1. This document was created to support maximum accessibility for all learners. If you would like to print a hard copy of this document, please follow the general instructions below to print multiple slides on a single page or in black and white.
2. This handout is for reference only. Non-essential images have been removed for your convenience. 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.
3. Copyright: Images used in this course are used in compliance with copyright laws and where required, permission has been secured to use the images in this course. All use of these images outside of this course may be in violation of copyright laws and is strictly prohibited.
4. Social Workers: For additional information regarding standards and indicators for cultural competence, please review the NASW resource: Standards and Indicators for Cultural Competence in Social Work Practice
5. Need Help? Select the "Help" option in the member dashboard to access FAQs or contact us.

How to print Handouts

On a Mac

- Open PDF in Preview
- Click File
- Click Print
- Click dropdown menu on the right "preview"
- Click layout
- Choose # of pages per sheet from dropdown menu
- Checkmark Black & White if wanted.

On a PC

- Open PDF
- Click Print
- Choose # of pages per sheet from dropdown menu
- Choose Black and White from "Color" dropdown

Bone Conduction Hearing Device (BCHD): Clinical and Surgical Considerations in Pediatrics

Laurie Mauro, Au.D., CCC-A

May 26, 2021

Children's Hospital of Philadelphia℠

Learning Objectives

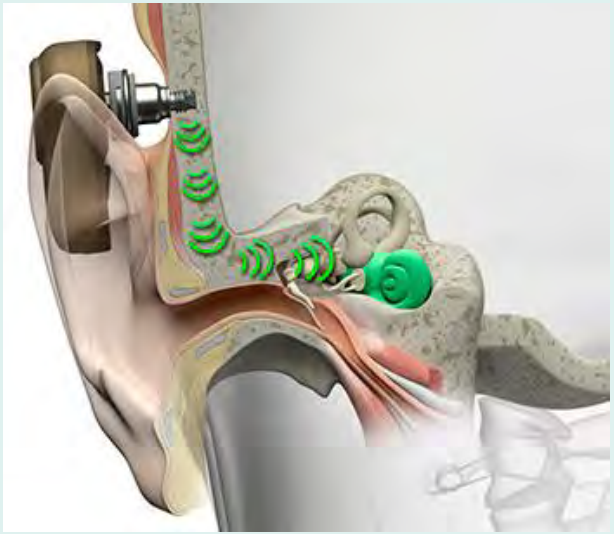
01	After this course, participants will be able to explain the non-surgical and surgical audiologic candidacy criteria for bone conduction hearing devices (BCHD)
02	After this course, participants will be able to list specific features desired in a BCHD for children.
03	After this course, participants will be able to recognize 3 surgical BCHD options.
04	After this course, participants will be able to identify fitting considerations for young children with SSD.

Agenda

- Introduction
- BCHD Candidacy Criteria
- BCHD Evaluation and Fitting
- Non-Surgical and Surgical Considerations
- Case Studies
- Conclusions/ Q&A

Introduction

Bone Conduction Hearing Device (BCHD)



A non-conventional form of amplification used to treat hearing loss through direct bone conduction. A BCHD can be **non-surgical or surgically implanted.** A BCHD should be recommended to individuals who are unable to use conventional air conduction amplification.

www.oticonmedical.com

Bone

ect Drive
urgical

Percutaneous BA

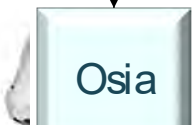
Active Transcutaneous
Implant (≥12 years)

Osia

Percutaneous
(≥5 years)

Baha®

Passive Transcutaneous
Implanted Magnet
Surgical



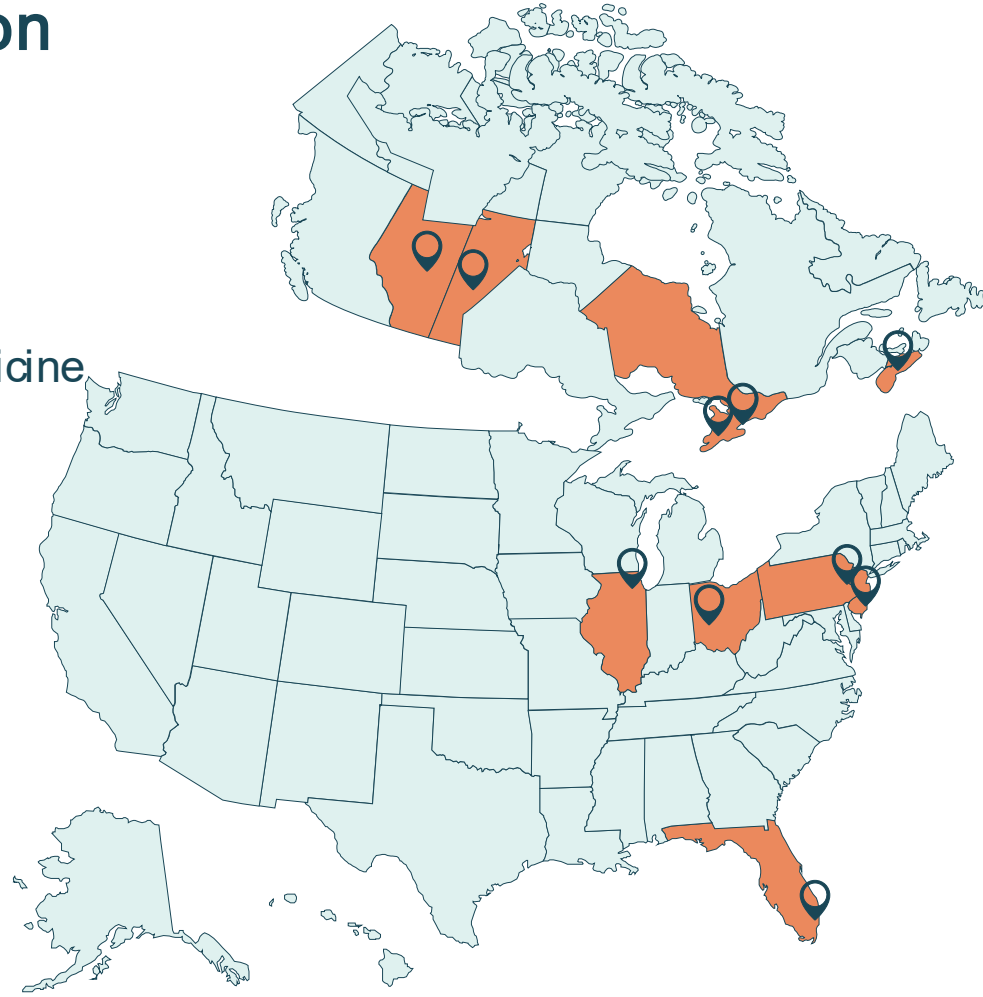



Background

- To date, fitting protocols for BCHD are not standardized, leaving gaps in clinical practice.
- Children's Hospital of Philadelphia (CHOP), like many other institutions, used existing evidence and clinical experience to develop practice guidelines.
- Information discussed today will include manufacturer recommendations, practice guidelines used by CHOP audiologists, clinical experience, and data from the Pediatric Bone Conduction Working Group (PBCWG).

