Advanced ABR Technology for Screening & Diagnostics in Pediatric Audiology

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Initial Motivation for Purchase

- Wireless technology
- High noise/artifact in our NICU
- Babies do not sleep “at will”
- Most updated technology on the market
- Success with Vivosonic Integrity System
Usage of Aurix at CoA

- NICU
- NICU “step down” unit
- Screening well baby ‘fails’ from birthing hospitals (outpatients at three locations)
- 1st method of screening prior to tympanograms and diagnostic ABR
Important Clinical Advantages of Aurix

- SHORT test time when babies pass (generally less than two minutes)
- Can test and obtain a pass:
  - with awake babies
  - with nursing babies
  - with pacifier sucking babies
  - when babies are fussy (but not screaming)
- Very few instances of noise interference
- Will often pass when an infant has fluid (compared to an OAE)
Advantages (cont)

- Ability to test one ear at a time
- Wireless technology, e.g. for nursing, use in NICU
- Touch screen option
- Insert earphone option is available
- Print out is small and easy to read
- Less expensive than competitor models
Impact on Children’s Program

- Can screen more babies with fewer resources
- Fewer ‘fails’ (false positive) of “active” babies
- More reliable screening in the NICU (quicker with less noise)
- Less rescheduling
- Reduce loss to follow-up
- Baby and mother comfort
Oops! TAB PLACEMENT!
Room for Improvement

Ear domes sticking to babies heads
- e.g. baby is active or hairy
- Not recommended to “hold the ear dome” while testing (potential to create acoustic noise)
- insert earphones provide alternative option

Electrode placement (nape is so difficult w/ infants!)

Would like to view the wave during testing (audiologist issue; great for nurses or techs screening well babies!)
Case Examples

NICU

“Room-in inpatient”

Outpatient

Cleft palate clinic
26 d/o seen in the NICU w/ gastroschisis, full term birth, respiratory distress

3 d/o seen in the NICU with arachnoid cyst and bilateral hydronephrosis

3 m/o who failed NBHS

7 w/o who failed NBHS x2

3 d/o seen at bedside; c-section due to failure to progress and dx with inguinal hernia
3 wk old with hx of 35 wk GA, amp/gent small colon, physiologic jaundice

Flat tymp in the left ear
22 d/o w/ hx of cleft lip and cleft palate. Failed NBHS bilaterally.
Integrity follow-up on cleft pt. (in the OR with BMT)
Even though this is FABULOUS equipment...
Your infant is scheduled on ______________ at ___________ for a newborn hearing screening and/or follow-up for failed newborn hearing screening.

It is very important for your infant to be still and quiet during the testing. Please bring any comforting items from home such as bottles, pacifiers, a favorite blanket or stuffed animal, extra diapers, extra clothing, etc.

Please try and keep your infant awake for a few hours prior to the appointment and especially during the drive to Children’s of Alabama. You may feed your infant once in the test room to help them fall asleep.

Please contact an Audiologist at (205) 939-9149 if you have any questions or concerns about this test.

Infants can be tested from birth... Don’t wait till it’s too late!

By one month of age: all children screened for possible hearing loss

By three months of age: all children with permanent hearing loss identified

By six months of age: all children with permanent hearing loss have amplification and treatment plan in place
“Real life” happens
Initial Motivation for Purchase

- Wireless technology
- High noise/artifact in our NICU
- Babies do not sleep “at will”
- Most updated technology on the market
- Cumbersome scheduling for sedation at Children’s
Usage of Integrity at CoA

- NICU as a screener on many occasions (70dBnHL and 30dBnHL)
- NICU “step down” unit
- 2nd Stage testing following a failed screening
- Use click, bone clicks, tone bursts, and beginning to use ASSR
Usage (cont)

- 2 units at the main hospital
- 1 unit at one off site location
- Schedule 5-10 OR (or sedated) cases per week
- Schedule 7-10 outpatient diagnostic AEPs per week
Instructions for Vivosonic testing

Your child has been scheduled for AEP testing to obtain further information regarding his/her hearing. Please know that test procedures are non-invasive but active parental involvement and interaction is required. Testing takes approximately two hours to complete.

What to bring
- Comfort items: pacifiers, blankets, favorite stuffed animal
- Activities: quiet games, favorite DVDs
- Clothing: extra diapers and wipes
- Infants: please bring extra bottles

Test preparations
- Your child will be seated in a chair to begin preparation. He/she may sit alone or in the parent’s lap.
- An alcohol solution will be used to clean surface areas on your child’s forehead and behind your child’s ears
- Electrodes resembling stickers will be placed on areas prepared by alcohol solution
- Insert earphones will deliver sound to the child’s ears
- A gray box will be placed near the child.

During the test
- Please have your child remain calm
- Your child may sleep during the test
- Your child may watch a DVD or play quiet games
  - Mild to moderate activity is acceptable; however, activity may prolong test times

After the test
- Your child may resume normal activities
- He/she may have temporary red markings where electrodes were placed

For an Infant Evaluation
- Please bring your child slightly hungry and sleepy to the appointment. Testing times can be prolonged if infants are fussy. Test preparations (see above) may make your child upset; however, you will be able to feed/comfort your child once preparations are complete. Test preparations take approximately 5-10 minutes to complete.

