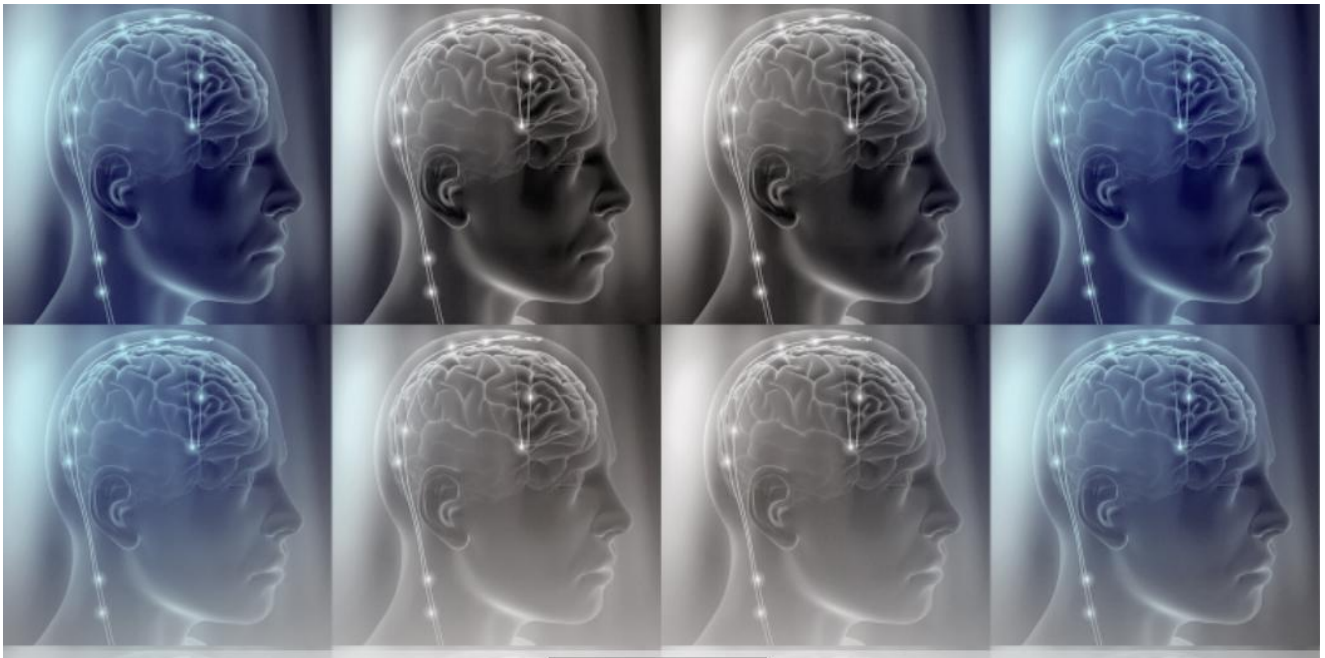


431

CNS Central Nervous System

Block

Physiology Team

Audiometry

Important Terminology

Air conduction:

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

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.

Air conduction is always better than bone conduction in a normal person.

Masking sound:

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

e.g masking sound will be provided to the left ear, if the right ear is tested

Pure tone

A pure tone is a single frequency tone with no harmonic content (no overtones) .This corresponds to a sine wave.

Audiometry

Is the **procedure** by which the nature of hearing disabilities e.g. conductive or sensory neural deafness are determined.

Audiometer:

Is an electronic oscillator capable of emitting pure tones of various frequencies through ear phones to the subject.

