Physiology practical

Neuropsychiatry block

Lecture two :

{Audiometry}

- **Objectives :**

➔ The usual primary purpose of pure tone tests is to determine the type, degree, and configuration of hearing loss.

➔ To plot the frequency intensity recording and construct the audiograms.

➔ To interpret the audiograms.

- **Team leaders :**

  L**ojain Alsiwat & Fahad alabdullatif.**

- **Team members :**

  Khawla Alammari.
  Nouf alRushaid.
  Shamma alsaad.
  Alanoud alsalman.
  Raghda alqasim.
  Mohammed Aldegaither
  Abdulrahman alzamil.

- **Recourses :**

  Physiology practical boys & girls slides + Physiology practical handouts.

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- ## Terminology

➔ **Air conduction (test):** Sound is given to the external ear. It measures sensitivity of the **entire hearing mechanism**: External, middle and the sensory neural mechanism of the cochlea and auditory nerve and then through the brain to the cortex. Testing may be performed using headphones or insert earphones.

Sound travels from: Air › Auricle › Tympanic membrane › middle ear › Inner ear › brain

➔ **Bone conduction (test) [1]:** This technique assesses sensitivity when the signal is transmitted through the bones of the skull to the cochlea and then through the auditory pathways of the brain. This type of testing bypasses the outer and middle ear.

Dr Tahje: the only difference between air and bone conduction is the acuity of the sound **(Air conduction > bone conduction)**

➔ **Masking:** Masking presents a constant noise to the **non-test ear** to prevent cross over from the test ear.The purpose of masking is to prevent the non-test ear from detecting the signal (line busy), so only the tested ear can respond.

Dr Tahje: you add a background sound to the normal ear to make sure that sound in the tested ear does not travel to the normal ear

➔ **Pure tone:**[2] A *pure tone* is a single frequency tone with no harmonic content (no overtones).This corresponds to a sine wave[3].

➔ **Pure tone audiometry[4]:** Is the instrument used by audiologists to measure hearing thresholds[5].measures your ability to hear sounds that reach the inner ear through the ear canal (AC)[6] or through bone (BC)[7].

- ## Requirements:

1. Sound proof room.
2. Pure tone audiometer.
3. Audiograph paper.

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[1] When we test the bone conduction that's mean > sound is transmitted through the bones > sound reaches the inner ear directly through the bones. هنا نتجاوز الأذن الخارجية والوسطى ونركز فقط على الأذن الداخلية.

[2] Pure tone : one single frequency with many intensities.

[3] a curve representing periodic oscillations (vibrations) of constant amplitude as given by a sine function.

[4] It can identify the severity of hearing loss and its cause whether it is sensory, conductive or mixed.

[5] the minimum level at which a signal can be detected.

[6] Air conduction.

[7] Bone conduction.

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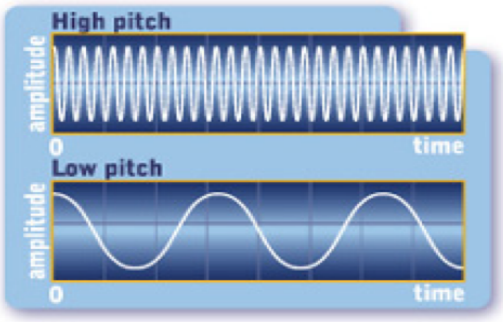
● Components of audiometer:

1. Frequency selector dial: selection of different pure-tone frequencies. Range 125 to 8000 Hz.
2. Hearing level dial: Controls the intensity of the signal 100 dB range in 5dB steps.
3. Presentation button: presents tone to the listener.
4. Output selector[8]: AC /BC.
5. Electronic vibrator: for testing bone conduction from the mastoid process to the cochlea.
6. Masking level dial: controls the intensity of the masking noise presented to the non test ear.

➔ Calibration: Zero intensity (0dB) level of sound at each frequency is the loudness that can be barely heard by the normal person.

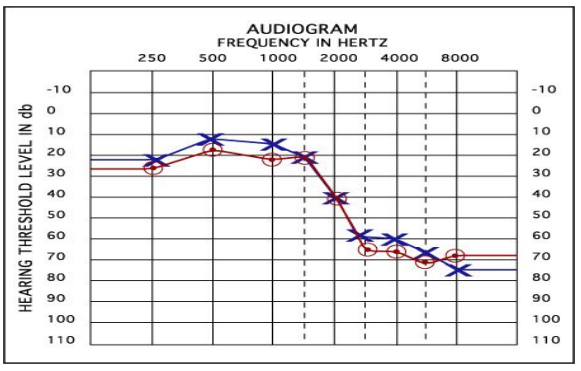


Pitch (Tone) depend on Numbers of cycle/sec. Human ear can detect sound waves with frequency 20-20000 cycle /sec.

