



Expanding Indications for Cochlear Implantation

Seilesh Babu, M.D.

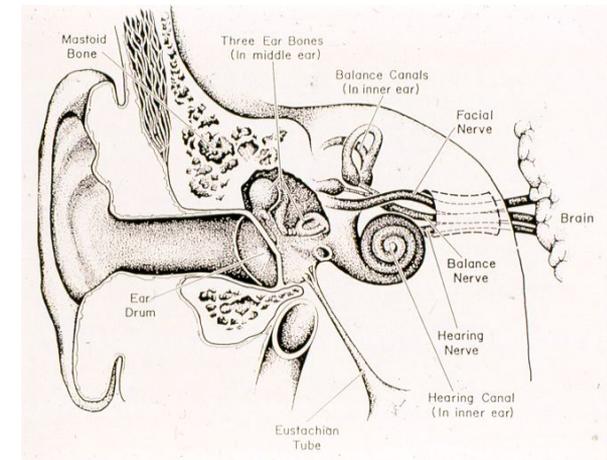
Neurotology/Skull Base Surgery

Michigan Ear Institute

Financial Disclosure

- No relevant disclosures
 - Research Grant: Oticon Medical and Cochlear Corp
 - Advisory role: Stryker and Acclarent

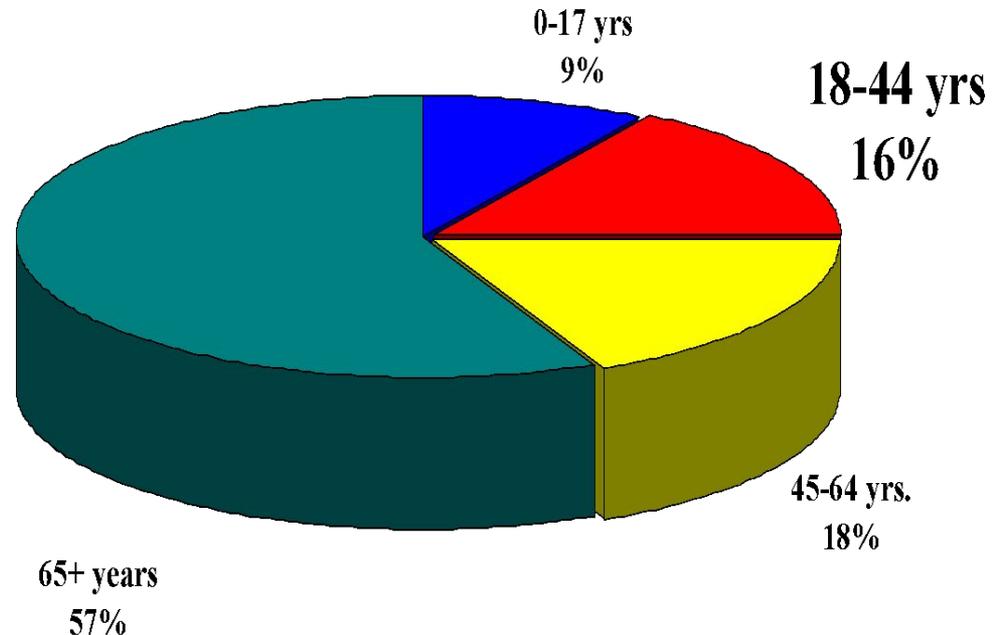
INTRODUCTION



- Cochlear implant
 - Greatest impact on hearing loss
- At present
 - Indicated for bilateral hearing loss
 - Bilateral implantation in selected cases
- Prevalence as of 2017 (4.8M candidates in US)
 - Worldwide- 375,000 recipients
 - United States- 200,000 recipients