Audiogram

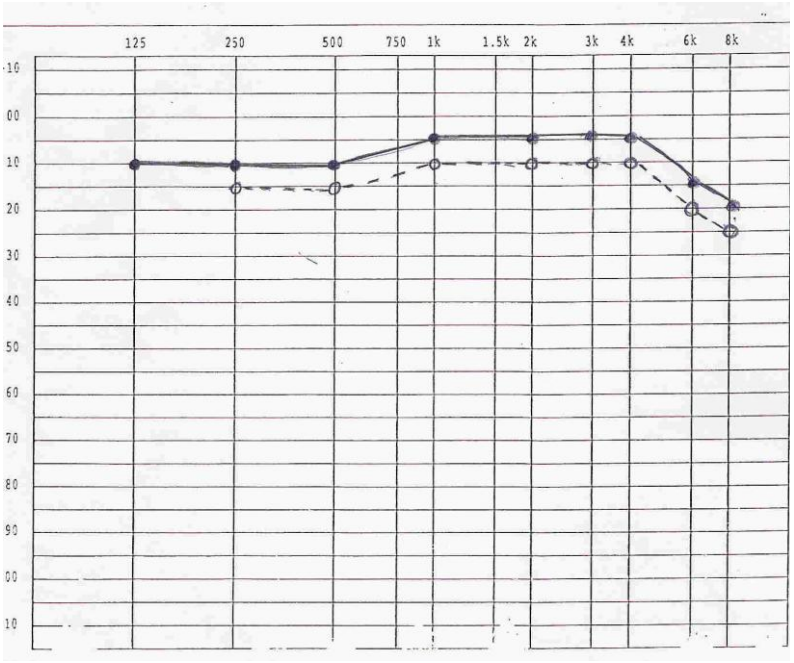
The audiogram is a chart of hearing sensitivity with

- frequency charted on the X- axis
- intensity on the Y-axis.

☒ Intensity is the level of sound power measured in decibels

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

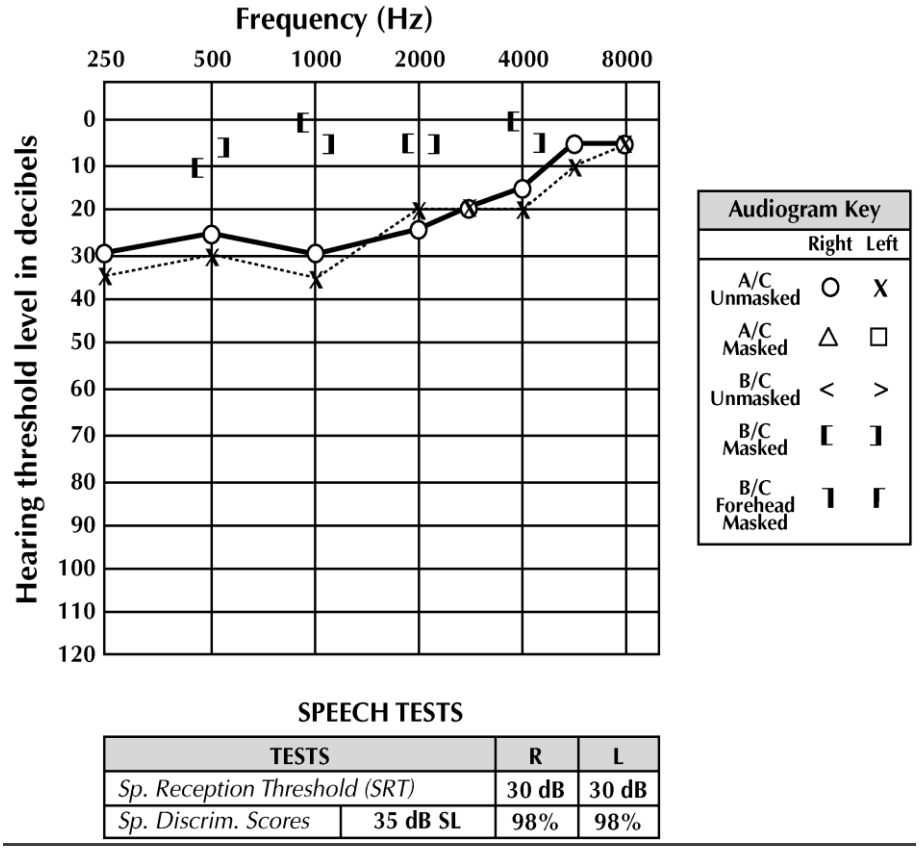
Audiogram of normal subject



TYPES OF HEARING LOSS

1- Conductive Hearing loss (deafness)

