Tuning Forks and Tests

The three tuning forks generally used include:
- 256 Hz, 512 Hz, 1024 Hz. Most common being 512Hz.
- 512 because - It has appropriate decay time, Less overtones and lies in speech frequency.
- Compressing the prongs with fingers produces around 70 dB sound and hitting against Knee or elbow 90dB.

A prediction of air-bone gap can be made if tuning forks of 256, 512 and 1024 Hz are used.
- Rinne test equal or negative for 256 Hz but positive for 512 Hz indicates air-bone gap of 20-30 dB.
- Rinne test negative for 256 and 512 Hz but positive for 1024 Hz indicates air-bone gap of 30-45 dB.
- Rinne negative for all three tuning forks, indicates air-bone gap of 45-60 dB.

Remember that a negative Rinne for 256, 512 and 1024 Hz indicates a minimum AB gap of 15, 30, 45 dB respectively.

PREREQUISITES FOR AN IDEAL TUNING FORK:

1. It should be made of a good alloy
2. It should vibrate at the specified frequency
3. It should be capable of maintaining the vibration for one full minute
4. It should not produce any overtones

METHODOLOGY OF USING TUNING FORK:

- The tuning fork must be struck against a firm surface (rubber pad / elbow of the examiner). The fork should be struck at the junction of upper 1/3 and lower 2/3 of the fork. It is this area of the fork which is capable of maximum vibration.
- The vibrating fork should be held parallel to the acoustic axis of the ear being tested.

Advantages of tuning fork tests:
1. Easy to perform
2. Can even be performed at bed side
3. Will give a rough estimate of the patient’s hearing acuity

The following tests can be performed using a tuning fork:
1. Weber test
2. Rinne test
3. Absolute Bone Conduction test
4. Schwäbachs test
5. Bing test
6. Politzer test
7. Bing Entotic test
8. Stenger’s test
9. Gelle test
10. Chimani-Moos test

WEBER TEST

- Done by placing a vibrating tuning fork on the patients forehead. Either the sound will be heard equally well (or not heard!!) on both sides (which is normal) or the patient will hear the sound louder on one side. This is known as lateralisng.
Better heard in one ear - either there is **conductive deafness** (no environmental disturbance/masking) and bone conduction is predominating thus patient is hearing better on AFFECTED side

OR

Bone conduction is weak ie SNHL and thus the sound is heard only in the side where normal bone conduction present.

In simple terms lateralisated to affected ear in CHL.

Lateralised to Normal ear in SNHL.

When its mixed hearing loss the basics help us understand where and how it should lateralisate.

Along with rinnes its a great tool to diagnose both CHL and SNHL.

**RINNES TEST**

The Rinne test is done by first putting the vibrating fork close to the ear canal and then putting the fork on the mastoid region, to determine if sound is better heard at the ear canal (air conduction) or when the fork is placed on mastoid region (bone conduction). In normal circumstances, AIR conduction should always be better than BONE conduction!! If normal, then Rinne's test is POSITIVE. If bone conduction is better than air conduction then Rinne's test is NEGATIVE.

Together these two tests will allow you to determine which ear has the hearing loss, and which type of hearing loss it is.

**False Negative Rinne**

It is seen in severe unilateral sensorineural hearing loss. Patient does not perceive any sound of tuning fork by air conduction but responds to bone conduction testing. This response to bone conduction is, in reality, from the opposite ear because of transcranial transmission of sound. In such cases, correct diagnosis can be made by masking the non-test ear with Barany's noise box while testing for bone conduction. Weber test will further help as it gets lateralisated to the better ear.

**To summarise**

Memory device for remembering which test is which: Weber's - one (i.e. you only need to put it once on the forehead), Rinne's - rings (the tuning fork is placed next to the ear and the patient should hear it ringing if test is normal)

- If Weber's lateralisates to the LEFT, then EITHER there is a CONDUCTIVE hearing loss on the LEFT, or there is SENSORINEURAL deficit on the RIGHT.
- If Rinne's test on the left is NEGATIVE, then there is CONDUCTIVE hearing loss on the LEFT.
- If Rinne's test on the LEFT is POSITIVE, then there is likely SENSORINEURAL deficit on the RIGHT.