Societal Impact: Age

Severe to profound hearing loss population is divided into four age groups



Cochlear Implant Candidacy

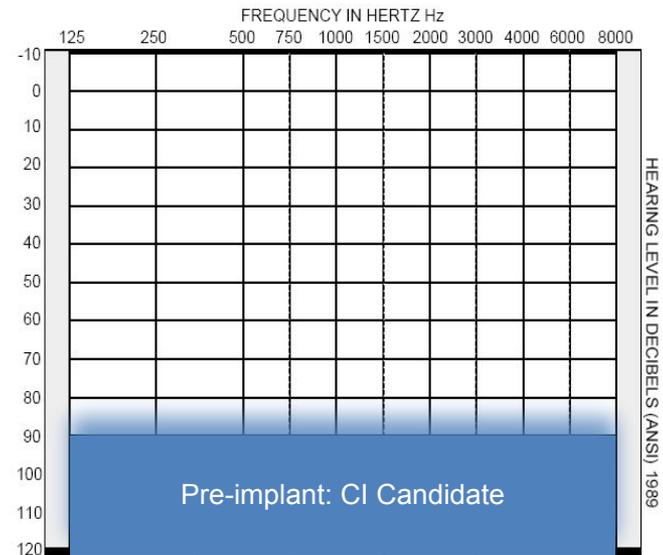


Who is a pediatric CI candidate?

- Infant identified and followed closely
- Little or no benefit from appropriately fitted hearing aids
- Parent or teacher reports
 - lack of speech and language progress
 - rarely responds to name
 - lack of social interaction with children or adults
 - sudden or progressive change in hearing

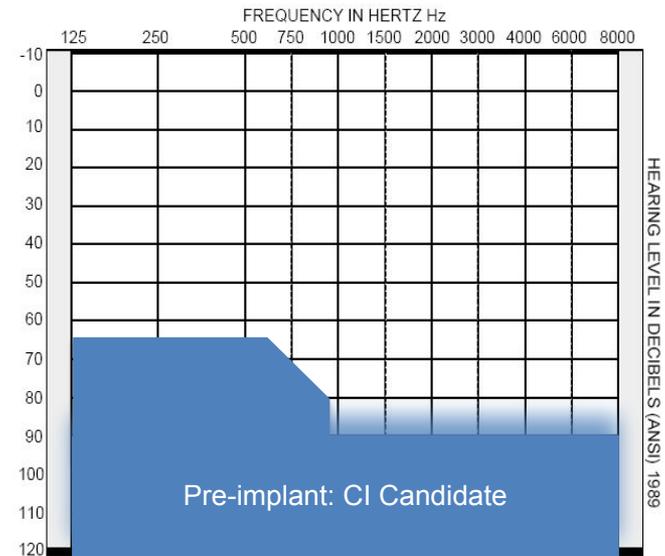
Who is a pediatric CI candidate?

- 12-24 months old
- Trial of Hearing devices with minimal benefit
- No cochlear ossification



Who is a pediatric CI candidate?

- 2-17yr old
- Trial of Hearing devices with minimal benefit or reduced benefit



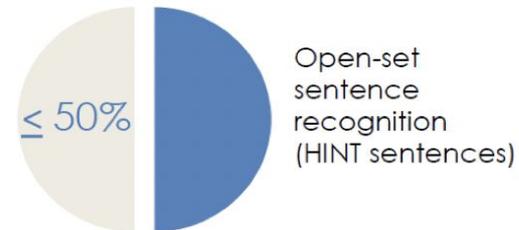
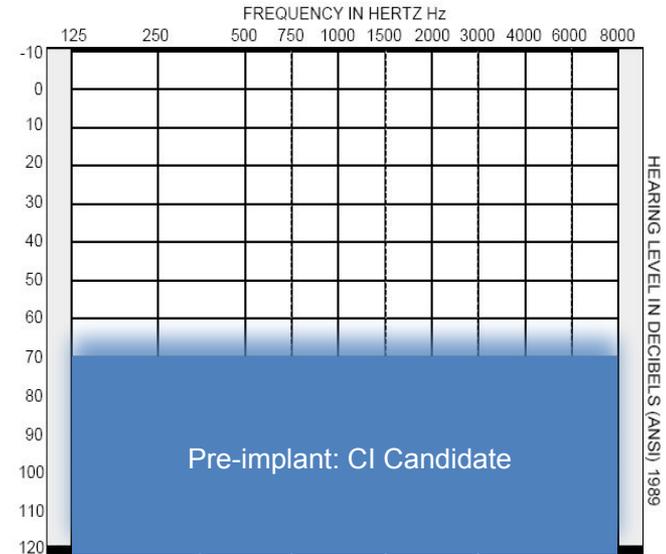
Candidacy Evaluation

