

# Clinical practicality of a hand-held otoacoustic emissions unit

By Alan B. Gertner

The clinical efficacy of otoacoustic emissions (OAE), from hearing screening to diagnostic audiology, has been demonstrated.<sup>1-3</sup>

Table-top diagnostic OAE units are priced in the \$10,000 to \$15,000 range. However, the recent introduction of several hand-held units provides opportunities for broader implementation of OAE measurements in the clinical audiology practice.

The hand-held OAE units are affordable, portable, and easy to operate. Therefore, they allow the clinical audiologist both greater access to OAE measurement and additional options that are not found with table-top models. The unit reported on in this article is the Etymotic Research Ero-Scan.

The Ero-Scan measures distortion product otoacoustic emissions (DPOAE). It consists of a small hand-held unit with built-in memory, which retains up to 50 DPOAE readings, and a small base attached to a strip-chart printer. The base and printer consume only about 12 inches, so the system is extremely compact.

The hand-held unit, which is the heart of the system, is set to follow a default measurement program, or it can be customized. The current default program is as follows:

- Number of frequencies tested = 3
- Frequency range = 2000 Hz to 4000 Hz
- P1 = 65 dB SPL
- P2 = 55 dB SPL
- Averaging time = 2 seconds
- Pass SNR = 5 dB
- Number of passing frequencies for overall test pass = 3

This default has proven, in infant hearing screening programs, to provide appropriate sensitivity and specificity. According to Christensen and Killion, "...this criterion will miss an ear with hearing loss ranging from moderate to profound 1 in 100 times. Thus it follows that significant bilateral hearing loss will be missed 1 in 10,000 times with this criterion."<sup>4</sup> In addition, experienced testers demonstrated comparable performance between the ILO table-top diagnostic OAE unit and the hand-held Ero-Scan.<sup>4</sup> The degree of success is apparently related to the operator's experience and learning with the equipment.

## EXPERIENCE IN A CLINIC

Over a recent 6-month period, I have integrated the Ero-Scan into my practice, which includes a university audiology clinic and a private audiology practice.

To achieve competency with the equipment took me 1 to 2 months for infants and toddlers and about 1 week for older children and adults. (There is a learning curve that depends upon volume of testing and experience.) In addition, testing infants and young children required some slight adaptations.

For instance, two techniques that proved helpful for testing infants were the following: (1) Just before placing the probe in the external auditory canal, I desensitized the infant by applying some gentle but firm pressure with my finger to the concha area; (2) I warmed the probe tip, slightly, prior to using it.

This combination made young children more accepting of the probe tip and quiescent during testing. I also found, with help from Laurel Christensen, PhD, at Etymotic Research, the most successful stimulus and test parameters for my infant population. For example, I reduced frequency stimuli from six with a 0.5-second duration for each, to three, with a 1-

second duration for each. This achieved better sampling and produced more reliable results. (Note: My equipment used an earlier software package. Its default program tested six frequencies at half a second each. Following extensive research, field testing, and modifications, the program for the Ero-Scan has been revised to the current parameters, which are described above, as the default program.)

## BENEFITS OF A HAND-HELD UNIT

Clinically, I have found that the hand-held OAE unit is an asset. Important clinical benefits include confidence and assurance gained by an objective cross-check measure for pediatric hearing assessment and the ability to specify the site of lesion of a sensorineural hearing loss as sensory vs. neural.

Of course, these benefits are present with all OAE equipment, but the hand-held unit has allowed me to

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get results that would otherwise be unattainable. I have obtained OAE measurements from children who were lying on the floor, had fallen asleep in carriages, or had been attached to multiple monitoring wires and machines. The hand-held unit has also permitted testing and retesting of adult patients who have moved from room to room (perhaps undergoing ENG or EP testing) or at an outside location, such as a hospital or long-term care facility.

