The American Academy of Audiology’s 2006 Guidelines for the Audiologic Management of Adult Hearing Impairment recommend that hearing healthcare professionals verify and validate hearing aid fittings to ensure that they will provide adequate benefit for every patient.

There are many ways of performing validation and verification, from simply asking the patient questions such as “How are the hearing aids working for you?” and “Are the hearing aids loud enough?” to more formal questionnaires, real-ear measurement, or aided speech-recognition testing.

Ricketts presented data that the hearing aid gain settings that patients find most pleasant may not provide them with much, if any, benefit. Therefore, it is insufficient to verify a fitting by simply asking the patient how the devices sound. It is our responsibility as clinicians to ensure that the devices are subjectively satisfactory and objectively appropriate. The clinician must decide what measures provide the most useful information, while not consuming too much valuable clinic time to perform these measures.

Given that the primary goal of a hearing aid fitting is to improve audibility, it is necessary to verify that speech sounds are indeed audible to the patient. Real-ear measures are the most efficient way of doing this; however, most hearing healthcare professionals do not use real-ear measures routinely, commonly citing cost of equipment and time constraints.

Data collected in a study conducted by the Veterans Administration have shown that using real-ear verification to ensure a match to a prescriptive target significantly improves subjective sound quality and perceived benefit. In the public arena, Consumer Reports reviewed the state of hearing aid dispensing last year by following 12 hearing-impaired participants as they purchased 48 pairs of hearing aids. Of this sample, two-thirds of the purchased hearing aids were classified as “incorrect amplification,” defined as either too little or too much amplification.

Additionally, the Consumer Reports article advised consumers that real-ear measures are a “must when purchasing hearing aids.” When consumer publications such as Consumer Reports educate the public on hearing aid fitting and stress the importance of validation measures, clinicians need to be prepared to serve these savvy patients.

Realizing that the constraints of time and cost limit the routine use of real-ear verification to approximately 20% of audiologists, Starkey developed Integrated Real-Ear Measurement, initially released in 2007. This technology, available in the full range of Starkey’s Destiny and Zon families of hearing aids, was introduced with the anticipation that clinicians would use it as a practical way to match patients’ prescriptive targets.

Integrated Real-Ear measures the patient’s real-ear-to-coupler difference (RECD) to predict the real-ear aided response (REAR). This technique was proven to improve the match to the selected prescriptive target. Although using the measured RECD improves the accuracy of the initial match to prescriptive targets, using the REAR is more clinically intuitive and offers clear advantages.

In the Starkey S Series product line, Live Real-Ear replaces the original Integrated Real-Ear, allowing a real-time measurement of the REAR. The Live Real-Ear measure uses a speech-shaped noise that is first generated by the hearing aid and then passed through the device, in the same manner as an externally generated signal. Live Real-Ear allows the user to present this speech-shaped noise stimulus at multiple signal levels, demonstrating, in real time, the in situ effects of the device’s gain and compression parameters. Verification at multiple signal levels was not possible in the original Integrated RECD-based implementation.

This routine can be performed for any of the prescriptive targets available in Starkey’s Inspire 2010 software. Live Real-Ear also automatically deactivates all advanced signal processing, such as digital noise reduction or expansion.
that may affect gain and interact negatively with the real-ear measurement.

The Live Real-Ear procedure allows for two options: “Measure and Match,” used at the time of fitting and “Measure Only,” which can be used to verify fine-tuning adjustments or changes to the acoustic plumbing of the hearing aid.

**MEASURE AND MATCH ROUTINE**

Below is a detailed overview of the automated Live Real-Ear Measure and Match routine:

1. The hearing aid is “Best Fit” based on the patient’s audiometric data via Inspire 2010 software. This initial fitting, as with all hearing aids, is based on average ear canal acoustics. So, unless verified by real-ear measurement, it may not be prescriptively appropriate.

2. The hearing aid is placed in the patient’s ear, along with the Live Real-Ear probe tube, as shown in Figure 1. Once placed in the ear, the supplied probe tube should extend at least 5 mm beyond the end of the receiver or earmold.

3. Upon initiating the Live Real-Ear “Measure and Match” routine, the fitted hearing aid will generate a speech-shaped noise from its receiver. The user may select up to three presentation levels to verify the prescribed compression parameters.

4. Via the inserted probe tube, the hearing aid microphone measures the REAR as a function of frequency and sends these data back to the Inspire 2010 software. Figure 2a shows an example of this measurement and how it compares to the “Predicted Best Fit” response. Note that in this example the high-frequency aided output is 5 dB above NAL-NL1 targets.

5. The Inspire 2010 software computes the difference between the selected prescribed targets and the measured REAR and automatically adjusts the output to minimize the deviation from prescriptive targets.

6. When the gain adjustments have been completed, the speech-shaped noise is presented again to verify that the automatic adjustment resulted in a better match to prescriptive targets.

7. When the gain adjustments have been completed, the speech-shaped noise is presented again to verify that the automatic adjustment resulted in a better match to prescriptive targets. This second REAR measure is the hearing aid response after the adjustments have been made and is shown in Figure 2b. As this figure demonstrates, the prescribed gain has been reduced by approximately 5 dB to match the prescribed output targets.

(7) The adjustments required for a prescriptively appropriate fitting are stored in the Inspire 2010 software and the S Series hearing aids. At subsequent patient visits for fine-tuning, these stored data will ensure that an accurately calibrated res-
CLINICAL FITTINGS

Averaged data from four hearing aid fittings using the S Series 11 in-the-canal (ITC) hearing aids are shown in Figure 3. The hearing losses were all sloping, mild-to-severe, high-frequency. Real-ear measurements were completed with the Audioscan Verifit system to compare the results of using Live Real Ear to adjust the gains in the instruments with results when this feature was not used.

The NAL-NL1 prescriptive targets are shown in black. The light blue response shows the averaged hearing aid responses before the “Measure and Match” routine. The dark blue response shows the improved match to target after “Measure and Match” was performed. The average initial fitting was 10.2 dB greater than the suggested NAL-NL1 target at 2000 Hz, with a standard deviation of 3.6 dB. The “Measure and Match” routine in Live Real-Ear quantified the difference between the measured “Predicted Best Fit” response for each patient and their prescriptive targets, and then automatically decreased gain in the appropriate channels, resulting in an average response within 2.5 dB of the prescribed NAL-NL1 target, with a standard deviation of 2.6 dB.

SUMMARY

Live Real-Ear enables clinicians to verify patient hearing aid fittings quickly and easily via an in situ aided response without the cost or time commitment associated with manual or external equipment adjustments to prescriptive targets. Offices without access to stand-alone real-ear equipment can improve the starting point of their hearing aid fittings by ensuring that patients have received a prescriptively appropriate fitting. Although a match to prescriptive targets is only the first step toward a successful hearing aid fitting, quantification of hearing aid output should be part of every fitting.

Jason A. Galster, PhD, is Director of Audiology Communications at Starkey Laboratories, Inc. Elizabeth A. Galster, AuD, is a Research Audiologist with Clinical Product Research at Starkey Laboratories, Inc. Readers may contact Dr. Jason Galster at jason_galster@starkey.com.

REFERENCES