**ABSOLUTE BONE CONDUCTION TEST:**

This test is performed to identify Sensorineural Hearing Loss. In this test the hearing level of the patient is compared to that of the examiner. The examiner's hearing is assumed to be normal. In this test the vibrating fork is placed over the mastoid process of the patient after occluding the external auditory canal. As soon as the patient indicates that he is unable to hear the sound anymore, the fork is transferred to the mastoid process of the examiner after occluding the external canal. In cases of normal hearing the examiner must not be able to hear the fork, but in cases of sensori neural hearing loss the examiner will be able to hear the sound, then the test is interpreted as ABC reduced. It is not reduced in cases with normal hearing.

**SCHWABACH'S TEST**

Here again BC of patient is compared with that of the normal hearing person (examiner) but **meatus is not occluded**. It has the same significance as absolute bone conduction test. Schwabach is reduced in sensorineural deafness and lengthened in conductive deafness.
BING TEST

- This is actually a modification of Weber’s test. The vibrating fork is placed over the mastoid process and when it ceases to be heard the examiner’s finger is used to occlude the external auditory canal. In normal individuals the sound will be heard again. This is because by occluding the external auditory canal the examiner is preventing sound from escaping via the external canal. The external auditory canal acts as a resonating chamber. If the vibrating fork is not heard again after the external canal is occluded then it is concluded that the middle ear conduction is the cause for deafness. In patients with pronounced deafness if the vibrating fork is heard after occlusion of external canal then deafness is construed to be due to labyrinthine causes.

POLITZER TEST:

- In this test the vibrating fork is held in front of open mouth and the patient is asked to swallow. If the Eustachian tubes are patulous then sound will be intensified during swallowing. If only one tube is patulous then sound will be accentuated only in that ear. Sometimes normal persons too may not hear the vibrating fork.

BING ENTOTIC TEST:

- Hypothetically this test is supposed to differentiate between deafness due to ankylosis of foot plate of stapes from that of conditions interfering with mobility of other ossicles. This test is actually of historic value only. Eustachian catheter is passed and to one of its ends is attached a speaking tube. If the patient is able to hear the fork better via this tube than that from the external auditory canal then middle ear ossicles other than foot plate of stapes is supposed to be at fault.

STENGER’S TEST:

- This test is performed to identify feigned hearing loss and malingering. This test is based on the auditory phenomenon known as “Stenger’s principle”. This principle states that when two similar sounds are presented to both ears only the louder of the two would be heard. Patients usually are not aware of this phenomenon. When two similar tuning forks of same frequencies are made to vibrate and held simultaneously in the acoustic axis of both ears only the louder fork will be heard. Loudness of vibrating fork can be adjusted by adjusting the distance of the fork from the external canal. Usually the vibrating fork is held closer to the allegedly deaf ear of the patient. The patient will not acknowledge hearing in that ear. According to Stenger’s principle he should be able to hear the louder fork. If the hearing loss in worse ear is genuine, patient will respond to the signal presented to the better ear. This is known as negative Stenger’s test. Feigning patient will not acknowledge hearing when louder sound is presented to the worse ear. This is known as positive Stenger’s test.

GELLE TEST:

- In this test, the air pressure in the external canal is varied using a Siegle’s speculum. The vibrating fork is held in contact with the mastoid process. In normal individuals and in those with sensorineural hearing loss, increased pressure in the external meatus causes a decrease in the loudness of the bone conducted sound. In stapes fixation no alteration in the hearing threshold is evident.

CHIMANI-MOOS TEST:

- This is actually a modification of Weber test. When the vibrating fork is placed on the vertex, the patient indicates that he hears it in the good ear and not in the deaf ear. The meatus of the good ear is
then occluded. A genuine deaf patient will still be able to lateralize the sound to the good ear, whereas a malingering will deny hearing the sound at all.

**NON ORGANIC HEARING LOSS:**

**DEFINITION:**
- Non Organic Hearing Loss can be defined as an apparent hearing loss with no evidence of known disorder or insufficient evidence to explain it.

It is of two types:
1. Psychogenic
2. Malingering

**SOME TERMINOLOGIES**
- **Pseudohypacusis** – False hearing loss
- **Functional** – Loss with no organic disorder detected.
- **Psychogenic** – Loss/disorder arising from psychological conditions, older synonym was hysterical deafness (patient is unaware of his condition)
- **Nonorganic** – Apparent loss with no known disorder or insufficient evidence to explain it
- **Malingering** – deliberately faking a loss

**PSYCHOGENIC HEARING LOSS**
- This includes hearing loss associated with psychological conditions. The patient is not aware that he is simulating deafness.
- This is also known as conversion deafness.