### SOME TEST SCENARIOS

Following are some examples of how I have used the hand-held unit:

#### *Baby J*

Baby J was referred by the local neonatologist to rule out hearing loss. The infant was premature (32 weeks gestational age) and suffered from respiratory distress syndrome (RDS) and hyperbilirubinemia. Baby J was wide awake during the office visit and cried frequently. Following a 20-minute waiting period, during which we attempted to quiet the infant, I asked the parents to take Baby J for a car ride.

When they returned, I warmed the probe tip and proceeded to the car. While the baby slept in the car seat, I began to desensitize the infant by applying pressure with my finger in and around the concha and concha-meatal opening. I then inserted the probe in the infant's ear. Distortion products were measured and the infant passed the screening.

The ease with which I was able to transport the probe unit, manipulate it in the confines of the car, and test the sleeping infant made testing feasible. Without the hand-held unit we would have had to wait for possibly an hour or more until the baby fell asleep, or we would have had to reschedule and arrange for sedatives and ABR testing.

#### *Child T*

Child T was 28 months old and diagnosed with pervasive developmental delay (PDD). Because of delays in speech and language acquisition, he was referred by his pediatrician to rule out hearing loss.

The child initially conditioned to visual reinforcement audiometry (VRA). However, he quickly lost interest in the activity and his response fatigued. I attempted conditioned play audiometry (CPA), but the

child's responses were inconsistent. Calibrated noisemakers confirmed gross hearing and fairly appropriate localization. All evidence pointed to "fairly good" hearing acuity, but further testing was indicated for confirmation and threshold information.

The child was content to lie on the floor and play with plastic rings. I had his mother engage him with the rings while I, on hands and knees, manipulated the hand-held unit and obtained excellent DPOAEs. Again, if not for the freedom and versatility of the hand-held unit, testing could not have been completed.

#### *Ms. L*

Ms. L, a 40-year-old woman, complained of tinnitus and difficulty hearing, especially in the left ear. Her history included multiple sclerosis. Audiologic examination demonstrated a bilateral sensorineural hearing loss. The right ear was normal through 4000 Hz with a moderate falling loss from 6000 Hz through 12,000 Hz. The left ear had a moderate-to-severe sloping loss, from 250 Hz through 12,000 Hz. Word understanding at most comfortable level (MCL) was good in each ear and PI-PB (performance intensity function for phonetically balanced word lists) testing did not produce significant rollover.

Tympanometry was normal, reflexes were present at appropriate hearing and sensation levels on the right, but were absent on the left.

ABR testing produced normal waveforms with appropriate interpeak latencies on the right. The ABR was not reproducible on the left.

When the ABR exam was finished, I carried in the hand-held OAE unit and, prior to her leaving the ABR room, I documented distortion products through 3000 Hz on the right, with no distortion products observed on the left. This confirmed cochlear involvement and helped rule out exacerbation of the patient's MS.

At her neurologist's request, we scheduled serial monitoring of her DPOAEs over a 3-month period. Although Ms. L had an extremely tight work calendar, we arranged for her to stop in on her way to or from work. Using the hand-held unit we were able to accommodate her hectic schedule by testing her in any of our exam rooms, the hearing aid lab, or even in a hallway chair. This made serial testing

convenient and easy to accomplish.

For hospital and other out-of-office consultations the hand-held unit allows fast and reliable testing. For instance, upon receiving a hospital's STAT consult

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to screen a meningitic child's hearing, it is useful to carry an otoscope and the hand-held OAE unit. This satisfies the initial STAT concern regarding normalcy of peripheral hearing acuity, after which further testing is appropriately scheduled. If the noise floor is quiet enough, testing can even be performed at bedside.

### CONCLUSION

The true portability and remarkable flexibility of the hand-held Ero-Scan, coupled with its affordable pricing, has demonstrated to me that a hand-held OAE unit is an extremely useful, versatile, and cost-effective addition to an audiologic office. HJ

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**Alan B. Gertner, MA**, is an Assistant Professor of Kean University. He is also a doctoral candidate at Columbia University. Correspondence to the author at Speech-Language-Hearing Science Program, Department of Special Education, Kean University, 1000 Morris Avenue, Union, NJ 07083, or e-mail: agertner@tulio.kean.edu.

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