- Determine the cause of hearing loss
- Assess status of middle ear & cochlea
- CT scan/MRI
- Counseling
 - Hearing loss and expectations
 - The surgical procedure



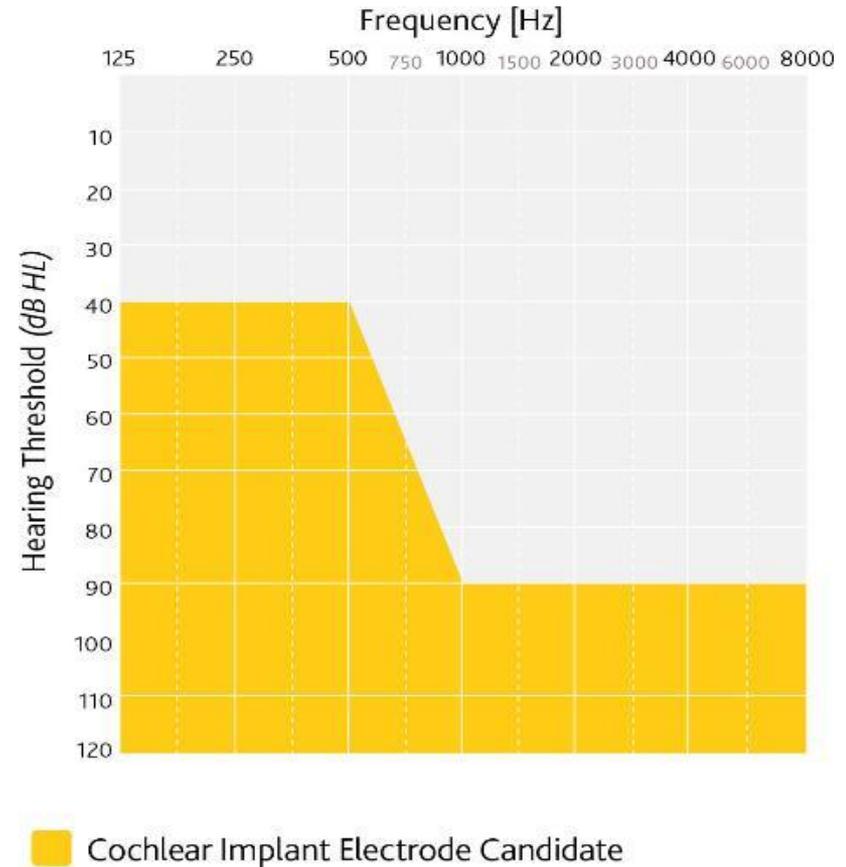
Who is an adult CI candidate?

- Limited benefit from HA
 - Difficulty communicating 1:1, even in quiet room
 - Need captions for TV
 - Avoid social activities
 - Depend on lip-reading to understand conversations
 - Trouble hearing on phone
 - No longer enjoy music



Expanding indications for CI

- Sentence Score no better than 50% in the ear to be implanted and no better than 60% in the best aided condition
- **Medicare National Coverage Determination:** Sentence Score no better than 40% (best aided) unless enrolled in a clinical trial
- ACIA continues to work on Medicare Coverage determination
 - Discrimination scores vs Sentence Score vs PTA



