



Evaluation and Management of SSD using Bone Conduction Devices

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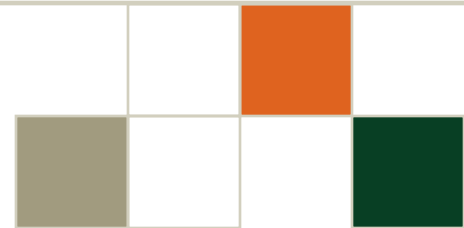
**Pediatric Unilateral Hearing Loss Conference
October 22 - 24, 2017**





Disclosures

- Chair, *7th International Conference on Bone Conduction and Related Technologies (2019)*
- Advanced Bionics, LLC Advisory Board
- Research agreement
 - Advanced Bionics
 - MED-EL
- Sponsored by Phonak for this conference





Background

- Identify the cause of UHL and assure parents there would be no handicap (Oyler et. al, 1987)
- 35% failed at least one grade, early in their academic careers (Bess & Tharpe, 1986)
 - **10 times higher than normal hearing population (3.5%)**
- Difficulty with receptive communication due to background noise and localization
 - Led to personal embarrassment and social exclusion (Reuben and Schwartz, 1999)
- **Inconsistencies** (Oyler et. al, 1987)
 1. Normal hearing in one ear deemed to be adequate for speech development
 2. Hearing aid provision is unnecessary



How and When to Treat?

Clear evidence, guidelines, and mandates for bilateral hearing loss

- Early and appropriate intervention: JCIH, EHDI

Pediatric SSD overlooked and underserved

- Delays in intervention
 - Children with UHL do not receive intervention until they are ~5 years of age (Harrison & Roush, 1996)

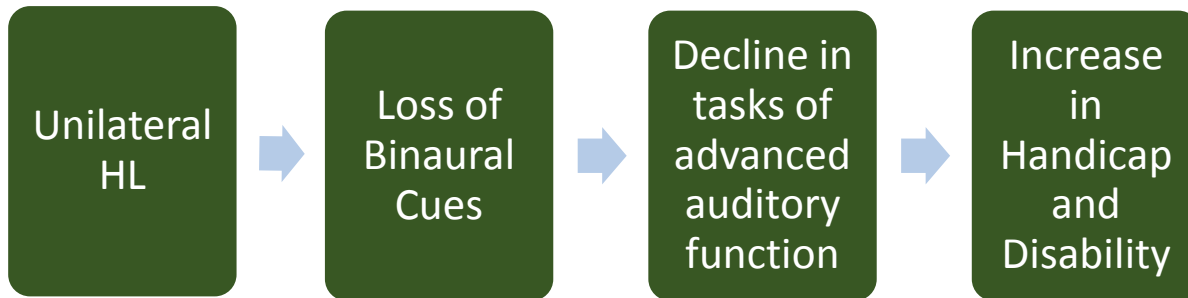


2013 AAA Guidelines

- “Children with unilateral hearing loss are at greater risk than children with normal hearing for speech and language delays and academic difficulties.”
- “Should be considered candidates for hearing instrument amplification in the impaired ear due to evidence for potential developmental and academic delays.”
- “In children with severe or profound unilateral hearing losses and normal hearing in the other ear, Contralateral Routing of Signal (CROS) or bone conduction devices **may be considered** depending on the child’s age and ability to control their environment.”
- “Currently there is a **limited amount of data available** to inform these decisions.”

