



Hearing Loss

429 ENT Team (F)

Sources: Dr. Hagr's lecture, ENT Lecture Notes 9ed, Color Atlas of ENT Diagnosis 4ed, Toronto Notes 2011 and emedicine.medscape.com (for hearing aids part). **NOTE:** these notes follow the outline of the lecture. Key points about some of the individual conditions were added as a quick revision/introduction. All pictures from the original lecture are included.

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INTRODUCTION

Types

1. **Conductive Hearing Loss (CHL):** The conduction of sound to the cochlea is impaired. Can be caused by external and middle ear disease
2. **Sensorineural Hearing Loss (SNHL):** Is due to a defect in the conversion of sound into neural signals or in the transmission of those signals to the cortex. Can be caused by disease of the cochlea, acoustic nerve (CN VIII), brainstem, or cortex
3. **Mixed Hearing Loss:** The conduction of sound to the cochlea is impaired, as well as transmission through the cochlea to the cortex

Auditory Acuity:

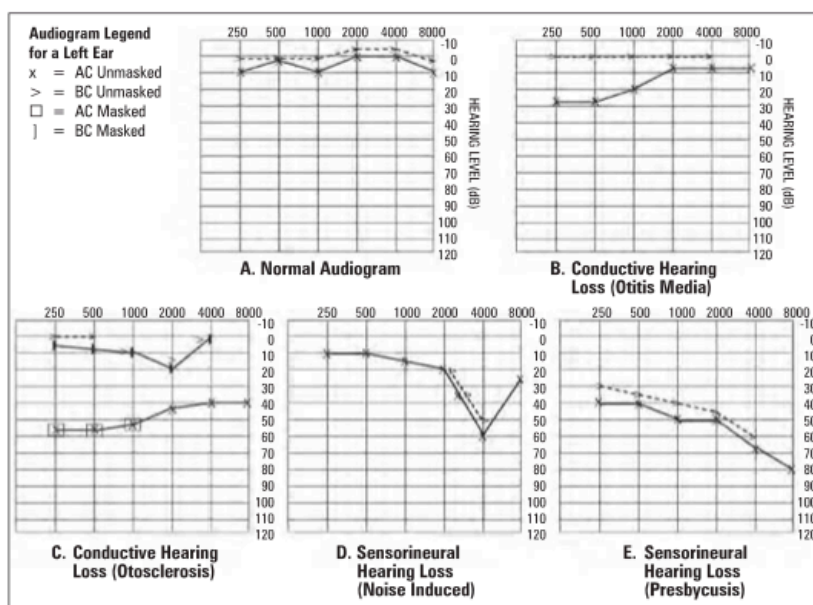
1. **Whispered-voice test:** mask one ear and whisper into the other
2. **Tuning fork tests (audiogram is better),** sensitivity depends on tuning fork used (256 Hz, 512 Hz)
 - a. **Rinne test:** 512-Hz tuning fork is struck and held firmly on mastoid process to test bone conduction. The tuning fork is then placed beside the pinna to test air conduction.
 - i. If AC > BC: positive Rinne, which is normal
 - b. **Weber test:** 512-Hz tuning fork is held on vertex of head and patient states whether it is heard centrally (Weber negative) or is lateralized to one side (Weber right, Weber left).

Table 5. The Interpretation of Tuning Fork Tests

Examples	Weber	Rinne
Normal or bilateral sensorineural hearing loss	Central	AC > BC (+) bilaterally
Right-sided conductive hearing loss, normal left ear	Lateralizes to Right	BC > AC (-) right
Right-sided sensorineural hearing loss, normal left ear	Lateralizes to Left	AC > BC (+) bilaterally
Right-sided severe sensorineural hearing loss or dead right ear, normal left ear	Lateralizes to Left	BC > AC (-) right*

