AUDIOLOGICAL RESEARCH DOCUMENTATION

News from Oticon

August 2006

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Amplification for People with Severe and Profound Hearing Loss

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Introduction

Introduction:

People with severe-to-profound sensorineural hearing loss (SNHL) are a minority of the total population of people with hearing loss. However, as hearing loss increases, so too, does individual variability. Therefore, people with severe-to-profound SNHL require significant attention to effectively and appropriately address their unique and life-long hearing needs.

In this article, we'll discuss issues and considerations related to fitting people with severe-to-profound SNHL with multi-channel non-linear hearing aids.

Severe-to-Profound Hearing Loss

Severe-to-Profound Hearing Loss: Demographics and Related Issues

Although exact numbers are unknown, there are likely between a half million (Blanchfield, Feldman, Dunbar, 1999) and one million (Mohr, Feldman et al., 2000) people in the USA with severe-to-profound SNHL. In addition to their challenging and dynamic amplification needs, these same people need appropriate and pragmatic educational opportunities, social services, occupational flexibility, adaptation and accommodation and other supportive services. Seniors aged 65 years and older represent about 54 percent of the severe-to-profound hearing loss population, adults between 18 and 64 years represent 38 percent and people under 18 years represent about 8 to 10 percent of the severe-to-profound SNHL population (Blanchfield, Feldman and Dunbar, 1999).

Educational and social trends for people with severe-to-profound hearing loss were reported by Blanchfield, Feldman and Dunbar (1999). The majority of people with severe-to-profound hearing loss had substantially less income than typical Americans, 44% did not complete high school and only 5% graduated from college. Among adults between ages 18 and 44 years, 42% with severe-to-profound hearing loss were not in the work force.

Mohr, Feldman et al. (2000) determined people who acquire severe-to-profound SNHL post-lingually, cost society about $297,000 in reduced work productivity and special education resources across their expected lifespans. For people with severe-to-profound hearing loss acquired pre-lingually, the cost is over one million dollars. Kochkin (2005) reported hearing loss negatively impacted household income based on 1,891 hearing aid user households and 1,949 non-user households. Those with the worst hearing losses earned 12 thousand dollars less annually than those with mild hearing loss. Importantly, for those who wore hearing aids, the negative financial impact was reduced by half.

Quality of Life and Hearing Aids:

Quality of Life and Hearing Aids

Hearing aid wearers experience improvements in their quality of life (QOL) through hearing aid amplification. Harless and McConnell (1982) noted a better self image for hearing aid wearers. Mulrow and Aguilar et. al. (1990) noted hearing loss is associated with adverse effects regarding QOL of elderly persons, and those effects are reversible with hearing aid use. The National Council on the Aging (NCOA, 1999) found the majority of hearing aid wearers reported significant improvement in QOL while wearing hearing aids, better relationships, improved feelings about themselves and improvements in attitudes and outlook. Cox, Alexander and Gray (2005) reported people who use hearing aids live healthier, happier and longer lives than those who do not.

Therefore, hearing aids improve the quality of life for those requiring amplification and hearing aids facilitate successful personal and financial outcomes for the wearer, year after year, across the lifespan.

Traditional Linear Hearing Aid Fittings for Patients with Severe-to-Profound Hearing Loss:

Traditional Linear Hearing Aid Fittings

Historically, many of us were taught that when managing patients with severe-to-profound hearing loss, power and super-power linear BTE hearing aids were the best choice. Our mentors spoke about "volume junkies" and their need to perceive extraordinarily loud sound to perceive benefit (Venema, 2000). Many difficult-to-fit patients with severe-to-profound hearing loss are not willing to listen to a "softer" or a "mushy" sound, such as what might be initially perceived via WDRC during the first days and weeks of a new hearing aid fitting. Dillon (2001) noted that indeed, some patients may not achieve an advantage using WDRC (as compared to linear amplification). However, he noted WDRC is most likely to be advantageous and it makes sense to select WDRC for essentially all patients..