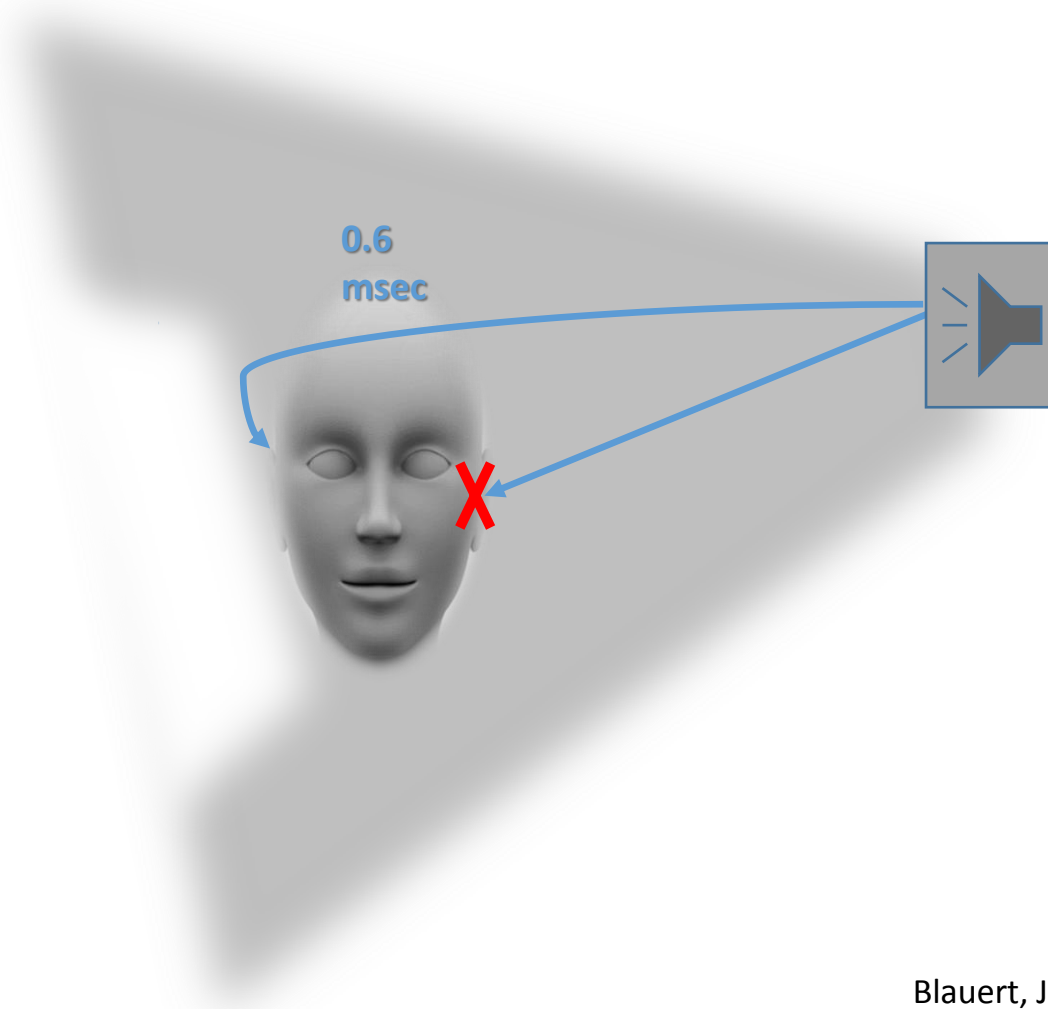


Impact of SSD



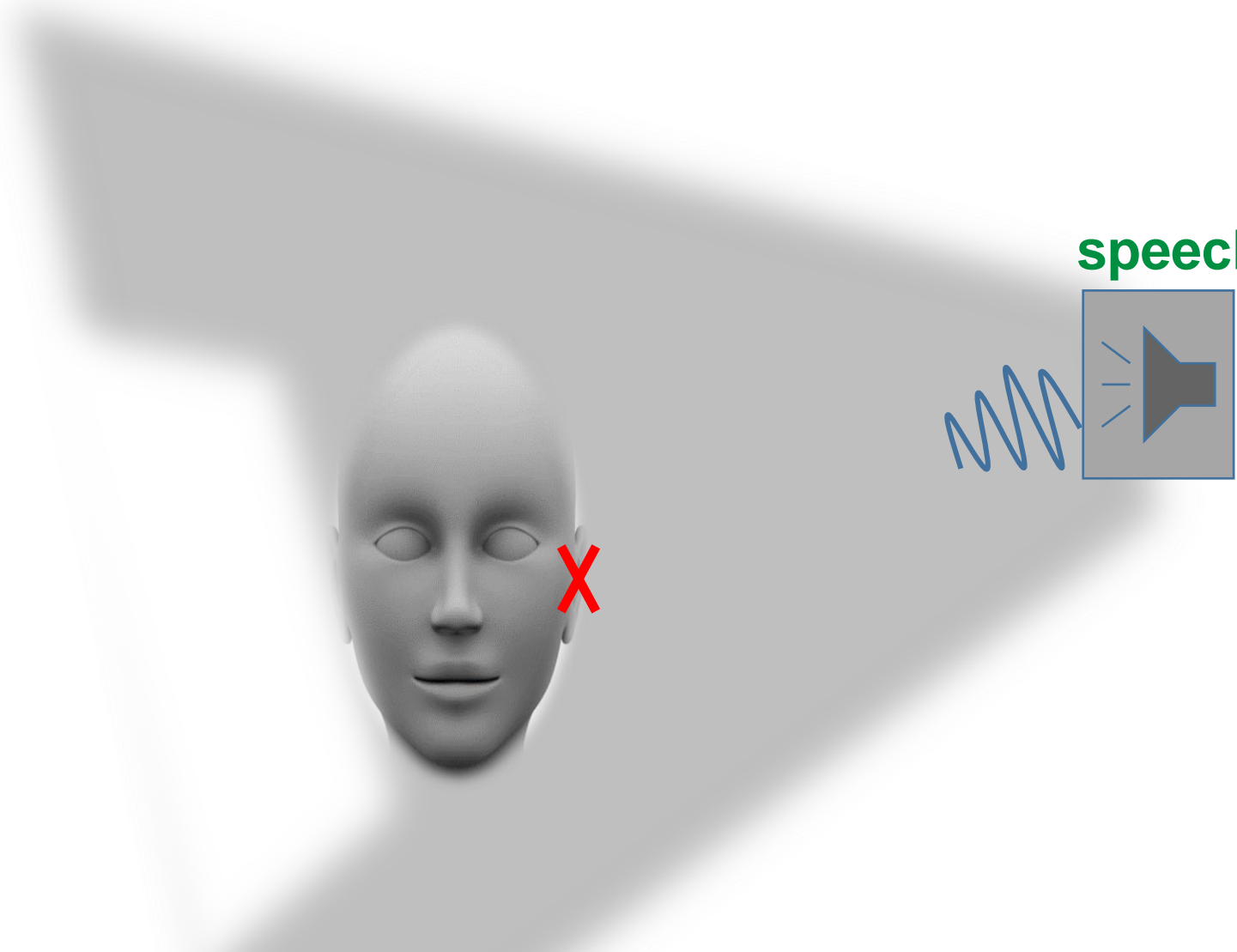


Binaural Benefit

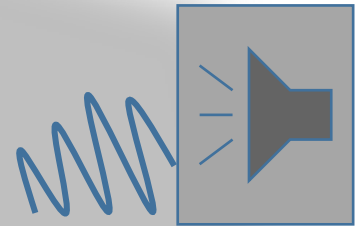




Binaural Benefit

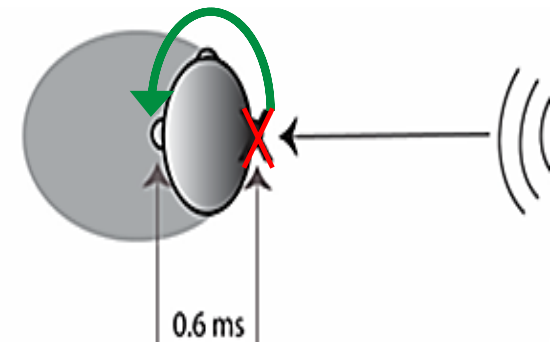


speech





Impact of Acoustic Head-Shadow



- SSD most reliant on access to high frequency information
- The attenuation for high frequency signals can be as much as 20 dB
- Loss of high frequency phonemes has significant implications for perception of speech.
- Even in low noise environments, MLs cannot successfully segregate sounds from noise.



Current Options for Pediatric SSD

CROS

- Child must be old enough to successfully use the device (know how to adapt for noise)
- Ear canal must be large enough so ear piece is not occluding
- Not optimal for high noise or distance listening

FM/DM

- Optimal for poor SNRs and listening at a distance
 - Ability to hear other children?
 - Home use?
 - Incidental learning?

