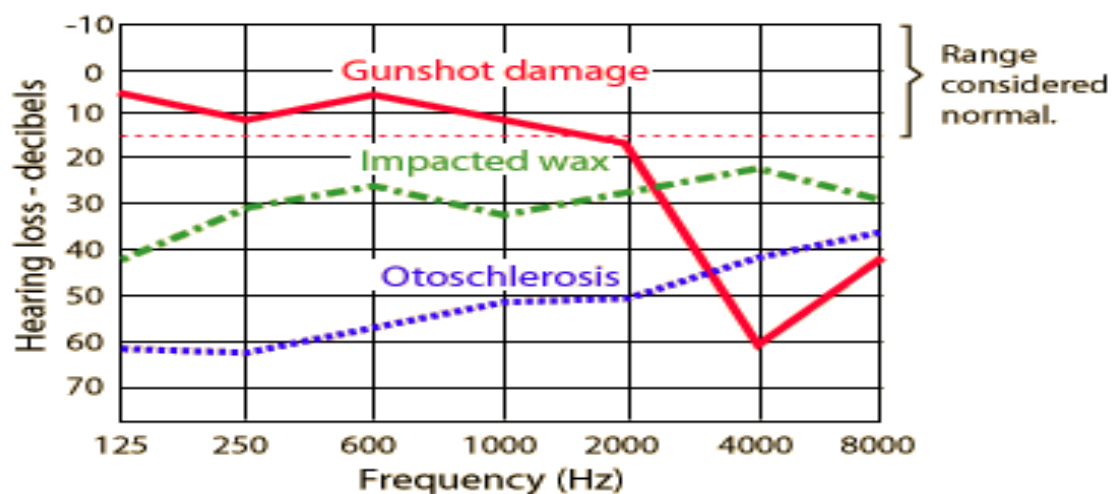


- BONE CONDUCTION
- AIR CONDUCTION
- INTERPRETATION

Conductive deafness
otosclerosis

*The below depicted diagrams of audiograms show various patterns of air conduction curves seen in different cases such as gunshot, impacted wax and otosclerosis.

*In the Noise-induced hearing loss, the hearing threshold is affected in only one particular frequency; most likely 4000 Hz as shown in the below air conduction curve in a case of gunshot damage.



2-Sensorineural Hearing loss (deafness):-

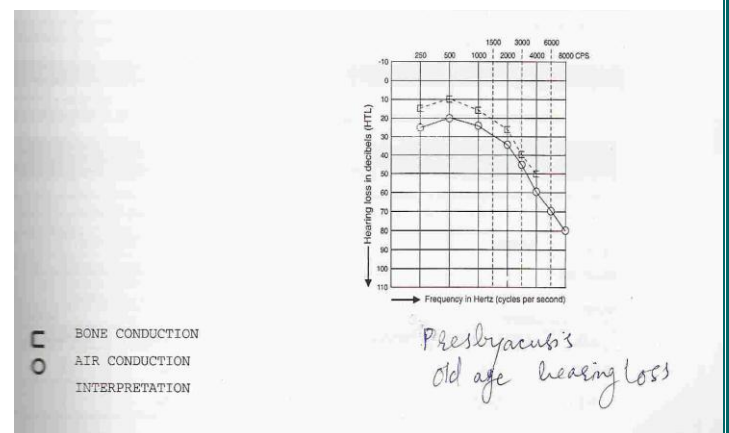
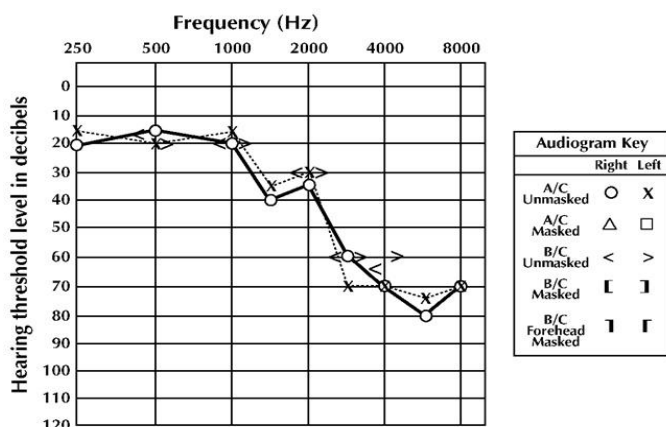
-Occurs when there is damage to the inner ear (cochlea), or to the nerve pathways from the inner ear to the brain.

-Reduces the ability to hear faint sounds. Even when speech is loud enough to hear, it may be unclear or sound muffled.

