

Hearing Loss and Cochlear Implantation

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Disclosures

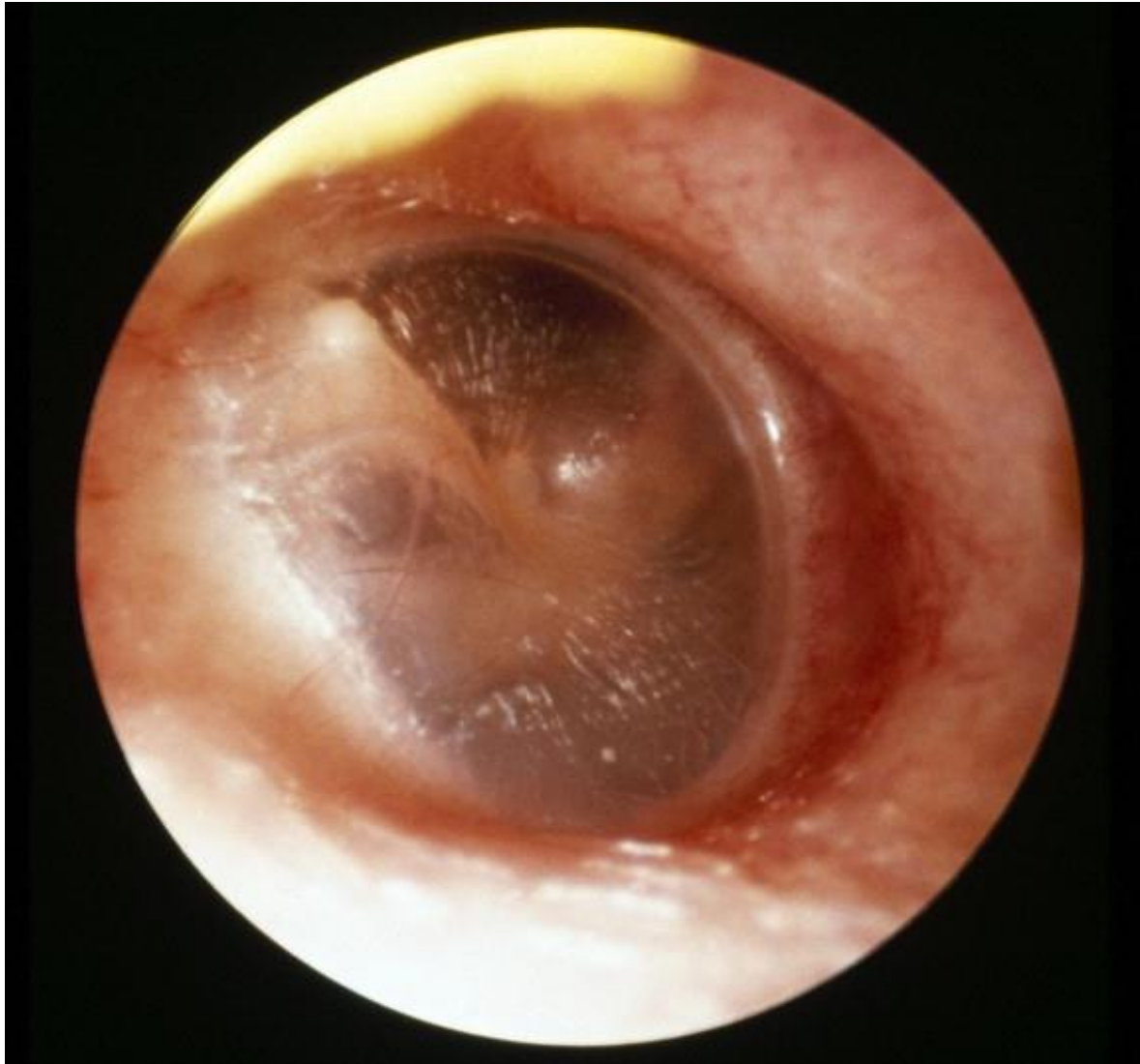
- I have no financial disclosures or conflicts of interest to disclose



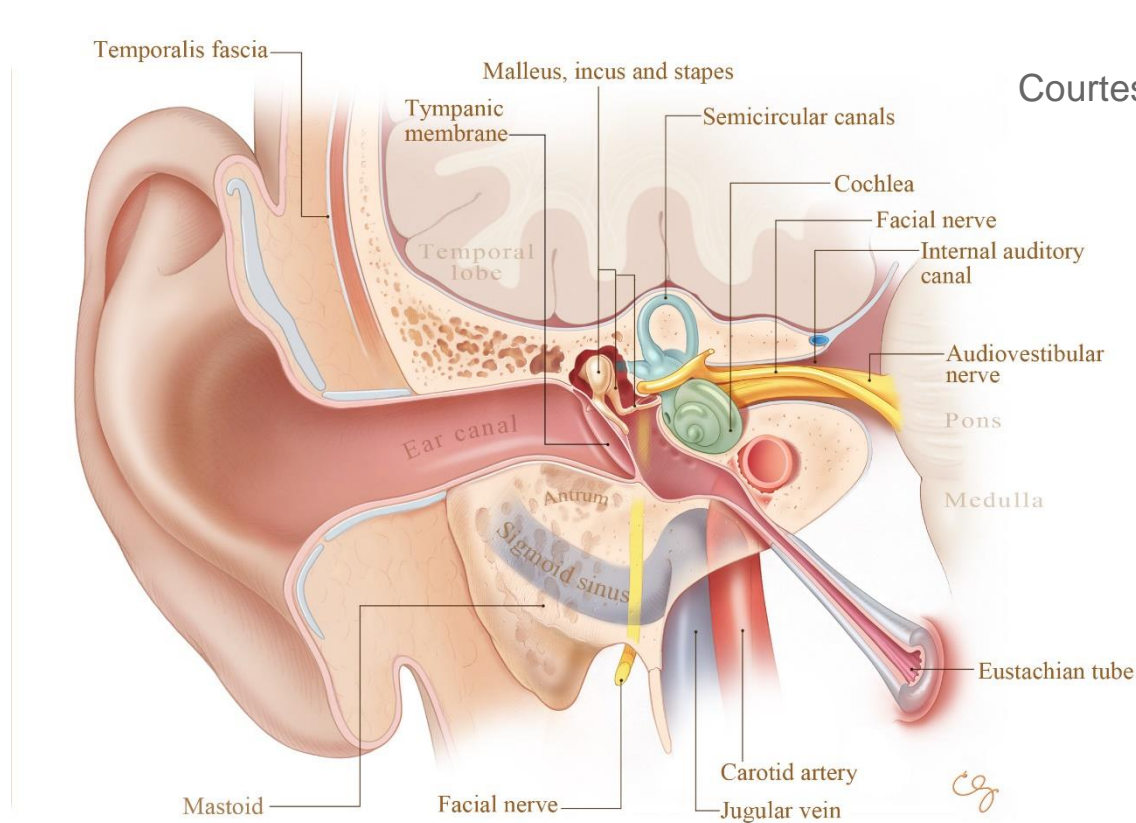
Outline

- Overview of hearing loss
- Introduction to cochlear implants
- Objectives:
 1. To discuss which patients may benefit from a cochlear implant
 2. To discuss cochlear implant criteria
 3. To discuss details of cochlear implants and electrodes