Compression Fittings for Patients with Severe-to-Profound Hearing Loss:

Winter and Eisenberg (1999) noted WDRC advantages for infants with mild-severe SNHL. In contrast to linear hearing aids with only one target response, WDRC produces a spectrum of targets to compensate for various input

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Marriage (2005) evaluated 15 children with severe-to-profound SNHL. All were fit bilaterally with high power, multi-channel compression hearing aids using three different processing strategies: linear with peak clipping, linear with compression limiting, and WDRC. DSL targets were confirmed. Each strategy was worn for a week using a round-robin, counter-balanced protocol. All participants benefited from WDRC. WDRC allowed better performance than other strategies in some instances and WDRC performance was never worse than the other strategies.

DSL m[i/o] v5.0

DSL m[i/o] v5.0

The updated version of the Desired Sensation Level (DSL) fitting rationale was released in 2005 (Scollie, Seewald, Cornelisse et al., 2005). "DSL m[i/o] v5.0" refers to the multistage input/output algorithm which adjusts and compensates for the highly variable input levels hearing aid wearers are exposed to daily. There are many unique aspects of "DSL 5.0" including: specific recommendations (prescriptions) for severe and profound SNHL, corrections for conductive hearing loss, specific adaptations for binaural fittings, and DSL 5.0 offers separate hearing aid fitting prescriptions for pediatric and adult application.

Oticon Advanced Technology Hearing Aids

Oticon Advanced Technology Hearing Aids:

Within the Oticon product portfolio there are many "power" models containing advanced technology for people with severe-to-profound SNHL: Syncro, Tego, Tego Pro, Gaia, Sumo DM and Safran. Of those, Sumo DM and Safran have been specifically designed for use with DSL m[i/o]5.0.

Sumo DM was designed for adult and pediatric application for those with severe-to-profound hearing loss. Sumo DM is a digital instrument with an MPO of 140 dB, peak gain of 82 dB, has a status light to verify the unit is on, is the smallest 675 BTE on the market, has TriState Noise Management to maintain the speech signal and add listening comfort in noise, and has Dynamic Feedback Cancellation.

Safran was introduced in 2006 and also incorporates DSL m[i/o] 5.0 as the hearing aid fitting rationale-of-choice for children. Safran is a full-featured, 8 channel digital hearing aid, with a power version for severe-to-profound hearing loss. Safran can be used with Oticon's Corda thin tube solution and features Voice Aligned Compression (VAC), Full Directionality and Adaptation Manager to allow hearing aid adaptation and has a modulation-based noise management system, wide range bandwidth and Dynamic Feedback Cancellation.

FM Considerations

FM Considerations for People with Severe-to-Profound Hearing Loss

As hearing loss increases, so too does variability. For people with severe-to-profound hearing loss, additional situation-specific (i.e., classroom, television, radio, telephone, etc.) solutions are beneficial. FM systems which easily attach to personal hearing aids facilitate improvements with respect to figure-ground listening problems and listener fatigue while improving the signal-to-noise ratio, eye contact, speech perception and speech recognition (see Beck, Doty-Tomasula, Sexton, 2006)

The new Oticon Amigo FM system (released 2006) combines portability, easy-to-use FM fitting and programming, increased durability, advanced speech signal processing, easy and secure physical connections and compatibility with all FM systems in the 216 MHz range (Beck, Doty-Tomasula and Sexton, 2006).

McArdle, Abrams and Chisolm (2005) reported of nearly 200,000 VA patients fit with hearing aid amplification, some 25% had severe-to-profound hearing loss. Of the potentially 50,000 eligible veterans who might be eligible to receive a cochlear implant, only 50 were implanted in 2004. Nonetheless, some 1,100 FM systems were issued to veterans with severe-to-profound hearing loss during 2004. The authors reported some patients fit with FM systems were so pleased that they removed themselves from cochlear implant candidacy. The authors reported their technique for verifying a smooth spectral response through the FM system based on real ear insertion gain (REIG).

Real Ear Considerations

Real Ear Considerations for People with Severe-to-Profound Hearing Loss:

Real-ear measures are grossly under-used in the USA. Recent reports indicated only one in three audiologists uses real-ear measures on a regular basis (Mueller, 2005). Although there are likely many reasons for the lack-of-use, one reason may be the majority of hearing aids are fit on post-lingually hearing impaired adults with mild-to-moderate SNHL. Perhaps professionals presume their adult, mild-to-moderate hearing loss patients will accurately report their auditory impression of amplified sound, and then the professional will "tweak" the program to satisfy the patient? However, for adult patients with severe to profound hearing loss, the ability to report aided auditory perceptions is dependent on observations through a distorted sound analysis, secondary to their type and degree of hearing loss. Further, hearing impaired children depend on amplification to develop speech and language skills, while lacking the knowledge, language and repertoire of sound memories necessary to accurately describe aided sound presentations. Further, the restricted dynamic range which accompanies severe-to-profound hearing loss introduces significant subjective perceptual differences. Without objective analysis (i.e., real-ear measures) it is almost impossible to assure comfortable amplification in tandem with protection from over-amplification.