Pediatric Bone Conduction Working Group (PBCWG)

- Children's Hospital of Philadelphia
- Cincinnati Children's Hospital
- Institute for Reconstructive Sciences in Medicine
- IWK Health Centre
- Lurie Children's Hospital of Chicago
- Nemours Alfred I. DuPont Hospital
- Oticon A/S
- Saskatoon Health Region
- University of Miami
- Western University



Clinical Consensus Document for Fitting Non-Surgical Transcutaneous Bone Conduction Hearing Devices to Children

Submitted to
International Journal of Audiology

BCHD Candidacy

Initial Audiologic Assessment: Obtaining Thresholds for BCHD Candidacy

Auditory Brainstem Response (ABR)	Behavioral Testing
• ≤ 6 months of age or those unable to complete behavioral testing • Air and bone conduction testing (if indicated)	• When developmentally appropriate • Air and bone conduction testing (if indicated)

NOTE: Minimally, it is recommended to obtain one low and one high-frequency bone conduction threshold in the indicated ear to fit a device

Candidacy for Bilateral CHL and/ or MHL

Manufacturer Criteria

BC PTA (.05, 1, 2 & 3K Hz)

- < 45 dB HL (most devices)
- ≤ 65 dB HL (power devices)
- Symmetric bone conduction thresholds

Additional CHOP Considerations

- 4K Hz adds more clinical value for children than 3K Hz
- Limited evidence/ outcome data for hearing loss >45 dB HL (BC)
- PTA air-bone gap >30 dB

Agterberg et al., 2018
Colquitt et al., 2011
De Wolff et al.,

Candidacy for Unilateral CHL and/ or MHL

Manufacturer Criteria

BC PTA (.05, 1, 2 & 3K Hz)

- < 45 dB HL (most devices)
- ≤ 65 dB HL (power devices)

Additional CHOP Considerations

AC PTA in indicated ear: > 40 dB HL

- AC PTA in normal ear: < 20 dB HL
- PTA air-bone gap: > 30 dB, most benefit perceived ≥ 50 dB

Agterberg et al., 2018
Cooper et al., 1996
Danhauer et al., 2010

Candidacy for SSD

Audiologic Criteria

- Severe to profound sensorineural hearing loss in the indicated ear
- Normal hearing: AC PTA ≤ 20 dB HL, in the contralateral ear

Additional CHOP Considerations

- >6 months developmental age (sits independently)
- UHL and binaural fittings, adequate head control is necessary to ensure that you maintain appropriate processor placement

Desmet et al., 2011
Roman et al., 2011

Family Talking Points for Fitting BCHD for SSD

To date, there is no evidence/ outcomes on BCHD use for infants and young children with SSD

Choosing to fit a BCHD for SSD should be a collaborating decision between audiology, ENT and the family

BCHD will not provide binaural hearing

The goal is to lift the head shadow effect by sending the signal via bone conduction from the impaired side to the normal hearing ear

Results can be expected to be like a CROS system

It may be beneficial in quiet, but maybe detrimental in noise, particularly when noise originates on the impaired side

Considerations for BCHD Fitting of a Baby/ Young Child with SSD

Previously BCHD was only recommended for older children (school-aged)

Advancements in signal processing, adaptive directional microphones and noise reduction

It is important to discuss appropriate expectations and device usage

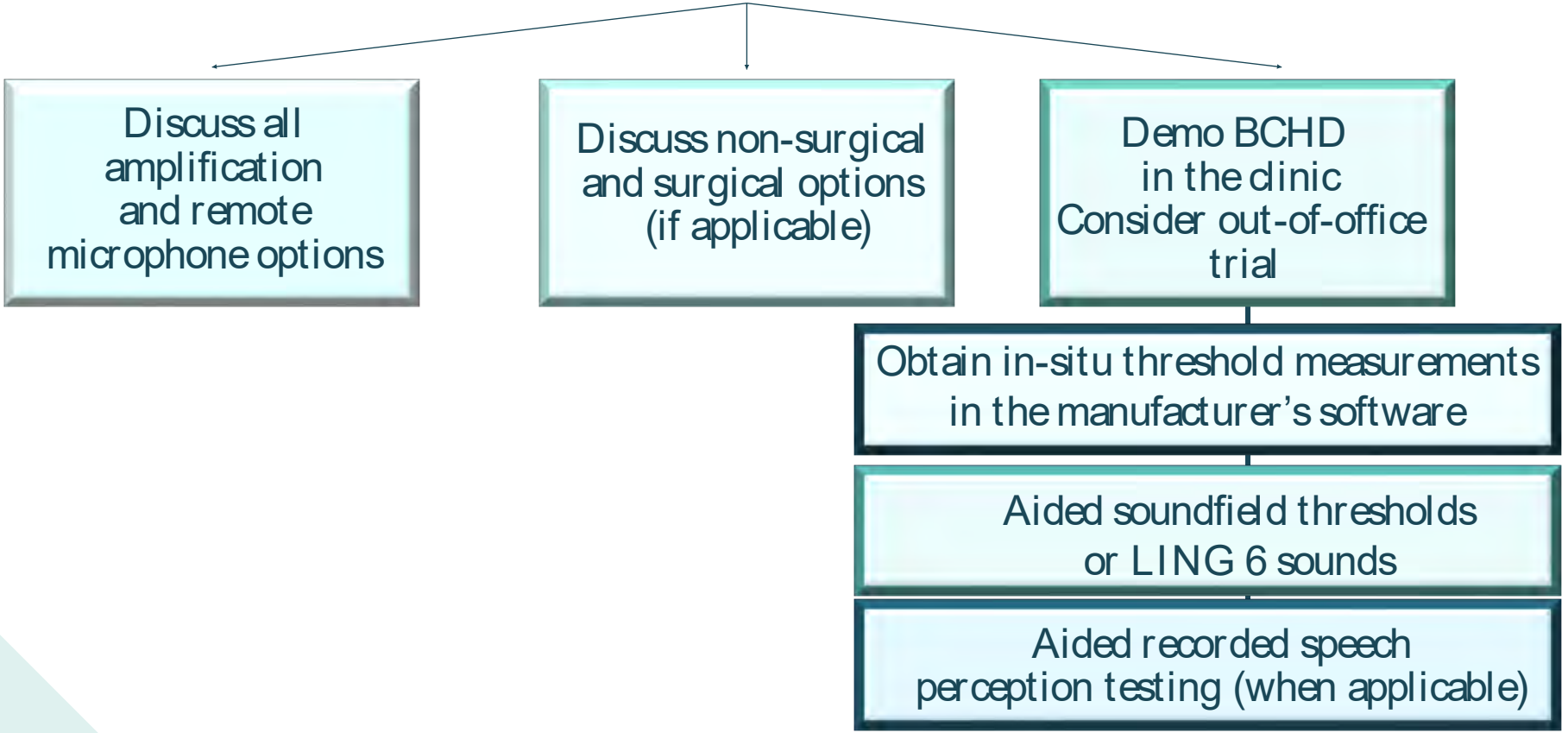
BCHD should be worn when the child is being supervised in quiet environments

Noisy environments (restaurants, daycare, free-play time at preschool, sports) could potentially be detrimental

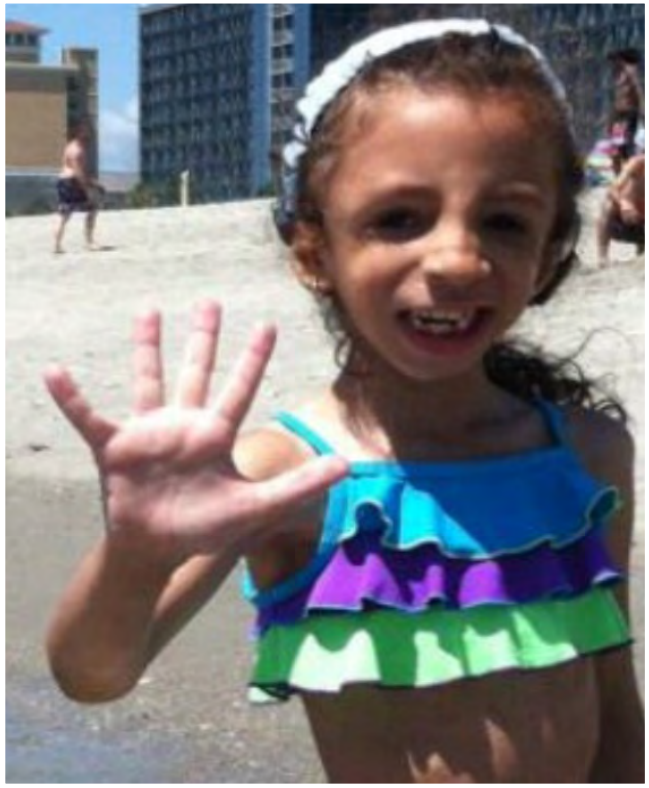
No evidence exists to guide fitting young children with SSD, the goal is to ensure that no harm is done