* a vibrating tuning fork on the mastoid stimulates the cochlea bilaterally, therefore in this case, the left cochlea is stimulated by the Rinne test on the right, i.e. a false negative test. These tests are not valid if the ear canals are obstructed with cerumen (i.e. will create conductive loss)

1. **Conductive Hearing Loss (CHL)**
 - a. Bone conduction (BC) in normal range, air conduction (AC) outside of normal range
 - b. Gap between AC and BC thresholds >10 dB (an air-bone gap)
2. **Sensorineural Hearing Loss (SNHL)**
 - a. Both air and bone conduction below normal. Gap between AC and BC <10 dB (no air-bone gap)
3. **Mixed Hearing Loss**
 - a. Both air and bone conduction thresholds below normal. Gap between AC & BC thresholds >10 dB.



PREVALENCE

- Overall about 1 in 10
- 1 in 3 adults aged 65-75
- 1 in 2 older than 75
- 1-2% school age children
- 4% children under 5

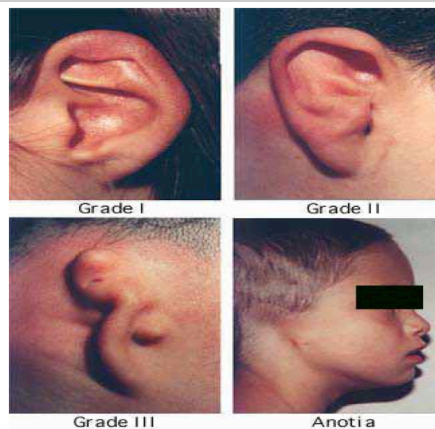
It is common and important.

SIGNS OF HEARING LOSS

1. Talk louder than necessary
2. Turn up the TV/radio volume
3. Complain that others “mumble”
4. Confuse similar sounding words
5. Inappropriate responses in conversations
6. Lip reading: watch speaker’s face intently; can’t hear someone behind; difficulty hearing over the phone
7. Ringing/buzzing in the ear

CONSEQUENCES OF HEARING LOSS

1. Don’t enjoy conversations
2. Scared to try new contacts
3. Strain relationships
4. Scared to take new job
5. Limits activities
6. Insecurity
7. Increase psychosocial difficulties
8. Isolation, anxiety, depression



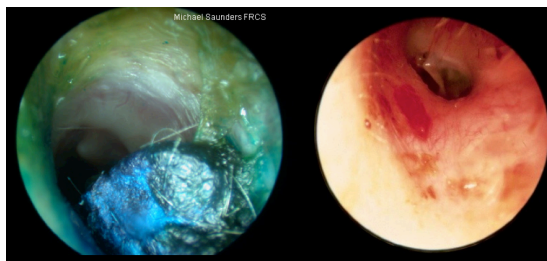
CONDUCTIVE HEARING LOSS

CONDITIONS OF THE PINNA

1. Microtia: failure of development of the pinna. May be associated with atresia of the external canal
 - a. Rx: BAHA (bone-anchored hearing aid) and prosthetic ears or surgical reconstruction

CONDITIONS OF THE EXTERNAL AUDITORY MEATUS

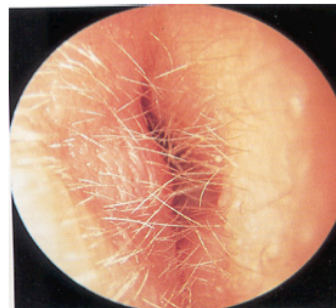
1. Atresia: failure of development of the external canal. Usually associated w/ossicular problems.
2. Wax (Cerumen): Cerumen impaction is the most common cause of conductive hearing loss for those aged 15-50 years.
 - a. Risk factors: narrow canal, hairy canal, cotton swab usage, in-the-ear hearing aids
 - b. Features: hearing loss ± tinnitus, vertigo, otalgia, fullness
 - c. Treatment: cerumenolytic drops e.g. glycerine, olive oil, bicarbonate; syringing etc