- In the graph we see two different pitches :

1. High pitch which indicates high frequency
2. low pitch which indicates low frequency

● The Audiogram:[9]



➔ It's a chart of hearing sensitivity with:

X axis: frequency (pitch) Is the number of sound waves per sec measured in Hertz
(125 Hz near left and 8000 Hz near Right)

Y axis: Intensity (loudness) is the level of sound power measured in decibels (db)
(0 dB near the top and 110 dB near the bottom)

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[8] Output selector : allows us to choose whether the sound will be sent through air or bone.

[9] What is the difference between intensity and frequency ? the intensity means the loudness of the sound (شدة الصوت) while the frequency means the pitch of the sound (الذبذبات).

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- **Rinne's test: (Video)**

steps:

First: Bone Conduction

1. Vibrating Tuning Fork held on Mastoid process
2. Patient covers opposite ear with hand
3. Patient signals when sound ceases

Next: Air Conduction

4. Move the vibrating tuning fork over the ear canal (Near, but not touching the ear

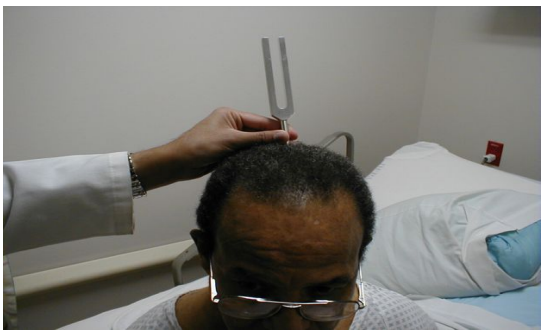
6. Patient indicates when the sound ceases

Results	
Normal	**Abnormal**
• Air Conduction > than Bone Conduction • Air conduction usually persists twice as long as bone Referred to as "positive test"	• Bone conduction > air conduction • Suggests Conductive Hearing Loss. • Referred to as "negative test"

- **Weber test:**

steps:

1. A vibrating tuning fork is placed on the middle of the head
2. The patient answers where the sound is coming from right, left, or both



- **Results:**

➔ Normal hearing: will indicate sound in the both ears.
➔ Conductive loss: sound travels toward the bad ear[10] (lateralization to the bad ear)
➔ Nerve loss: sound travels towards the good ear (lateralization to the good ear)

[10] Because BC>AC.

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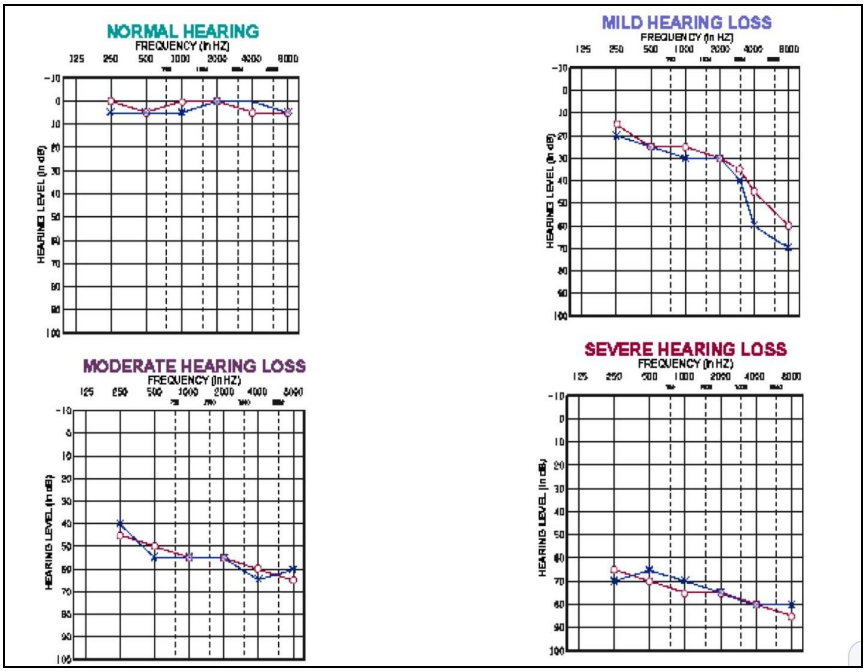
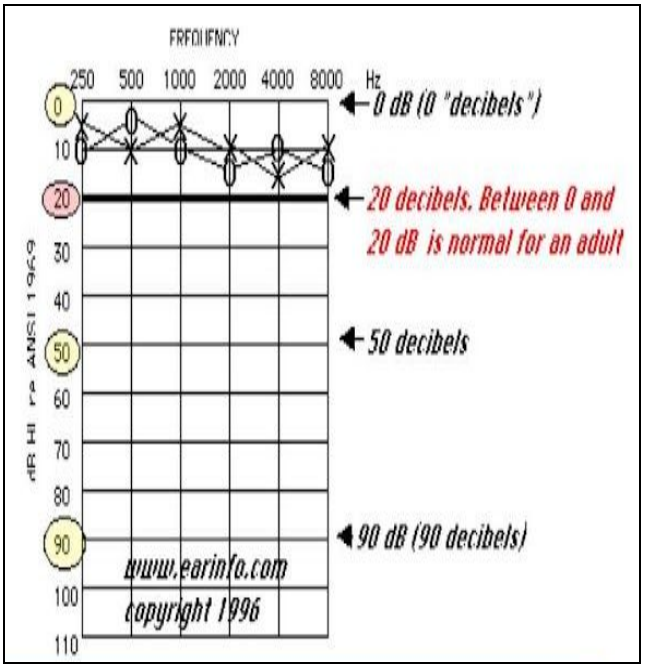
- **Pure tone audiometry:**
- **steps:**

