Hearing.
Audiometric measurements.
Outline

• hearing – basic principles
• definitions
• phonetic audiometry
• tuning fork testing
• quantitative audiometric measurements
Hearing
Definitions

- examination of hearing: determines the presence/absence of hearing loss (hypoacusis)
- quantitative audiometry: determines the severity of hypoacusis
- type of hypoacusis:
  - conduction (an impairment resulting from dysfunction in any of the mechanisms that normally conduct sound waves through the outer ear, the eardrum or the bones of the middle ear)
  - senzorineural (resulting from dysfunction in the inner ear, especially the cochlea where sound vibrations are converted into neural signals, or in any part of the brain that subsequently processes these signals)
  - mixed
Phonetic audiometry

- quantitative assessment of hearing, in quiet room
- physician lateral to patient (no lip reading) at 6 meters whispering words (controlateral ear is covered)
- normally patient should hear whispered words from 6 meter
- if not then normal conversational speech at 6 m
- if not then approach patient gradually
- examine both ears separately
- hypoacusis is considered to be severe when normal speech cannot be heard from 25 cm
Tune fork testing

• 128 Hz tuning fork
• qualitative measurement
• assessing types of hearing impairment:
  – conduction
  – senzorineural
  – mixed
Schwabach’s test

• assess: bone conduction time
• place the base of vibrating tuning fork on the mastoid process
• normal value: 20 seconds
• increased: conduction hearing loss
• decreased: sensorineural hearing loss
Rinne’s test

- assess: compares perception of sounds, as transmitted by air or by bone conduction through the mastoid
- place the base of vibrating tuning fork on the mastoid process
- when sound is no longer heard, the fork is immediately placed just outside the ear - normally, the sound is audible at the ear.
- normal value:
  - 20 seconds bone conduction
  - 30-40 seconds air conduction
- this is called: positive Rinne
Rinne’s test

• if conduction hypoacusis exists:
  – bone conduction time increases or is the same
  – air conduction time decreases

• this is called: negative Rinne
Rinne’s test

• if sensorineural hearing impairment exists:
  – both bone and air conduction time decreases
  – the ratio of air/bone conduction time remains the same

• this is called: pathological positive Rinne
Rinne’s test
Summary

- AC > BC $\rightarrow$ positive Rinne $\rightarrow$ normal
- AC < BC $\rightarrow$ negative Rinne $\rightarrow$ conductive hearing loss
- AC > BC, but both decreased $\rightarrow$ pathological positive Rinne $\rightarrow$ sensorineural hearing loss
Weber’s test

- quick screening test for hearing
- can detect unilateral (one-sided) conductive hearing loss and unilateral sensorineural hearing loss
- the vibrating tuning fork is placed in the middle of the forehead equidistant from the patient's ears
- the patient is asked to report in which ear the sound is heard louder
- normal value: sound is heard equally loud in both ears (no lateralization) = indifferent Weber
- however a patient with symmetrical hearing loss will have the same findings. Thus, there is diagnostic utility only in asymmetric hearing losses
Weber’s test

- the vibrating tuning fork is placed in the middle of the forehead equidistant from the patient's ears; the patient is asked to report in which ear the sound is heard louder
- if there is a unilateral conduction hearing loss: vibrations reach equally both inner ears, but the conduction block causes no exteriorization thus the excitation of the inner ear is greater.
- Weber with lateralization to the lesion side
Weber’s test

- The vibrating tuning fork is placed in the middle of the forehead equidistant from the patient's ears; the patient is asked to report in which ear the sound is heard louder.
- If there is a unilateral sensorineural hearing loss: vibrations do not reach the lesion side, only the healthy side.
- Weber with lateralization to the healthy side.
Audiometry

- determine a subject's hearing levels with the help of an audiometer; may also measure ability to discriminate between different sound intensities, recognize pitch, or distinguished speech from background noise
- the most commonly used assessment of hearing is the determination of the threshold of audibility, i.e. the level of sound required to be just audible, using steps of octaves within a 125Hz and 8kHz frequency range and steps of 5 dB in intensity
- expressed as dB (minimal intensity perceived by normal hearing = 0dB)
- tests:
  - air conduction (headset)
  - bone conduction (vibration conducted from mastoid process)
Audiometry
Audiometry - normal
Audiometry – conduction hearing impairment

![Graph showing audiometry results for conduction hearing impairment. The x-axis represents frequency in kHz (0.125, 0.25, 0.5, 1, 2, 4, 8), and the y-axis represents hearing loss in dB (0 to 110). The graph shows two lines: one for air conduction and one for bone conduction. The air conduction line is represented by solid circles connected by a solid line, while the bone conduction line is represented by dotted circles connected by a dotted line. The graph indicates a hearing impairment across different frequencies.](image-url)
Audiometry – senzorineural hearing impairment

![Audiogram graph showing hearing loss and frequency in kHz and dB. The graph compares air conduction and bone conduction.](image)
Audiometry – mixed hearing impairment

-20  -10   0   10   20   30   40   50   60   70   80   90   100
Hearing loss

0.125 0.25 0.5 1 2 4 8
Frequency (kHz)

Air conduction
Bone conduction
Audiometry

[Graph showing audiometry results with frequencies and hearing loss in dB for both right and left ears.]