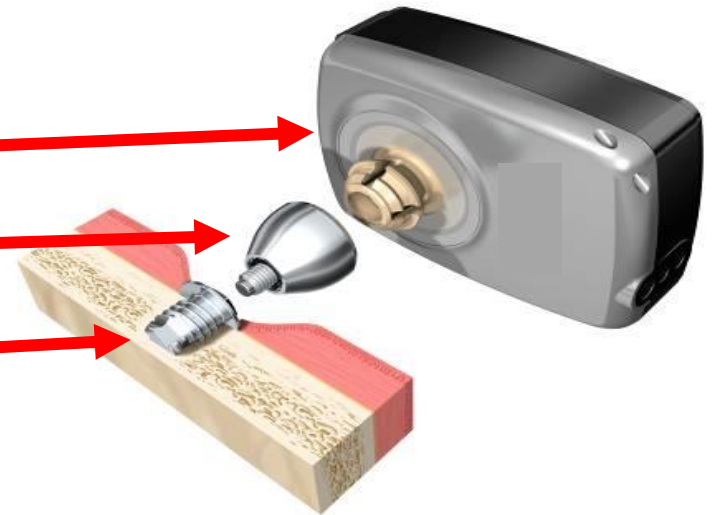


Bone Anchored Implants

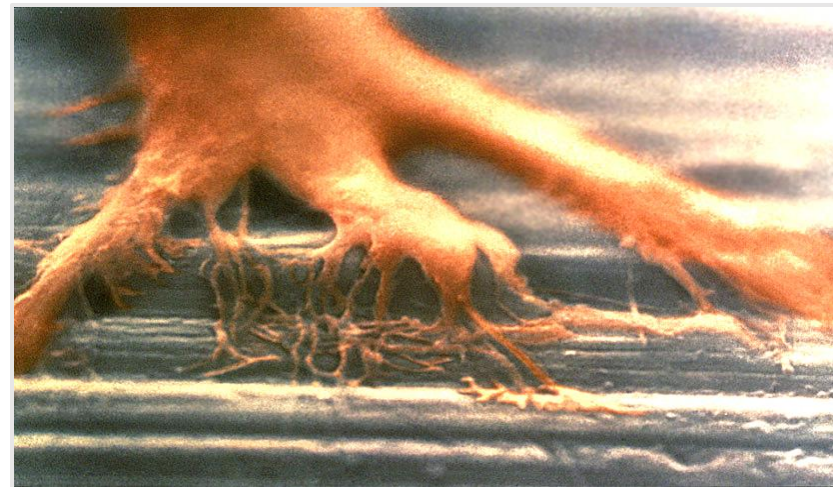
Detachable Sound Processor

External Abutment

Titanium implant



Osseointegration



BAIs

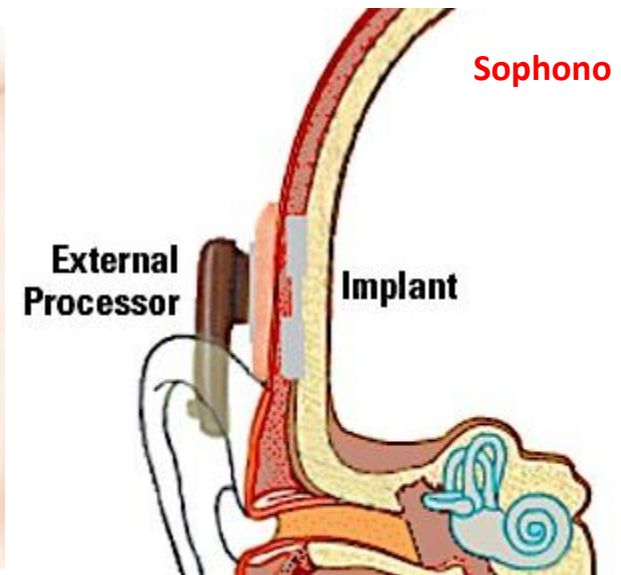
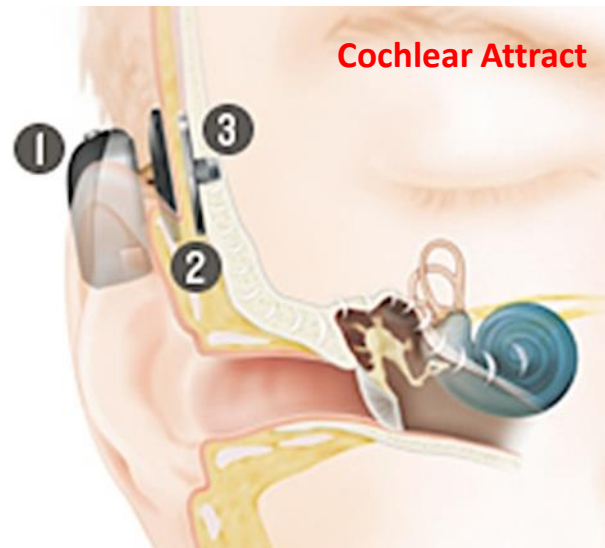
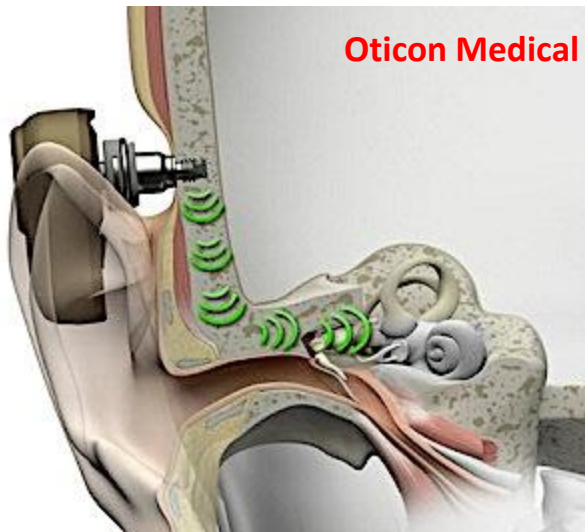


- Percutaneous

- Cochlear Corp “Direct Connect”
- Oticon Medical “Ponto Plus”