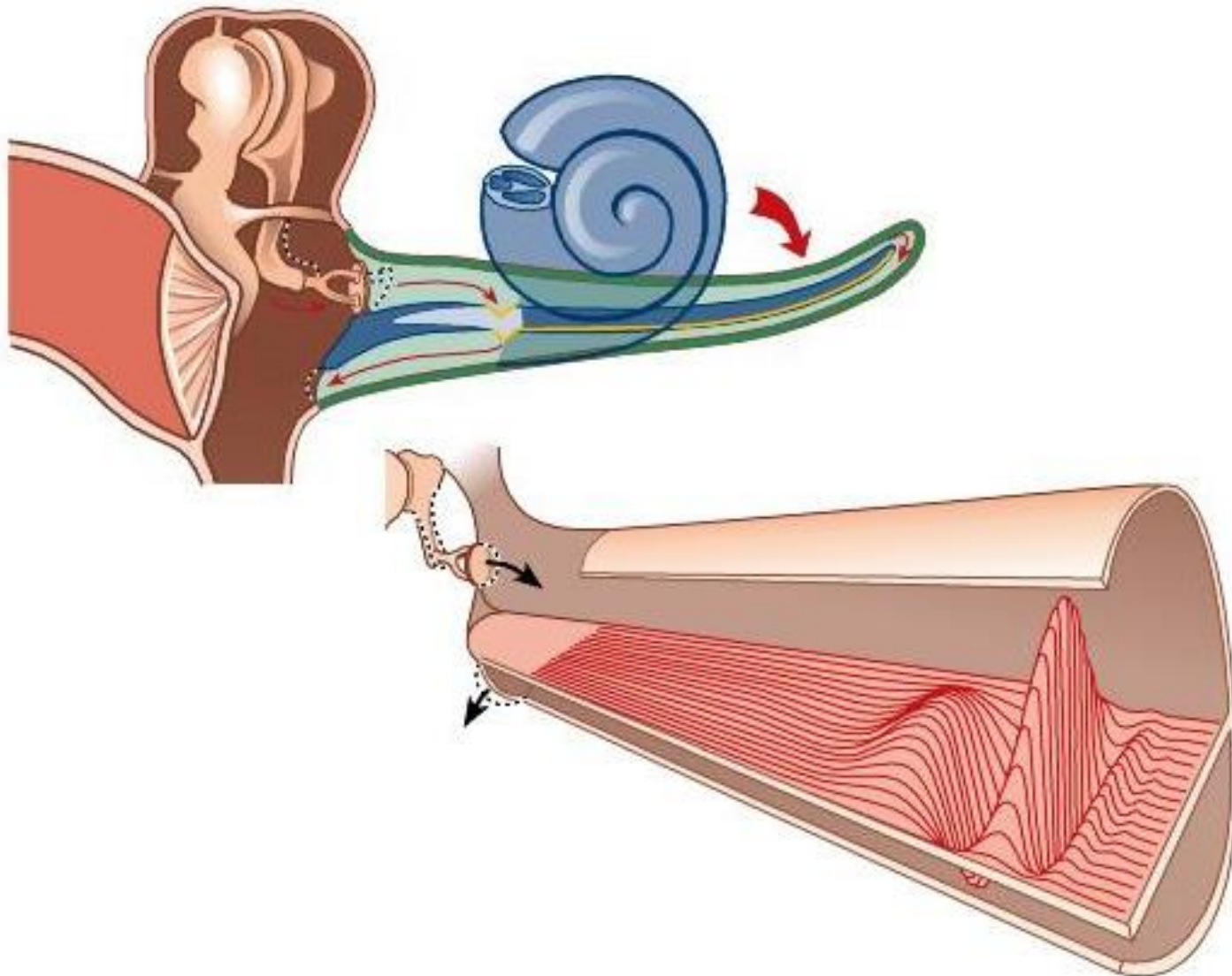
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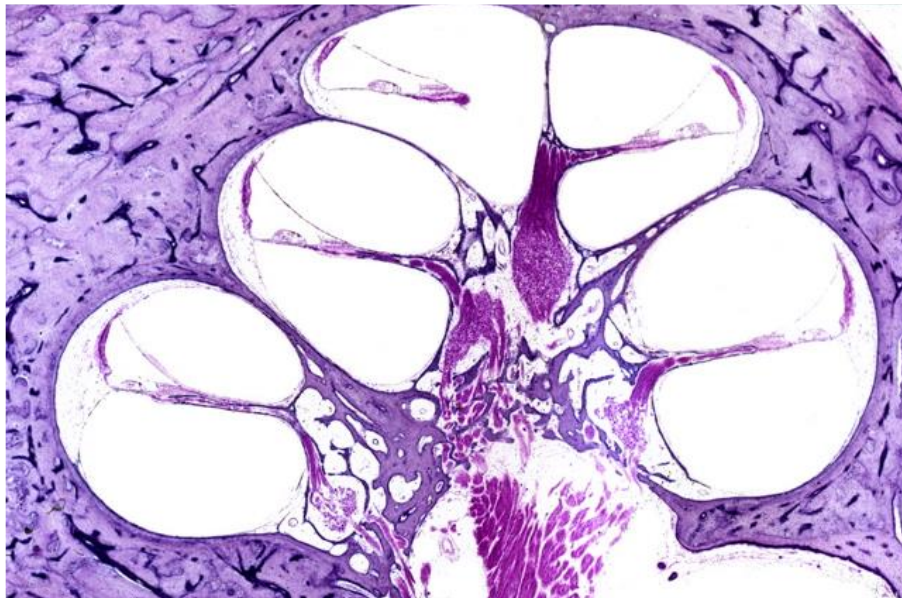
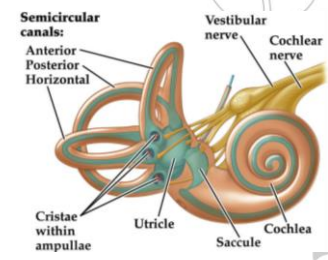
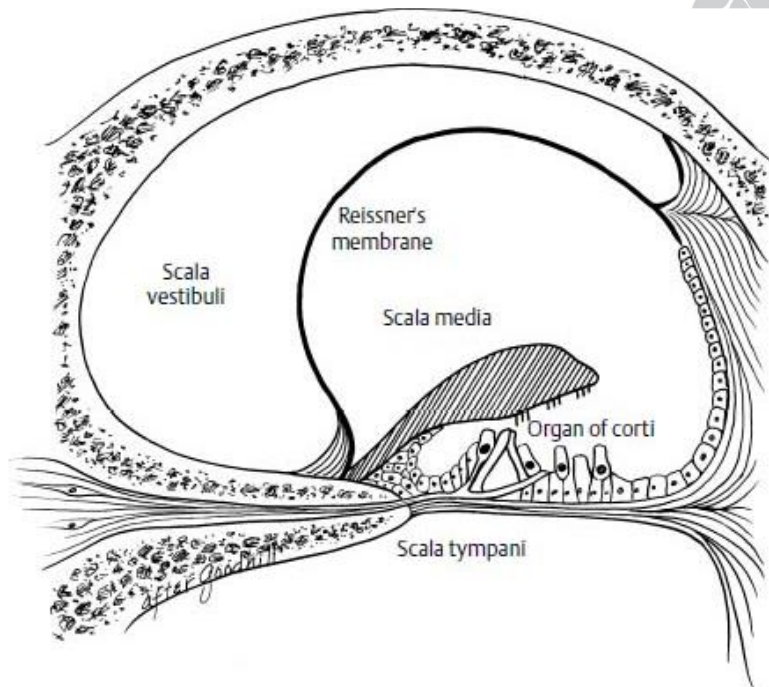


