If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

This handout is for reference only. It may not include content identical to the PowerPoint. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.
A Pediatric Bone Anchored Implant Protocol

Margaret McRedmond, Au.D., CCC-A
Brandy Stephens, Au.D., CCC-A
Co-author of protocol: Anna Fry, Au.D., CCC-A

Learner Outcomes

- As a result of this course, participants will be able to:
  1. Identify candidacy criteria for a bone anchored hearing device based on hearing loss and age
  2. Describe appropriate testing options for candidacy determination and follow-up visits
  3. List the differences between softband and surgical fittings, as well as considerations for special populations
Agenda

- Protocol based on type of hearing loss
  - Bilateral conductive and mixed hearing loss
  - Unilateral conductive and mixed hearing loss
  - Single sided deafness
- Other considerations
  - Developmental disabilities
  - Age
  - Surgical fittings
  - Softband fittings
- Hearing evaluation and aided testing
- Q&A

Bilateral conductive/ mixed hearing loss

NOTE: aided testing does not need to be completed for patients with bilateral atresia, but may be utilized as a counseling tool
Criteria for Candidacy- Bilateral Conductive/ Mixed

- BC PTA= 65dB or better (500, 1000, 2000, 3000Hz)
- Unsuccessful user of air-conduction hearing aid
  - Chronic drainage or ear infections
  - Patients with air-bone gap more than 30dB tend to perform better with BAI device
- Anatomy (e.g., microtia, atresia)
- Mixed hearing loss:
  - Air-bone gap of at least 30-35dB
  - Sensorineural components in the mild to moderate range
  - Bilateral fitting \(\rightarrow\) symmetric bone conduction thresholds (less than 10dB difference between PTAs, or less than 15dB difference at individual frequencies) \(^{12,24}\)

Aided Speech Testing- Bilateral Conductive/ Mixed

- Conditions:
  - Unaided in the soundfield (baseline)
  - Testband BAI processor, mastoid of ear with larger air-bone gap
  - Hearing aid(s) on aidable ears (when appropriate)
  - Testband BAI processor and hearing aid (switch ears and repeat, if both ears are aidable)

- Set-up:
  - Speech and noise at 0 degrees azimuth
  - Start with +5 SNR and increase or decrease SNR as needed depending on performance
  - Optional:
    - Speech and noise to the sides
    - Switch ear that BAI processor/ hearing aid is on
    - Consider bilateral BAI processor testing
Intervention Options- Bilateral Conductive/ Mixed

- Unilateral or bilateral hearing aid
- Unilateral or bilateral BAI
- Consider the addition of a personal FM system in the classroom, if needed.

Discussion- Bilateral Conductive/Mixed

- Device(s) should be fit as soon as possible (following 1-3-6 guidelines)\textsuperscript{24}
- Earlier fittings result in greater benefit, similarly to other forms of amplification\textsuperscript{21}
- This population tends to have consistent device usage (more than 8 hours per day)
- General benefits of a BAI fitting for bilateral hearing loss:
  - Improved detection of sounds- average of 40dB functional gain with unilateral softband
  - Improved speech understanding in noise (some patients still report difficulty)
  - Improved health status, behavior, concentration, learning, and development\textsuperscript{8,12}
Discussion cont.- Bilateral Conductive/ Mixed

- Benefits of a bilateral BAI fitting (compared to unilateral fitting)
  2, 12
  - Improved hearing sensitivity in quiet
  - Improved speech reception thresholds and detection of tonal stimuli
  - Improved word recognition scores in quiet
  - Improved localization abilities
  - Better subjective benefit
  - Findings support fitting of a second BAI device even later in life

- A bilateral fitting may not increase speech-in-noise understanding (compared to a unilateral fitting), and may actually make it worse in certain conditions (although device can be turned off in these situations, if needed) 2, 4

- It may be beneficial for a child to start with one device and choose a second device at a later date if hearing difficulties continue 19

Unilateral conductive/ mixed hearing loss
Criteria for Candidacy- Unilateral Conductive/ Mixed