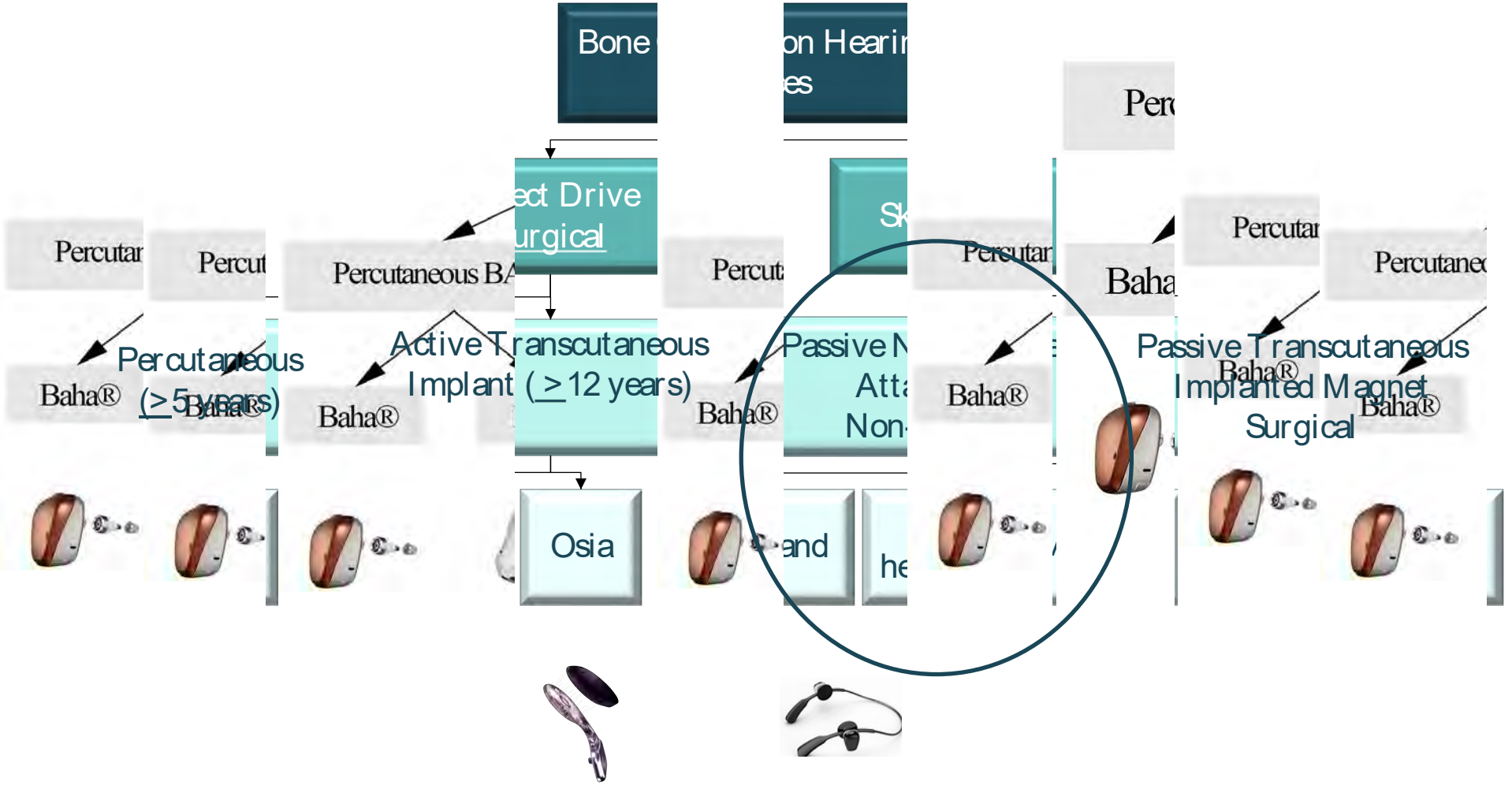
From careful monitoring of its use, we hope parents can provide us with situations where they found it appeared to be beneficial.

General BCHD Evaluation



Non-Surgical BCHD




Bone
on Hearin
es
Perc
ect Drive
urgical
Sk
Percutar
Percut
Percutaneous BA
Percut
Percutar
Baha
Percutaneo
Percutaneous
(≥5 years)
Active Transcutaneous
Implant (≥12 years)
Passive N
Atta
Non-
Passive Transcutaneous
Implanted Magnet
Surgical
Baha®
Baha®
Baha®
Baha®
Baha®
Baha®
Osia
and
he

Soft Headband Fitting Considerations

1. Position BCHD on the mastoid or high temporal bone as studies show improved hearing compared to forehead placement

2. Maintain sufficient and consistent tightness of the BCHD soft headband to ensure consistent output

3. Soft headband should have a snug fit, but still be comfortable

4. Consider head control capabilities for fitting unilateral hearing loss and bilateral fittings

Agterberg et al., 2018
Mackey et al., 2016
Hodgetts et al., 2006;

Important Pediatric Features for BCHDs

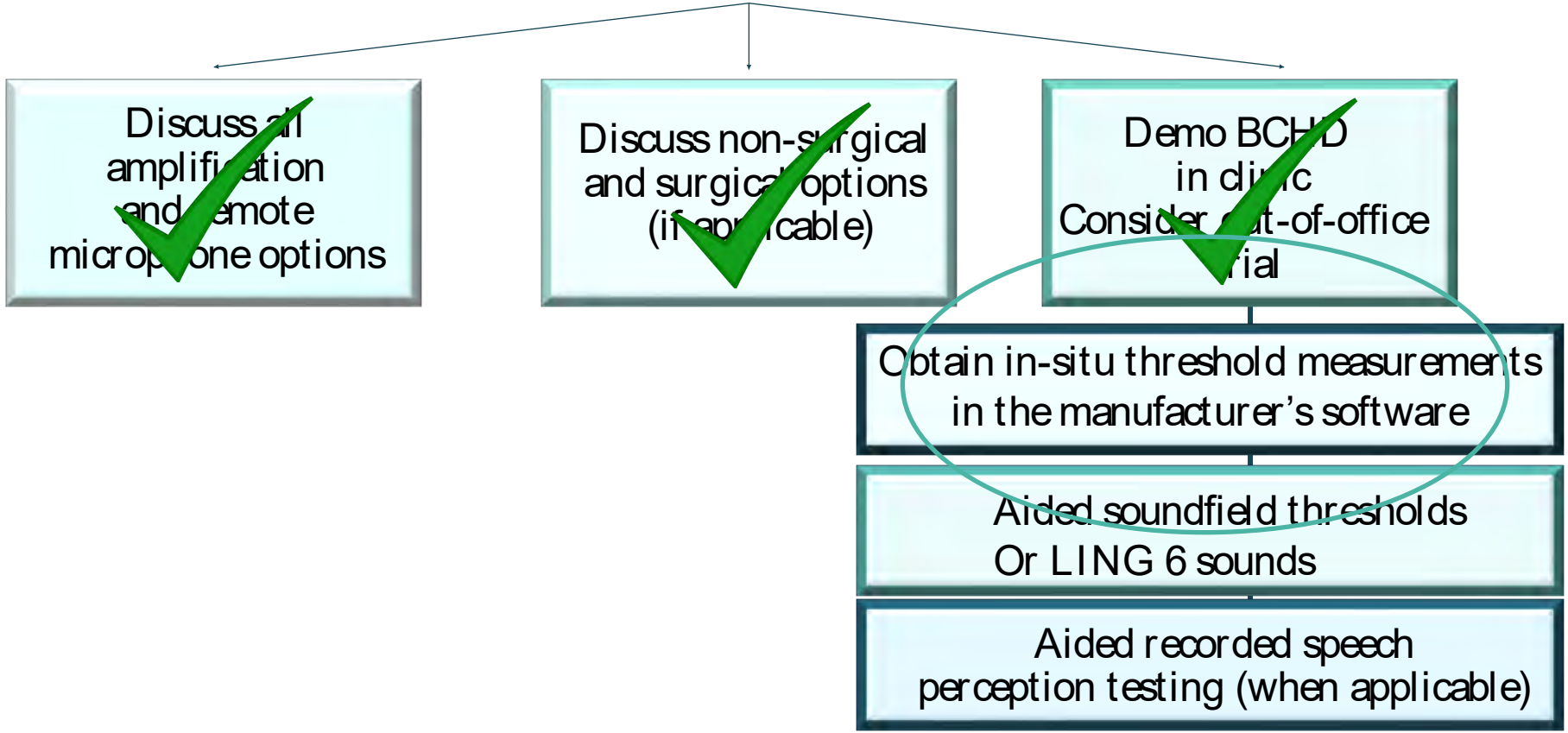
- Unilateral and bilateral soft headband
- Tamper resistant battery door to industry standards
- Disable volume control and programming button
- Durability
- Indicator light
- Remote Microphone (RM) accessibility
- Advanced features, multiple programs and wireless connectivity

