 VALIDATION OF THE AUDIOSCAN VERIFIT2 PROBE TUBE PLACEMENT TOOL

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Rationale
Although routine verification of hearing aid responses using real ear measures (REM) is a part of recommended practice\(^3\)-\(^5\), this verification technique is frequently not performed by clinicians\(^6\)-\(^8\). This lack of use is attributed by some to the perceived complexity of the REM process\(^9\). The probe tube used in REM must be placed within 5mm of the eardrum to obtain accurate measurements, particularly in the high frequencies\(^9\).\(^{10}\); however, contact with the tympanic membrane (TM), which can cause discomfort, must be avoided. To aid in probe tube placement, Audioscan has developed a probe tube placement tool, referred to as the Probe Tube Guide (PTG). The PTG is an automated, software-driven feature that uses a machine-learning algorithm which considers the location of standing waves in the ear canal relative to a previously measured acoustic data set to predict the location of the probe tube relative to the TM\(^9\). In this poster, we will describe the performance of the PTG as it is integrated in the Verifit2 with adults with normal middle ear status and normal external ear canal status.

Materials and Methods
The accuracy and test-retest reliability of both probe tube placement and REM was assessed in two conditions: (1) a probe tube placed by an experienced clinician using a clinically typical visually-assisted (VA) positioning method with otoscopy; and (2) a probe tube placed using the PTG. Twenty participants (10 males and 10 females ages 25-81) who presented with normal middle ear and external ear canal status completed the protocol. Probe tube placement was completed on the forty (40) adult ears, twice using the VA positioning method, and twice using the Audioscan PTG method. The starting order was counterbalanced across ear and across condition. A within-subjects design was used to measure these system performance variables at the individual level using comparisons of Real Ear Unaided Responses (REUR) and probe tube depths across participants and methods. Expert clinician confirmation of acceptability of placement of PTG using otoscopy and patient reports of tympanic membrane contact were recorded.

Procedure
1. Initial Otoscopy.
2. Setup Verifit2 for probe tube placement.
3. Start with the probe tube outside of the ear.

Probe Tube Guide Protocol (PTG)
1. Mark probe tube at tragal notch.
2. Mark probe tube at inter-tragal notch.
3. Mark probe tube at tragal notch.
4. Mark probe tube at inter-tragal notch.
5. Select ear on PTG Screen and press.
6. Insert probe tube into selected ear canal until \(\checkmark\) appears on-screen and there is an audible “Chime”.
7. Run REUR.
8. Repeat protocol for test-retest.

Visually-Assisted Protocol (VA)
1. Mark probe tube at inter-tragal notch.
2. Mark probe tube at inter-tragal notch.
3. Mark probe tube at tragal notch.
4. Mark probe tube at inter-tragal notch.
5. Select ear on PTG Screen and press.
6. Insert probe tube into selected ear canal until \(\checkmark\) appears on-screen.
7. Run REUR.

Results
1. Real Ear Unaided Response (REUR) Comparison
All statistics were completed using SPSS v24. A repeated measures analysis of variance (ANOVA) was completed with frequency as the within-subject factor and method and ear as between-subject variables. Eight tests were compared: Visually-assisted (VA) and Probe Tube Guide (PTG) x 2 ears x 2 runs each.

As expected, results (Fig. 1.1) indicated that frequency was significant: \(F(5, 98) = 15.65, p < 0.001, \\
eta^2 = 0.36\). For tested was not significant \(F(1, 53) = 0.01, p > 0.05\). Test Method (i.e. VA1 vs. VA2 vs. PTG1 vs. PTG2) was also not significant \(F (5, 154) = 0.05\), indicating good test-retest reliability within the test methods and a lack of differences between test methods.

2. Probe Tube Depth Comparison
Probe tube placements (Fig. 2.1) ranged from 29.41 mm (x=33.80 mm) for males and 25.35 mm (x=30.11 mm) for females. Probe tube depth per gender was significantly different, \(F(1, 53) = 20.03, p < 0.01, \\
\eta^2 = 0.34\).

When the probe tube depth of the 40 ears (20 left and 20 right) were compared across the four test methods (VA1, VA2, PTG2, PTG2), the ANOVA results indicated Test Method was not significant \(F(2, 73) = 0.87, p > 0.05\), nor was Method by Gender \(F(2, 73) = 0.76, p > 0.05\).

Summary
In the cases that were evaluated using the recommended protocol, the Verifit2 Probe Tube Guide (PTG) provided a probe tube placement depth and resulting REUR measure that was not significantly different than those obtained by an experienced clinician using traditional probe tube placement methods. Test-retest reliability was good for both visually-assisted (VA) and PTG methods. The PTG resulted in acceptable probe tube placements as assessed by an experienced clinician using otoscopy for all participants. There was no reported contact with the tympanic membrane for either method. Further evaluation is required to assess the tool with other clinical populations, such as infants, children, and those with atypical external or middle ears.

References
10. American Academy of Audiology pediatric guideline: protocols for applying and predicting earmold RECDs. 1999, available online.