Auditory disorders in patients with normal peripheral hearing acuity have long been recognized. Many of these patients report considerable difficulty listening in less than optimal environments, such as in the presence of reverberation or with unfavorable signal-to-noise ratio. Karlin (1942) stated that “...conventional auditory acuity tests have little predictive value of auditory behavior in more complex social situations.”

In the 60 years since Karlin’s statement, recognition of these clinical populations, often generally classified as having auditory processing disorders (APD), has grown, and yet is often dismissed by audiologists based on conventional audiometry results and/or the belief that even if a disorder is identified, effective treatment does not exist or the listener will not pursue treatment.

Patients with APD can often benefit from signal-to-noise ratio enhancement, greater than what can be provided merely by attending to room acoustics. The Phonak MicroEar is a product designed for patients with normal hearing acuity who require additional signal-to-noise ratio enhancement. It is tool which can be used as part of a comprehensive rehabilitative approach to treatment for these patients. This product is designed to be an ear-level self contained unit with electroacoustic characteristics designed to accommodate normal peripheral hearing acuity. In addition, a number of transmitter options are available which allows the listener to be able to maximize flexibility depending on their listening needs. Clinical findings and clinical experiences with the Phonak MicroEar will be highlighted in this paper, including specific case history findings and funding options available.

The focus of this paper is on adult listeners, with needs that may be very different from those anticipated and/or required in more traditional uses of FM technology, such as in a classroom environment. These patients are referred to audiologists by a number of other professionals, including psychologists, neuropsychologists, neurologists, and otologists. These patients are often “self-selected” in that they clearly perceive that their “loss of hearing” impacts their communication function. Often, FM is not considered as a potential aspect of remediation, due to the perception that patients will either not utilize and/or pay for this type of device. However, this technology can prove to be one which most effectively addresses the most pressing presenting concern: the inability to hear well in less than optimal environments when multiple talkers are present. This type of ear level technology may also be of benefit to children who require this type of signal-to-noise ratio enhancement, including those with auditory processing disorder, unilateral hearing loss, or fluctuant hearing loss, due to otitis media.

For patients with normal hearing acuity to be considered as candidates for an FM device such as the MicroEar, a process similar to that for consideration for use of any FM technology should be considered. Careful case history and description of current levels of hearing/listening difficulties must be documented. Use of one of many self-assessment questionnaires may be beneficial in this decision making, including analysis of the Hearing Handicap Inventory in Adults (HHIA) (Newman, Weinstein, Jacobson, and Hug, 1990; Newman, Jacobson, Hug, and Sandridge, 1997.) Performing a comprehensive auditory processing assessment must be conducted in order to develop an understanding of listening difficulties and help to
direct rehabilitation. Counseling related to results of assessment and how results are related to communication difficulties experienced must be addressed.

Recommendations for addressing communication difficulties reported and verified by results of an auditory processing evaluation are often considered as a “triad” approach: environmental modifications, compensatory strategies, and direct therapy. Environmental modifications include both modifications of the listening environment and use of technology which can enhance the listening environment. Success with use of such technology is based on a number of factors, including helping the patient to clearly understand personal FM technology, appropriate expectations for this type of technology, and limitations of this technology. As mentioned previously, the Phonak MicroEar product is an FM receiver designed for population of patients with normal hearing acuity. It has electroacoustic characteristics designed to address listeners with normal hearing acuity. The receiver is available in both BTE and ITE options and is compatible with a number of Phonak transmitter options available that allow consideration of a number of factors including cost and desired listener flexibility.

Fitting considerations for a device to be placed on an ear with normal hearing acuity are paramount to success with a device such as the MicroEar and must be considered to assure maximum benefit while assuring preservation of hearing acuity. The ASHA (2002) Guidelines for Fitting and Monitoring FM Systems provide direction for verification of fitting of a FM device in terms of overall gain and output characteristics of a given device. The general goals are to provide appropriate signal-to-noise ratio enhancement while verifying a “transparent” or “zero gain” system. As this guideline assumes devices fit to listeners with peripheral hearing loss, an earlier ASHA Technical report addresses specific considerations related to fitting FM technology to listeners with normal peripheral hearing acuity.