- The abnormality reduces the effective intensity of the air-conducted signal reaching the cochlea, but it does not affect the bone-conducted signal that does not pass through the outer or middle ear.
- Examples of abnormalities include perforated tympanic membranes, fluid in the middle ear system, or scarring of the tympanic membrane. Otosclerosis:
- So the bone conduction is better than the air conduction



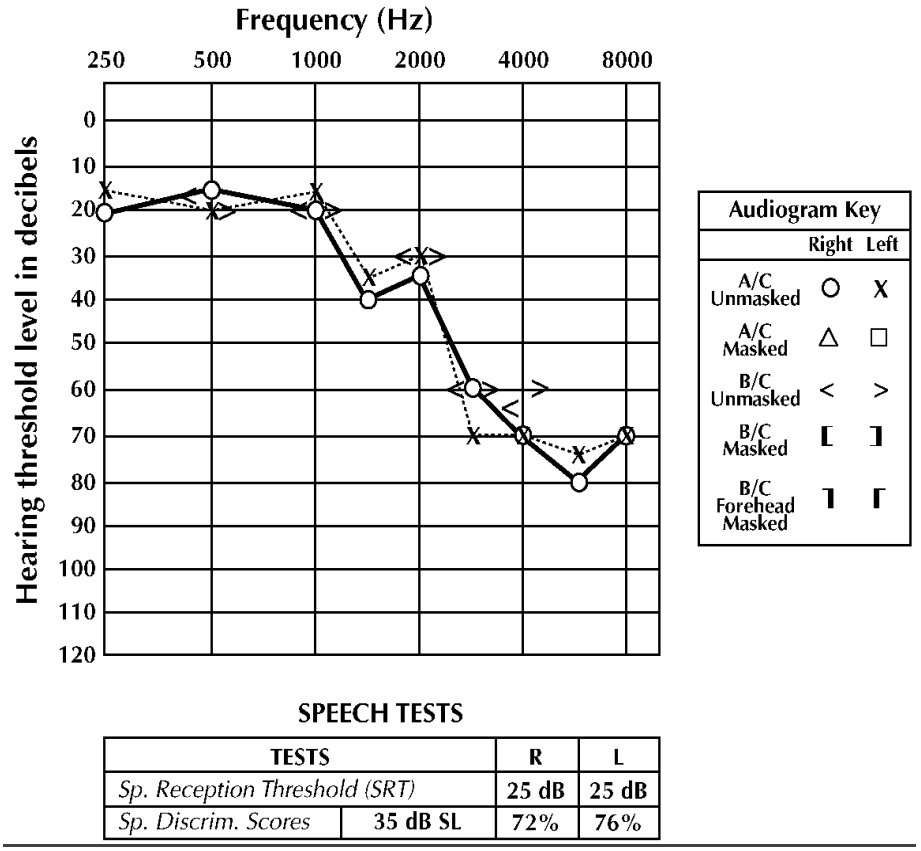
SPEECH TESTS

TESTS		R	L
Sp. Reception Threshold (SRT)		30 dB	30 dB
Sp. Discrim. Scores	35 dB SL	98%	98%

- Pure-tone air-conduction thresholds are poorer than bone-conduction thresholds by **more than 10 dB**.
-

2- Sensorineural Hearing loss (deafness)

- This type of hearing loss is secondary to cochlear abnormality and/or abnormality of the auditory nerve or central auditory pathways. Because the outer ear and middle ear do not reduce the signal intensity of the air-conducted signal, both air- and bone-conducted signals are effective in stimulating the cochlea.