- External ear
 - Auricle
 - External auditory canal
- Middle ear
 - Tympanic membrane
 - Middle ear cavity
 - Ossicles
- Mastoid
- Eustachian Tube
- Inner ear
 - Cochlea
 - Vestibule
 - Semicircular canals



Physiology of Hearing





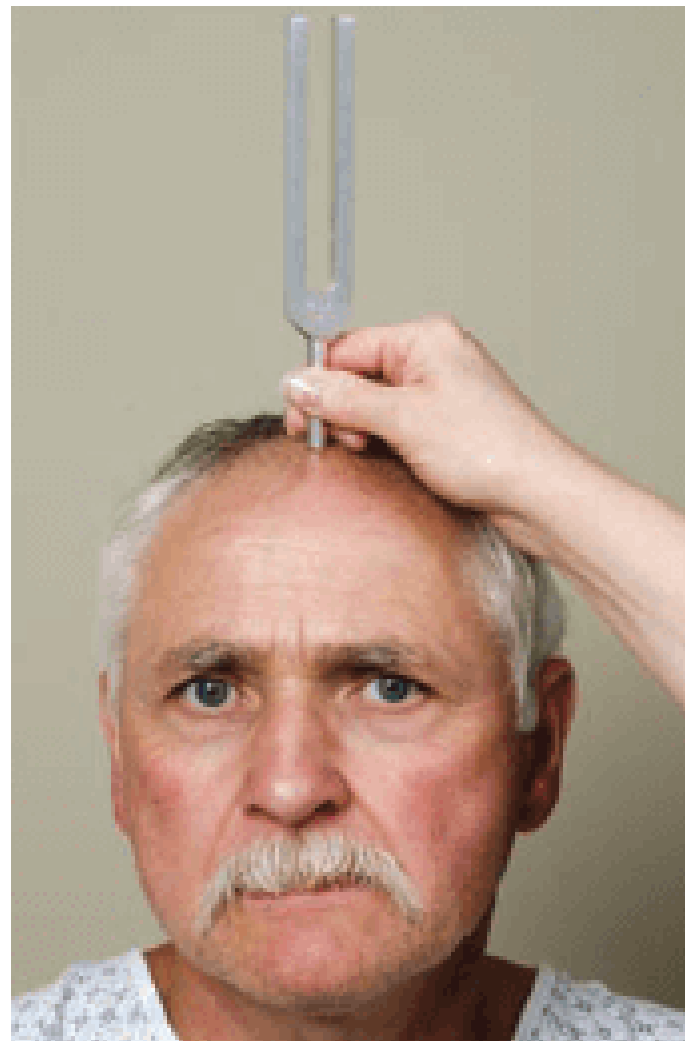
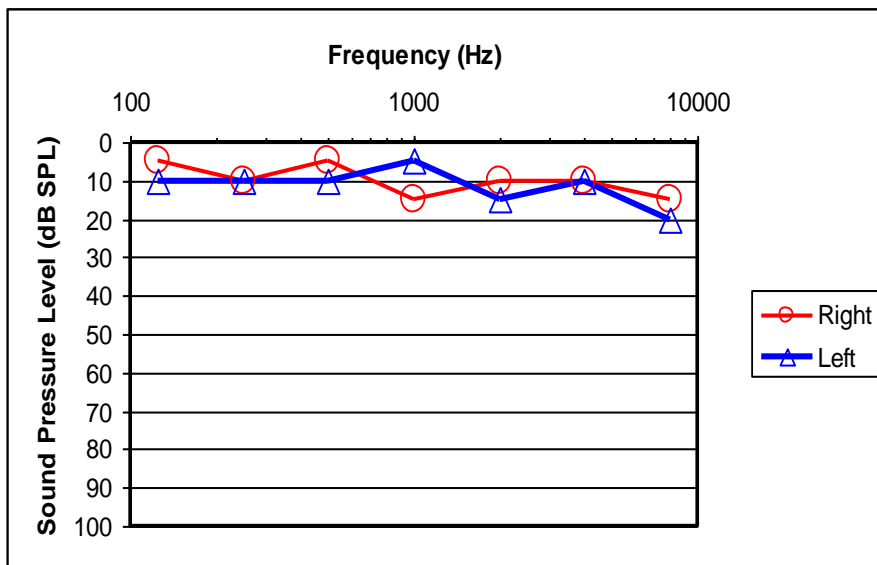
Hearing Loss

- ~45 Million with hearing loss increasing prevalence with age
- Occupational HL most common - recreational types on the rise!
- Hearing aids not well accepted: < 20% of candidates utilize technology
 - Discrimination issues - louder but not better
- Cochlear implantation - currently only capture about 5% of candidates!
- Conductive hearing loss (CHL)
- Sensorineural hearing loss (SNHL)
- Mixed hearing loss (MHL)



Work-Up

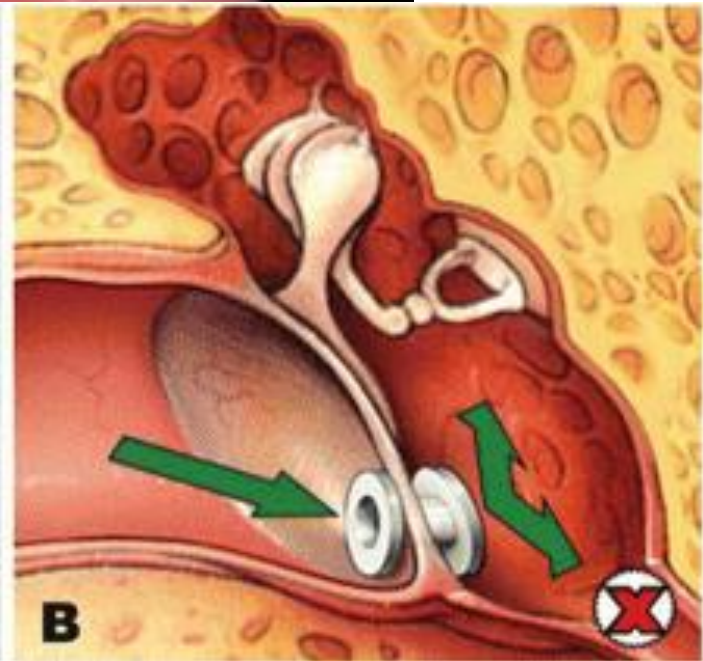
- Audiogram
- Tympanometry
- Tuning fork



