

# The Baha<sup>®</sup> Softband: Candidacy, evaluation and fitting

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## Candidacy

- Conductive Hearing Loss
  - Treacher Collins Syndrome
  - Atresia/microtia
  - Fluctuating losses – Down Syndrome
  - Unilateral or bilateral
- MHL
  - Bilateral with BC PTA or 35 dB or less for children (Christensen)
  - Power devices
  - Unilateral or bilateral
- Single sided deafness (SSD)
  - Unilateral hearing loss profound SNHL, MHL, or CHL
  - Normal (15 dB or less) in the “good ear”

## Guidelines

- Softbands
  - No age restrictions
  - Bilateral CHL
  - Bilateral MHL
  - SSD or unilateral losses
  - Unilateral or bilateral softbands available
- Implants
  - FDA guidelines: 5 years of age or older
  - FDA: Bilateral implants (can be simultaneously implanted) must be symmetric bone conduction thresholds less than 10 dB difference on average (500, 1000, 2000, and 3000 Hz) or less than 15 dB at individual frequencies

## Softbands

- When should a Softband be fit on a child?
- How can a Softband fitting be verified and validated?



## AAA Clinical Practice Guidelines Pediatric Amplification June 2013

### 3. AUDIOLOGIC CANDIDACY CRITERIA (page 12)

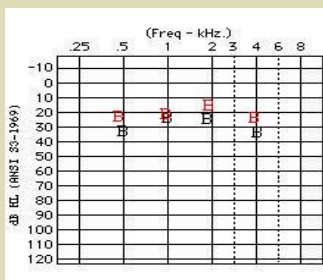
#### Recommendations for Determining Candidacy

Children with permanent conductive hearing loss should be fit with air conduction hearing aids when anatomically possible (sufficient external ear and canal anatomy to support the coupling of an earmold and retention of the device), or bone conduction hearing aids if anatomy is insufficient for coupling (atresia, chronically draining ears, or other significant anatomical malformations).

## When to fit...

- Bilateral CHL/MHL
  - Fit ASAP just like traditional hearing aid fittings
    - EHDI 1-3-6
  - Some will be implanted when they are 5 years old
  - Some will receive other surgical intervention
  - Many of these infants will not wear the processor on their mastoid initially
  - Bilateral fittings should take head control of the infant in to consideration; but when hearing loss is bilateral, the child should be fit bilaterally
- Unilateral losses (SNHL/MHL/CHL)
  - Head control must be considered because a processor must be kept near the affected ear on a full time basis

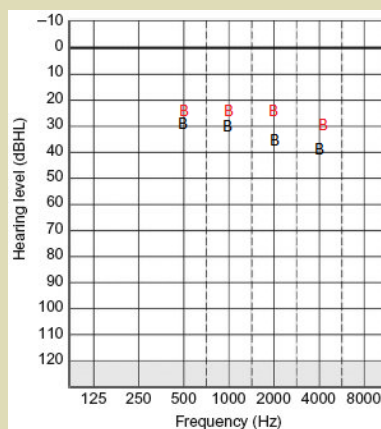
## Two ears are better than one...



- 4 year old female with TCS
- Baha Divino® Sound Processor(s)
- CPA
  - Black B = unilateral Softband
  - Red B = bilateral Softband

## Two ears are better than one...

- 6 year old male
- TCS
- Softband BP100
- Red B – bilateral
- Black B - unilateral



## How to fit...

- Placement of Baha Softband
  - Infants - not always on mastoid
  - Toddlers
  - Preschoolers
- Fitting the Softband
  - Spring Scales
  - Helping parents find the perfect fit
  - Functional gain – this is the true test of how it is fitting and what level of gain they are getting from the processor

## How to fit...

## Verification

- Softbands fit for bilateral CHL/MHL are like most pediatric hearing aid fittings - Except no real ear measurements
  - Is there a real ear machine for cochlear implants?
  - Was there routine use of real ear measures when fitting children in 1960? 1970? 1980? Were children still fit with amplification?

## Verification

- When in doubt follow the rules...
  - What does your state licensure law require for pediatric fittings?
  - What does AAA say about it?