BCHD Evaluation

- 28 months adopted from China
- Bilateral atresia/ microtia
- Severe conductive hearing loss in both ears
- BCHD options were between Cochlear Baha 5 or Oticon Medical Ponto 3
- Selected Cochlear Baha 5's with Mini Microphone 2 + in both ears
- Baha was recommended over the Ponto as a streamer is not needed

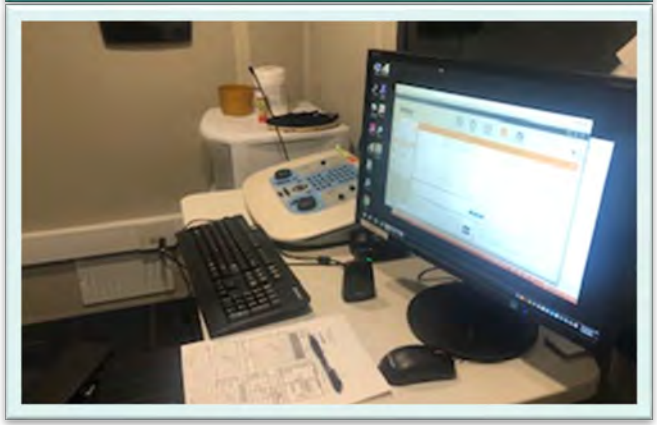
Meet Beau

Beau's BCHD Evaluation Continued



Performing In-Situ Audiometry

- Complete in hearing aid/ programming room using Noah Hi-Pro or Noahlink Wireless
- Prefer to obtain measurements in the sound booth using Noahlink Wireless or Hi-Pro cables patched through wall panel
  - Allows for VRA, CPA, and voluntary audiometry to be completed in a quiet environment
  - Install Noah or manufacturer stand alone software on the computer



Technology Needs Change Over Time

- As child gets older, different features may be warranted
- New processors are released
- Manufacturer and device choice for non-surgical should meet current needs
- Choice for non-surgical BCHD does not commit the patient to single manufacturer for lifetime

Beau 4 years of age

- Time for an upgrade
- Power processor with higher MFO is better option for use with soft headband
- Not consistently using his remote microphone
- Baha 5 Power and Ponto 3 P/ SP available
- Selected binaural Ponto 3 SP's
- Started surgical discussions

Surgical BCHD Evaluation

Counseling for Surgical BCHD

An exact demonstration of surgical BCHD does not exist.

Differences exist in the output of BCHD on a soft headband compared to a surgical system.

Benefit with a BCHD worn on a soft headband can give some indication of expected performance.

Out-of-Office trial is encouraged for anyone considering surgery.

Benefits of Surgical BCHD

- Improvement in aided thresholds and speech perception testing
- Better sound quality and performance
- Increase in learning speed
- Enhanced working memory
- More high frequency emphasis with surgical transmission than with a soft headband since they are weakened by the passing through skin

Kara et al., 2016
Pittman, 2019

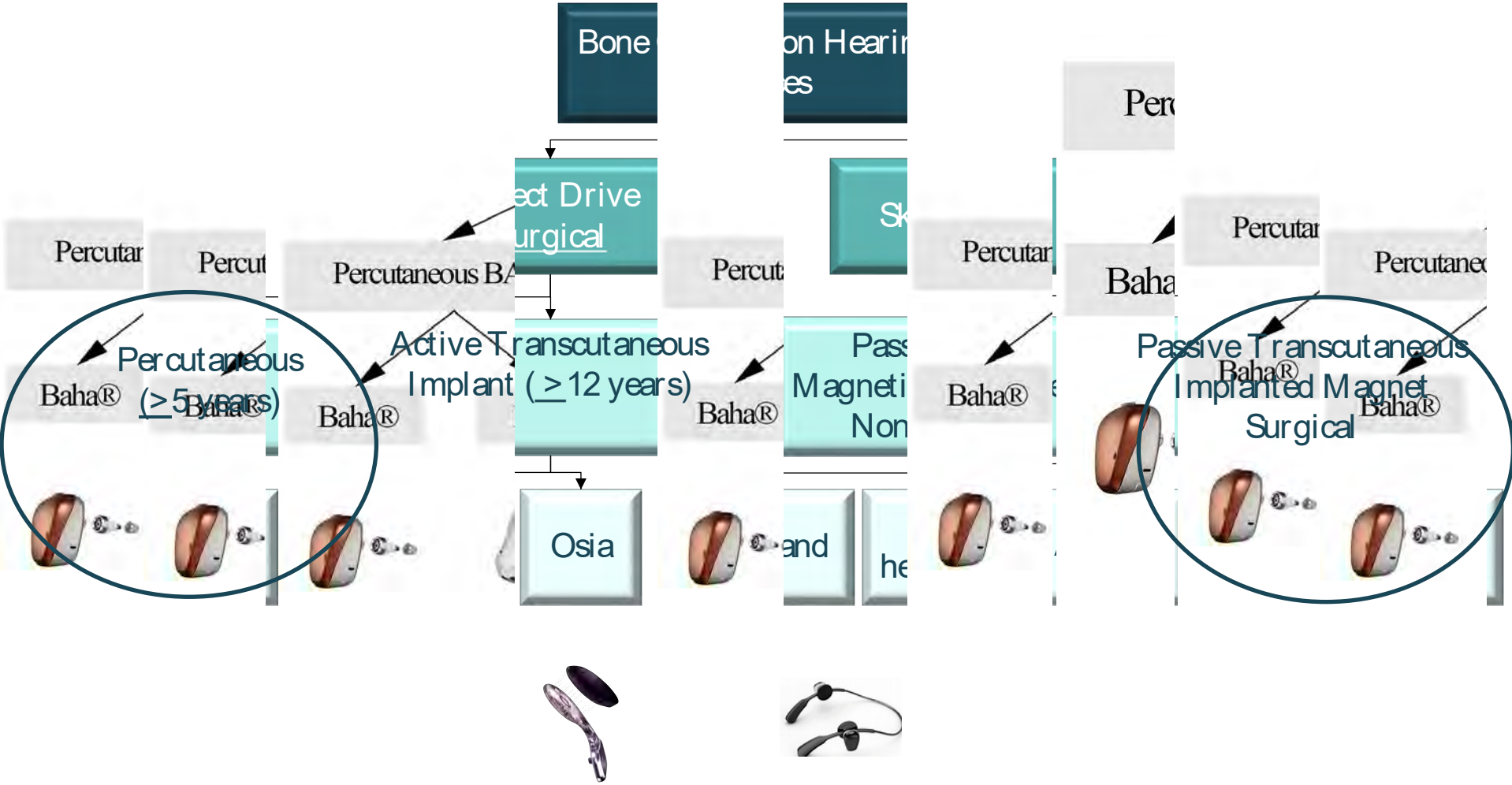
Considerations for Surgical BCHD in SSD

- More high frequency amplification is needed to compensate for transcranial attenuation.
- The goal is to lift head shadow effect which exists above 1500 Hz, therefore only high frequencies need to be amplified.
- Direct drive surgical systems will give best outcomes