SPEECH TESTS

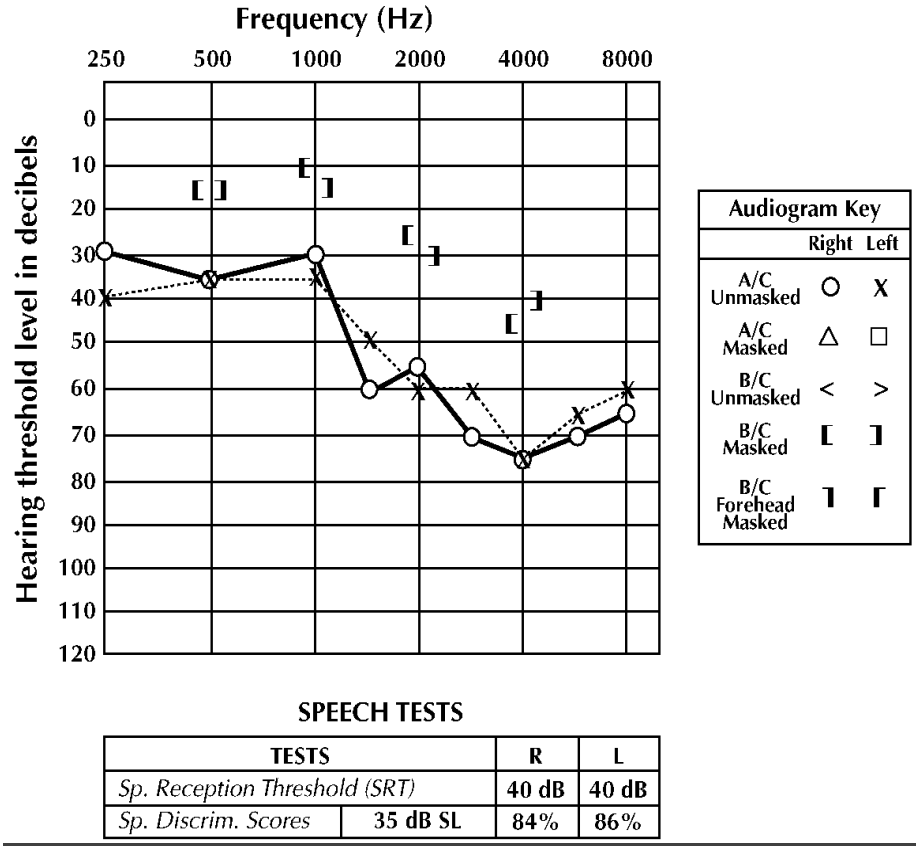
TESTS		R	L
Sp. Reception Threshold (SRT)		25 dB	25 dB
Sp. Discrim. Scores	35 dB SL	72%	76%

Pure-tone air-conduction and bone-conduction thresholds are **within 10 dB.**

- Example: **Ménière disease** an inner ear disorder that affects balance and hearing.

3- Mixed hearing loss

This type of hearing loss has sensorineural and conductive components



SPEECH TESTS

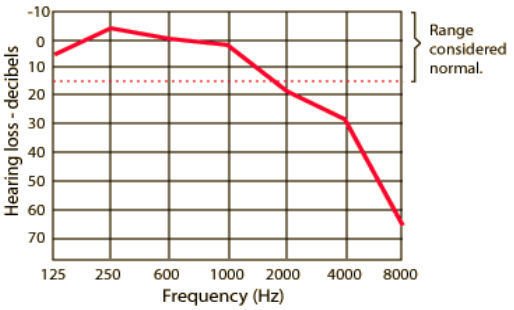
TESTS		R	L
Sp. Reception Threshold (SRT)		40 dB	40 dB
Sp. Discrim. Scores	35 dB SL	84%	86%

Pure-tone air-conduction thresholds are poorer than bone-conduction thresholds by **more than 10 dB**, and bone-conduction thresholds **are less than 25 dB**.

Example : **Presbyacusis** (age related hearing loss)

Exceptions of 10 dB Role: 3 Exceptions

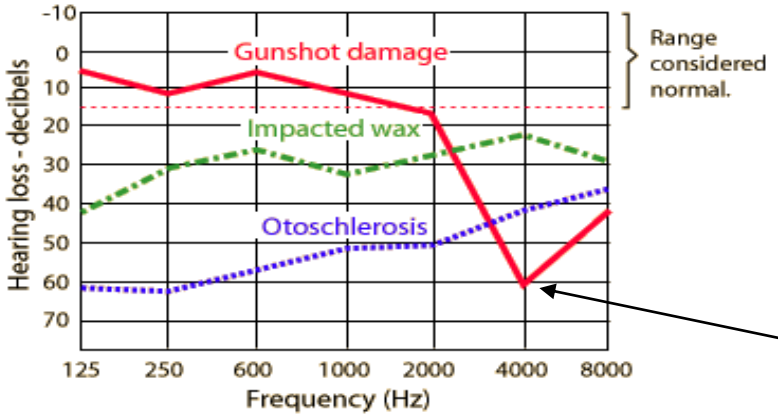
1- **Presbyacusis** (age related hearing loss): Mixed type. It can be **10** .