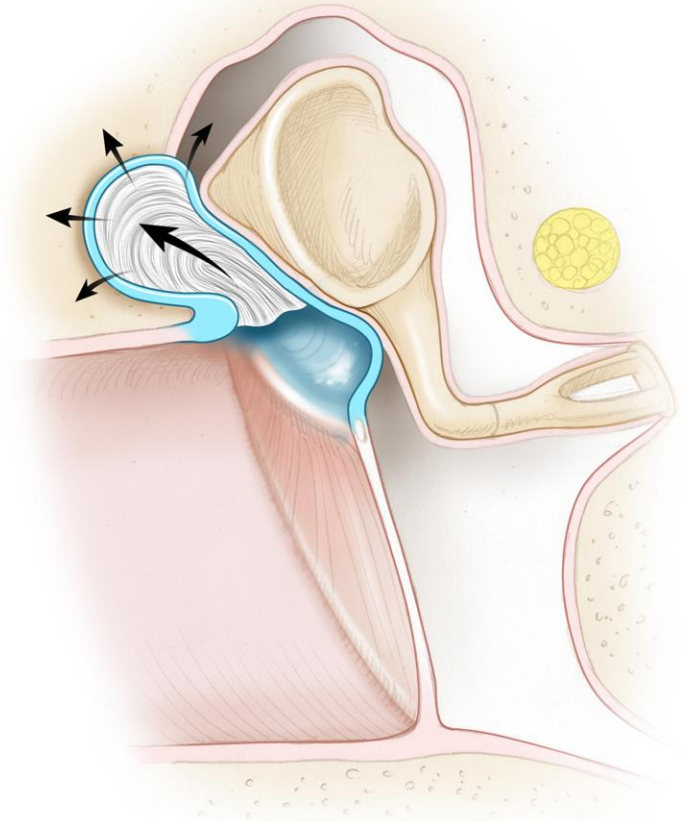
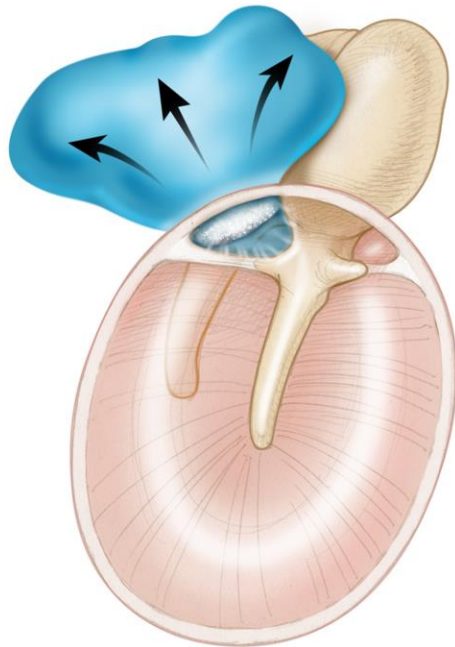
Conductive Hearing Loss

- External auditory canal
 - Cerumen
 - Otitis externa
 - EAC exostoses, osteoma
 - Congenital canal/aural atresia
- Middle ear
 - Tympanic membrane perforation
 - Ossicular discontinuity/fixation - Otosclerosis
 - Otitis media - acute/chronic





