Utility of the Vivosonic Integrity™ ABR System as a Hearing Screening Device for Children who are Difficult to Test

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ABSTRACT

Hearing screenings are an important tool to determine when an individual is at a higher risk of having hearing loss. It is especially important to identify at-risk individuals in the pediatric population, due to the significant impact that undetected hearing loss may have on language and educational development. Currently, methods exist to effectively screen most typically developing children. However, there is a lack of screening methods for children who are difficult to test, such as those with developmental disabilities. The current study compared the rate of ability to test from hearing screenings of preschool and school-aged children in a program that used traditional behavioral methods alone with one using the Vivosonic Integrity™ ABR device in conjunction with behavioral methods. The study demonstrated that use of the Vivosonic Integrity™ ABR device as a hearing screener for difficult-to-test children results in significantly fewer referrals for comprehensive audiologic evaluation due to an inability to test. The availability of a valid screening device for this population has the potential to save resources and provide valuable information on a child's hearing status that may otherwise be unavailable.

INTRODUCTION

- Hearing loss prevalence increases from birth to childhood, demonstrating a need to screen hearing beyond the universal newborn hearing screening (UNHS).[1, 2]
- Hearing loss prevalence is higher for children diagnosed with developmental disorders than for typically developing children.[3, 4] Identifying hearing loss in this population is essential to provide appropriate intervention.
- Hearing loss of even a mild degree can have negative impacts on education and language outcomes.[5, 6] Early intervention can improve these outcomes.[7]
- Current screening methods:
  - UNHS: Auditory brainstem response, otoacoustic emissions
  - School screenings: Pure tone behavioral audiometry, tympanometry
- Current hearing screening methods are appropriate for typically developing children,[8] but there is a lack of effective screening methods for children who are difficult to test due to cognitive limitations or challenging behaviors.
- The Vivosonic Integrity™ ABR system has unique features, which are purported to significantly reduce noise in the response, resulting in the ability to obtain a clinically useful ABR response without the limitations of a more traditional ABR, such as the need to have an optimal testing environment or a quiet child.
- The purpose of the present study was to investigate whether use of the Vivosonic Integrity™ ABR system as a hearing screening device for children who are difficult to test may improve the ability to obtain results in this population.

METHODS

Participants

•Forty-three children (38 male and 5 female) between the ages of 3 and 11 years (mean = 6.4, SD = 2.4) participated.

•Participants were recruited from the Helping Hands Center for Special Needs in Columbus, OH.

Instrumentation

•Micro Audiometrics Earscan ES-TR Tympanometer

•Beltone Model 120 Audiometer

- TDH-39 supra-aural headphones

•Vivosonic Integrity™ ABR system

- ER3-14B disposable foam insert earphones and Ambu Neuroline 720 electrodes

Procedure.

•Part 1: Otoscopy, tympanometry, and pure tone behavioral hearing screening (using conventional and/or conditioned play audiometry) performed at 1-4 kHz presented at 20 dB HL [per ASHA (1997) guidelines].[9]

- All participants that did not respond to tonal stimuli and those that were unable to complete testing (recorded as "could not test" (CNT)) were referred on to Part 2.

•Part 2: Otoscopy, tympanometry, and ABR screening using click stimuli presented at 30 dB nHL.

- Conventional electrode montage utilized.
- Toy and video available to calm and distract child from task.
- Refer to figures 2 and 3 for sample waveforms.

RESULTS

- Forty-two participants included in the final analysis.
- Chi-square used for all analyses.
- No significant gender or age effects for any screening results ($p > 0.05$).
- Of the participants that could be tested, no significant difference in referral rate was found between screening completed with behavioral methods only, and that completed with behavioral and ABR methods ($p > 0.05$).

Ability to test

- Twenty-four participants completed Part 1 behavioral screenings.
- Eighteen participants recorded as CNT, and referred on to Part 2.
  - Ten participants completed Part 2 ABR screenings
  - Eight participants labeled as CNT.

- Twenty-four participants completed screening following behavioral screenings alone (57%).
- Thirty-four participants completed screening following behavioral and ABR screenings (81%).
- A significant difference was found in the ability to test participants following Part 1 and Part 2 of the study ($p < 0.05$). Refer to figure 1.

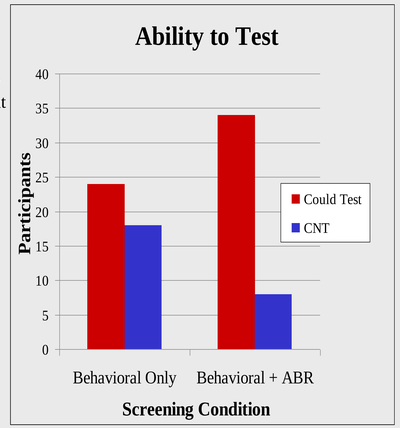

FIGURE 1. Significantly more subjects were able to be tested following behavioral + ABR screenings vs. following behavioral screenings alone.

Sample ABR Tracings

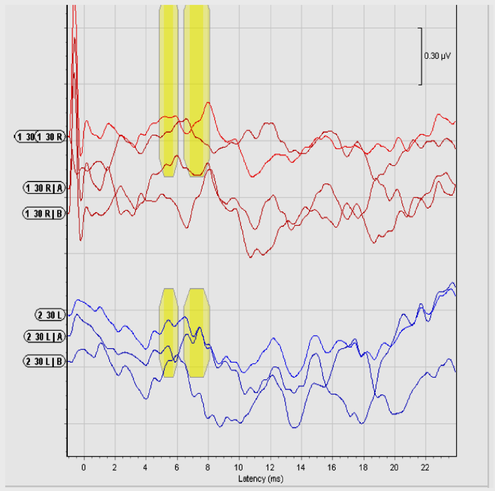

FIGURE 2. Sample ABR tracings from a child who failed the ABR screening bilaterally and was referred for further testing.

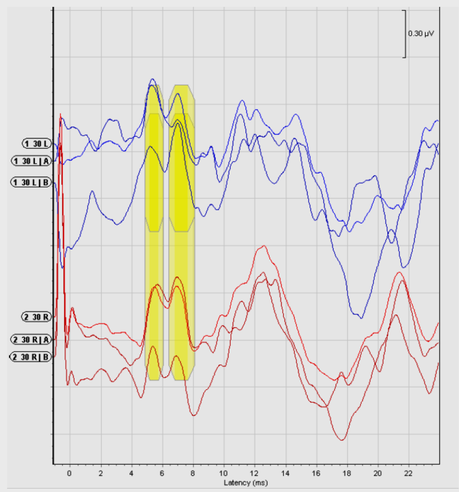

FIGURE 3. Sample ABR tracings from a child who passed the ABR screening bilaterally.

SUMMARY & CONCLUSIONS

- Results suggest that use of the Vivosonic Integrity™ ABR system as an auditory screener for children who are difficult-to-test is an effective means of reducing the referral rate due to an inability to test.
  - Potential to reduce resources used for comprehensive testing
  - Potential to provide information regarding auditory status that may otherwise be unavailable
- Results are potentially obtainable for children who were unable to understand task for behavioral audiometry, as well as for children for whom challenging behaviors (e.g. pulling off headphones, crying) prevented screening in this manner.
- Toys and video were essential for successful screening for some children.

Limitations and Future Studies

- This study should be replicated with larger sample size to confirm results.
- Presentation level of 30 dB nHL may miss mild hearing loss.
- Studies to confirm validity of hearing screening results obtained with Vivosonic Integrity™ should be completed. Future studies should compare screening results with results of comprehensive assessment.

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