Hearing Assessment
Hearing tests

• Subjective: requires patient’s cooperation
  • Pure tone audiometry
  • Speech audiometry

• Objective: requires no cooperation
  • Tympanometry
  • Otoacoustic emission (OAE)
  • Brainstem Evoked Response Audiometry (BERA)
  • Stapedius reflex test
Audiometry

• Subjective test – verbal or physical response
• Tests all parts of the ear – the entire auditory system
  • Pure Tone
    • Air conduction
      • Headphone, Insert Earphone, Speaker
    • Bone conduction
  • Speech testing
• Generate an Audiogram
Audiometry

• Measures hearing sensitivity
  • **Air conduction** ➔ measures sensitivity of entire pathway of auditory system, including outer, middle, and inner-ear.
  • **Bone conduction** ➔ “by-passes” outer and middle-ear to measure sensitivity of inner ear directly.

• Determines type and severity of hearing loss

• Results are used to generate the audiogram
Audiogram

• Mark Air and Bone thresholds on the chart
  • o Right ear
  • X Left ear
  • ‹ Right Bone (unmasked)
  • › Left Bone (unmasked)

• Behavioral response - cooperation of the patient is important
Audiogram
Audiogram

- Hearing Loss is described as a range
- Ranges from Mild through Profound
Types of Hearing Loss
Conductive Hearing loss

- Conductive Hearing loss - Primarily caused by damage to the outer or middle ear
- Bone conduction is within the normal range, Air Conduction is not
- If the Air-bone gap is >30db, suspect ossicular pathology.

Audiogram depicting a mild rising conductive hearing loss in the left ear. Note the significant air-bone gaps.
Conductive Hearing loss

Pathology of the EXTERNAL EAR
- External ear canal deformity (*atresia*)
- Blockage from *cerumen* or foreign *object*
- Perforated tympanic membrane

Pathology in the MIDDLE EAR
- Serous and Purulent Otitis media
- Otosclerosis: Carhat notch at 2 KHz
- Cholesteatoma
Sensorineural Hearing Loss

- Sensorineural-Damage to the Cochlea or beyond

Audiogram depicting a high-frequency sloping sensorineural hearing loss in the left ear.
Sensorineural Hearing Loss

- Noise exposure: dip at 4 KHz
- Ototoxic medication
- Meniere’s disease
- Infections
- Idiopathic
- Congenital
- Aging (presbycusis)
Mixed Hearing Loss

- Mixed Hearing Loss
  - Has both conductive and sensorineural components

Audiogram depicting a mixed sloping hearing loss in the left ear.
Tympanometry
Tympanometry

- Objective measure of the middle-ear system
- “Not a hearing test”
- Graphic representation of ear compliance in relation to the pressurization of the ear canal
- Objectively demonstrate the mechanical-acoustic characteristics of the outer and middle ear
- Measures the ease in which energy flows through the system
Tympanometry

• A probe is inserted in the ear canal that contains a loudspeaker, a microphone, and a pump.

• A tone (226Hz) is delivered into the ear while the pressure is changed within the sealed canal.

• Measurement taken at the probe - plots the flexibility of the TM and the ossicles.

• Plot is displayed in a graph called the tympanogram
So the Tympanogram tells us....

• Middle-ear pressure (normally equal to atmospheric pressure)

• Ear canal volume

• Compliance of middle-ear system (eardrum movement)
Tympanogram

• Shape of the tracing gives diagnostic information regarding the function of the middle ear

• “Normal” middle ear function is a range represented by the box

• The tracing is interpreted and labeled as a type – A, B, C
## Normal values in Tympanometry

<table>
<thead>
<tr>
<th>Measure</th>
<th>Infants &amp; Toddlers</th>
<th>School Children</th>
<th>Young Adults</th>
<th>Older Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Acoustic Admittance</td>
<td>.2 to .7</td>
<td>.4 to 1.4</td>
<td>.3 to 1.5</td>
<td>.2 to 1.5</td>
</tr>
<tr>
<td>Ear Canal Volume</td>
<td>.3 to 1.0</td>
<td>.6 to 1.4</td>
<td>.9 to 1.8</td>
<td>.9 to 2.0</td>
</tr>
<tr>
<td>Tympanometric Width</td>
<td>102 to 204</td>
<td>60 to 168</td>
<td>36 to 95</td>
<td>35 to 125</td>
</tr>
</tbody>
</table>
Types of Tympanograms
Type A

- Normal middle ear pressure
- Normal eardrum movement
- Normal ear canal volume

Example:
- Normal middle ear
Type A<sub>s</sub>

- Reduced Compliance
- Normal Middle-ear pressure
- Normal ear canal volume

Example:
- Fixation of ossicles
- Scarring on TM
Type A_d

- Increased compliance
- Normal middle-ear pressure
- Normal ear canal volume

Example:

➢ Disarticulation of ossicles
Type B  (normal volume)

- “Flat”
- No compliance or pressure peak indicated
- **Normal** ear canal volume

Example:
- Middle-ear fluid
Type B (increased volume)

- “Flat”
- No compliance or pressure peak indicated
- Increased ear canal volume

Example:
- Perforated TM
Type B (decreased volume)

- “Flat”
- No compliance or pressure peak indicated
- Decreased ear canal volume

Example:
- Occluding Wax
- Probe up against canal wall??
Type C

- Excessive negative middle-ear pressure
- Normal or reduced compliance
- Normal ear canal volume

Example:
- Eustachian tube dysfunction, initiation or resolution of middle-ear fluid
<table>
<thead>
<tr>
<th>Type</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A</td>
<td>Normal tympanogram/ sensorineural hearing loss where conductive mechanism is normal.</td>
</tr>
<tr>
<td>Type B</td>
<td>Flat curve, no change in compliance with pressure changes. Seen in fluid in the middle ear.</td>
</tr>
<tr>
<td>Type C</td>
<td>Maximum compliance in negative pressure. Seen in eustachian tube obstruction.</td>
</tr>
<tr>
<td>Type As</td>
<td>Compliance is lower at or near ambient air pressure. Seen in otosclerosis or malleus fixation.</td>
</tr>
<tr>
<td>Type Ad</td>
<td>High compliance at or near ambient pressure. Seen in ossicular discontinuity.</td>
</tr>
</tbody>
</table>