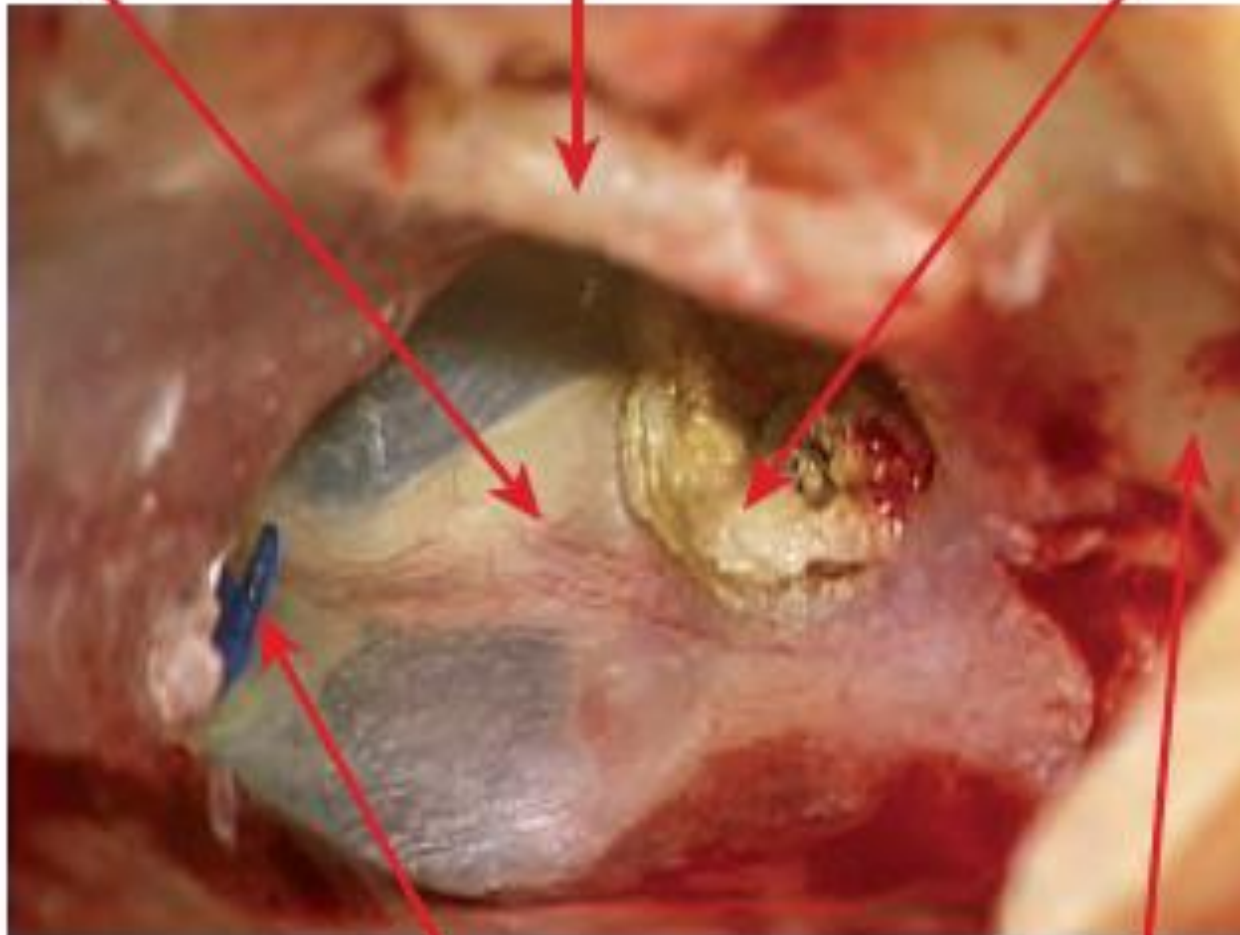




Manubrium

Anterior canal wall

Cholesteatoma



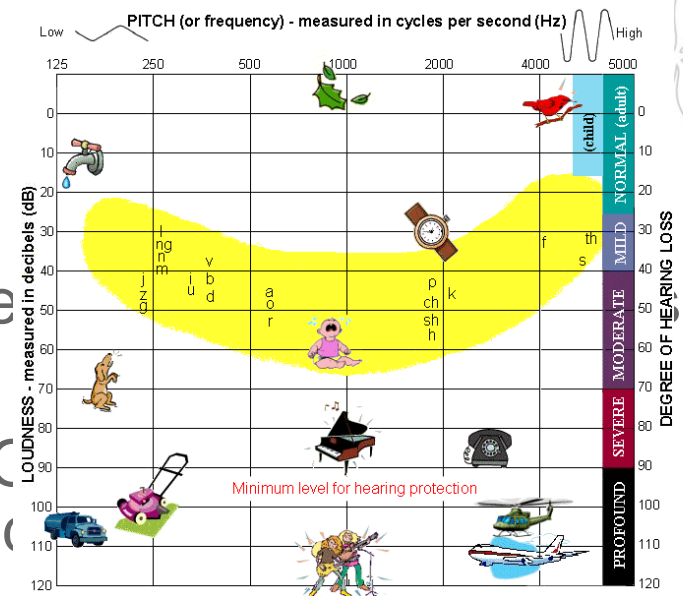
PE tube in situ

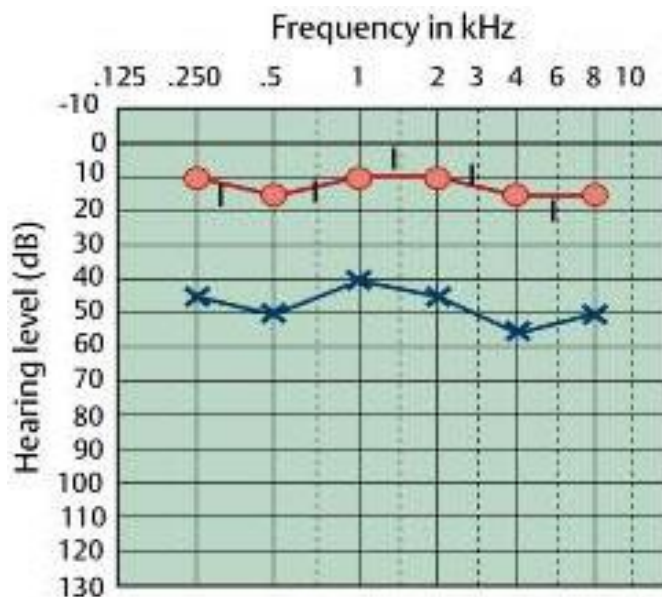
Vascular strip elevated

H. Intraoperative image of an epitympanic cholesteatoma (retraction pocket cholesteatoma).

Sensorineural Hearing Loss

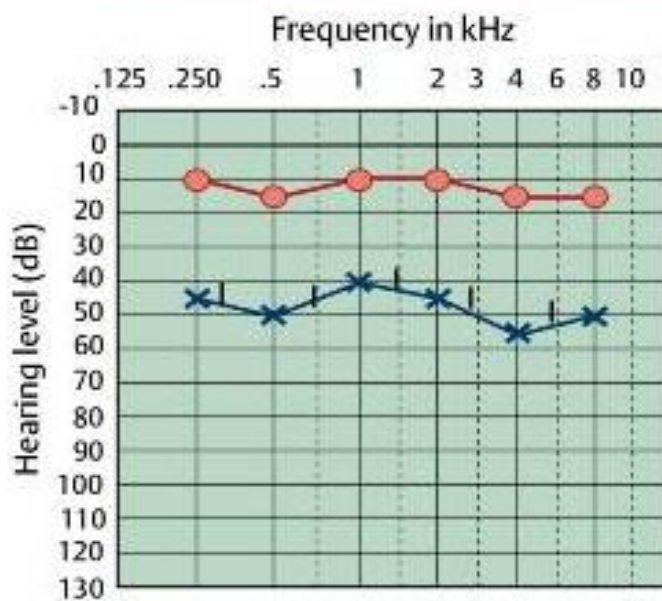
- Presbycusis – age related, starts old
- Noise exposure – OSHA and NIOSH 90 dB require hearing protection and
- Ototoxic medications – cisplatin, aminoglycosides, loop diuretics, aspirin
- Genetics – earlier hearing loss
- Sudden sensorineural hearing loss – decrease in hearing of >30 dB affecting at least 3 consecutive frequencies in relation to the other ear
 - 90% remains idiopathic
 - Recommend high dose steroids and MRI





Unilateral
conductive
loss

- Right ear
- × Left ear
- | Left bone conduction



Unilateral
sensorineural
loss



Why Do We Care?

- Hearing loss causes decreased verbal communication and social isolation
- Lin et al. – New evidence that hearing loss is independently associated with dementia
 - Also with poorer cognitive functioning in general
 - This becomes a 5-fold increase with severe hearing loss
 - Risk of Alzheimer's disease increases 20% for every 10 dB of hearing loss
 - Hearing loss may contribute to a faster rate of cerebral atrophy



Treatment Options

- Analog and digital devices
- Mainly amplification - does typically not improve discrimination
- Frequency compression, Bluetooth



Treatment Options

- Many continue to struggle
 - People don't like the way they look
 - \$\$\$\$\$
 - 8.4 million hearing aid users in the US, 840,000 with severe to profound hearing loss, and 523,000 who could benefit from a cochlear implant
 - Average length of severe-to-profound hearing loss prior to receiving a cochlear implant is 11-12 years
 - Outcomes with cochlear implants exceed performance with a hearing aid



Why do we care so much about cochlear implants?



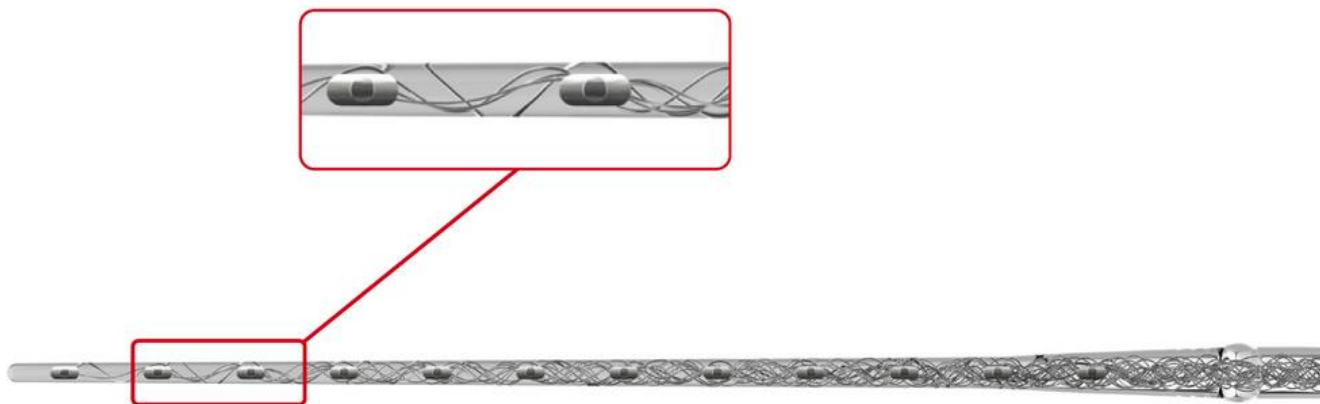
Cochlear Implants

- Cochlear implants were approved by the FDA in 1984 for adults
- Shown to improve speech discrimination, decrease tinnitus, improve sound localization, and improve QOL...thus, restore communication
- Can be performed as early as 6-12 months old to 90+ years old
- Provides hearing in hearing impaired children and thus language acquisition



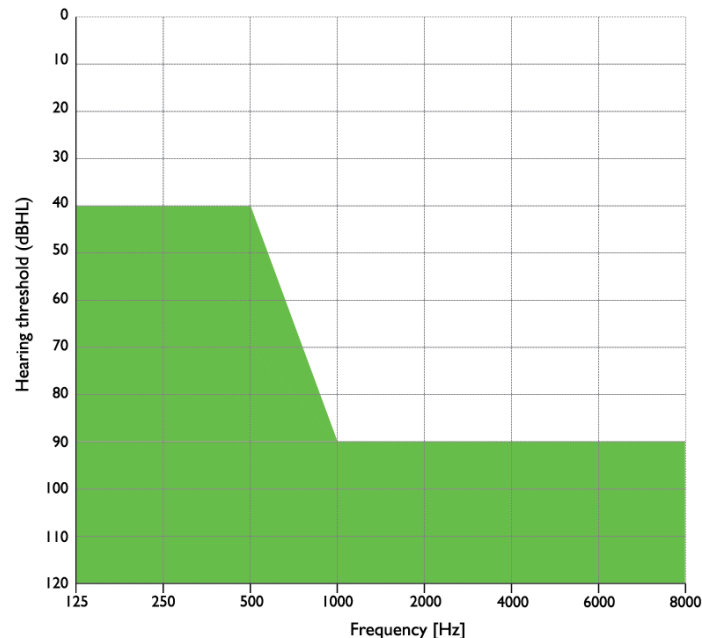
What is a Cochlear Implant?