-Air conduction is better than bone conduction but the difference between them is within 10 db in each frequency of sound. The hearing threshold should be more than 25 db in one frequency of sound at least.

-Some possible causes of Sensorineural hearing loss include:

- 1-Illnesses like labyrinthitis (inner ear infection) and Meniere's disease
- 2-Drugs that are toxic to hearing
- 3-Hearing loss that runs in the family (genetic or hereditary)
- 4-Aging
- 5-Head trauma
- 6-Malformation of the inner ear
- 7-Exposure to loud noise



****These 2 audiograms are showing :-**

Sensorineural Hearing loss

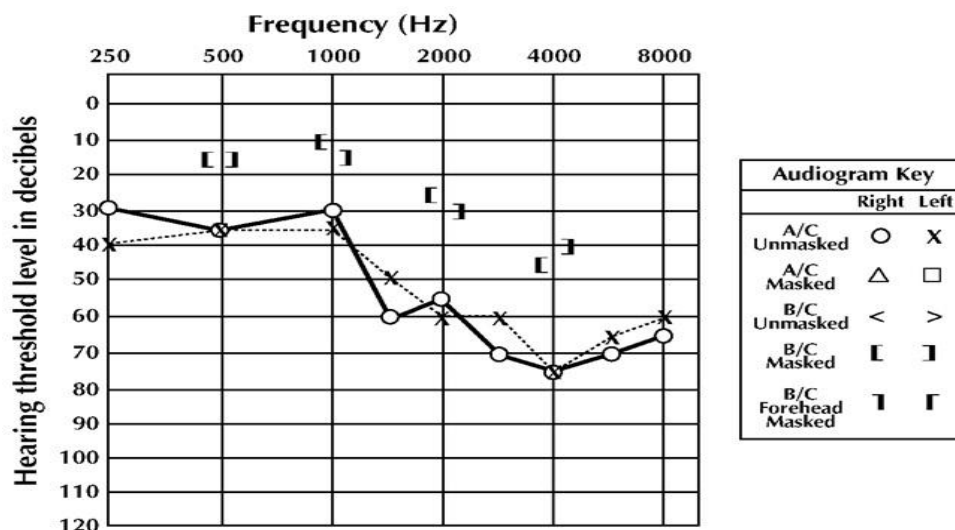
-In these 2 audiograms , **air conduction** is **better** than **bone conduction** and the hearing threshold is more than 25 db at higher frequencies, so it is a case of sensorineural deafness at higher frequencies or **Presbycusis due to old age.**

3-Mixed Hearing loss:-

-Sometimes a conductive hearing loss occurs in combination with a sensorineural hearing loss . In other words, there may be damage in the outer or middle ear and in the inner ear (cochlea) or auditory nerve. When this occurs, the hearing loss is referred to as a mixed hearing loss.

-In these cases, bone conduction is better than air conduction and the difference between them is more than 10 db and the hearing thresholds for air conduction in most of the frequencies is more than 25 db.

****This audiogram shows:-**



Mixed hearing loss

-Here **bone conduction** is better than **air conduction** and the difference between them is more than 10 db in all frequencies and also the hearing threshold for air conduction in most of the frequencies is more than 25 db.

*Common Auditory Disorders ;.

1- Presbycusis;.

a progressive bilateral symmetrical age-related sensorineural hearing loss. The hearing loss is most marked at higher frequencies.

2- Otitis media;.

an inflammation of the middle ear, usually caused by bacteria, that occurs when fluid builds up behind the eardrum in the middle ear cavity.

3- Noise-induced hearing loss;.

usually caused by exposure to excessively loud sounds.

- Noise-induced hearing loss can result from a one-time exposure to a very loud sound, blast, or impulse, or from listening to loud sounds over an extended period of time.

- It can be conductive deafness if only ear drum is ruptured by loud sound.

- or it may be sensorineural deafness if only cochlea is damaged by the loud sound.

- or it may be mixed hearing loss if both the tympanic membrane and the cochlea are damaged by the loud sound.

4- Otosclerosis;.

a hereditary condition in which the hearing loss occurs slowly, over time.

- It is caused by the growth of the fibrous tissue over the margin of footplate of stapes (3rd Ossicle) that fixes it with the margin of the oval window, immobilizing the ossicles and causing conductive deafness.

5- Ménière disease;.

an inner ear disorder that affects balance and hearing.

- It is thought to be caused by increased pressure of endolymph within the inner ear cavity.
- It is characterized by episodes of vertigo and tinnitus and progressive hearing loss, usually in one ear.

★Good Luck★