**MALINGERING**
- Individual is consciously pretending to be deaf to avoid some responsibility / seeking concession even though his hearing may be absolutely normal.
- It occurs suddenly and disappears suddenly. It is often associated with mutism when bilateral.

**HOW TO IDENTIFY MALINGERING?**
- **Quality of voice**: Unlike in deaf persons the quality of voice is normal in malingeringers.
- **Cochleoauricular / Pupillary / Palpebral Reflexes** are normally present in these patients. These reflexes cause twitching of pinna / contraction of palpebral muscles on exposure to loud noise.
- Malingering should always be suspected when there is a gross discrepancy between pure tone audiometry and speech audiometry.
- Lack of cross over (shadow effect) in pure tone audiometry should cause suspicion.

**TESTS FOR MALINGERING:** (Chimani STEALS Bekesy’s D.D.)

1. **Chimani Moose test** – as described
2. **Stenger's test** – as described
3. **Teal's test**: In this test a vibrating tuning fork is applied over the mastoid process of the so called deaf ear, the patient accepts to hear it. Then the patient is blind folded and with a non vibrating fork on the mastoid process, the malingering patient claim's to hear the sound.
- **Erhard's test**: This test is also known as loud voice test. In normal person when the ear is occluded with a finger, it dampens the sound but it can still be heard. Malingerer often denies hearing the sound even when it is loudest.
- **Auditory reflex threshold**: In normal individuals the stapedial reflex is elicited at 70 - 100 dB. If a malingerer says he is totally deaf and if this reflex is elicited it is suggestive of malingering.
- **Lombard's test**: This is based on "Lombard's principle". This principle says that one raises his / her voice when speaking in noisy environment. While performing this test, the patient is allowed to read a book. Noise is introduced into the ear. The noise is gradually increased till the patient raises his / her voice or stops the process of reading.
  - If there is no change in voice loudness level the patient does not have functional hearing defect.
  - **Stethoscope (Coggins) test**: In this test, one ear piece of the stethoscope is closed with wax and used on the side of deafness. The funnel shaped chest piece is used to talk to the patient.
  - The malingerer gets confused and cannot tell whether he is hearing on the right / left side.
  - **Swinging Story Test**: to catch a unilateral loss.
  - Story switches from one ear to both and to the other ear
  - Two possible meanings:
    - --one if you hear whole story
    - --other if you hear only what is in both ears or in good ear.
  - **Doefler Stewart test**: This test is based on the fact that persons with normal hearing raise their voice in the presence of background noise. This test can be performed in two ways:
    - The patient is made to read a passage from a book, while masking noise is fed into the so called deaf ear. In the case of true deafness, the masking noise has no effect on the voice until it reaches the threshold of deafness.
    - The patient may also be asked to listen to spoken voice instead of reading from a book.
  - **Delayed speech feedback test**: Have patient talk while you play back their own voice to them with a 200ms delay. Gradually raise level: when they hear their own voice, they will change their speech (intensity, rate, fluency).
  - **Bekesy audiometry**: This uses continuous and pulsed tone tracings. Continuous tone produces greater loudness than the interrupted tone So, Continuous gives lower thresholds & Pulsed gives higher thresholds.
  - The normal graph recorded may be interleaved / continuous tracings below pulsed tone tracings.
  - In patients with nonorganic hearing loss will have opposite curves – their pulsed tracings are tracked below the continuous tracings. This type of curve is known as Type V Bekesy pattern.
  - **Lengthened off time test**: LOT: Conventional Bekesy Audiometry uses pulsed tones that are on and off for equal amounts of time (200 milliseconds on and 200 milliseconds off).
    - The LOT is a test for nonorganic hearing loss that uses Bekesy audiometry in which the pulsed tones have an off time that is lengthened from 200ms to 800ms. In addition the LOT uses fixed frequency rather than sweep frequency tracings. In this test the continuous tracing is compared to the pulsed tracing that is obtained with a tone that pulses at a rate of 200ms on and 800ms off. The LOT increases the degree to which the pulsed tracing falls below the continuous tracing in malingerers.