- Transcutaneous

- Cochlear Corp “Attract”
- Sophono “Alpha 2”



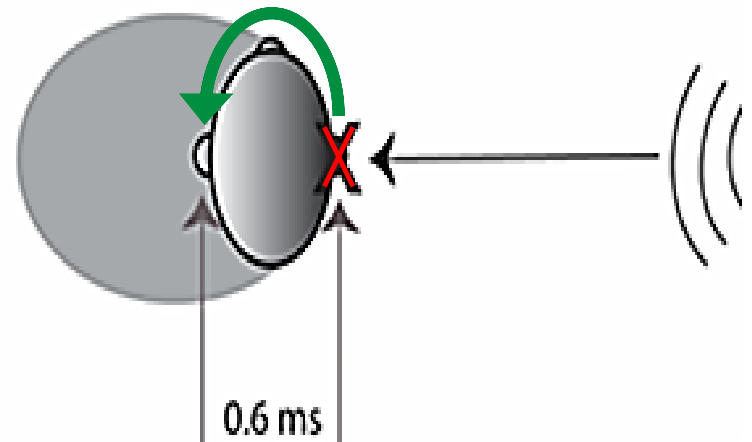
FDA Guidelines: normal hearing better ear: PTA < 20 dB 0.5, 1, 2, & 3 KHz



Bone Conduction Devices for SSD

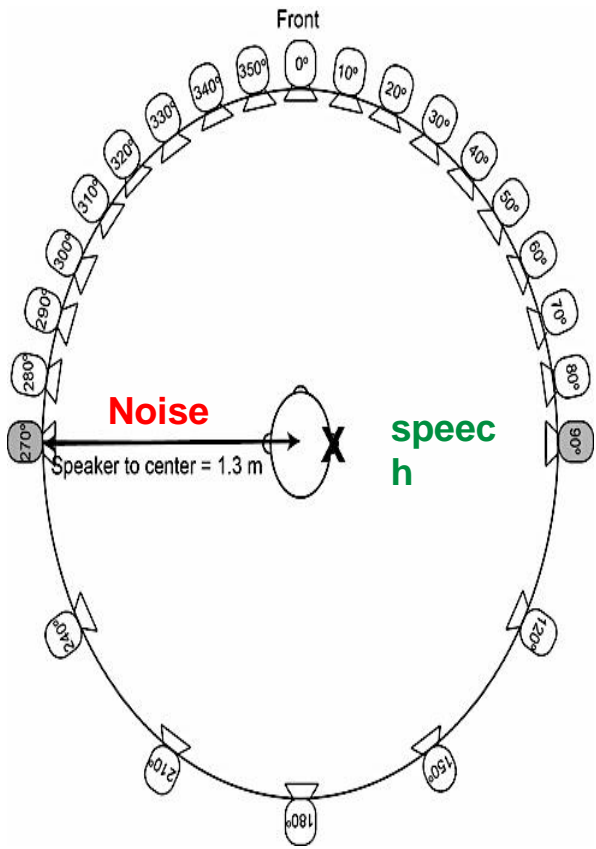
Purpose

To provide sufficient amplification to overcome the head shadow effect in order to stimulate the contralateral cochlea