Stenfelt, 2012
Westbrook, 2015

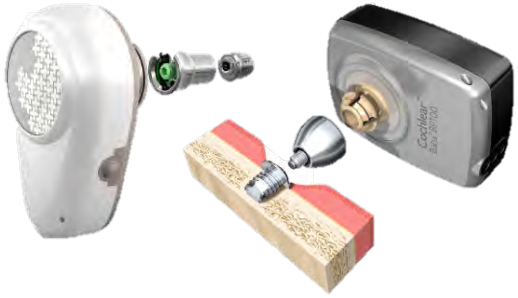
Beau's Surgical BCHD Evaluation

5 years of age


Bone
on Hearin
es
ect Drive
urgical
Sk
Percutar
Percut
Percutaneous BA
Percutaneous
(≥5 years)
Baha®
Active Transcutaneous
Implant (≥12 years)
Pass
Magneti
Non
Osia
and
he
Perc
Percutar
Baha
Percutaneo
Passive Transcutaneous
Implanted Magnet
Surgical

Percutaneous vs. Transcutaneous (Passive) Surgical Options

THROUGH
the skin (abutment)
Cochlear Connect
Oticon Medical Ponto



ACROSS
the skin (magnet)
Cochlear Attract

Percutaneous (Abutment) Considerations

- ≥ 5 years of age
- Conductive, mixed and SSD
- Best outcome for mixed hearing loss
- No medical contraindications
- Sufficient skull thickness (>2.5 mm) and bone quality
- Ability to maintain/ clean abutment site

Note: significant developmental delays or behavior problems that may jeopardize surgical site need to be considered on a case-by-case basis

Davidset al., 2007
Kara et all, 2016
Roman et al., 2011
Tjellstrom et al., 2001

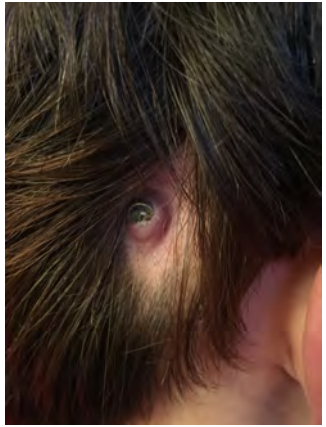
Abutment Infections/ Revisions

Inflammation and infection around the abutment:

- An inflammatory reaction results in soft tissue thickening or complete overgrowth of the abutment by soft tissue
- Poor or excessive personal hygiene can be most common cause
- Prevalent in male teenagers often can require surgical intervention
- ENT may recommend cleaning of site, steroid cream, oral antibiotic, steroid cream, steroid injection, and/ or surgical intervention

Surgical Intervention

- Surgical procedure to revise the skin or place a longer abutment



Considerations for Passive Transcutaneous System

ADVANTAGES

- No abutment
- Cosmetically appealing
- No infection issues
- No special cleaning
- Easy to connect
- Easy to convert to traditional abutment

DISADVANTAGES

- Abutment results in better hearing
- Magnet and processor are not secure, retention is huge issue
- Rarely recommended for bilateral hearing loss

Beau's Surgical Outcome

- Discussed all available surgical options
- Decided on bilateral simultaneous Ponto percutaneous system 2-stage procedure
- 1st-stage to place the Ponto implant was completed at 5 years of age
- 2nd-stage to place the abutment was completed 5 months later
- Selected Ponto 4 processors with Oticon Connect Clip remote microphone

Surgical BCHD Fitting

Must be medically cleared for processor fitting

Soft tissue should be healed to avoid discomfort

In some cases of percutaneous procedures, it may be beneficial to wait until the implant is fully osseointegrated

Percutaneous fittings should be verified to DSL-BC targets using the Audioscan Verifit Skull Simulator

SKULL SIMULATOR CAPABILITIES

EAA ANSI Check

Compares BCHD overtime
No current BCHD specs

Prescriptive Targets

DSL BC Child
DSL BC Adult

Percutaneous Only

Assess Noise Reduction & Directional Mic

Verification of advanced features

Calculate Aided SII

SII values are lower when the degree of hearing loss is higher

Verification of Remote Microphones

Verify transparency

Asses Impact of Feedback Manager

Does feedback manager affect the frequency response

For More Information: AudiologyOnline

[DSL for Bone Anchored Hearing Devices: Prescriptive Targets and Verification (Hodgetts & Scollie, 2018)]

[Verification and DSL in Bone Anchored Hearing (Scollie, 2020)]

Beau's Ponto 4 Fitting to DSL-BC Targets

Audiologic Follow-Up Recommendations

BCHD Monitoring

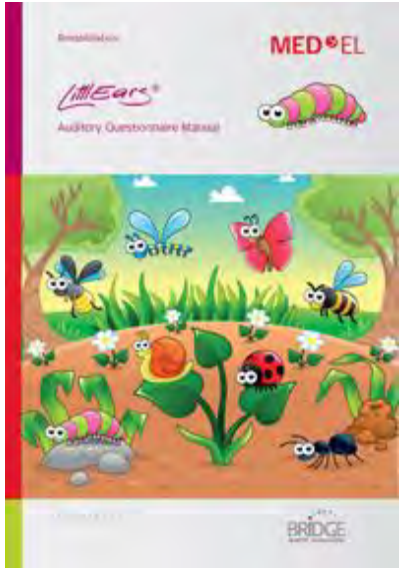
- 1 month post fitting
- Every 3 months for first year
- Every 3-6 months for second year
- Every 6-12 months thereafter
- Sooner if concerns arise

Validation Tools

- Access to information (data logging)
- Aided speech perception testing
- Outcome measurements