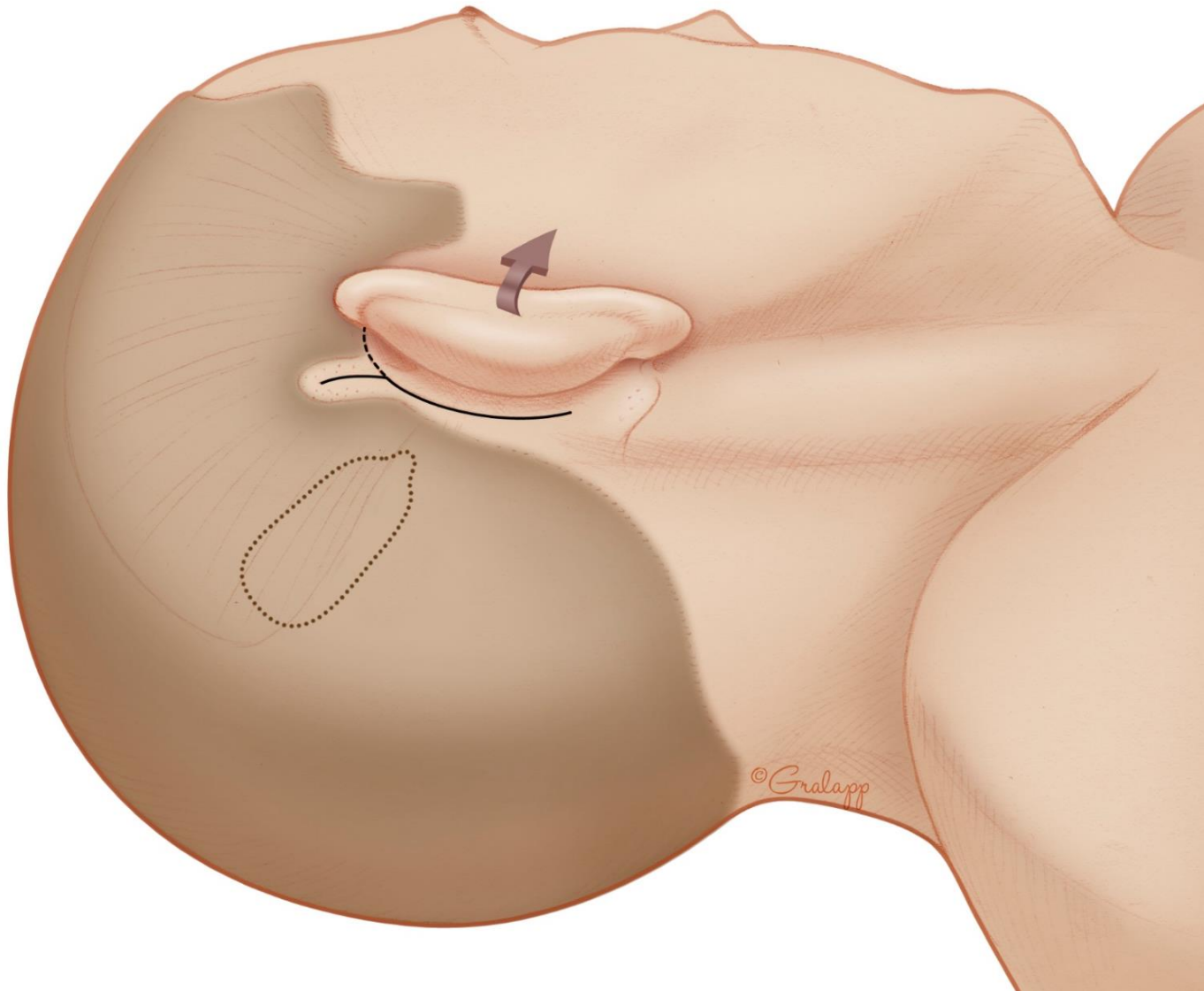
- Microphone, speech processor, batter, receiver-stimulator, electrode array
- Acoustic to electrical stimulation of cochlear ganglion