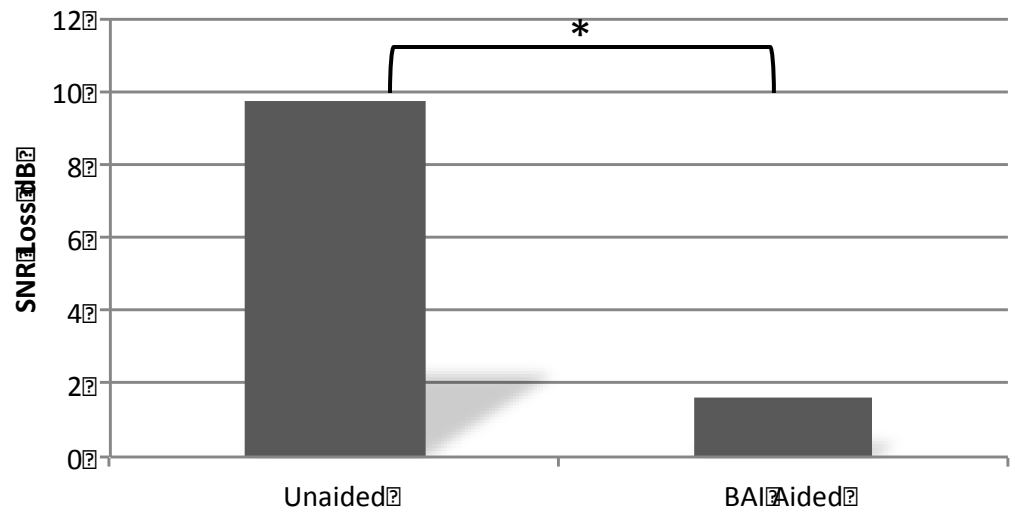




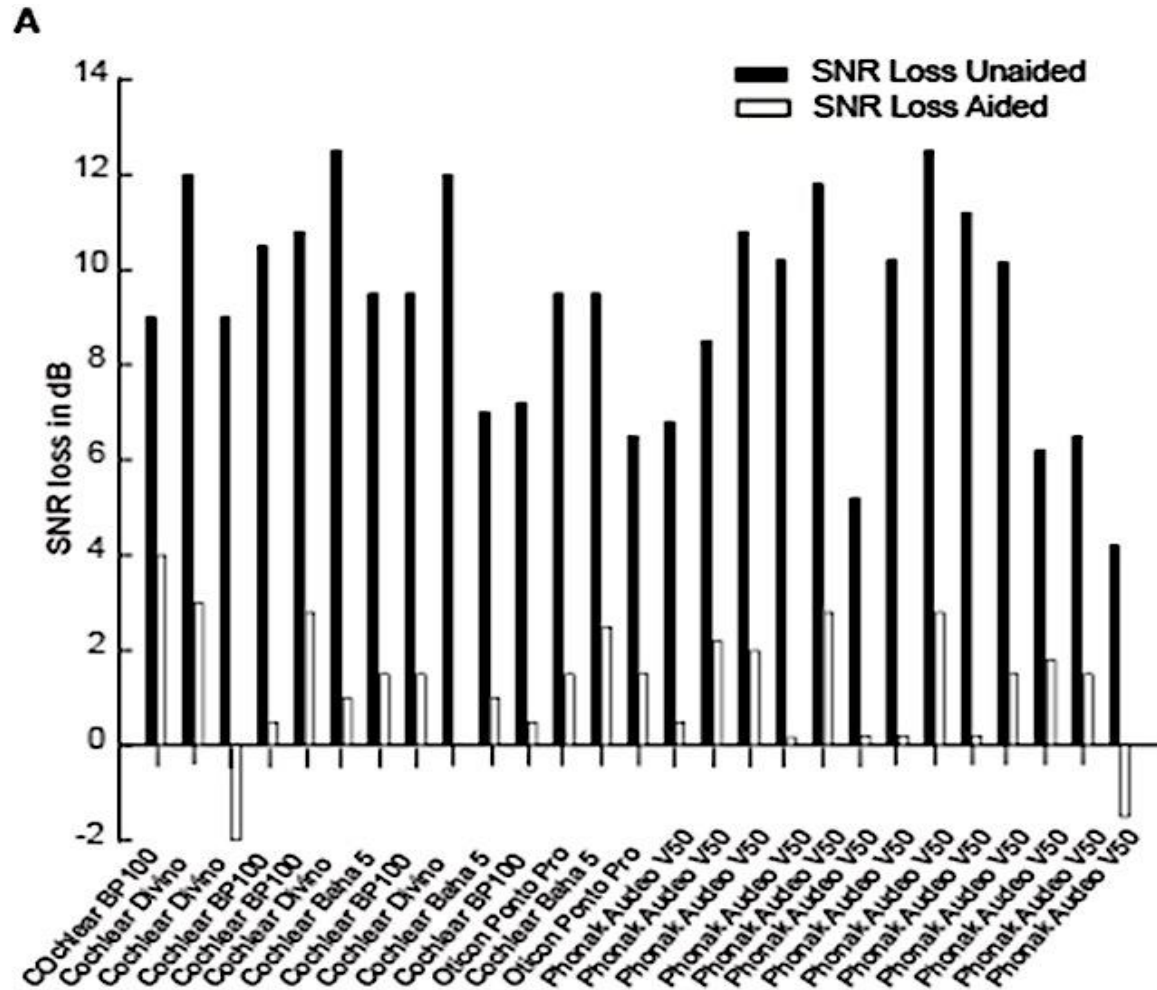
BAIs for SSD: Adult Performance



Speech-in-Noise Performance

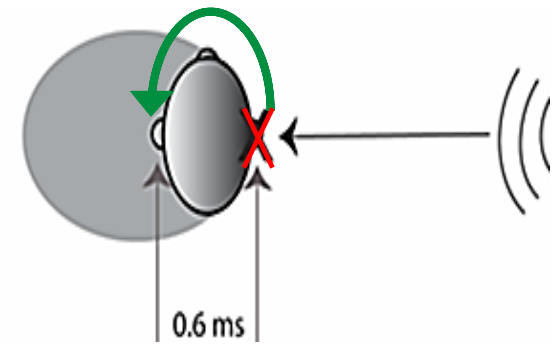


* = $p < 0.0001$





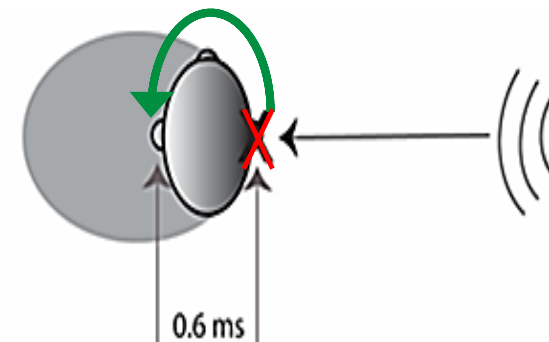
Clinical Considerations



- BCD recipients with SSD are subject to **transcranial** attenuation ≥ 10 dB
- **Transcutaneous** stimulation (Softband) results in an attenuation of the signal ~ 5 -25 dB
- Most significant for high frequency information



Clinical Considerations



- Transcranial and Transcutaneous attenuation do not negatively impact speech perception at average conversational levels
- Do not address how these variables affect soft inputs
- Ensuring access to the entire speech spectrum
- Optimizing audibility for soft sounds is critical



Ongoing Studies

- There is ongoing work in our lab investigating the effects of transcutaneous stimulation in the SSD population for soft speech inputs
 - Preliminary data suggests that transcutaneous stimulation negatively impacts speech perception
 - This effect is greater for soft speech both in quiet and in noise
 - Manuscript preparation is underway