(in the mixed type Pure-tone air-conduction thresholds are poorer than bone-conduction thresholds by more than 10 dB, and bone-conduction thresholds are less than 25 dB but in the case of presbyacusis the difference between air and bone conducting could be exactly 10 and still considered as a mixed type)

(The curve looks in progressive decline) .

2- **Gunshot damage:** sound of a gunshot is very high and can produce damage to the cochlea. The frequency of the sound of the shot is only one frequency. The patient will have damage at this particular frequency.



As you see the curve is declining at this particular frequency (4000Hz) which is the same frequency of the shot sound. But the curve looks better on the next frequency because there is no damage at it and patient hears better.

3- **Noise Pollution** : same mechanism of Gunshot damage. Person who hears noise which has specific Frequency, he has difficulty hearing that particular frequency and can hears other frequencies normally.

At these Exceptions the difference could be 10.

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:-

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

COMMON AUDITORY DISORDERS

- **Presbyacusis** (age related hearing loss)
- **Otitis media**: This condition is marked by fluid in the middle ear space.
- **Noise-induced hearing loss**
- **Otosclerosis**: The condition is caused by stapedial fixation in the oval window, stiffening the middle ear system.
- **Ménière disease** an inner ear disorder that affects balance and hearing.

TUNING FORK TESTS

1- Rinne's Test

It compares perception of sounds transmitted by air conduction to those transmitted by bone conduction through the mastoid

Technique

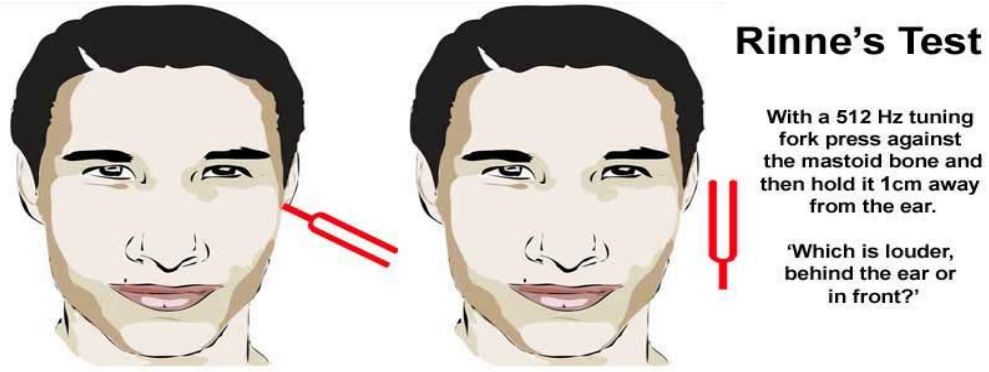
- First: Bone Conduction
  - Vibrating Tuning Fork held on Mastoid
  - Patient covers opposite ear with hand
  - Patient signals when sound ceases
  - Move the vibrating tuning fork over the ear canal
    - Near, but not touching the ear
- Next: Air Conduction
  - Patient indicates when the sound ceases

In Normal person :

- Air Conduction is better than Bone Conduction
  - Air conduction usually persists twice as long as bone
  - Referred to as "positive test"

Abnormal:

- Bone conduction better than air conduction
  - Suggests Conductive Hearing Loss.
  - Referred to as "negative test"