3. Acute otitis externa: (many types)
 - a. Mainly bacterial (*P. aeruginosa*, *E. coli*, *Staph. aureus*) or fungal (*C. albicans*, *Aspergillus niger*)
 - b. Risk factors: swimming “swimmer’s ear”, Q-tip usage, excessive scratching, hearing aids or earphones
 - c. Features:
 - i. **Pain aggravated by movement of auricle**, otorrhea, hearing loss \pm fullness (if external canal is obstructed by swelling), and post-auricular lymphadenopathies.
 - ii. Complicated if periauricular tissues are red & swollen.
 - d. Treatment: Swab for C&S, clean (ear toilet). Give: Analgesics +
 - i. Acute bacterial: **anti-pseudomonal** drops (gentamicin or ciprofloxacin) \pm steroid. Do not use gentamicin if tympanic membrane is perforated (why? Risk of ototoxicity). Systemic antibiotics if lymphadenopathy or cellulitis.
 - ii. Fungal: repeated debridement and topical anti-fungal



Swimmer's Ear (AOE)



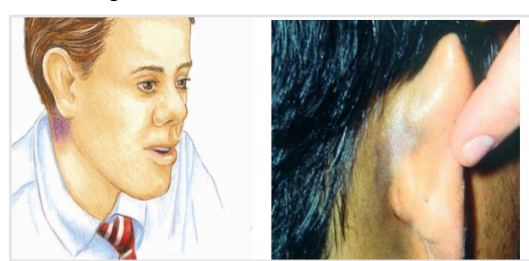
CONDITIONS OF THE TYMPANIC MEMBRANE

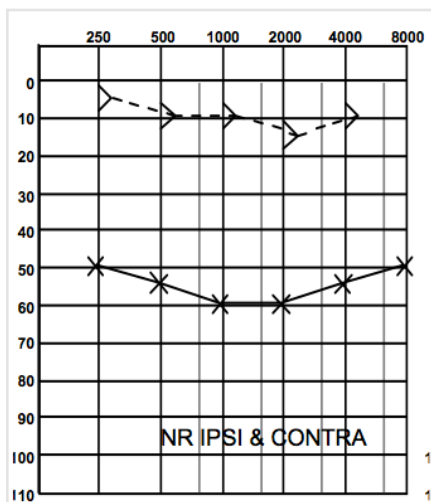
1. Direct trauma: poking with a sharp object e.g. unskilled attempts to remove wax, toddlers playing
2. Indirect trauma: usually caused by pressure e.g. slap, blast injury or temporal bone fracture
 - a. Symptoms: pain (often transient), hearing loss (usually not severe), tinnitus (if persistent = cochlear damage), vertigo (rare)
 - b. Signs: bleeding from the ear, blood clot in the meatus, and visible tear in the membrane. With skull base fracture “raccoon’s eyes” and “battle sign” may be present.
 - c. Rx: DO NOT clean, put in drops or syringe. Prophylactic antibiotics if direct trauma or evidence of infection.
 - d. In almost all cases, the tear will close rapidly

Raccoon's eyes sign:



Battle's sign:





Pure Tone Audiometry of perforated eardrum showing moderately severe conductive hearing loss

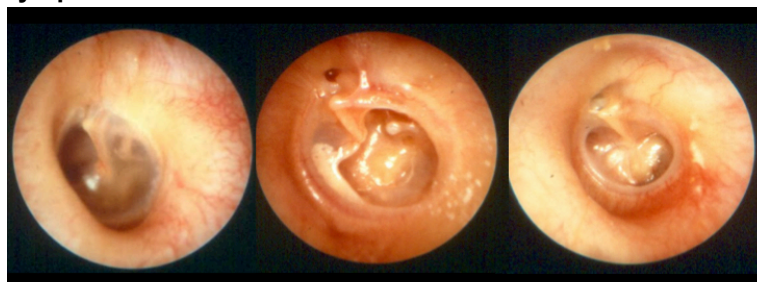


3. Tympanosclerosis: Usually asymptomatic by itself. A past history of otorrhea in childhood or grommet insertion is usual.