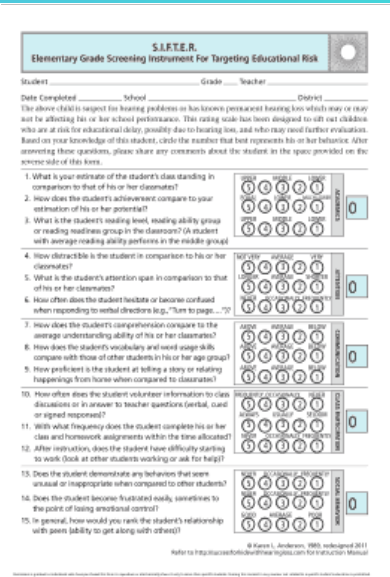
Outcome Measures

LittlEars
Birth to 2 years of age



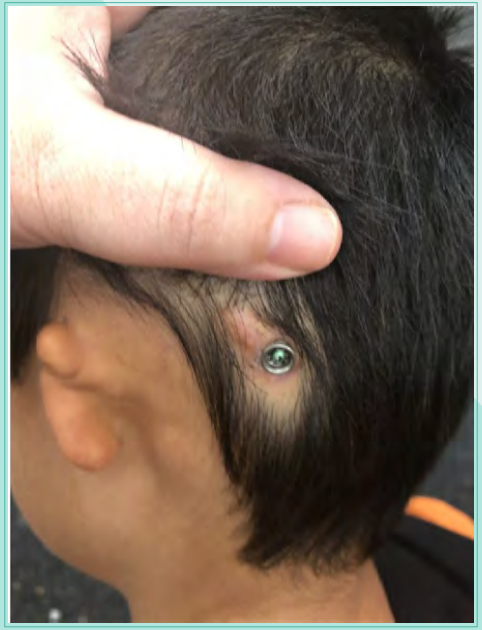
PEACH
3 years of age
through school-age

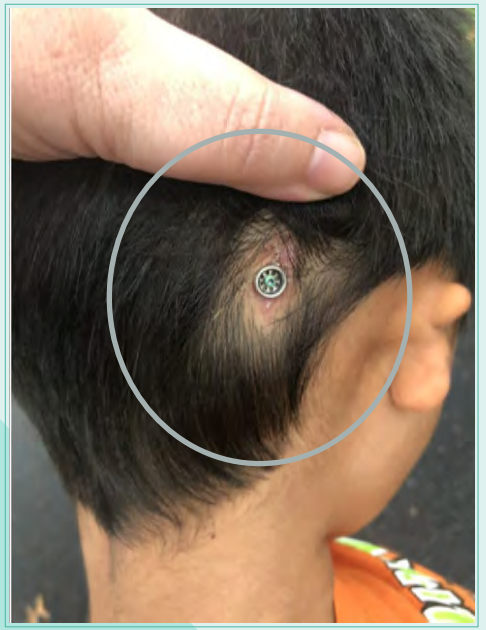
SIFTER
School-age



Beau~6 Weeks Post Fitting

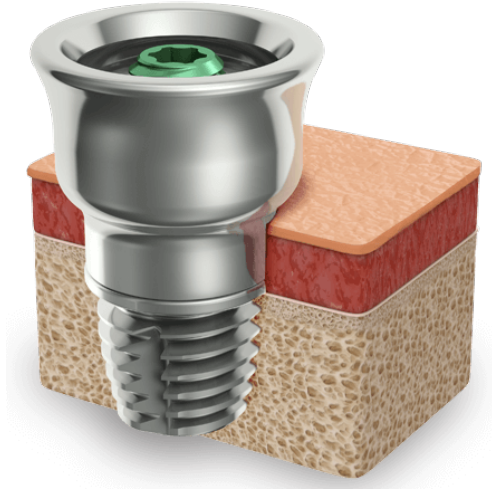
- Redness/ irritation reported near the right abutment
- Treated with oral antibiotics
- Recommended cleaning with soft toothbrush
- 2 weeks later received a call from parents reporting Beau's abutment fell off





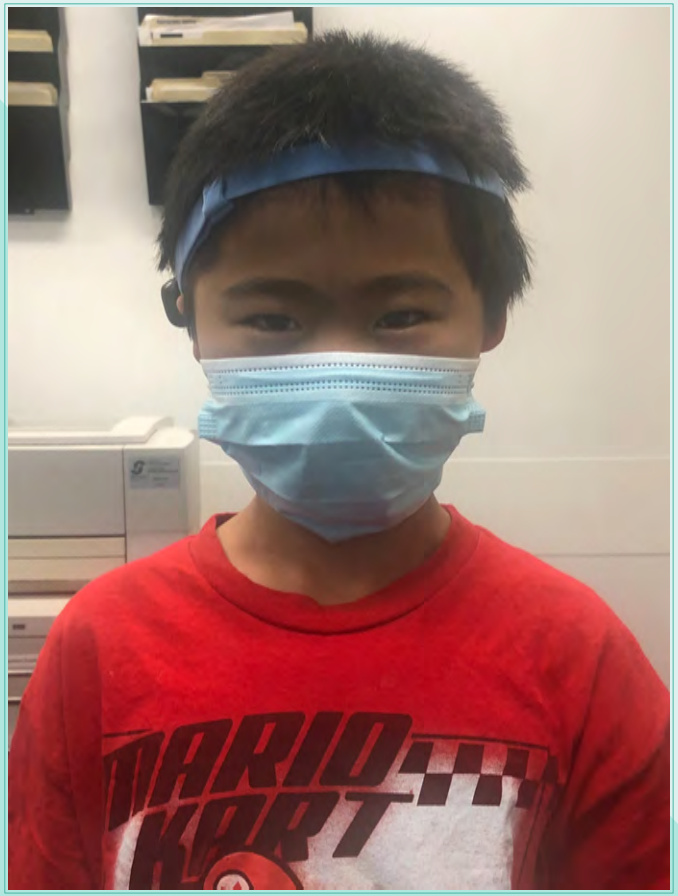
8 Weeks Post Fitting: Implant Failure

- Entire abutment and implant became dislodged while removing the processor
- No reports of trauma
- Surgery was recommended to replace the implant and abutment
- 2nd (sleeper) implant was not placed due to the binaural procedure
- Beau was hesitant to proceed with another surgery and refused to resume using his soft headband
- BCHD implant failures are extremely rare!



Beau Today

- Recommended utilizing both processors at every follow up visit
- At a recent appointment, Beau agreed to trial both devices in the clinic
  - Aided testing showed good benefit
  - Ling 6 all 20 dB
  - 100 % PBK-50
  - Beau admitted to hearing better



Final Thoughts on Beau

His Ponto was re-programmed for use on a soft headband immediately, but it took some time (and convincing) for Beau to agree.

Beau has a speech delay, so resumption of binaural fitting was strongly encouraged. Especially given the current state of social distancing and use of face masks.

Parents report improvement in Beau's responses and attention.

Beau finally admits that he hears better with both!

Revisited surgical options. Interested in an active transcutaneous BCHD. Should Oticon Medical release one that is compatible with his Ponto.

Meet Grace

- Hemifacial Microsomia with atresia of right ear
- Moderately severe conductive hearing loss in the right ear
- Normal appearing ear in the left with absent cochlear nerve
- First fit with BCHD on a soft headband at 2 months of age
- For many years, Cochlear device was the only option with her Medical Assistance insurance
- Full evaluation was not required

Grace 2-4 Years of Age

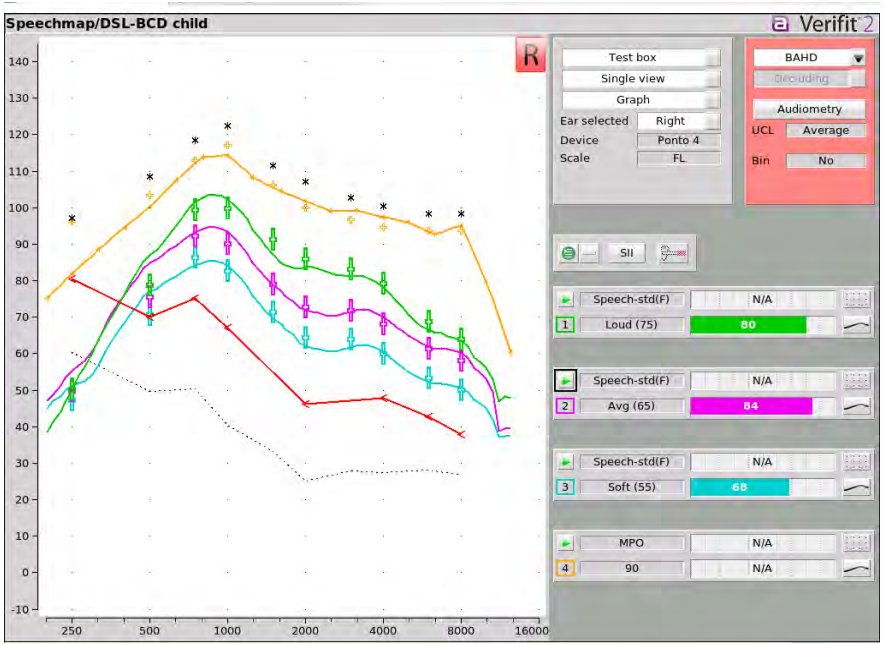
- Over the years, Grace had many processor models (Intenso, BP110, and Baha 5 P)

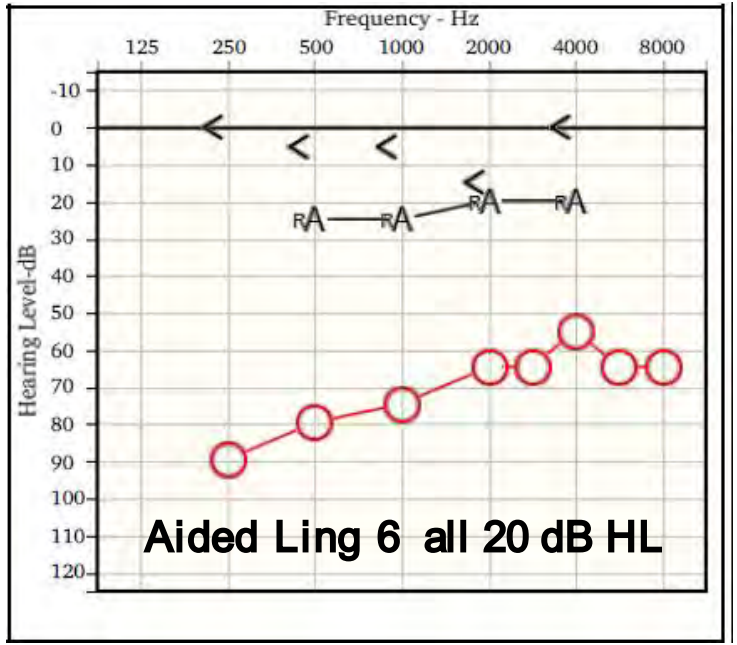
- Aided Testing with Baha 5 Power
  - Ling 6 [ah] 20 dB HL; [ee] 20 dB HL; [oo] 20 dB HL; [sh] 25 dB HL; [s] 30 dB HL; [m] 20 dB HL
  - Aided NU-CHIPS: 100% presented at 60 dBA
  - PEACH revealed typical performance in all conditions