	1985	1990	1998	2000
AGE of Implantation	Adults (18 yrs)	Adults & Children (2 yrs)	Adults & Children (18 months)	Adults & Children (12 months)
ONSET of Hearing Loss	<u>Postlinguistic</u>	<u>Postlinguistic</u> Adults Pre & <u>Postlinguistic</u> Children	Adults & Children Pre & Postlinguistic	Adults & Children Pre & Postlinguistic
DEGREE of SNHL	Profound	Profound	Severe-Profound Adults Profound Children	Severe-Profound Patients - 2 yr. and older Profound Children - younger than 2 yrs.
ADULT Speech Scores (open-set)	0%	0%	40% or Less (CID)	50% or Less (HINT) in Ear to be Implanted with 60% or Less in Contralateral Ear or Binaurally
CHILD Speech Scores	Not Candidates	0% Open-Set	Less than 20%	Lack of Auditory Progress (MAIS), </- 40% (MLNT/ LNT) (depending on age)

The Candidacy Evaluation

Bilateral Cochlear Implants

- Hearing with two ears
- Simultaneous vs. Sequential
- Benefits:
 - ✓ Improved directionality
 - ✓ Improved hearing in noise
 - ✓ Clarity of speech
 - ✓ Developmental
- Develop listening skills which aid them in understanding speech in noise, locating a sound source, and incidentally learning from their environment. (Litovsky, 2006; Wolf, 2008)



Outcomes with a Cochlear Implant

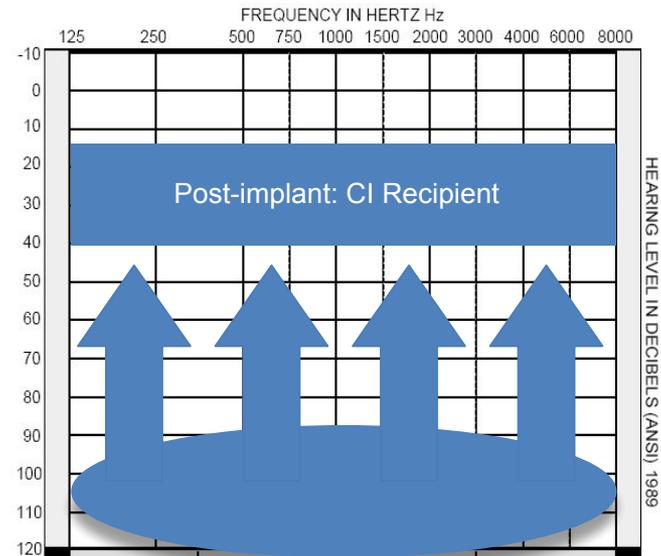
Can be influenced by:

- Age at onset of deafness
- Hearing loss duration
- Age at time of implantation
- Residual hearing
- Etiology
- Multiple handicapping conditions



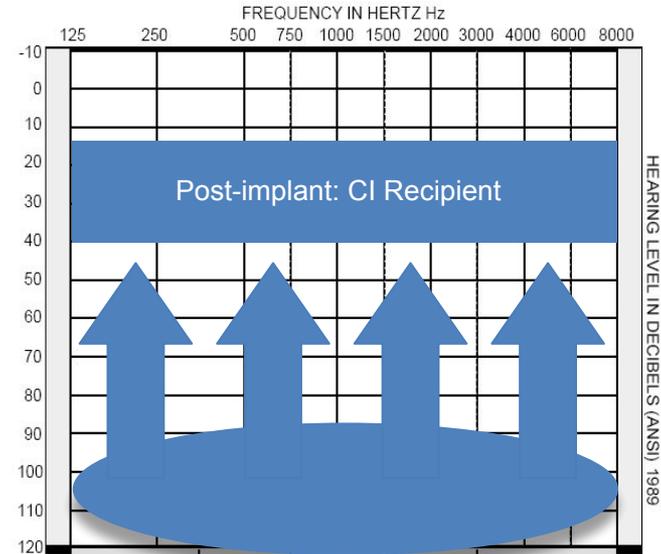
Pediatric Outcomes

- Improved sound awareness
- Access to oral language
- Development of age-appropriate speech and language
- Mainstreamed education with normal-hearing children



Adult Outcomes

- Pre-CI speech scores
 - ✓ ≤50% HINT Quiet
- Post-CI speech scores
 - ✓ 90% HINT Quiet
 - ✓ 68% HINT Noise (+8dB SNR)
 - ✓ 64% CNC words
- Most use telephone (75% of users)
 - ✓ 54% clear/very clear on cell phone