Modern hearing aid fitting rationales with appropriate real-ear measurement and verification allows the professional to verify their hearing aid fittings. We believe real-ear verification of hearing aid fittings is an important and necessary tool for pediatric hearing aid fittings and for severe-to-profound adult hearing aid fittings.

Summary

Summary:

Severe-to-profound hearing loss has a significant impact on children and adults, with respect to their daily lives at home, school, work and recreation. The potential negative impact of severe-to-profound hearing loss is significant across the lifespan and therefore, mandates special consideration.

Combining MCNL hearing aid fitting rationales (such as DSL 5.0 for pediatric hearing aid fittings) with advanced technology hearing instruments maximizes pediatric hearing aid fittings, and improves adult hearing aid fittings for people with severe-to-profound hearing loss.

Although traditional (linear) hearing aid fittings have often been the “go to” hearing aid fitting rationale for severe-to-profound SNHL, there exists a plethora of research reports and case studies indicating the starting point for the majority of these hearing aid fittings would best be served using MCNL hearing aid fittings.

levels. Winter and Eisenberg noted WDRC provides consistent audibility across multiple input levels, without violating loudness discomfort levels (LDLs) and without risk of acoustic trauma.

Non-linear hearing aid fittings for severe-to-profound hearing loss

Marriage and Moore (2003) reported discrimination results for three groups of subjects aged 4-14 years, comparing WDRC and linear amplification. The three groups were children with moderate (51-70 dB), severe (71-90 dB) and profound (91-115 dB) hearing loss. Frequency responses of the test hearing aids were adjusted to match the child’s own hearing aids. Consonant confusion scores were significantly better for the combined (severe/profound) group using WDRC, and although only marginally significant, WDRC yielded better open-set scores, too.

Pogash and Flynn (2003) reported on 15 children (ages 7 to 16 years) with profound SNHL, each of whom was upgraded to MCNL amplification. They reported significant improvements with regard to audibility and speech understanding in quiet and noise. The largest improvements were obtained while listening in adverse listening situations, such as listening in noise or at a distance. Upon conclusion of the study, the children and their parents were asked which amplification system they preferred. Fourteen of fifteen children preferred MCNL, while 15 of 15 parents preferred the MCNL system. Importantly, although 3 of the 15 children were previously considered candidates for cochlear implantation, however, based on their improved speech perception abilities with MCNL amplification, they were no longer considered cochlear implant (CI) candidates.

Flynn, Davis and Pogash (2004) investigated MCNL compression in children with severe SNHL. They evaluated 21 children with severe SNHL at 2 weeks post-fitting, 8 weeks, 6 months and 12 months. The 21 children were previously fit with modern, well fitting hearing aids, which included linear peak clipping (n=7), linear automatic gain control (n=9), frequency transposition (n=1) and two-channel analog units (n=4). Results indicated MCNL amplification provided statistically significant benefits with respect to aided thresholds (making soft sounds more audible) and regarding the children’s ability to understand speech in adverse situations. MCNL also allowed children to listen from a greater distance while outdoors. When asked their hearing aid preference (their own versus the MCNL), 19 of 21 children preferred MCNL and 21 of 21 parents preferred MCNL. The authors concluded MCNL amplification does provide greater access to speech information, and the authors noted the importance of verifying that children undergoing CI evaluation are tested using the best possible hearing aid technology.

Beck and Schum (2005) noted nearly all advanced technology hearing aids use multi-channel non-linear (MCNL) hearing aid fitting rationales to tailor gain and compression characteristics for individual listeners. MCNL amplification allows temporal characteristics of individual phonemes to be maximally maintained to preserve phoneme and speech recognition while allowing comfortable amplification of quiet speech sounds without over-amplifying loud sounds.