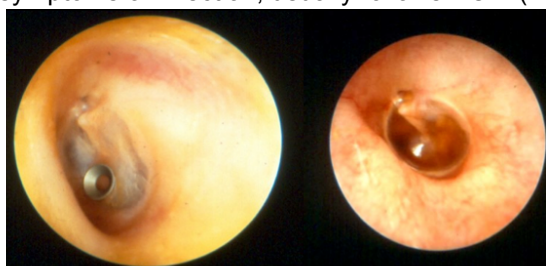


CONDITIONS OF THE MIDDLE EAR

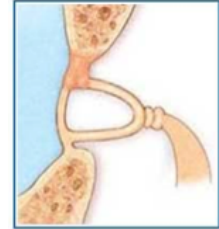
1. Adhesive otitis media: formation of adhesions in the middle ear (between middle ear wall and tympanic membrane itself) after reactivation and subsequent healing of either **CSOM** or **OME**.
- a. **Tympanic membrane is retracted**



- b. Rx: difficult to treat; observation, hearing aid, and ventilation tube insertion in children
2. Otitis media with effusion [discussed extensively in separate lecture]: presence of fluid in middle ear w/o signs & symptoms of infection; usually follows AOM (in children esp.)



3. Otosclerosis: fusion of **stapes** footplate to oval window so that it cannot vibrate
 - a. Autosomal dominant; females > males; progresses during pregnancy (hormonal factor?)
 - b. Features: progressive conductive hearing loss starting in teens-20's – may progress to SNHL if cochlea becomes involved ± tinnitus
 - c. Dx: tympanic membrane **normal** ± pink blush (Schwartz's sign) associated w/ neovascularization of otosclerotic bone. Characteristic **dip at 2,000 Hz** (Carhart's notch) on audiogram.
 - d. Rx: serial PTA and hearing aids (air conduction or BAHA). Definitive Rx is stapedectomy or stapedotomy with prosthesis is definitive.



SENSORINEURAL HEARING LOSS

ETIOLOGY:

1. Congenital:

- a. Deafness affects 0.2%
- b. SNHL attributed to
 - i. 50% genetic factors
 - ii. 20-25% environmental – 25-30% sporadic
- c. Genetic
 - i. 75% AR
 - ii. 20% to AD
 - iii. 5% X-linked
 - iv. Over 400 syndromes; Trauma

Risk factors:

- Low birth weight/prematurity
- Perinatal anoxia (lowAPGARs)
- Kernicterus: bilirubin >25 mg/dL
- Craniofacial abnormality
- Family history of deafness in childhood
- 1st trimester illness - TORCH infections
- Neonatal sepsis
- Ototoxic drugs
- Perinatal infection, including post-natal meningitis
- Consanguinity

2. Infection

3. Noise-induced

- a. Boilermaker's deafness
- b. One of the most common occupationally
- c. Induced disabilities
- d. Tinnitus
 - i. Commonly accompanied NISNHL
 - ii. Warning sign
- e. 98 rule
 - i. 90 db for 8 hours
 - ii. 95 db for 4 hours
 - iii. 100 db for 2 hours
 - iv. 105 db for 1 hours

4. Ototoxic

- a. Medications:
 - i. **Antibiotics**, **diuretics**, anti-**neoplastics**, Anti-**inflammatories**, anti-**malarial** agents, ototoxic agents
- b. High risk
 - i. Renal failure (Elevated peak and trough levels)
 - ii. Liver failure
 - iii. Immunocompromised
 - iv. Collagen-vascular disorders
 - v. Advanced age (> 65 years)
 - vi. Prior ototoxicity
 - vii. Concurrent use of known ototoxic agents
 - viii. Preexisting HL or Vestibular