Discussion

- Important to take into account the entire speech spectrum during the selection
- Greatest need for SSD is high frequency information
- Biggest complaint in SSD population is listening in noise
- Bone conduction is a poor predictor of outcomes in isolation
- Impacts processor/implant selection
 - Power vs standard devices?
 - Transcutaneous vs percutaneous implants?



The Impact of SSD in the Developing Child

- Inconsistent access to speech
More words = more language (Hart & Risley, 1995)
#1 predictor of language outcomes (Yoshinaga-Itano et al, 2008)
- Lose access to high frequency sounds
 - Critical for speech and language development (Stelmachowicz et al, 2004)
- Delayed language compared to normal hearing peers (Borg et al., 2002)
- Delays in presentation of 2 word utterances (Kiese-Himmel, 2002)



Impact of Pediatric Hearing Loss

Adults use their residual hearing to continue to communicate.

Children use their residual hearing to learn to communicate.



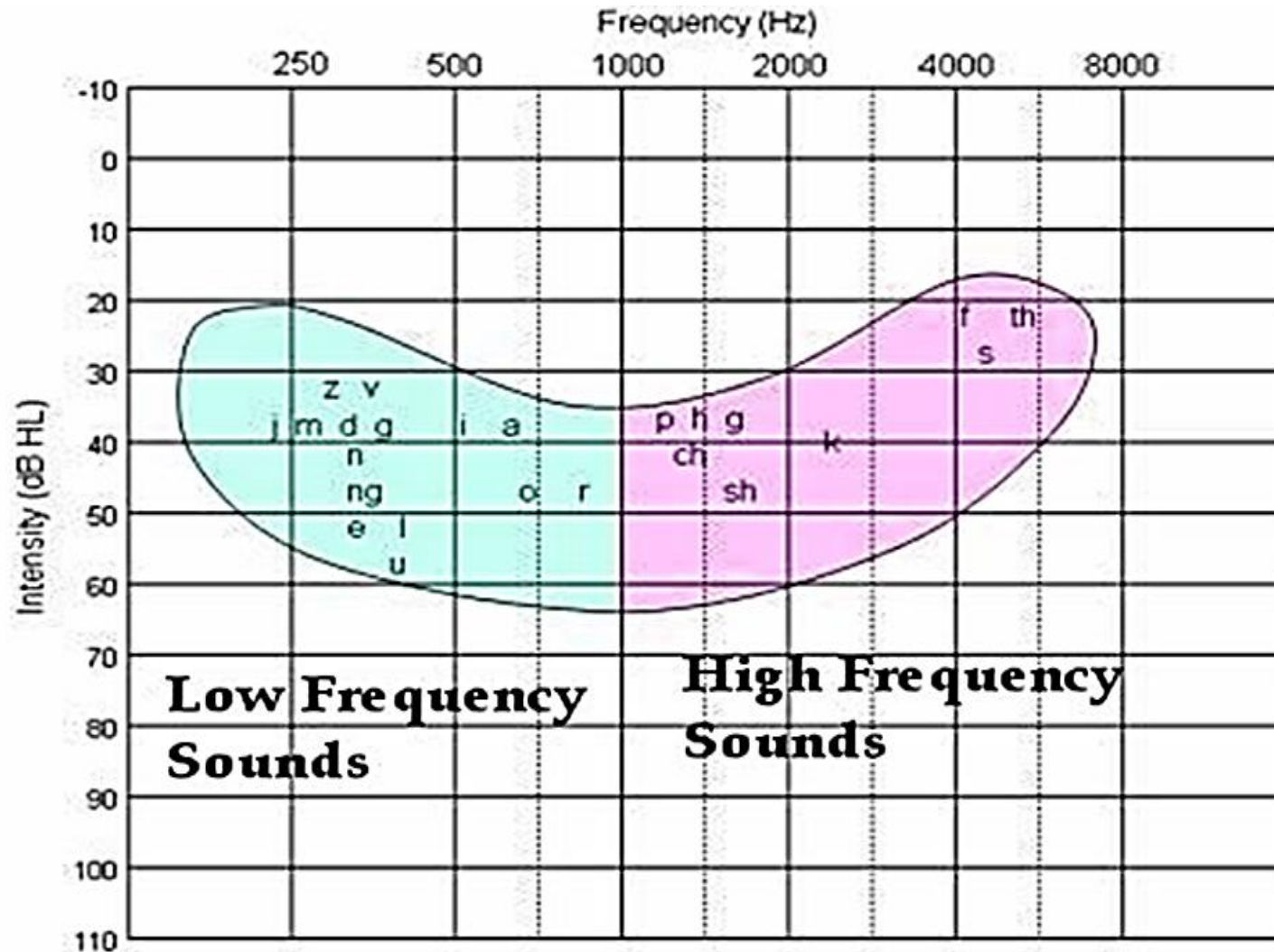
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(Nagy, W.E, 1995. On the role of context in first-and second –language vocabulary learning)