## Arkansas Licensure Law

Evaluation of hearing aids must be performed with the hearing aids on the patient. This shall be accomplished EITHER in sound field OR with instruments which objectively measure hearing aid performance with appropriate prescriptive techniques to account for the different means of programming the hearing aid (linear versus nonlinear, digital versus analog). The preferred verification method of fitting is to use probe microphone measures in conjunction with the patient's ear, ear mold, and personal amplification system. A real ear to coupler difference (RECD) can be obtained and probe tube measurement performed in a coupler if a patient is unwilling to tolerate probe microphone measurement in the ear. A prescriptive measure addressing gain should be in place to address the possibility of over- or underestimating gain until the patient is five (5) years of age.

## AAA PEDIATRIC AMPLIFICATION PROTOCOL October 2003

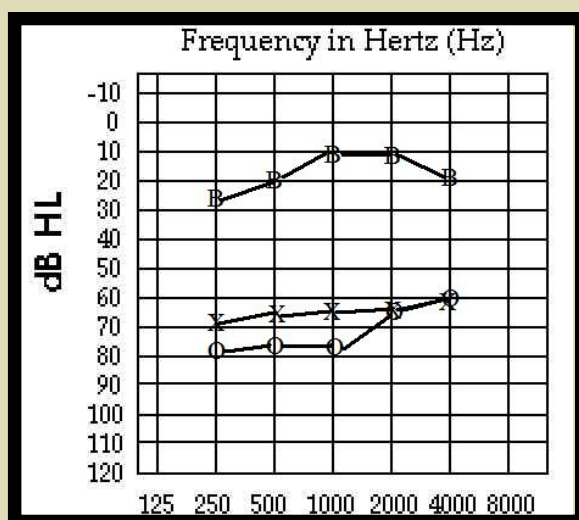
- **6. Verification**
  - a) The electroacoustic performance of the instrument should be matched to the prescribed 2 cm<sup>3</sup> coupler target values for gain and output limiting where the 2 cm<sup>3</sup> coupler values have been derived using an individualized real ear to 2 cm<sup>3</sup> coupler transform (e.g., the RECD).
  - b) Aided soundfield threshold measurements may be useful for the evaluation of audibility of soft sounds but they are not recommended and should not be used for verifying electroacoustic characteristics of hearing instruments in infants and children for several reasons:
    - 1) prolonged cooperation from the child is required
    - 2) frequency resolution is poor
    - 3) test-retest reliability is frequently poor
    - (Seewald, Moodie, Sinclair & Cornelisse 1996)
    - 4) misleading information may be obtained in cases of severe to profound hearing loss, minimal or mild loss, or when non-linear signal processing, digital noise reduction, or automatic feedback reduction circuitry is used

AAA Clinical Practice Guidelines  
 Pediatric Amplification  
 June 2013

**6.2.3 Aided Thresholds in the Sound Field (pp 39-40)**

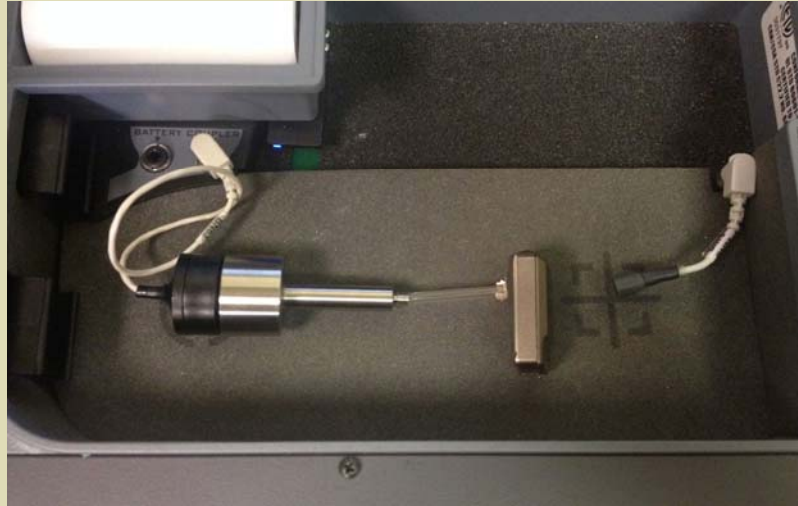
2. In cases of bone conduction hearing aids, real-ear probe microphone measures cannot be conducted (when there is no acoustic signal in an ear canal), and the aided audiogram may be the most readily available verification option. In spite of its limitations, the aided audiogram can provide information, and in the case of bone conduction and frequency transposition/compression hearing aids, may be the most valid way to quantify the aided response with currently available technologies.