Adult Outcomes with a Cochlear Implant

Adults with severe to profound hearing loss have a tremendous potential for an improved quality of life after receiving a cochlear implant :

- improved emotional health
- reduced isolation
- expanded options in education and work



Expanding Criteria for CI: Recent Developments

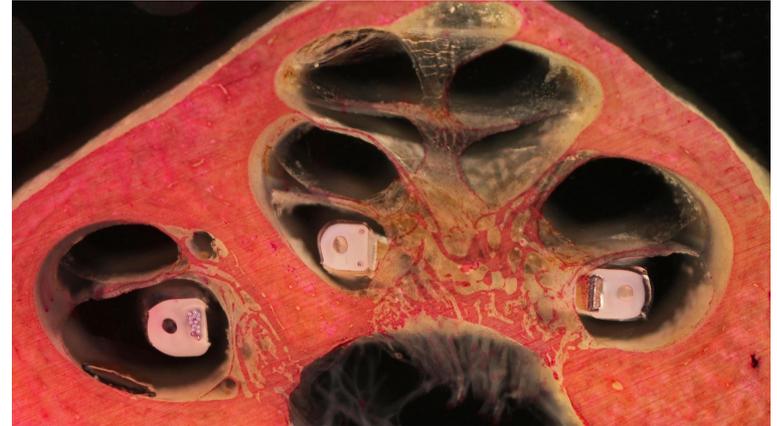
1. Manufacturer improvements

- Less traumatic electrode design
- Battery life
- Combining HA technology with CI