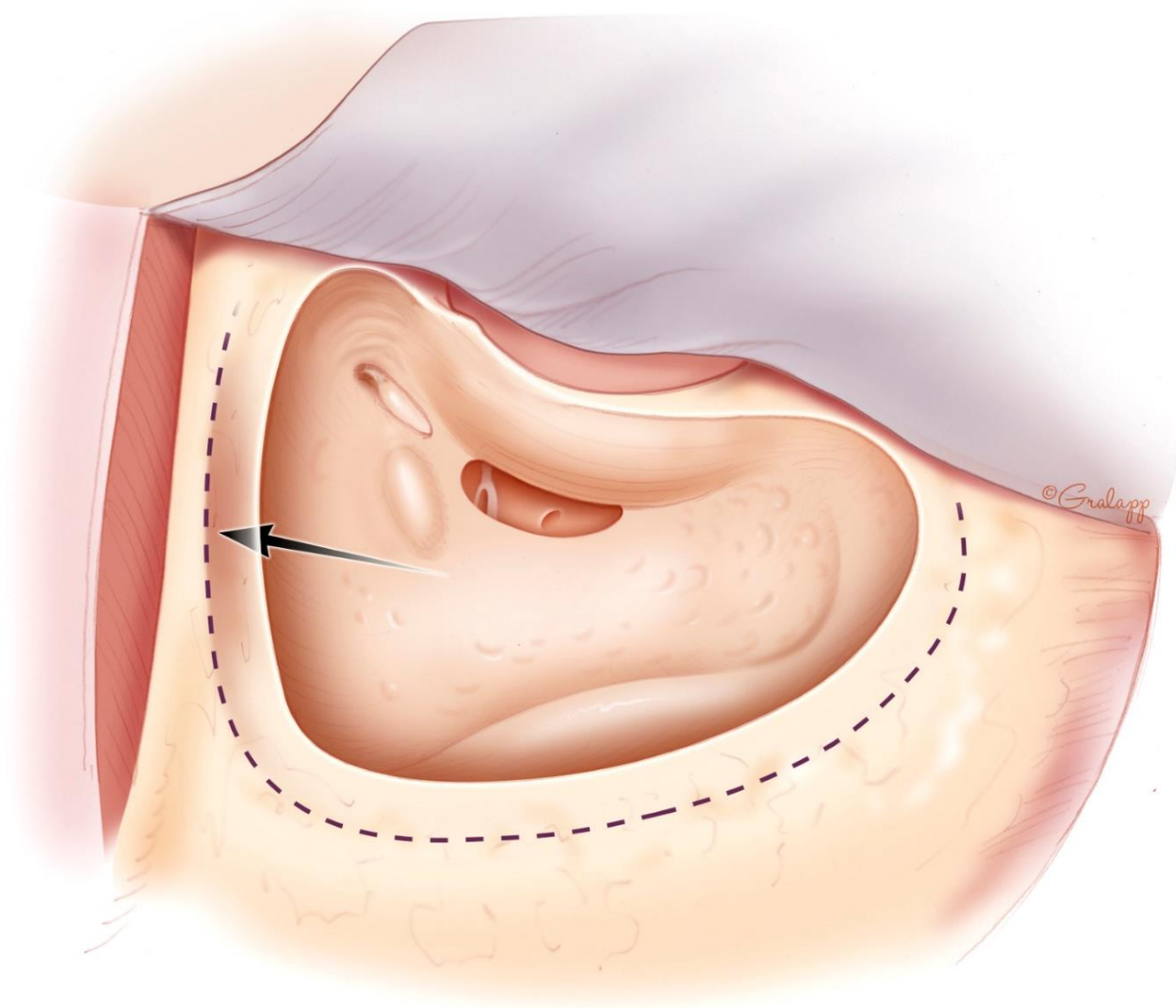


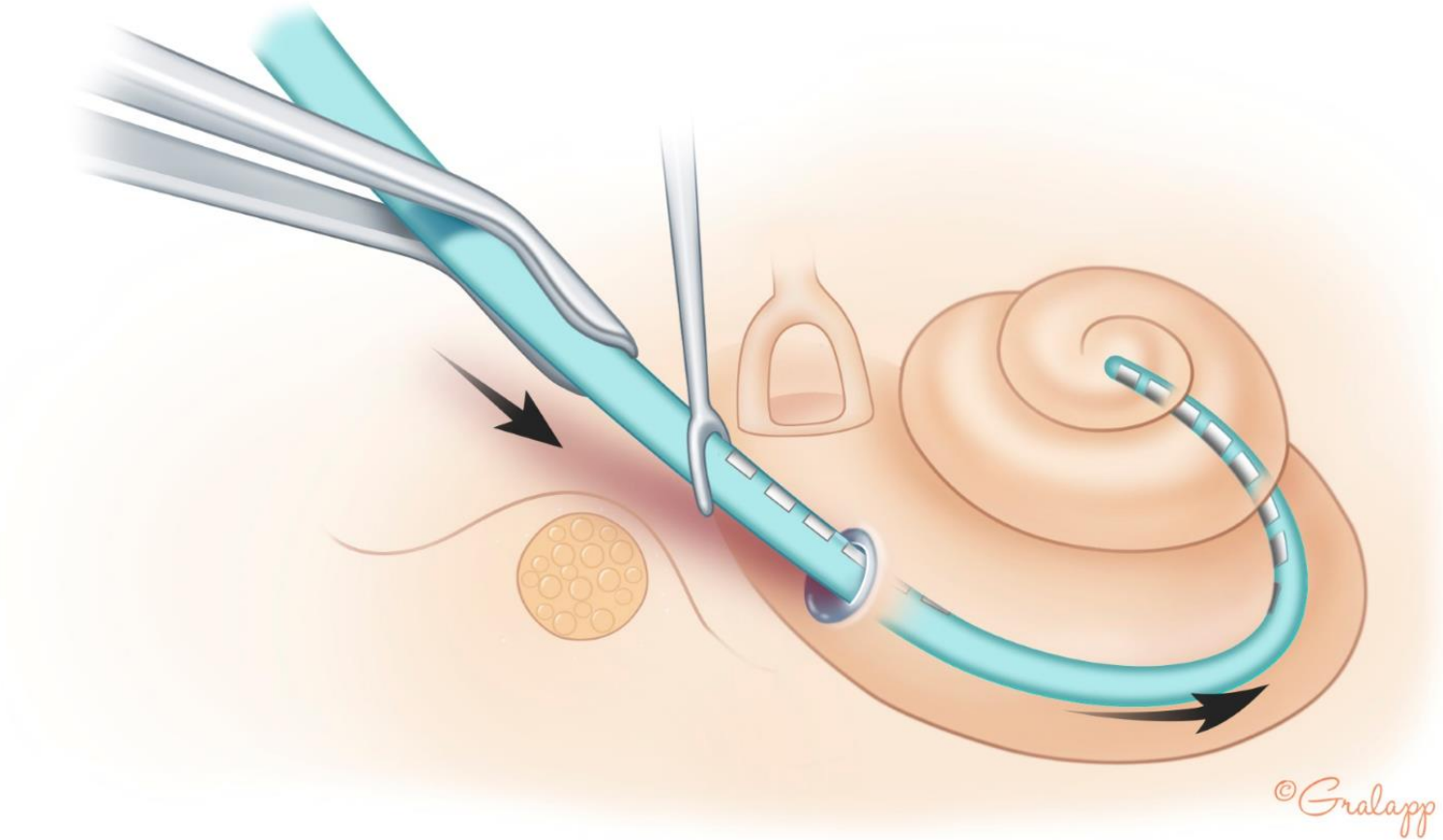
Implant Criteria

- Vary according to insurance:
 - In general, moderate-to-profound SNHL in both ears
 - Speech recognition criteria in best aided scenario
 - <50% sentences in ear to be implanted, <60% bilaterally in best aided condition
 - Medicare more strict (<40% in ear to be implanted)
 - +5 and +10 signal-to-noise ratios