- BC PTA = 65dB or better (500, 1000, 2000, 3000Hz)
- Unsuccessful user of air-conduction hearing aid
  - Chronic drainage or ear infections
  - Patients with air-bone gap more than 30dB tend to perform better with BAI device
- Anatomy (e.g., microtia, atresia)
- Mixed hearing loss:
  - Air-bone gap of at least 30-35dB
  - Sensorineural components in the mild to moderate range

Aided Speech Testing- Unilateral Conductive/ Mixed

- Conditions:
  - Unaided (soundfield); no masking = baseline
  - Testband BAI, poorer hearing ear, no masking
  - Hearing aid, no masking (when appropriate)

- Set-up:
  - Speech to poor ear/ noise to good ear
  - Speech to good ear/ noise to poor ear
  - Optional: complete testing with better hearing ear masked
Intervention Options- Unilateral Conductive/ Mixed

- Close monitoring of hearing and speech/language development (without amplification)
- FM System
- Traditional air-conduction hearing aid
- BAI

Discussion- Unilateral Conductive/ Mixed

- Several review articles have concluded that at this time there is not convincing evidence for early intervention/amplification for all children with unilateral, congenital CHL 6, 19
- If hearing and speech/language concerns are denied, BAI device fitting may not be indicated at that time
- For softband fittings, wait until child is able to sit independently with good head control so the processor can be fit behind the affected ear 24
- Amplification has the potential to provide continued cochlear stimulation in the ear with hearing loss, however, there is no evidence of this currently
- No significant improvements for speech understanding in noise or localization abilities (may aid in sound awareness) 6, 12
- Successful, but less consistent device usage 12
Single-sided deafness (ssd)

Criteria for Candidacy- SSD

- Poorer hearing ear must have either:
  - Permanent severe to profound sensorineural or mixed hearing loss in one ear.
  - Poor or absent word recognition.

- Normal hearing ear:
  - PTA of air-conduction thresholds = 20dB or better (500, 1000, 2000, 3000Hz).

- Patient cannot benefit from a traditional hearing aid due to degree of hearing loss and/or poor aided word recognition.

- Patient has considered other options.

- Consider the patient’s motivation, and be sure to counsel on realistic expectations.
Aided Speech Testing- SSD

- Conditions:
  - Unaided in the soundfield (baseline)
  - Testband BAI processor (poorer hearing ear, no masking)
  - CROS system

- Set-up:
  - Speech to poor ear/
    noise to good ear
  - Speech to good ear/
    noise to poor ear

Intervention Options- SSD

- Close monitoring of hearing and speech/
  language development (without amplification)
- FM system
- CROS
- BAI
- Cochlear implant *
  - May be an option for motivated families
  - Very little research available at this time
Discussion - SSD

- Surgical BAI option is not recommended until 10 years of age at this clinic.  
- BAI has the potential to cause worse performance in noise.  
- A trial with a personal FM system or CROS system should be considered prior to moving forward with a surgical BAI, and potential risks of the device should be discussed.  
- A BAI fitting may help reduce the head shadow effect, which can improve patient satisfaction and ability to understand speech in noise.  
- If hearing and speech/language concerns are denied, BAI device fitting may not be indicated at that time.  
- Softband fittings:
  - Wait until the child is at least able to sit independently with good head control so the processor can be fit behind the affected ear.  
  - The family should be encouraged to wait until the patient is old enough to identify limitations of the BAI fitting and manipulate the environment or device controls.

Other considerations
Patients with Developmental Disabilities

- Early intervention is recommended to facilitate speech and language development (begin with a softband).
- Use of a BAI device for patients with cognitive disabilities has shown to have comparable benefit to other BAI users, and is often a more beneficial option than middle ear surgery.
- BAI is a successful and viable treatment option for children with Down Syndrome, if a traditional hearing aid is unsuccessful.
- Surgical complications are similar to patients without cognitive disabilities.
- Post-operative management was not shown to be difficult, despite learning difficulties.