## Softband Verification





Sorry...not this!



### Audiological Guidelines for the Assessment of Hearing in Infants and Young Children August 2012

- Behavioral observation
- Visual Reinforcement Audiometry (VRA)
- Conditioned Play Audiometry (CPA)
  - Frequency-specific stimuli
  - Speech Audiometry
- Physiologic Assessments, including
  - Acoustic Immittance, including Tympanometry and acoustic reflex testing
  - Otoacoustic Emission (OAE) testing
- Electrophysiologic Audiometry including
  - Auditory Brainstem Response (ABR)
  - Auditory Steady State Response (ASSR)

## Behavioral Observation

- Newborns and infants under approximately six-months developmental age
- Infants under 6 months with bilateral CHL or MHL that have been fit with a softband, need to be verified using **Behavioral Observation**
- Aided vs. unaided thresholds (functional gain) for speech and tonal stimuli will give you verification information for very young infants
- EHDI 1-3-6
- Testing Babies: You Can Do It! Behavioral Observation Audiometry (BOA) by Jane R. Madell
  - *Perspectives on Hearing and Hearing Disorders in Childhood* December 2011 21:59-65.

## VRA & CPA

- Visual Reinforcement Audiometry
  - Infants between 5 and 24 months developmental age
- Conditioned Play Audiometry
  - Children between approximately 2 and 5 years developmental age

Audiologic Guidelines for the Assessment of Hearing in Infants and Young Children (2012)

- <http://audiology.org/resources/documentlibrary/Pages/PediatricDiagnostics.aspx>
- Contains tips and specific information

## Softband Validation

- Any validation measure you currently use for other traditional BTE fittings with children will work well with Softband validation for bilateral CHL/MHL.
- Karen Anderson - Success for Kids with Hearing Loss
  - <https://successforkidswithhearingloss.com/tests>
- ELF - Early Listening Function
- CHILD - Children's Home Inventory of Listening Difficulties
- Preschool SIFTER – Preschool Screening Instrument For Targeting Educational Risk
- SIFTER – Screening Instrument For Targeting Educational Risk of Elementary School Children
- Secondary SIFTER - Secondary Screening Instrument For Targeting Educational Risk
- LIFE-R – Revised Listening Inventory For Education
- LIFE – Learning Inventory For Education
- LIFE Student Appraisal
- LIFE Student Appraisal Pictures
- LIFE Teacher Appraisal
- CHAPS- Children's Auditory Performance Scale
- SAC-A-Self Assessment of Communication-Adolescent
- SOAC-A– Significant Other Assessment of Communication – Adolescent
- FLE – Functional Listening Evaluation
- Children's Peer Relationship Scale
- Minnesota Social Skills Checklist for Students who are Deaf - Hard of Hearing
- PARC– Placement Readiness Checklists for Children who are Deaf or Hard of Hearing (Colorado)

## Unilateral Hearing Loss

- Unilateral CHL/MHL
- You may put masking in the normal hearing ear and test functional gain for a Softband on the CHL/MHL ear for verification.
  - You CANNOT do this for Single-sided Sensorineural Deafness (SSD)....Why?
    - You only have one cochlea available for testing.

## SSD & Softbands

Areas of concern for SSD:

- localization
- understanding speech in noise
- head shadow effect

Will functional gain tell us anything about these areas of concern?

Should we still worry about this when there is an emerging trend for cochlear implants for SSD?