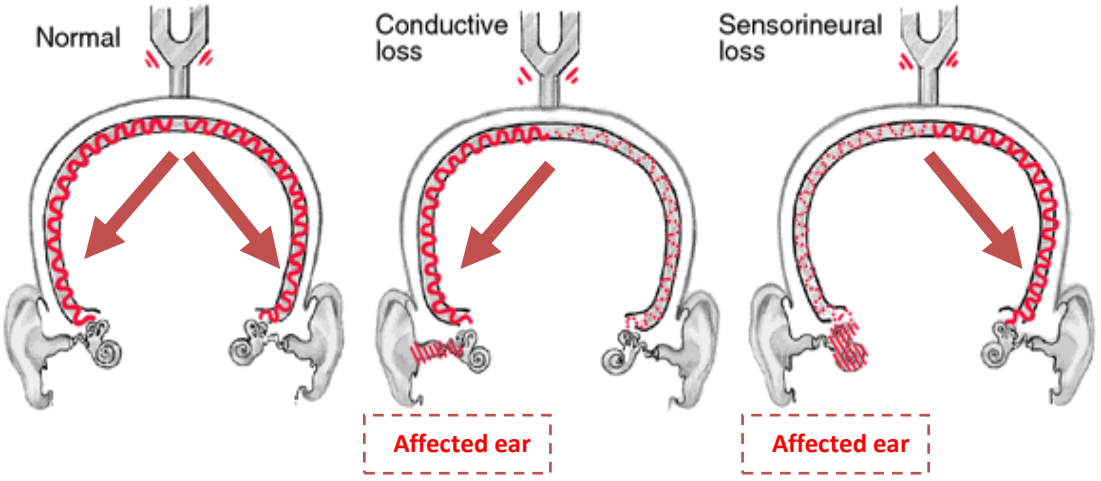


2- Weber Test

This test distinguishes between conductive and sensorineural deafness

Tuning Fork placed at midline forehead

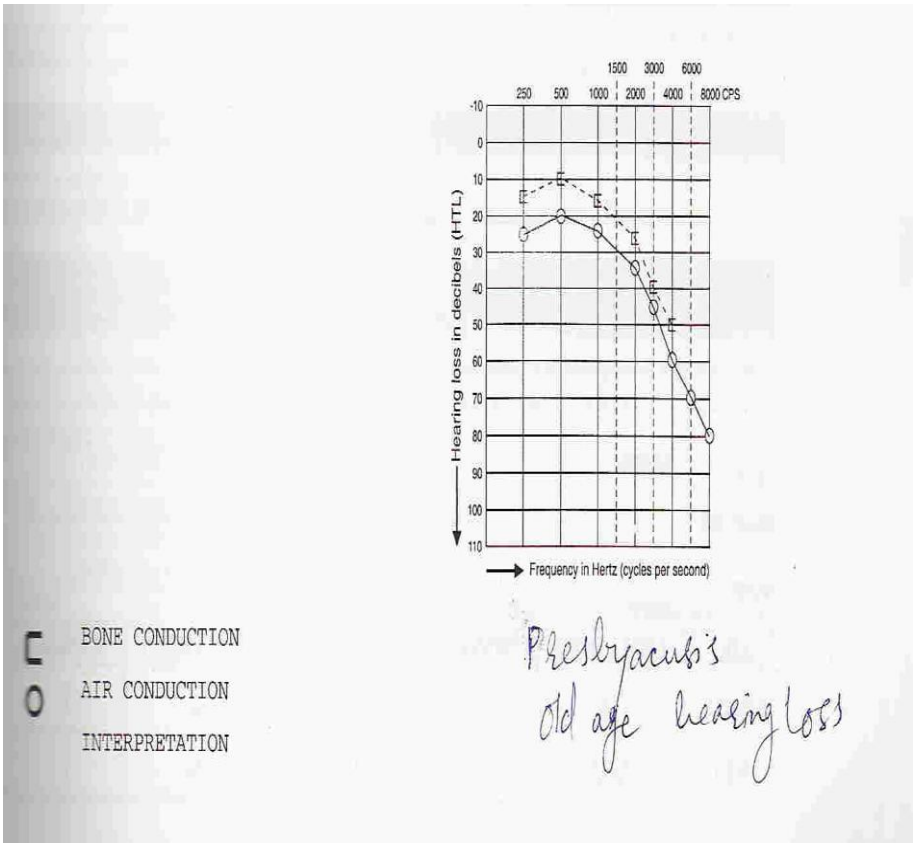
- Normal: Sound radiates to both ears equally
- Abnormal: Sound lateralizes to one ear
  - Ipsilateral Conductive Hearing Loss OR
  - Contralateral Sensorineural Hearing Loss
  - Sound localizes toward the poor ear with a conductive loss
  - Sound localizes toward the good ear with a sensorineural hearing loss