The importance of context

- rêver ~ to dream
- empêcher ~ to prevent
- craindre ~ to fear, to be afraid of
- épouser ~ to marry, to espouse
- gosse ~ kid (colloquial, child, youngster)





Bone Conduction Device (BCD) on a Softband

- Allows for early intervention
 - 1-3-6 rule (JCIH, 2007)
- SSD subject to intermittent access to speech
- Speech and language development
 - More words = More language
- Consider detriments from introduced noise by BCDs
- Potential limitations of transcutaneous stimulation



Incidental Learning: The case for BCD

- What if the good ear is covered?
 - Car seat
 - Stroller
 - Breastfeeding
- Good ear masked?
- Speech at a distance?
- Soft speech?

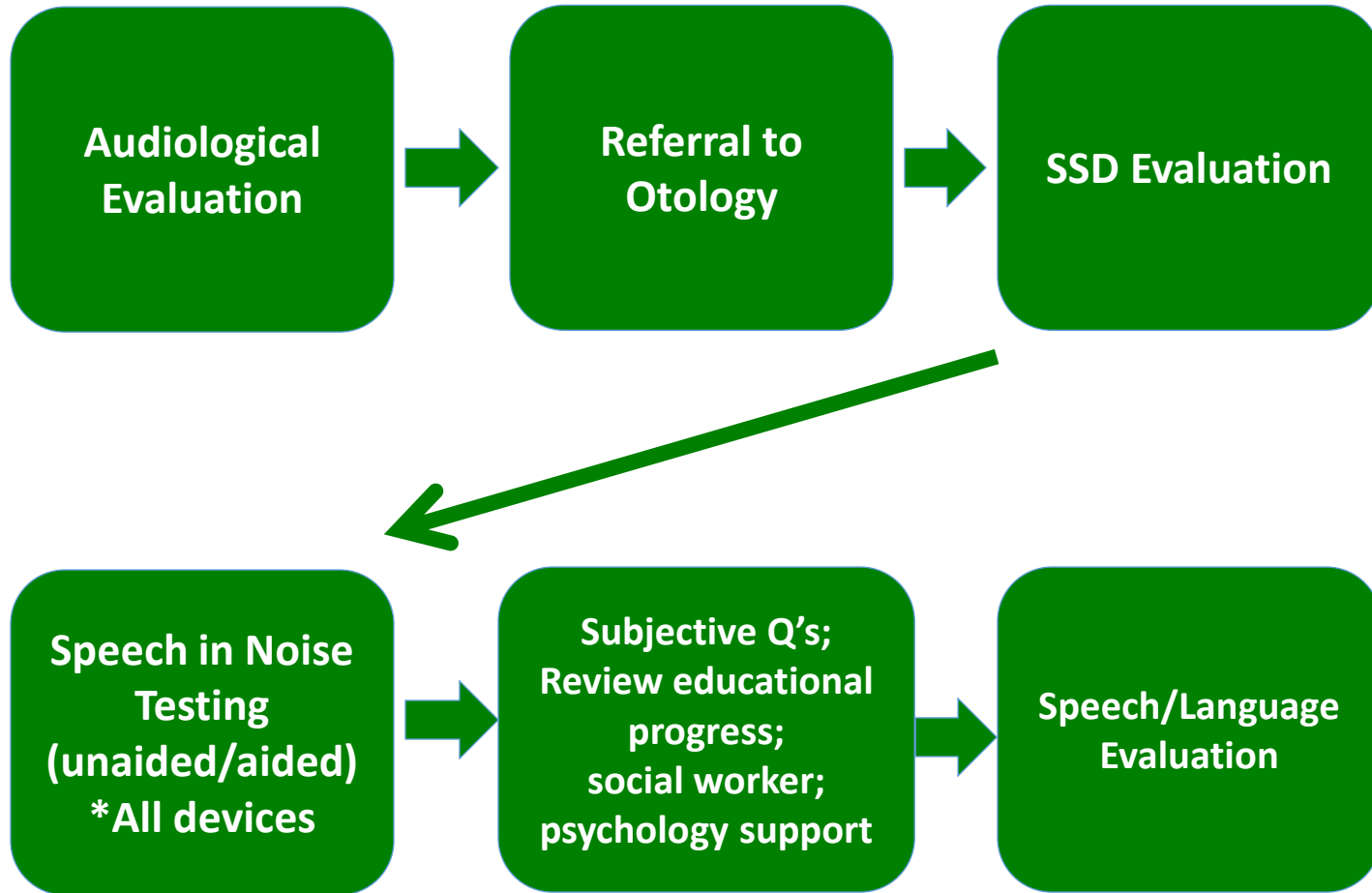


Children's Hearing Program at UMEI Intervention Protocol

- BCD on a softband < age 5
 - Infants placed in loaner program until behavioral information is obtained
 - Close monitoring of parent and child
 - Parent/Care taker education
 - Deaf educator, social worker, psychologist
- Speech and language monitoring every 6 months
- CROS and/or FM once child meets criteria for successful use
 - Close monitoring of parent, child, academic outcome measures
- **CONSISTENT AND CLOSE MONITORING**
- Each case is individualized