Surgical BCHD Evaluation ~5 Years of Age

- Did not consider Cochlear Attract as percutaneous yields better hearing
- Percutaneous options between Cochlear and Oticon Medical were discussed
- Trial with an Oticon Ponto 3 SP on a soft headband was completed
- Grace preferred the Ponto 3 SP over her existing Baha 5 P
- 2-stage Oticon Medical Ponto BHX procedure with sleeper implant
- Fit with Ponto 3 SP 5 weeks following her 2nd stage to place the abutment

Grace Today –Upgrade to Ponto 4





Final Thoughts on Grace

Normal appearing ear ≠ Normal hearing

Grace can never have binaural hearing

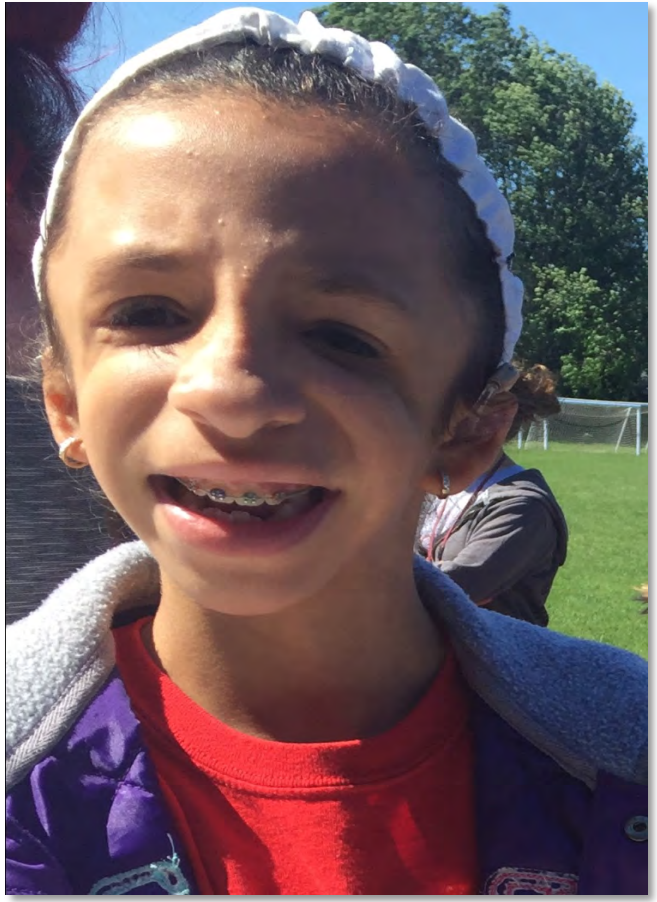
Can there be an option for a BiCROS BCHD?

Grace played an integral part of her surgical decision

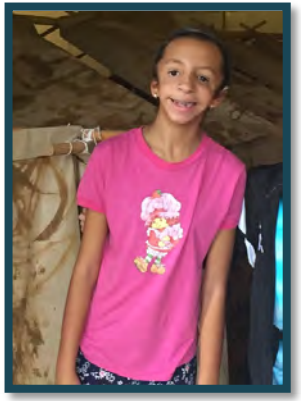
When comparing 2 processors, out-of-office trial may give additional insight that cannot be seen in clinic setting

Meet Bianca:
5 years of age

- Treacher Collins Syndrome
- Bilateral Microtia
- Moderate conductive hearing loss in both ears
- Utilized an air conduction hearing aid in the left ear and a Cochlear Baha 5 Power via soft headband on the right ear
- Benefits of surgical BCHD was discussed
- Bianca did not want to have surgery
- Continued using both devices for several years

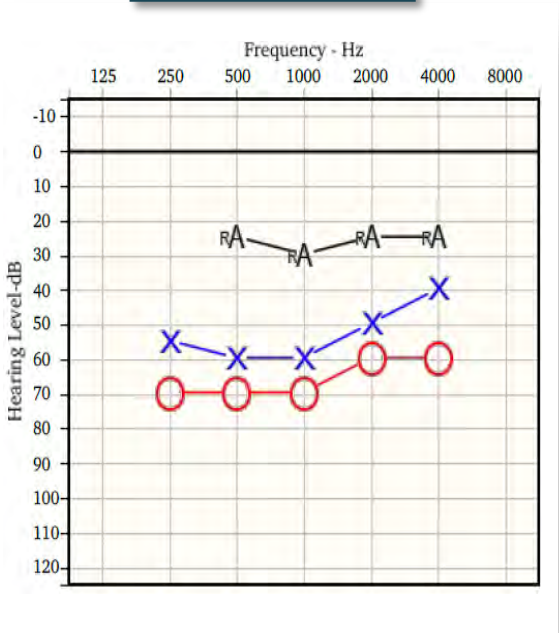


Bianca: 9 years of age



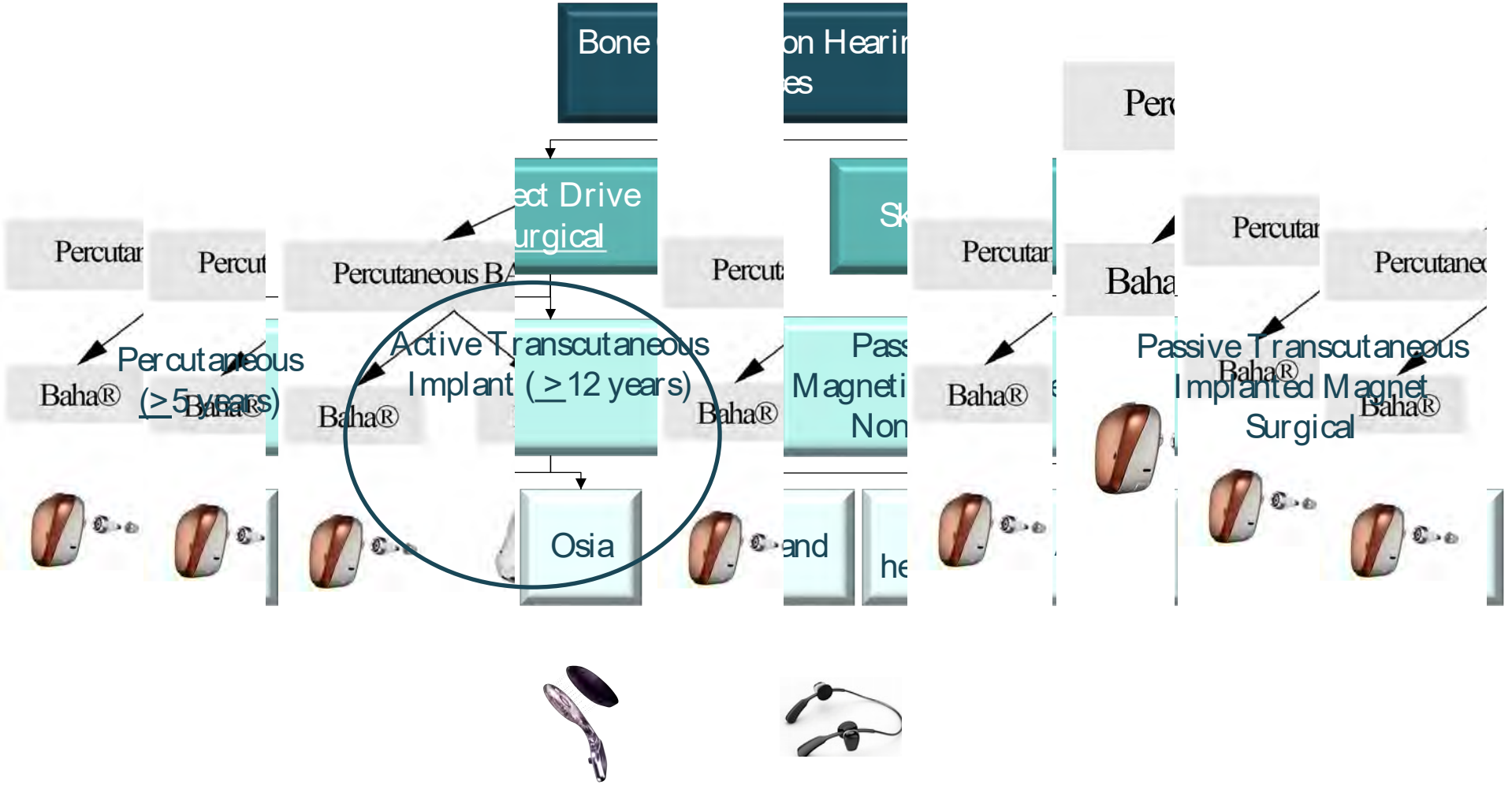
- Baha softband was only worn in school due to cosmetic concerns
- Revisited surgical options
- Did not want an abutment
- Good aided results with softband
- Decided on right Cochlear Baha Attract

