Fitting to target: How close do we get?

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Background Information

- The American Speech-Language-Hearing Association "mandates that audiologists …incorporate the principles of evidence-based practice in clinical decision making to provide high quality clinical care (ASHA, 2005)."
- Technological advances along with our profession's goal of utilizing evidence-based practice have made the use of prescriptive formulae the starting point for modern hearing aid fittings; matching the hearing aid output to a desired target gain has never been easier.
- Prescriptive fitting methods serve as an accurate and efficient guide for fitting hearing aids.
- Two prevalent prescriptive fitting methods utilized in fitting non-linear digital hearing aids are NAL-NL1 and DSL [i/o].
- Prescriptive methods are an integral part of fitting digital hearing aids to the hearing impaired population. However, if the hearing aid fitting is not verified, then there is a lack of evidence supporting the prescribed targets. Real ear measures provide objective information used to validate these target values at the patient's eardrum to ensure effective audibility.

NAL NL-1 and DSL [i/o] Facts

- NAL-NL1's goal was to maximize speech intelligibility and effective audibility without normalizing loudness. These variations in loudness would help preserve a natural sound quality (Bryne et al. 2001).
- NAL-NL1 incorporates three main parameters into achieving the goal of maximizing speech intelligibility: limiting low and high frequency emphasis, hearing loss desensitization and an individuals hearing loss. These are based upon theoretical models: modified speech intelligibility index and loudness model.
- DSL [i/o]'s goals were to have loud sounds not exceed the individuals uncomfortable listening level, make speech undistorted and audible across a wide range of input levels without discomfort, and to normalize loudness (Cornelisse et al., 1995).
- DSL [i/o] was primarily designed and used for the fitting of hearing aids to infants and children. DSL [i/o] utilizes low-compression thresholds to increase audibility of softer speech sounds.

Purpose

- The purpose of this study was to examine the decibel difference (if any) between the measured Real Ear Aided Gain (REAG) and prescriptive output targets for fitting digital programmable hearing aids based on the individual's hearing loss. Specifically, this study compared the difference between REAG measurements and the prescribed NAL-NL1 and DSL [i/o] REAG targets at the initial fitting in a university clinic.

Method

- 253 charts from Bloomsburg University Speech, Language and Hearing Clinic were reviewed to gather audiometric data, prescriptive fitting method information and real ear measures.
- 88 adults (age ≥18 years) were seen for digital, non-linear hearing aid fittings using either the NAL-NL1 or DSL [i/o] prescriptive method and had their hearing aid's output verified with REAG measures. Each ear was recorded separately and 110 ears met criteria.
- 21 participants had been initially fitted with NAL-NL1 prescriptive targets and 89 participants had been fitted with DSL [i/o] prescriptive targets
- Each participant's hearing thresholds at 0.25, 0.5, 1, 2, 3, 4, 6 and 8 kHz were input into the DSL [i/o] Version 4.1 software and NAL-NL1 Version 1.28 software to determine the participant's REAG targets at each of the above frequencies.
- Each participant's real ear aided response (REAR) value for 65dBSPL was measured at 0.25, 0.5, 1, 2, 3, 4, 6 and 8 kHz. The REAR values were subtracted from the 65dB input to determine each participant's REAG for each frequency.

Results

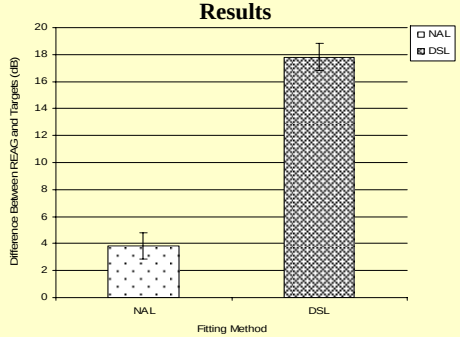

Figure 1. The mean decibel difference and standard error between each prescriptive method target and the measured REAG at 65dBSPL.

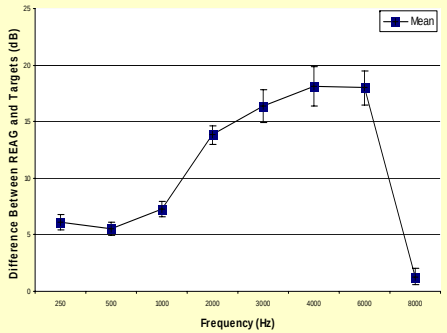

Figure 2. The mean decibel difference and standard error between measured and target REAG as a function of frequency.

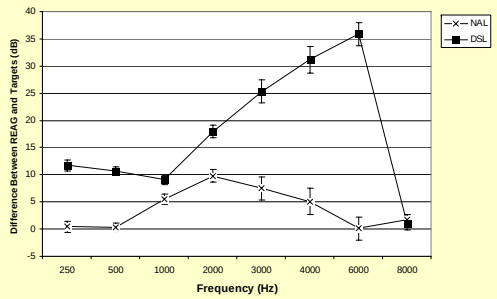

Figure 3. The mean decibel difference and standard error between measured and target REAG as a function of frequency and fitting method (NAL-NL1 and DSL [i/o]).

Data Analyses

- REAG values were subtracted from the participant's prescriptive targets for both NAL-NL1 and DSL [i/o] fitting methods. This provided the REAG difference at each frequency for both NAL-NL1 and DSL [i/o] fitting methods.
- A two-way Analysis of Variance (ANOVA) was calculated to find any significant main effects and interaction effects between the difference between the REAG and NAL-NL1 and DSL [i/o] targets.
- Mann-Whitney test was performed to analyze the unpaired groups and confirm any significant findings for the main effects on frequency between the difference between the REAG and the NAL-NL1 and DSL [i/o] targets since the data was not normally distributed.

Results and Conclusions

- Statistical analysis showed a significant main effect on fitting strategy. (F (1,218) = 101.48, p< .001) NAL-NL1 had a smaller difference between measured and target REAG values compared to the DSL [i/o] fitting method for these participants (Figure 1.) .
- Further, significant differences were found for each measured frequency between the two fitting methods (F (7, 1526) = 49.87, p< .001) . The greatest variability was observed from 2000-6000Hz, which may be due to the greater degree of hearing loss at these frequencies (Figure 2.) .
- There was a significant interaction effect between fitting and frequency which was confirmed by the Mann-Whitney Test. This may be attributed to the different goals of each fitting method (Figure 3.).
- Both prescriptive methods recommended amplification that significantly exceeds the aided gain that patients accepted at the initial fitting.
- NAL-NL1 targets appear to be a closer approximation to what patients will accept at an initial fitting of digital hearing aids for adults than DSL [i/o] Version 4.1 targets. This conclusion is based on the smaller difference between REAG values at 65dBSPL and NAL-NL1 REAG target values at 65dBSPL than the DSL [i/o] REAG difference.
- DSL [i/o] overestimates the required gain for adult hearing aid users would accept at the initial fitting. This is evident from the greater difference between REAG values at the initial fitting and DSL [i/o] REAG target values at 65dBSPL.
- Fitting hearing aids to approximate NAL-NL1 targets at initial fitting will be more accepted by adult patients.
- Overall this study found that prescriptive fitting methods may be a good starting point for determining the hearing aid output for the hearing aid fitting. However patient input may dictate that changes be made in order for the patient to tolerate and accept the fitting initially. Prescriptive fitting methods have been proven to provide adequate amplification. Using proven methods supports an evidence-based standard of practice.

Future Research

- With the publication of a new DSL [i/o] fitting method (version 5.0); are the same differences seen between prescribed and actual REAG measures?