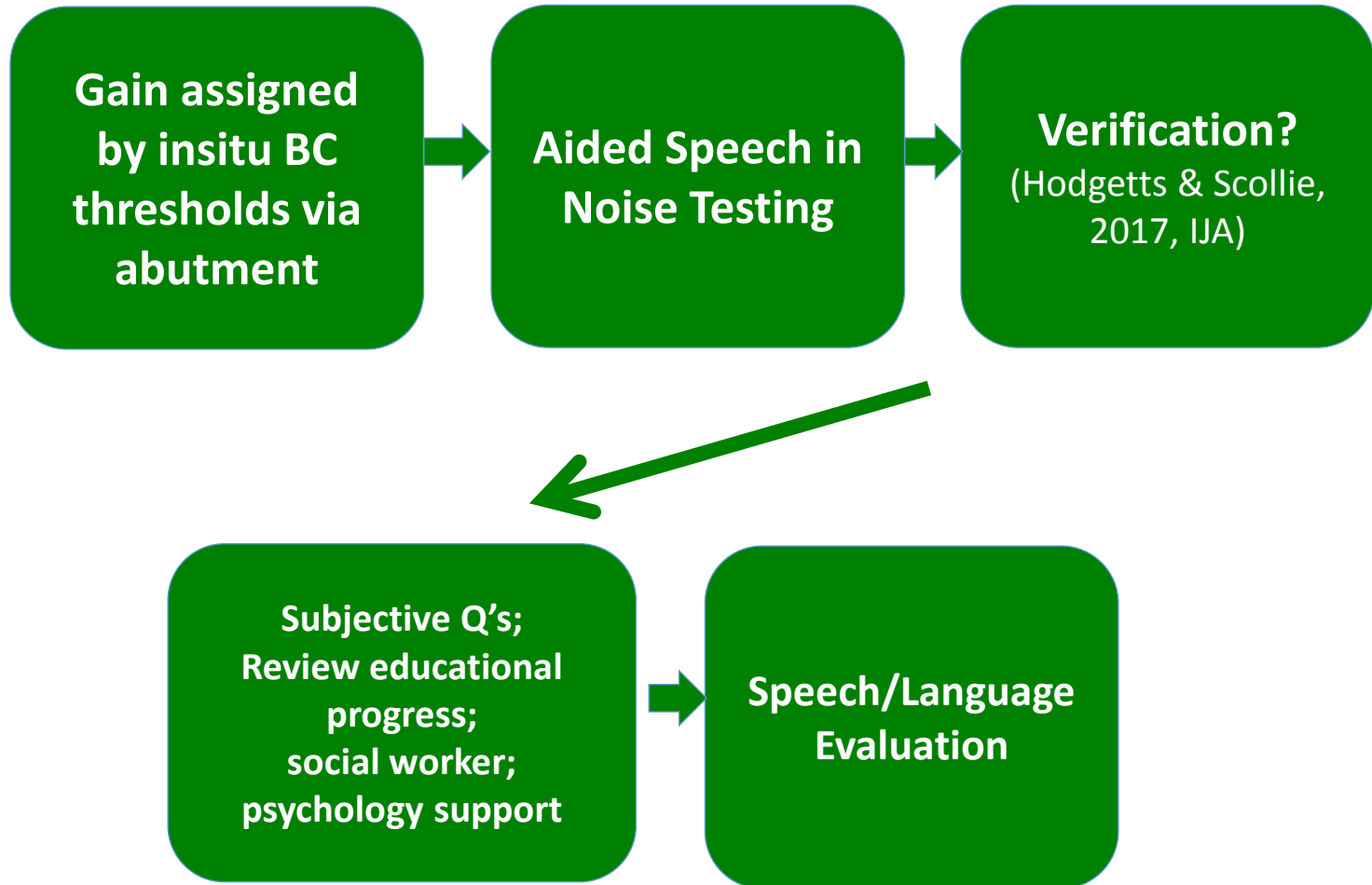


Pediatric SSD Evaluation: University of Miami Experience





Pediatric SSD Fitting and Verification: University of Miami Experience





Discussion: Early Years

- Auditory development is crucial
- Softband may provide a means to early intervention
- Selective/situational use combined with wireless accessories
- If child and/or parent present with concerns, discontinue BCD use and monitor
- OME in good ear results in a bilateral HL
- Establishing evidence based protocols
- Longitudinal studies are lacking
- BCDs are not a replacement for binaural



Discussion: > 5 years

- May provide a means for re-routing **if non-invasive solutions are not an option**
- Consider transcranial attenuation and transcutaneous attenuation for consideration of implant and processor selection
- Utilize comprehensive evaluations including speech in noise testing
- Frequent monitoring including parent and child subjective report





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*7th International Conference on Bone Conduction and
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*2019 ACI 16th Symposium on Cochlear Implants in
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