Electroacoustic verification of fitting is critical to assure that the device is fit appropriately, however of equal importance is validation of fitting. This validation is key to helping the user understand the benefits of the MicroEar and limitations that will need to be addressed by other strategies or technologies. In adults, validation may include use of a diary and use of an outcome measure similar to those used for the fitting of hearing instruments, such as the Client Oriented Scale of Improvement (COSI) (Dillion, James, and Ginis, 1997). With children, the Listening Inventory for Education (LIFE) questionnaire (Anderson and Smaldino, 1999) provides additional data in order to verify benefit in the actual listen situation as observed by both the user and by the teacher or others in the educational environment. Speech in noise protocols can also provide some objective information regarding benefit, including obtaining word recognition scores at 50 dB HL, 35 dB HL, and 50 dB with noise at +6 s/n ratio or use of a speech in noise test, such as the Speech Perception in Noise (SPIN), the Hearing in Noise Test (HINT), or the Quick Speech in Noise (Quick SIN). Speech in noise protocols will vary based on listener need and expectation.

Based on the experiences with twenty-one adult patients using the Phonak MicroEar system, some general observations regarding fitting can be made. The BTE style was consistently selected by every patient, as the ITE option was reported as not being comfortable and the “one size fits all” appeared to be much more of “one size fits none.”

In addition, it should be noted that all adults choosing a trial of a MicroEar were very motivated to improve their hearing/listening abilities, and cosmetics appeared to be a tertiary issue when compared to determining potential benefit from technology. As an aside, patients found that the hassle of changing the battery in the MicroEar ITE receiver made this an inconvenient choice and most reported they preferred BTE in terms of ease of use. In general, the BTE receiver was coupled to an open earmold fabricated from a semi-rigid material. Binaural fitting was generally recommended, however patient preference revealed a preference for monaural fit in about 1/3 of all patients. However, cost issues also drive monaural vs. binaural decisions. Patients preferred the Phonak TX3 transmitter (“Handimic”), which maximized flexibility, particularly in some of the most reported “trouble” situations, including listening in an automobile, listening in a medium to large meeting setting, and hearing effectively in group situations, such as restaurants.

The clinical protocol used with these patients required either medical clearance or a signed hearing aid waiver provided prior to the fitting of the MicroEar device. Many of these patients had been referred by physicians, and obtaining medical clearance was both allows communication with the physician and provides information regarding a potential solution for the patient. Physician understanding of this solution may be an important component in addressing
funding options, as the more support and agreement a third party payer has from professionals involved with the patient, the greater likelihood that the solution may be covered.

All of the patients of the twenty-one reported here have what would be described as neurologically-based auditory disorders, all with essentially normal peripheral hearing acuity. Of the twenty-one patients that participated in a trial of the MicroEar system, 10 opted to purchase the system at the end of the trial. Of the patients who opted not to continue use with the MicroEar system, a number of reasons were offered, including what was described as the “hassle” of using remote microphone technology, changes in lifestyle that reduced the number of situations the person found to be problematic, deficits, lack of support of use in the daily listening environment, and cost.

Funding sources that covered the MicroEar system include Bureau of Worker’s Compensation (BWC), Bureau of Vocational Rehabilitation (BVR), and local school districts. Currently, several requests to third party insurance payers are pending. The key to coverage appears to be careful documentation of success during a trial period. Success for some payer sources certainly includes how use of the MicroEar may improve listening in the academic setting or allow an employee to be a more efficient communicator. This type of documentation is time and labor intensive on the part of the audiologist, therefore although the MicroEar is an easy product to fit, follow-up may take more time consuming for the audiologists “traditional” amplification options, even when a third party resource is utilized.

Three cases are presented here that illustrate potential clinical benefits from the Phonak MicroEar system.

Case 1

The first case is that of a 40 year old female, referred by her speech/language pathologist at a major rehabilitation hospital where the patient was an inpatient. She fell what she described as “head over end” down about 15 stairs in a stairway at work and hit her head 1½ years prior to initial appointment at clinic. Her initial inpatient hospitalization was at a community hospital with the primary diagnosis of concussion and for treatment for injuries to her back, legs, and hands. During her hospitalized at the rehabilitation hospital, she had experienced considerable upper body recovery, although difficulty with fine motor skills persisted.