1. person is seated comfortably In a sound proof room
2. Ear phones are applied which are color coded, (Red for right ear, blue for left ear.)
3. Masking sound is delivered to the non-test ear.
4. Start with a frequency of 125hz. & 0 db.[11]
5. Gradually increase the db Till the person hears the sound & respond.
6. Find the threshold of hearing from 125 hz To 8000 hz & Mark on the audiogram paper.
7. Mark the threshold intensity on the audiogram paper.
8. Join the points to make air conduction audiogram.
9. Place the bone vibrator over the mastoid process.
10. Deliver the sound through the vibrator & find out the threshold of hearing for different frequencies of sound and marked with a different sign on the audiogram paper.

N.B. Use different sign to mark the bone conduction audiogram.Select the other ear and repeat the whole procedure.





- The horizontal line at 0 db to 20 db hearing level represents normal hearing sensitivity for the average young adults

[11] When the dial = zero, it does not mean that there is no sound. It is just a reference value (the minimum sound that can be heard by a normal person "the normal person can hear the sound of 0 db !").

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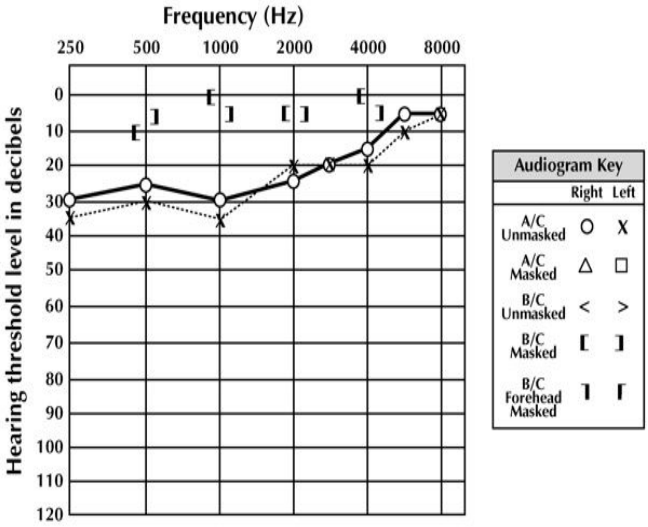
❖ Types of hearing loss:

1) Conductive deafness[12]:



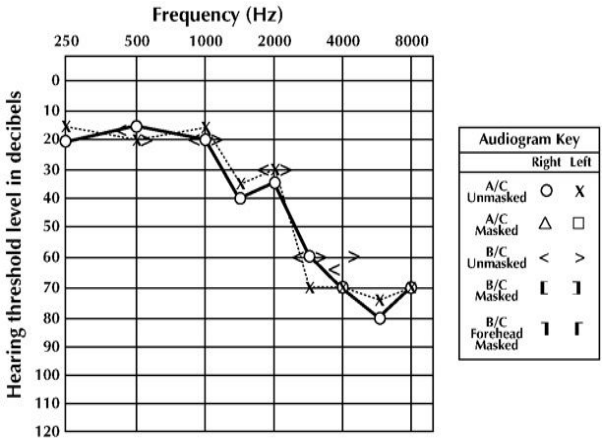
Parts affected: Obstruction or blockage Outer or middle ear.

- ➔ Bone conduction is better than Air conduction.(BC>AC)
- ➔ they are merging with each other at high frequency.
- ➔ Air conduction is Reduced. Bone conduction is normal "due to loss of Amplification"
- ➔ Air conduction thresholds are poorer than bone-conduction thresholds by more than 10 db

Causes

1. wax in ear canal
2. Rupture of tympanic membrane.
3. Otitis media[13]
4. Otosclerosis[14]

2) Sensorineural Deafness[15]



Parts affected: Inner ear or neural Pathway.