2. Better understanding of anatomy and hearing preservation techniques

3. Hybrid Electrodes

- Acoustic and electrical combination device



1. Manufacturer Improvements: Electrode Design

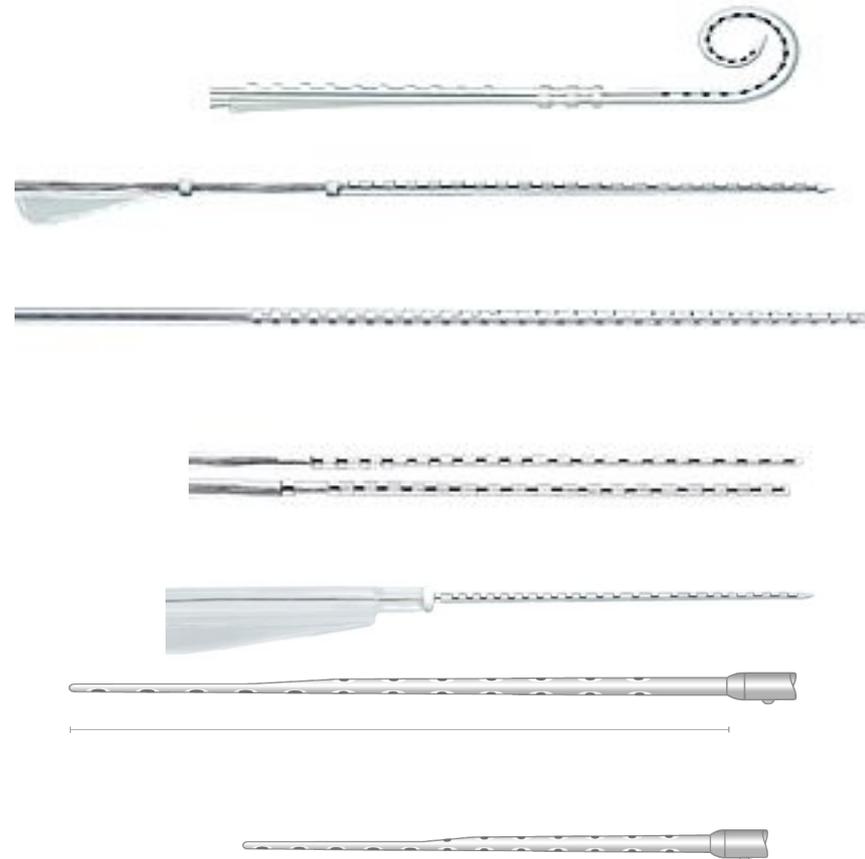
- Advanced Bionics



- Cochlear Americas



- Med-El



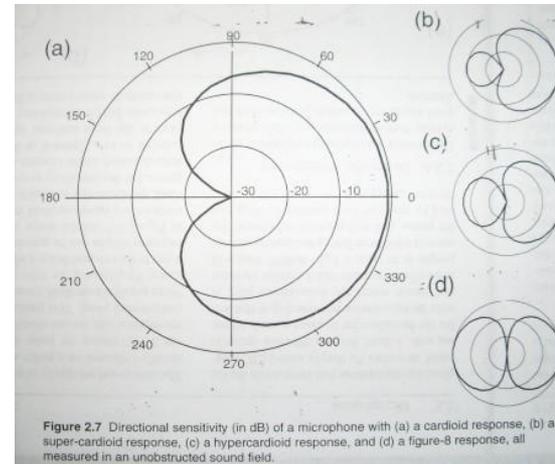
Battery life and size of device

- External device has decreasing in size
- Rechargeable and hearing aid size batteries
 - 12 hour life for rechargeable
 - HA batteries last 2-3 days



Combination Hearing aid technology

- Directional microphones
- Automatic Gain Control
- Noise reduction algorithms
- Wind noise reduction
- Data logging
- Maps/programs
 - Automatic in newest processors



MRI compatibility improvement

- Change in magnet design
- Able to be placed in up to 3T without need for head wrapping



2. Hearing preservation

- Surgical technique
 - Use “soft techniques” to maintain low frequency hearing
 - Minimizing drilling on cochlea
 - Careful opening of cochlea (either round window or cochleostomy)
 - Slow electrode insertion speed/underwater
- Potential
 - Theoretically allow better performance of CI
 - Allow possibility of acoustic stimulation of implanted ear

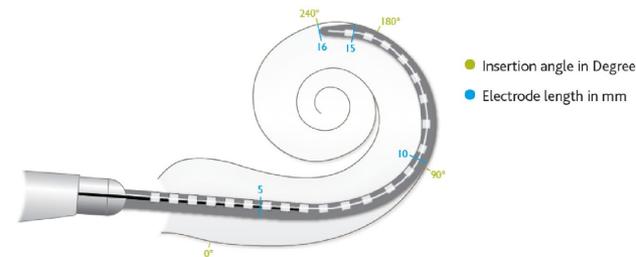
Better electrode and hearing preservation technique

Preserve hearing

- Shortened electrode arrays (20mm, 10mm)
- Basal turn of cochlea stimulated electrically
- Low-frequency residual hearing preserved