Her major auditory complaint was difficulty concentrating when background noise was present. She descried speech as “distorted” and “echo-y”. Because she was unable to drive, her husband drove her where she needed to go and she described that she required “total silence” in the car in order to converse. Socially, she no longer wanted to participate in conversations and described that conversing with others was “exhausting.” Obviously, her listening abilities impacted her socially; however she was also impacted vocationally, as she held a professional position that required auditory-oral communication as a significant aspect of her employment. History of hearing loss and/or learning disability prior to this accident was denied.

This patient experienced vertigo immediately following accident and reported nearly constant dizziness. In addition, she reported constant tinnitus and hyperacusis with onset immediately after the accident. At her initial audiologic appointment, she arrived with earplugs, which she was utilizing during nearly all waking hours, which had been suggested by her family physician. Language issues were described as “mild-moderate receptive deficits, characterized by processing delays, and an observed difficulty to tolerate noisy environments.”

Initial audiologic assessment following the accident revealed normal hearing acuity and normal middle ear functioning bilaterally, with normal word recognition scores in quiet. Auditory processing assessment revealed significant deficits in dichotic listening abilities, with dichotic results on SCAN-A (Competing Words and Competing Sentences) both at the 1st percentile and results of the Staggered Spondaic Word (SSW) test demonstrating all conditions greater than 2 standard deviations from the mean with left ear performance poorer than that of the right ear. In addition, her performance on the Auditory Figure-Ground subtest of SCAN-A fell in the 1st percentile. Other tests in the auditory processing assessment demonstrated normal performance. It should be noted, however, that this patient demonstrated a number of behavioral difficulties in the test battery including extremely slow responses and the need for frequent breaks. She reported that she was “exhausted” by completion of test battery and these behavioral issues were reported as representative of her daily listening
experiences. No evidence of malingering was observed.

A number of recommendations were offered to address auditory deficits reported and identified in the assessment. These included a trial use of Phonak MicroEar, based on her commitment to improve communication skills, concurrent enrollment in language treatment, and consistent complaints regarding listening in background noise. In addition, addressing hyperacusis and tinnitus were priorities based on how debilitating these issues were to her. The initial trial of the MicroEar was an abysmal failure as she reported that she “hated it.” The main issue, in retrospect, was that the tinnitus and hyperacusis were her major issues and should have been addressed prior to addressing auditory processing concerns. She was counseled to discontinue use of ear plugs and receive treatment for hyperacusis and tinnitus.

She returned to the clinic 9 months after initial trial with the Phonak MicroEar and requested that she be able to try the system again, as now her tinnitus and hyperacusis were more less bothersome to her, however still present. During this trial, she had considerable success with MicroEar. She reported that her ability to listen in social situations improved. Her listening in noisy environments was reported as “less stressful” and she found listening to be less fatiguing. In addition, her previous somatic complaints which she attributed to listening (e.g. headaches) had reduced significantly. She considered this device a success and continues to use it several years after initial fitting. She has also participated in a formal tinnitus/hyperacusis retraining program.

Case 2

A 43 year old woman was referred for audiologic consultation by her psychologist and neuro-opthalmologist. Her initial concerns had been related to visual processing and she was diagnosed with underlying neurologic issues related to the visual system. In addition to visual concerns, she had a long history of unilateral hearing loss of the left ear. She reported that she originally had stapedectomy surgery at age 16, which did not improve hearing acuity. Results of an audiologic evaluation performed at age 35 revealed a severe to profound unilateral sensorineural hearing loss for the left ear, at which time she had started to note a greater degree of communication difficulty with her long-standing unilateral hearing loss. At that time, she was fit with a CROS hearing aid on a trial basis; however she noted that it “drove her crazy” and she discontinued use of the hearing aid. At age 40, she had an otologic examination in which she was told that she had “cilia damage”, thought to be the result of measles she had at age 5.

At the time of the initial evaluation, she owned her own business, however had recently returned to college as a humanities student, with the goal to obtain a graduate degree in the area of “conflict management.” She stated that she believed she had adapted well to her unilateral loss until recently and believed her major listening concerns were related to her normal hearing right ear. She noted that in class listening situations, she experienced what she described as considerable difficulty with hearing and listening, particularly in large group situations or where background noise was present.