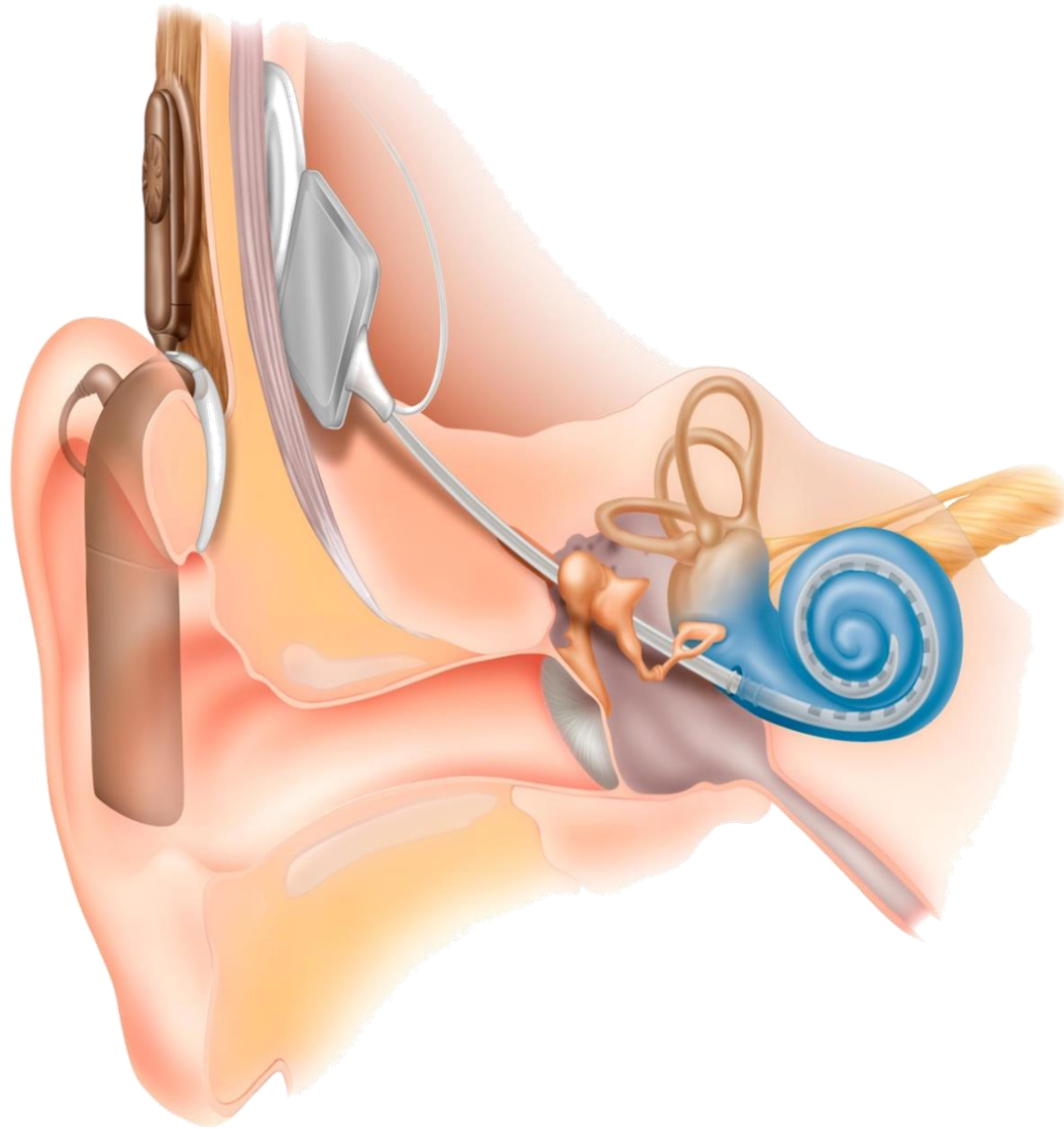








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Predictors of Success

- Adults
 - Duration of deafness - the shorter, the better
 - Mental status
- Children
 - Age at implantation - the earlier, the better
 - Residual hearing - the more pre-implant hearing, the better
 - Comorbidities



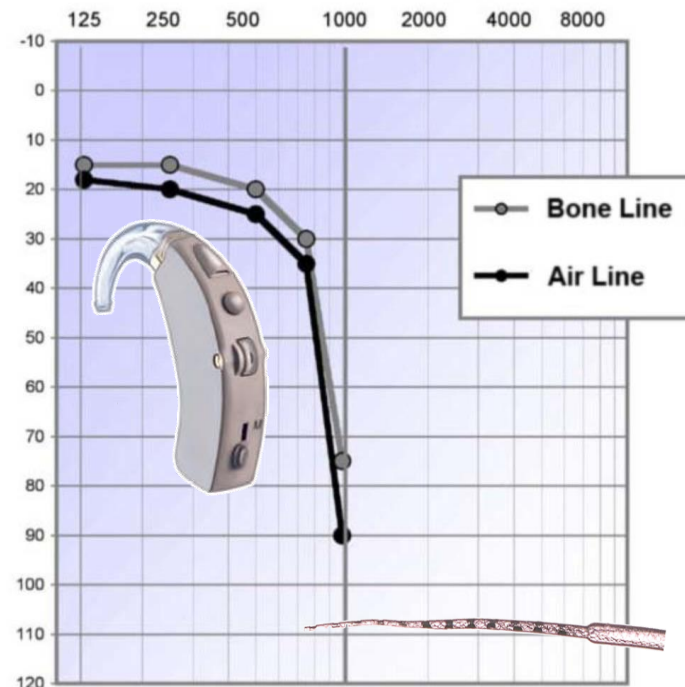
Hearing Preservation Surgery

- Traditional indication – moderate-to-profound hearing loss
- Problematic scenario –
 - Relatively good hearing (pure-tones only)
 - Not doing well with hearing aids
 - Not traditional cochlear implant candidates
- Electrode in the cochlea destroys intracochlear structures
 - Destroys acoustic hearing
- Current indications broader
 - Technology improvements
 - Improved clinical predictors of success



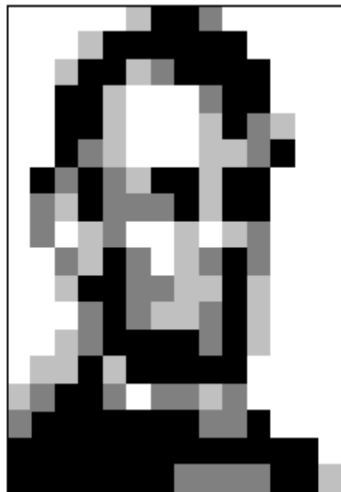
Hearing Preservation Surgery

- “Ski-slope” style hearing loss – preserved low frequency hearing and moderate-to-profound high frequency loss and poor speech understanding
- Better methods for preserving hearing have demonstrated good success – minimizing bleeding and bone dust, newer electrodes
- Combined electric and acoustic
- Improved hearing in noise, improved music appreciation



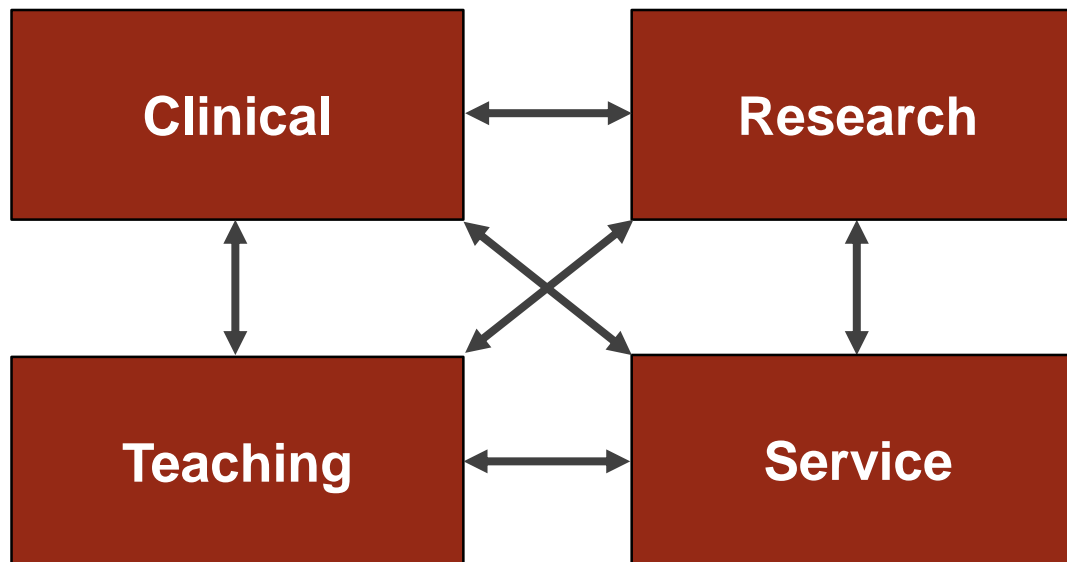
Auditory Training

- Not an on/off switch
- Train the brain to use degraded input in a more effective and efficient manner
- Takes advantage of auditory plasticity
- Like second-language learning



Ohio State

- The Ohio State University and Nationwide Children's Hospital Experience
 - ~150-200 implants/year
 - Approximately 50/50 pediatrics and adults
- Bottom-up processes – electrocochleography
- Top-down processes – aural rehab



Thank You!

- Feel free to reach out to me with any questions!
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