- ➔ Air conduction and bone conduction bothe decreased but air conduction is better than bone conduction. (AC>BC)
- ➔ Same at all frequencies.
- ➔ Sound threshold must be more than 30 db for each

[12] Conductive hearing loss : The defect is in the external & middle ear, while the inner ear is intact. Which means that the air conduction is disturbed while the bone conduction is intact.

[13] Inflammation of the middle ear. Usually by bacteria that occurs when fluid build in the middle ear cavity

[14] Is a heredity condition in which the hearing loss occurs slowly over time.caused by the growth of the fibrous tissues over the margin of footplate of stapes (3ed ossicle) that fixes it with the margin of the oval window. Immobilizing the ossicle and causing conductive deafness

[15] Sensorineural hearing loss (perceptive) : there is damage in the inner ear or the nerve pathway from the inner ear to the brain.

frequency to be heard

➔ hearing threshold is more than 25-30 db at higher frequency.

Notice here in the chart there is sloping it means the patients has presbyacousis.[16]

Causes:

- **Congenital:**

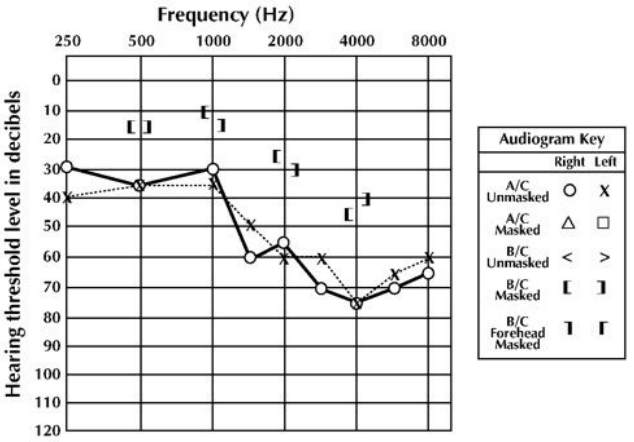
1. Heredity
2. Complication of maternal infection
3. Birth trauma

- **Acquired:**

1. Noise[17]: Low frequency sounds
2. Aging: For high frequency sounds (sloping audiogram): presbyacousis.
3. Ototoxic drugs: For all frequencies
4. Inflammatory disease: measles, mumps.

3) Mixed Hearing Loss

Parts affected: Middle or outer with inner or neural pathway.



➔ The patient has both conductive and bone hearing loss

➔ They are both reduced but Bone conduction is better than air conduction (BC>AC)

➔ the difference between them is more than 10db in all frequencies.(there is gap)

➔ also the hearing threshold of air conduction in most frequency is more than 25db [18]

➔ Frequencies between them is more than 10 db Sound threshold must be more than 30 db for each Frequency to be heard.

[16] Presbycusis : Loss of hearing associated with aging; manifest as reduced ability to perceive or discriminate sounds.

[17] Can result from a one time exposure to a vary load sound or listing to loud sounds for a long period of time. It can be conductive deafness if the eardrum is rupture , or sensorineural deafness if only cochlea is damaged or mixed hearing loss if both eardrum and cochlea are damaged.

[18] Reduced sensitivity means high threshold which indicates some degree of hearing loss

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- **Degrees of hearing loss:**

➔ Normal hearing (0-25 dB)

➔ Mild hearing loss (26-40 dB)

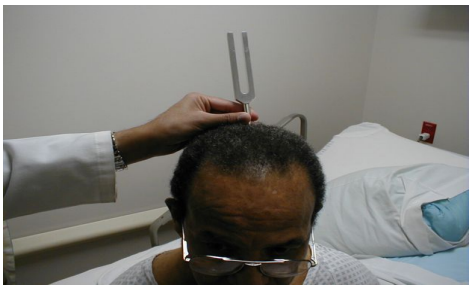
➔ Moderate hearing loss (41-55 dB)

➔ Moderate-severe hearing loss (56-70 dB)

➔ Severe hearing loss (71-90 dB)

➔ Profound hearing loss (>90 dB)

❖ With tests:



➔ **Normal hearing:**[19] air conduction twice as long as bone conduction (AC>BC).

➔ **conductive hearing loss:**[20] bone conduction sound is heard longer than or equally as long as air conduction (BC>AC)

➔ **sensorineural hearing loss:**[21] air conduction is heard longer than bone conduction in affected ear, but less than 2:1 ratio (AC>BC).

Summary of Hearing loss types

	conductive	Sensorineural	Mixed
AC	decreased	Decreased with no gab	Decreased with gab (BC>AC)
BC	Normal	Decreased	Decreased

[19] Rinne positive

[20] Rinne negative.

[21] Rinne positive (but not the double).