At the time of the audiologic evaluation, she demonstrated normal peripheral hearing acuity for the right ear and severe to profound cochlear hearing loss for the left ear, with excellent word recognition for the right ear and very poor skills for the left ear. Auditory processing assessment could not be performed due to unilateral hearing loss and nature of her complaints. Word recognition abilities in noise were assessed however results were difficult to interpret due to lack of binaural hearing. An auditory brainstem response (ABR) was performed on the right ear at the request of neuro-opthalmologist and the results were found to be normal.

Based on the results of the audiometric assessment and the patient’s complaints, a number of recommendations were offered. Initially, a hearing aid was recommended for the left ear based on the “don’t assume it’s dead until you poke at it” philosophy. Hearing aid use for that ear had never been initiated and this recommendation needed to be pursued prior to pursuing other options. A trial use of a digital hearing aid with directional microphone in the left ear was not successful as she reported that she found it “distracting” and it provided no benefit in localization of sound. A trial of the MicroEar was initiated in the right ear and she reported immediate benefit. She found the use of the remote microphone technology to be of benefit in many of her most problematic listening situations, including in dealing with clients in her business, in listening to others speaking in the car, and most significantly, in the classroom.
environment. She stated that it had enhanced her ability to listen in class. Based on her documented success with the MicroEar on a trial basis, her local Bureau of Vocational Rehabilitation (BVR) purchased the system for her. Ironically, her BVR counselor referred two other “clients” for assessment and consideration of the MicroEar, as this was an option that had not been considered previously and appeared to address the issues reported by these patients.

Case 3

An eight year old boy was referred for assessment of “problematic” listening skills. He reportedly misheard instructions, and his mother noted that auditory information did not “register with him.” Both his mother and his teacher reported delayed responses to auditory-oral instructions. Psychological assessments performed privately and at school both revealed superior cognitive abilities. At the time of the initial audiologic assessment, the etiology of what were suspected to be progressive neurologic deficits were being explored. He was experiencing regression in language skills, and increase in soft neurologic signs and “clumsiness.” His mother stated that he was no longer able to respond to rote information “automatically” as he had been able to in the past and parents and classroom teacher had observed that he demonstrated periods of “blanking out.”

The audiologic evaluation revealed normal peripheral hearing acuity bilaterally, with normal middle ear functioning bilaterally. Auditory processing assessment results were generally within the range of normal, however results on the SCAN-C revealed a total score of 94, resulting in more than two standard deviation discrepancy between auditory processing scores and cognitive/achievement scores. Since identification of learning disabilities can be defined by scatter and discrepancy, discussion with the multifaceted evaluation team at his school resulted in agreement that he would be classified as a child with an auditory processing disorder, and his classification at school would be “other health impaired” (OHI).

A number of recommendations were offered to address listening concerns at school. Based on the options suggested, he and his family wanted to use the Phonak MicroEar as a school-based FM on a trial basis. His situation was certainly complex in terms of apparent progression of deficits with an etiology at the time of this writing as not identified. He was a motivated child who had support of both school personnel and his family. The general consensus was that the MicroEar would provide greater signal-to-noise ratio enhancement for him than the classroom soundfield FM system that he had previously tried with some success.

He was very successful with binaural MicroEar receivers and a TX3 transmitter which he utilizes at school. His classroom teacher has made several significant observations including a general improvement in his listening abilities and a shorter time to respond to auditory information, particularly on novel information. He reports less listening fatigue. Significant support for adoption of the MicroEar technology was provided based on LIFE questionnaire responses provided both the teacher and the child, both in comparison to the no technology option and the soundfield FM condition. His classroom teacher has also commented on the flexibility this system provides in comparison to a classroom listening system. The school district has opted to purchase the MicroEar system as part of the accommodations offered to this child.

Summary

The Phonak MicroEar can provide an excellent solution for patients identified as having auditory processing disorders. It is designed to address specific listening needs of patients with normal peripheral hearing acuity. It provides an FM option that can alleviate many of communication issues reported by patients, which is especially true in adult patient population who believed they would need to “learn to live with difficulties” based on their understanding that because they have a normal audiogram, no options were available to them. The MicroEar is one option in a comprehensive approach to management and remediation of auditory processing disorders, but is an effective approach for addressing the signal-to-noise ratio issues that patients often report as one of their most difficult situations.

References