- ix. Bacteremia (fever)
 - x. Treatment course longer than 14 days
 - xi. FHx of aminoglycoside ototoxicity
5. **Presbycusis** = Deafness + Tinnitus + Recruitment
- a. Overview:
 - i. #1 Handicapping disorder
 - ii. 60% of Americans > 65 HL
 - iii. 90% of >75 Y have HL
 - iv. HL + degenerative processes of aging.
 - v. 1/2 Vestibular symptoms
 - b. Etiology: hair cell degeneration, degeneration of basilar membrane, cochlear neuron damage, ischemia of inner ear
 - c. Features: progressive, gradual bilateral hearing loss **initially at high frequencies**, then middle frequencies; **loss of speech discrimination** - especially with background noise present- patients describe people as mumbling; recruitment phenomenon: **inability to tolerate loud sounds; tinnitus**
 - d. Problems with Dx:
 - i. Shame or embarrassment.
 - ii. Hearing aid social stigma
 - iii. Embarrassment prevents 15 million elderly people from getting help
 - e. Rx: hearing aids (if HL >30 dB, and good speech discrimination), ± lip reading, auditory training, auditory aids
6. **Acoustic neuroma**

HEARING AIDS

HEARING AIDS

Hearing aids can be defined as any devices that amplify the acoustic signals to a degree that enables individuals with hearing loss to use their remaining hearing in a useful and efficient manner.

1. Behind-the-ear hearing aid
2. In-the-ear hearing aid

BONE-ANCHORED HEARING AIDS

Bone-anchored hearing devices allow patients with conductive hearing loss, mixed hearing loss, or unilateral profound sensorineural hearing loss (single-sided deafness) to achieve improved auditory acuity by transmitting the sound directly through the bone into the inner ears.

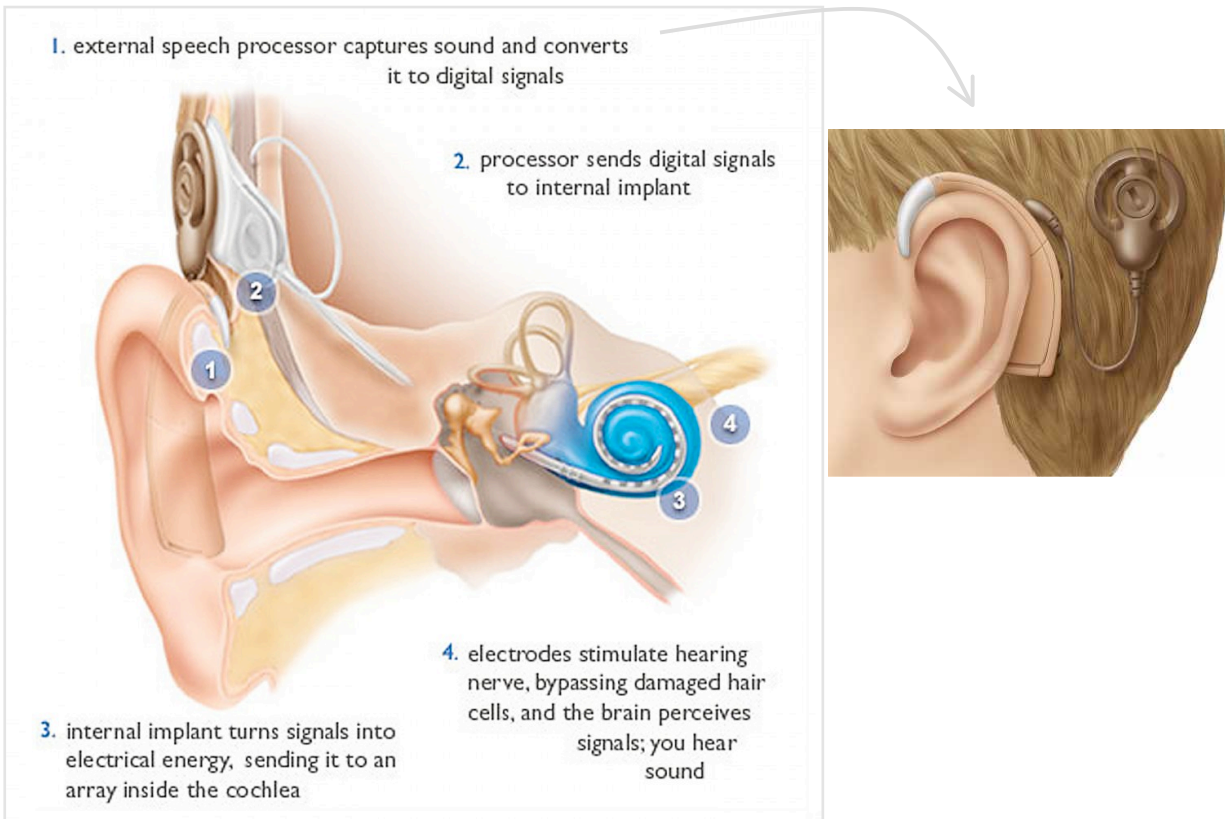
1. BAHA (see picture)
2. Sophone 1(S): bone conduction device used with a soft headband without an implant