If you must cancel or reschedule the appointment, please give a minimum of 24 hour notice. Please call 205-939-9149.
Important Clinical Advantages of Integrity

- Very few instances of noise interference
- You are not attached to your patient
- Decreased sedation need
- Portable
- Less expensive than other models
Advantages (cont)

Can test and duplicate waveforms:
- with awake babies
- with nursing babies
- with pacifier sucking babies (and toddlers)
- when babies are fussy (but not screaming)
- mobile toddlers
Impact on Children’s Program

- More reliable AEP in the OR
- Increased ability to perform outpatient diagnostic (unsedated) ABR
- Early ABR diagnostic testing
- Ability to test “active” babies and toddlers -- rescheduling is minimized
- Reduced lost to follow-up due to testing “while they are in the building”
Clinical Tips and Keys to Success

1. Like any AEP, you must repeat your waveforms (at least the softest level).
2. Watch your waveforms as they gather AND the # of sweeps.
3. It is advisable to obtain clinic norms for nHL to HL.
4. Use battery packs provided.
5. Don’t forget to SAVE YOUR WAVES prior to creating a new chart.
CoA protocols

37.7/sec

18-22ms window

Rarefaction (always except for bone conduction)

Perform “as much as we can with the time we have”
Case Examples

- Failed NBHS (OAE)
- 4 wk old failed NBHS - Awake vs asleep
- 12 day old with family hx of profound SNHL
- 2 m/o failed NBHS x2 w/ family hx of moderate HL
Case 1

- Failed initial NBHS (OAE)
- Failed follow-up testing upon readmit to our hospital (Aurix and flat tymps)
- ABR was WNL
4 w/o w/m seen f/u NBHS; born full and failed NBHS in bilaterally; no family hx of hearing loss; pt does not seem to respond to sounds or startle.

Failed Aurix with normal 1000Hz tymps

Continued with a diagnostic AEP that day
November

Left air click

Right ear click

Better bone click
Case 3

- Failed NBHS
- Seen at 12 days old for ABR
- Pts ½ brother w/ bilateral SNHL and CI
- Tymps WNL
- OAE’s inconclusive due to pt crying
- Mild HL bilaterally
September
HAF in November

Speech eval same day as HAF
January
Behavioral Testing at 7 mos old February

Genetic testing indicates 3q29 microduplication syndrome, which has been assoc with mild to moderate MR, microcephaly and dysmorphic features.

Family hx is significant for half-brother with profound SNHL and has a CI.

Moderate HL for the better ear

Responses to speech, noise makers and BC were in the 55-60 dB HL range.
Case 4

Failed 4 NBHS

No startle at home

Brother with SNHL

Genetic testing pending
January
February
Screening and Diagnosing Hearing Loss in 1 - 3 - 6

Well babies

Screening using OAE or automated ABR at discharge (or via primary care physician if not available at discharge from hospital)

Pass (normal hearing)

Refer/Fail

Rescreening—must be ABR if ABR used at initial screening

Pass (normal hearing)

Refer/Fail

Audio evaluation at 12 months of age*

Diagnostic test needed: ABR provided by qualified audiologist (ABR must be one form of diagnosis if child <3 years of age)

Normal hearing

Hearing loss confirmed in type and degree

Refer child to appropriate disciplines including audiologist for amplification consultation and fitting, ENT physician, genetics, ophthalmologist, etc.

Screen by 1 month of age

Diagnose by 3 months of age

Intervention by 6 months of age

* indicates more conservative screening/monitoring procedures than recommended by the Joint Committee on Infant Hearing (JCIH) conducted at Children’s of Alabama that we feel are best practice in care and management of children at risk for hearing loss.

The Charity League Hearing and Speech Center at Children’s of Alabama
For Appointments: 205-939-9141 For more information: 205-939-9149
Children’s Hospital
1600 7th Avenue South
Birmingham, Alabama 35233

Children’s South
1940 Elmer J. Bissell Road
Birmingham, Alabama 35243

Children’s on 3rd Outpatient Center
1208 3rd Avenue South
Birmingham, Alabama 35233
Screening and Diagnosing Hearing Loss in 1 - 3 - 6

Stay in NICU 5 days or more

**NICU babies**

Stay in NICU less than 5 days

Screening using **ABR**

- **Refer / Fail**
  - **Rescreening** (must be ABR)
    - **Refer / Fail**
  - **Pass (Normal hearing)** see follow-up recommendations below

- **Pass (Normal hearing)** see follow-up recommendations below

Screening using **OAE or ABR**

- **Refer / Fail**
  - **Rescreening**—must be ABR if ABR used at initial screening
  - **Pass (Normal hearing)** see follow-up recommendations below

**Diagnostic test needed:** **ABR provided by qualified audiologist**

- **ABR must be one form of diagnosis if child <3 years of age**

- **Normal hearing** see follow-up recommendations below

- **Hearing loss confirmed in type and degree**

- **Refer child to appropriate disciplines including audiologist for amplification consultation and fitting, ENT physician, genetics, ophthalmologist, etc.**

* Indicates more conservative testing/monitoring procedures than recommended by the Joint Committee on Infant Hearing (JCIH) conducted at Children’s of Alabama that we feel are best practice in care and management of children at risk for hearing loss.

**Terms to know**

- **ABR:** Auditory Brainstem Response - measurement of hearing acuity obtained from surface electrodes that record neural activity generated in the cochlea, auditory nerve, and brainstem in response to acoustic stimuli delivered via earphone. There are automated versions of this test used for screening purposes and diagnostic versions used to determine type and degree of hearing loss.
- **OAE:** Otoacoustic Emission - measurement of peripheral hearing acuity made using sensitive microphones placed in the ear canal that record cochlear responses to acoustic stimuli.

**“Normal Hearing” follow-up recommendations:**

- Diagnostic audiological evaluation by 30 months of age recommended by American Academy of Pediatrics.
- *Behavioral audiological evaluation at 9-12 months of age.*
- **If high risk for hearing loss (CMV, ECMO, PPHN) test every 3 months until age 12 months, and every 6 months until age 3 years.**
- **Routine care by the primary care physician, including monitoring for developmental milestones in speech and hearing.**