Test Condition	PB-K 50	dB HL	SNR
Aided Right (BCHD)	92%	50	
Aided Left (AC)	92%	50	
Aided Both	100%	50	
Aided Both	64%	50	+5



Bianca's Surgical Considerations Revisited 9-12 years of age

- As predicted, retention issues were reported with the Cochlear Baha Attract
- Bianca would not consider conversion to a percutaneous system
- Discussed now available surgical active transcutaneous options


Bone
on Hearin
es
Perc
ect Drive
urgical
Sk
Percutar
Percut
Percutaneous BA
Percuta
Percutar
Baha
Percutar
Percutaneo
Percutaneous
(≥5 years)
Active Transcutaneous
Implant (≥12 years)
Pass
Magneti
Non
Passive Transcutaneous
Implanted Magnet
Surgical
Baha®
Baha®
Baha®
Baha®
Baha®
Baha®
Osia
and
he

Active Transcutaneous

Cochlear Osia

Bone Conduction PTA equal to or better than 55 dB at 0.5, 1, 2 & 3K Hz (manufacturer criteria)

Osia 2
- Wireless accessories and connectivity
- Remote microphone
- Smartphone app

MED-EL Bonebridge

Bone Conduction PTA equal to or better than 45 dB at 0.5, 1, 2 & 3K Hz (manufacturer criteria)

Samba
- No wireless connectivity
- No smartphone app
- Siemen's miniTek accessory needed for bluetooth/ remote mic connectivity

Age: ≥12 years

Conductive/ Mixed Hearing Loss

Available Processors

MRI COMPATIBILITY

Percutaneous

3.0 T

* Recommended for those anticipating serial MRI

Cochlear Attract

1.5 T with magnet in place

3.0 T with magnet removed

Bonebridge

1.5 T with the magnet in place

Osia

Removal of magnet is recommended for 1.5 T and 3.oT

Bianca's Surgical Decision

- Both Cochlear Osia and MED-EL BONEBRIDGE systems were discussed
- The technology, features and connectivity available with the Osia 2 processor was more favorable than the Samba (Samba 2 now has remote app and wireless streaming with the Samba 2 Go)
- Decided to proceed with Cochlear Osia conversion
- Attract magnet removed, new Osia implant was placed during a single procedure

Final Thoughts on Bianca

Current Technology:
Right ear Cochlear Osia 2

Left ReSound Linx 3D 77 air conduction hearing aid

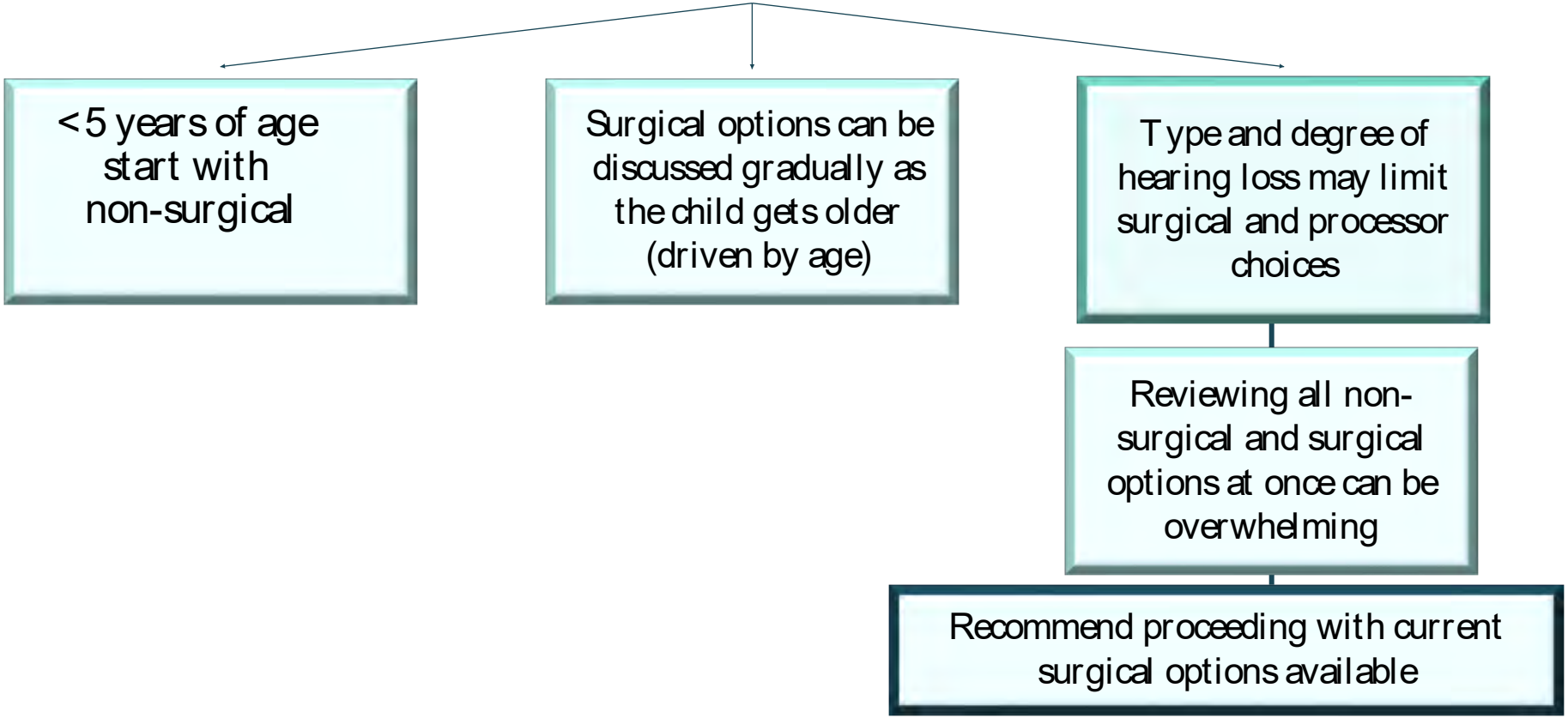
Cochlear Mini microphone 2+ transmits to both devices for use in school

Bianca is unable to stream from her phone or pair additional wireless accessories to both devices simultaneously

What about Osia for the left ear?

Is air conduction still preferred?

Surgical BCHD Evaluation Summarized




Oticon Medical
Navigating Your Child's Hearing Future with a Bone Conduction Hearing System
Parent's Guide

Coming Soon!


Oticon Medical
Moving from the Softband to the Ponto Implant
A Parent's Guide

ANY QUESTIONS?

Thank You

MauroL@chop.edu
267-426-5580