COCHLEAR IMPLANTS

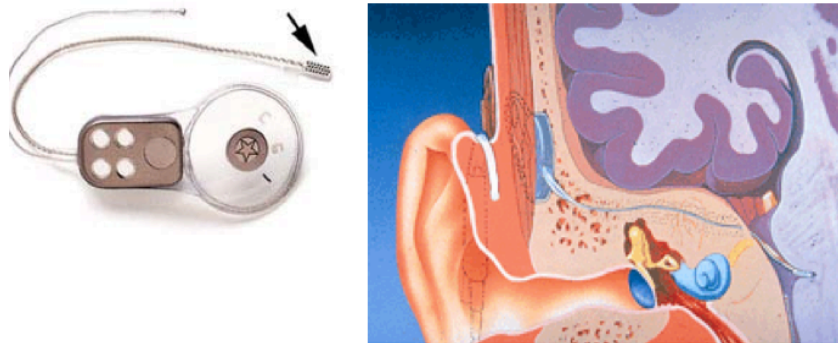
A cochlear implant is a medical device that transmits sound information via an implanted electrode to the auditory nerve. Cochlear implants **replace the sense of hearing** and can aid an appropriate candidate in developing spoken language

- An ideal cochlear implant candidate is an individual with **severe-to-profound sensorineural** hearing loss (typically bilateral) who receives limited benefit from the use of hearing aids.
- Implants are approved for children >12 months with profound bilateral hearing loss and for adults with similar hearing loss who demonstrate limited benefit from hearing aid use as demonstrated by speech perception test scores



AUDITORY BRAINSTEM IMPLANT

The auditory brain stem implant uses similar technology as the cochlear implant, but instead of electrical stimulation being used to stimulate the cochlea; it is instead used to stimulate the brain stem.



SUMMARY

Conductive Hearing Loss

- **Pinna**
 - Microtia/Anotia
- **External Canal**
 - Atresia
 - Wax impaction
 - Acute otitis externa
- **Tympanic Membrane**
 - Trauma (direct/indirect)
 - Tympanosclerosis
- **Middle Ear**
 - Adhesive otitis media
 - Otitis media w/effusion (OME)
 - Otosclerosis

Sensorineural Hearing Loss

- Congenital
- Trauma
- Infection
- Noise-Induced
- Ototoxicity
 - Antibiotics, diuretics, anti-inflammatories, anti-neoplastics, anti-malarials, ototopics
- Presbycusis
- Acoustic Neuroma

Hearing Aids

- **Hearing aids**
 - Outside-the-ear
 - In-the-ear
- **Bone-Anchored-Hearing-Aid**
 - BAHA
 - Sophone
- **Cochlear Implants**
- **Auditory Brainstem Implants**