## SSD Verification & Validation

Speech in noise testing

- Body parts
- SRT/SAT
- WIPI
- Spondee words/cards

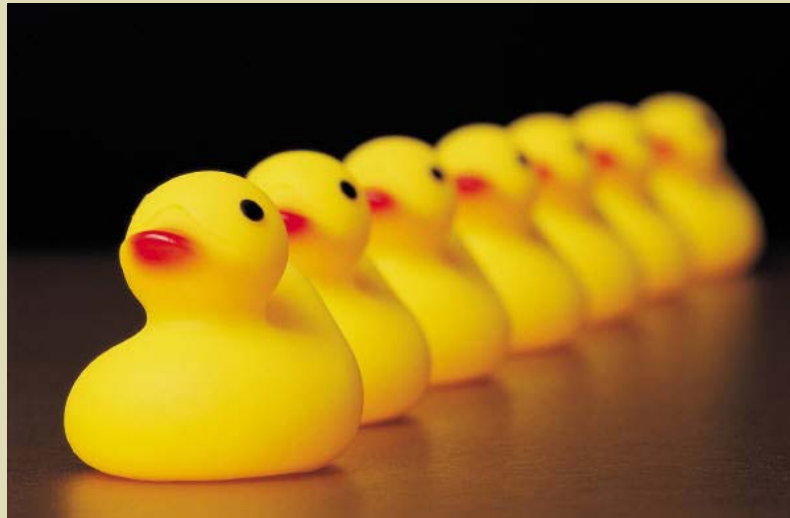
Outcome Measures

- ELF
- CHILD (5 to 12 year olds)

## Unilateral CHL

- Kesser, Krook, and Gray
- Compared unilateral SNHL to unilateral atresia for academic performance
- 40 atresia patients
- None repeated a grade
- 65% needed some resources
  - 12.5% used a hearing aid
  - 32.5% used a FM system in school
  - 47.5% had an IEP
  - 45% were in speech therapy
- Conclusions: unilateral CHL/atresia has an impact on academic performance in children; not as a profound impact as the unilateral SNHL

Kesser, B, Krook, K, Gray, L. (2013). Impact of unilateral conductive hearing loss due to aural atresia on academic performance in children. *Laryngoscope*, (123) 9:2270-2275.



## Softband Data

- Hol et al 2005
- Two subjects
  - 3 y/o and 29 months
- Compared Baha Compact, Baha Classic, and Oticon E 300 P
- The electro-acoustic measurements showed minor differences in gain between the three devices
- Both children showed speech and language development that was in accordance with their cognitive development.
- **Conclusions:** The Baha Softband was a valid intervention in children with congenital bilateral aural atresia who were too young for percutaneous Baha System application

Hol, MK, Cremers CW, Coppens-Schellenkens W, Snik AF. The BAHA softband: A new treatment for young children with bilateral congenital aural atresia. International Journal of Pediatric Otorhinolaryngology, 69:973-980.

## Softband Data

- A retrospective study of Baha patient charts of infants and children 2002 to 2006
- 20 infants and children
- 8 months to 16 years (mean age = 5.04 years)
- Inclusion criteria was:
  - (a) Bilateral symmetrical conductive hearing loss
  - (b) Fit unilaterally with Softband

## Softband Data

|                                                                |            |             |             |             |
|----------------------------------------------------------------|------------|-------------|-------------|-------------|
| <b>Unaided SF</b>                                              |            |             |             |             |
| M (SD)                                                         | 61.2 (9.2) | 60.2 (11.7) | 56.4 (13.6) | 54.8 (13.9) |
| 95% CI                                                         | 57.6, 64.8 | 55.6, 64.8  | 51.8, 61.7  | 49.4, 60.2  |
| <b>Aided SF</b>                                                |            |             |             |             |
| M (SD)                                                         | 20.2 (3.1) | 18.8 (3.6)  | 17.8 (4.8)  | 20.2 (4.7)  |
| 95% CI                                                         | 19.0, 21.4 | 17.4, 20.2  | 16.1, 19.5  | 18.4, 22.0  |
| <b>Functional gain</b>                                         |            |             |             |             |
| M (SD)                                                         | 41.0 (6.1) | 41.4 (8.1)  | 38.6 (9.2)  | 34.6 (9.2)  |
| 95% CI                                                         | 38.6, 43.4 | 38.2, 44.6  | 35.0, 42.2  | 31.0, 38.2  |
| <b>Paired <i>t</i> test statistic for unaided-aided values</b> |            |             |             |             |
| <i>p</i> value                                                 | <.001      | <.001       | .001        | .001        |