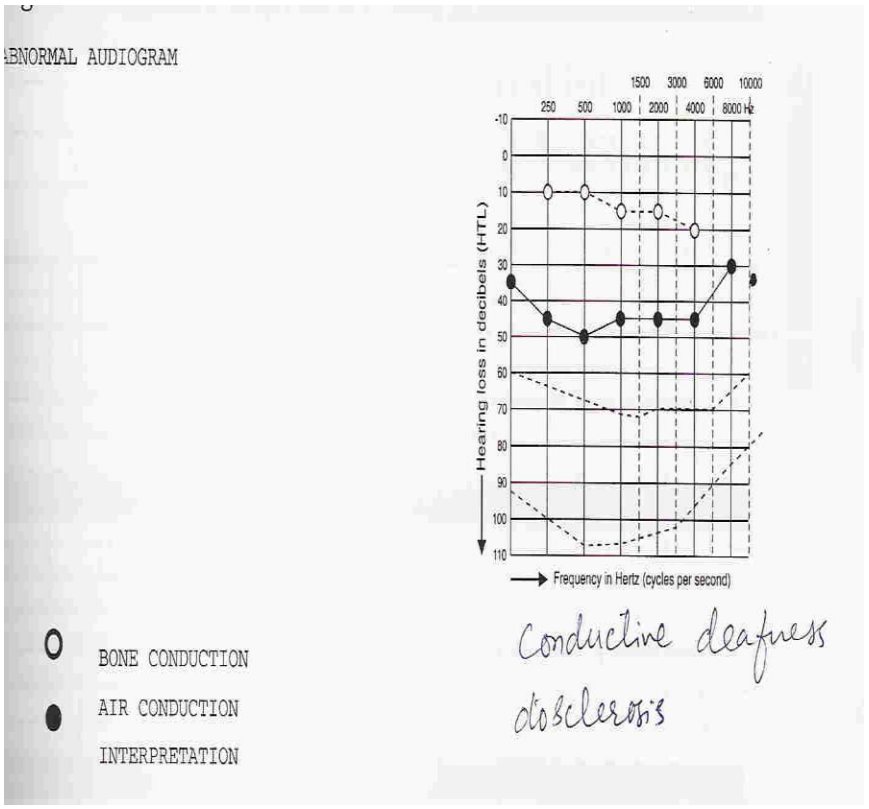


Rinne and Weber tests

	Weber without lateralization	**Weber lateralizes left**	**Weber lateralizes right**
Rinne both ears AC>BC	Normal	Sensorineural loss in right	Sensorineural loss in left
Rinne left BC>AC		Conductive loss in left	Combined loss : conductive and sensorineural loss in left
Rinne right BC>AC		Combined loss : conductive and sensorineural loss in right	Conductive loss in right
Rinne both ears BC>AC	Conductive loss in both ears	Combined loss in right and conductive loss on left	Combined loss in left and conductive loss on right

Cases


1500 3000 6000
250 500 1000 2000 4000 8000 CPS
-10 0 10 20 30 40 50 60 70 80 90 100 110
Hearing loss in decibels (HTL)
Frequency in Hertz (cycles per second)
BONE CONDUCTION
AIR CONDUCTION
INTERPRETATION
Presbyacusis
Old age hearing loss


ABNORMAL AUDIOGRAM
1500 3000 6000 10000
250 500 1000 2000 4000 8000 Hz
-10 0 10 20 30 40 50 60 70 80 90 100 110
Hearing loss in decibels (HTL)
Frequency in Hertz (cycles per second)
BONE CONDUCTION
AIR CONDUCTION
INTERPRETATION
Conductive deafness
Otosclerosis