Age

- Birth- 5 years old
  - Surgical abutment is not yet an option.
  - **Bilateral** conductive or mixed hearing loss: fit as soon as possible (following 1-3-6 guidelines)
  - **Unilateral** conductive or mixed hearing loss or SSD:
    - Wait until patient is at least able to sit independently with good head control, so the processor can be fit behind the affected ear.
    - Consider patient’s ability to identify noisy environments where device may actually cause interference
    - Consider postponing if concerns are denied.
- 5 years old and older
  - Surgical abutment is an option, pending medical clearance.
  - Trial with softband (abutment will likely provide more benefit).
  - For SSD, a BAI surgical option is not recommended until at least 10 years of age at this clinic, due to the risks.
Softband BAI Fittings

- Language development for children wearing softband BAI is variable, but within normal variation.
- For children with bilateral CHL, aided thresholds average 25-30 dB HL
  - Sufficient for acquiring basic language
  - Not necessarily sufficient for more complex language acquisition (grammar) as quickly as normal hearing peers
- Consider use of a power BAI device to overcome effects of the softband, (potential 10-15dB reduction).
- A softband fitting is a good temporary option until the patient is a surgical candidate.
  - Early intervention is important for children with bilateral hearing loss.
  - Consider waiting until the patient is able to sit up with good head control for patients with unilateral hearing loss.

Surgical BAI Fittings

- Patient should be at least 5 years of age or older
- Patient should have a surgical consultation with ENT to determine surgical candidacy
- Most common complication is skin infection around the abutment site
- Some children report difficulties wearing hats or helmets due to feedback
- Implant failures are reported to be relatively low
- Some children report an increase in self-consciousness and embarrassment after being fit with BAI
BAI Evaluation and Selection of Device

Test Devices

- BAI Evaluation and testing will be based on protocol for specific patient population.
- Choose and program the devices that will be needed for testing:
  - Hearing aids(s)
  - BAI processor
  - CROS system
Test Materials

- Complete testing in the unaided and aided conditions
- Choose the most difficult test that is appropriate for the patient’s developmental age.
- Recorded speech stimuli
- Preferred SIN test materials:
  - BKB-SIN
  - QuickSIN
  - HINT
- Words recognition list (with multi-talker babble) may be used if necessary (NU-CHIPS, WIPI, PBK).

Outcome Measures

- LittlEars
- Auditory Skills Checklist (ASC)
- PEACH
Device Consultation and Intervention Recommendations

- Discussions of results and realistic expectations
  - **NOTE**: aided results may not be the best predictor to indicate if a patient should or should not proceed with a BAI device
- Good BAI candidates:
  - Choose a processor and fitting method.
  - Discuss long-term implications of a surgical device.
  - Discuss considerations for the future (costs of future devices/repairs, how to complete repairs, etc.).
- Poor BAI candidates/ patients interested in non-surgical options -- discuss alternative options for intervention
- Close monitoring of hearing and speech/language development, regardless of intervention choice.
- Other referrals and recommendations:
  - Baseline speech-language evaluation
  - ENT

Follow-up visits
Initial Follow-Up Visit

- 1 month after the fitting
  
  **NOTE**: If the patient is fit with a magnet system, they should be seen for a 1-2 week follow-up to assess the magnet strength.

- Listening check
- Skull simulator, if concerns for device function
- Check data logging
- Programming changes, if needed
- Answer questions about care and use
- Post-fitting outcome measures

Follow-Up Visits

- Hearing evaluation and BAI check every 3 months for the first year
- Hearing evaluation and BAI check every 6 months for the second year
- If stable, annual hearing evaluations and BAI checks every 6 months

These are the minimum recommendations for follow-up. The patient should return sooner if concerns arise.
Follow-Up Visits

- Bone simulator (consider at every follow-up visit, but at least annually or if concerns)
- In-situ measures
  - 1-3 months after the first fitting
  - At least annually
- Data logging
- Programming changes, if needed
- Aided testing (annually)
  - Speech-in-Noise testing
  - Aided thresholds (narrowband noise)
  - Consider Ling 6 Sounds

---

Follow-Up Visits

- Continue to evaluate the need for other classroom accommodations and interventions
- Monitor speech and language development
- Follow ENT recommendations
References


References Continued