\* dB = decibel; HL = hearing level; SF = soundfield; M = mean; SD = standard deviation; CI = confidence interval

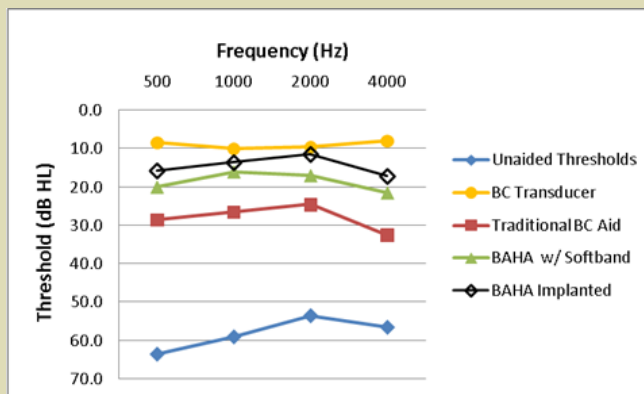
Nicholson, N. Christensen, L. Dornhoffer, J. Martin, P. Smith-Olinde, L. (2011). Verification of speech spectrum audibility for pediatric Baha Softband users with craniofacial anomalies. *Cleft Palate-Craniofacial Journal*, (48)1: 56-65.

## Baha System vs. Traditional BC

Retrospective study of 10 subjects

- Ages: 6 months to 18 years of age
- Congenital bilateral conductive hearing loss
- Initially fit with a traditional bone conduction hearing aid
- Fit unilaterally with a Baha Compact or Divino via the Softband
- Implanted unilaterally with the Baha system
- Unaided and aided soundfield thresholds available for four frequencies from 500 Hz to 4000 Hz
- Consistent full-time use of amplification
- Ear and frequency specific thresholds obtained via supra aural headphones at 500, 1000, 2000, and 4000 Hz were recorded on datasheets and transferred to a spreadsheet
- Audiometric data for frequency specific unaided and aided sound field thresholds obtained with the speaker positioned at a 90° azimuth to the target ear were also transferred to a spreadsheet

## Softband Data



Christensen L, Smith-Olinde L, Kimberlain J, Richter G, Dornhoffer J (2010). Comparison of traditional bone-conduction hearing aids with the Baha system. *Journal of the American Academy of Audiology*. (21)4:267-273.

## Results

- Bone conduction transducer provides the most gain of any device tested
- The implanted Baha system provided second highest amount of functional gain
- ***Softband results provided the third amount of highest functional gain.***
- ***Traditional bone conduction hearing aids provided the least amount of functional gain.***
- There is some overlap among devices at 1000 Hz, but at no other frequency.
- Implanted Baha System has statistically as much gain as a bone conduction transducer at all frequencies tested;
- Implanted Baha System provides statistically more gain at 500 Hz than the Baha sound processor attached to a Softband
- Traditional bone conduction hearing aid provides significantly less gain than all the other devices at all frequencies with the exception of the Baha sound processor on a Softband at 2000 Hz.

Christensen L, Smith-Olinde L, Kimberlain J, Richter G, Dornhoffer J (2010). Comparison of traditional bone-conduction hearing aids with the Baha system. *Journal of the American Academy of Audiology*. (21)4:267-273.



## SOFTBAND SCENARIOS

### Scenario 1

- Treacher Collins Syndrome; failed NBHS
- ABR at 3 weeks
  - Moderate CHL in both ears
- Softband fitting at 2 months of age
  - Verification
    - Behavioral Observation
  - Validation
    - ELF
    - IT-MAIS

## Scenario 2

- Cleft palate; 8 months old
- CHL AU
  - Verification
    - VRA
  - Validation
    - ELF
    - IT-MAIS

## Scenario 3

- Down Syndrome 6 years old
- Mild permanent CHL plus ongoing persistent COM
- Verification
  - CPA
- Validation
  - LIFE – for teacher
  - CHILD – parent version only

## Conclusions

- Fit Softbands early
  - This might not mean bilateral fittings initially depending on the developmental status of the child
  - It also might mean using an alternative processor placement for a period of time
- Aided testing for verification
- Use outcome measures for validation
- Bilateral Softbands

QUESTIONS?

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