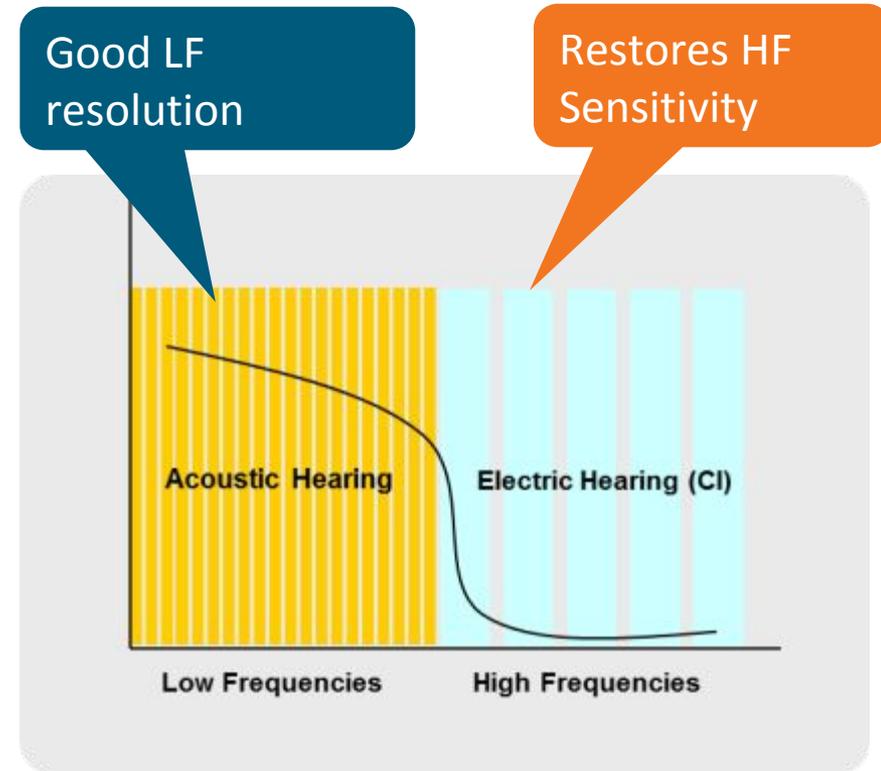
Utilize both aspects

- Combined usage of acoustic and electric hearing:
- Hybrid CI/ EAS CI



Goals of hybrid hearing

- Restore HF hearing
 - Critical for consonant discrimination
 - Clarity of speech
- Maintain LF hearing
 - Vowel and pitch discrimination
 - Sound quality
 - Understanding in background noise



Expanding indications

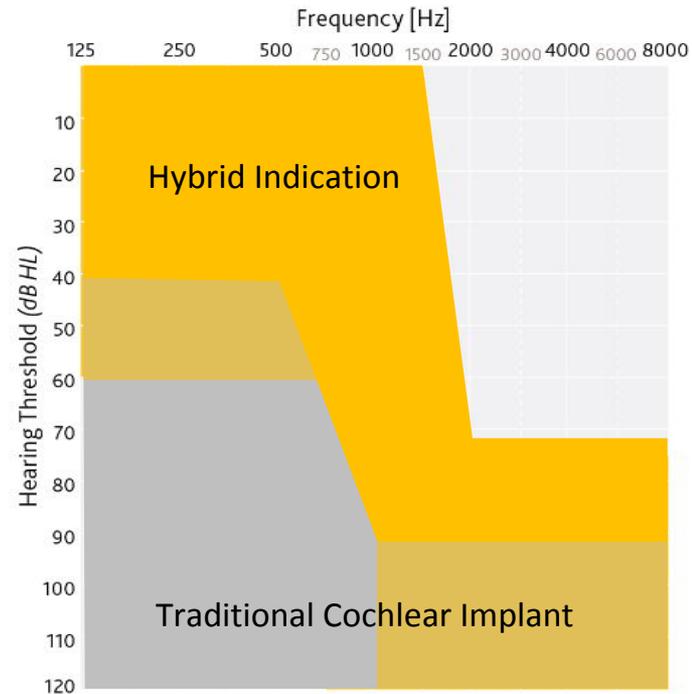
Word (CNC) score $\geq 10\%$ and $\leq 60\%$ in the poorer ear (ear to be implanted)
PTA of 2k, 3k, 4k ≥ 75 dB HL

Word (CNC) score $\leq 80\%$ in the opposite ear (better ear)
PTA @ 2k,3k, 4k ≥ 60 dBHL

For Traditional CI: BEST AIDED

Sentence score $\leq 50\%$ in the poorer ear

Sentence score $\leq 60\%$ in the best listening condition



Future of CI

- Continued electrode improvements
 - Cochlear malformation
 - Cochlear ossification
- Implantation in SSD
 - Insurance issues
- Use of CI in AN rehabilitation
- Totally implantable CI



Barriers to Access

- Implantation of cochlear implants is extremely low among those who could benefit
 - Lack of consumer/professional awareness
 - Social and ethical issues
 - Lack of insurance
 - Financial Disincentives, i.e., inadequate reimbursement

Summary

- Cochlear implants have revolutionized the care of severe/profound deafness
 - Criteria is expanding
- Major advances in
 - Electrode Size/Capability
 - Performance
 - CI technology
- Recent concepts
 - Hearing preservation
 - Hybrid technology



Cochlear Implant Candidacy

