INDIVIDUAL DIFFERENCES IN OUTCOMES OF TINNITUS INTERVENTION

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Factors commonly associated with hearing loss, such as age and noise exposure, have close correlations with tinnitus (Steinmetz et al., 2009; Roberts et al., 2010). It is, therefore, not unexpected for patients being tested for hearing loss to also report chronic tinnitus. Effects of tinnitus vary, however, such that only about 20 percent of those who experience tinnitus have it to a degree that is considered clinically significant (Henry, Dennis & Schechter, 2005). The neural mechanisms that contribute to tinnitus are, as of yet, not fully understood; therefore, patients seeking treatment must choose between available behavioral therapies to manage their reactions to tinnitus. Being that so many variables contribute to the impact that tinnitus has on one’s quality of life, it is not surprising that no single management strategy has proven to be a panacea (Stephens, Hallam & Jakes, 1986). An effective approach to tinnitus management may involve a combination of strategies; however, educational counseling should be foundational for any program (Henry et al., 2007).

Ear-Level Devices for Patients with Hearing Loss and Tinnitus

In general, the use of therapeutic sounds, such as those considered soothing or interesting to a patient, can be helpful in minimizing reactions to tinnitus (Henry, Zaugg, Myers & Schechter, 2008). For patients with both hearing loss and tinnitus, it has long been recognized that hearing aids can both improve communication ability and reduce awareness and the functional effects of the tinnitus (Saltzman & Ersner, 1947; Del Bo & Ambrosetti, 2007; Searchfield, Kaur & Martin, 2010). Folmer and Carroll (2006) observed that patients using ear-level devices experienced greater relief from tinnitus than those who did not wear such devices. In recent years, ear-level devices combining amplification with a broadband noise generator (combination instruments) have become an increasingly available option for these patients.

Research Study to Evaluate Combination Instruments for Patients with Hearing Loss and Tinnitus

The recent proliferation of combination instruments raises the question of how effective the added broadband noise is for tinnitus management when compared to hearing aids without this feature. A study recently completed at the National Center for Rehabilitative Auditory Research (NCRAR) in Portland, Ore., examined Starkey Hearing Technologies’ combination instrument, Xino™ Tinnitus*, which provides Multiflex Tinnitus Technology along with amplification. Multiflex Tinnitus Technology generates an adjustable broadband noise signal along with optional modulation that changes the amplitude and frequency response of the noise signal over time, resulting in a sound similar to ocean waves or a breeze. Study participants were fitted bilaterally with the devices and randomly assigned to one of two groups: one that utilized Multiflex Tinnitus Technology and one for which this feature was not activated.
The purpose of this report is to review three individual patients in that study who were each hearing aid candidates and had bothersome tinnitus. We will describe some of the individual differences that characterized these three patients as it related to the level of distress caused by the condition and the management strategies that ultimately turned out to be effective. Exploring such differences and identifying the factors that might facilitate one’s success with a tinnitus management strategy is important for appreciating the importance of individual differences in the delivery of patient-centered tinnitus care.

These three patients had no previous hearing aid experience and each expressed high levels of motivation to try hearing aids and find relief from their tinnitus. Each was subsequently fit with bilateral Xino Tinnitus receiver-in-canal (RIC) hearing aids. Real-ear verification measures ensured that appropriate gain was being prescribed; however, minor adjustments were made to ensure comfort. Table 1 provides a summary of the hearing aid fittings. Immediately following the hearing aid fitting and orientation, patients were counseled on how different types of environmental sounds can be used to manage their tinnitus. They returned for a hearing aid check approximately two weeks from their fitting and then again three months later for outcomes testing.

Comparing Outcomes between Patients

The Tinnitus Functional Index (TFI) was used as the outcome measure to assess changes in reactions to tinnitus. The TFI is a relatively new clinical tool validated for measuring the severity and negative impact of tinnitus, as well as change that can occur as a result of intervention (Meikle et al., 2012). A reduction in score of 13 points in the TFI index score is considered clinically significant (Weinstein, Spitzer & Ventry, 1986). Data logging information was also documented throughout the study. Each of these three patients demonstrated excellent compliance wearing the hearing aids and documented throughout the study. Each of these three patients was the Hearing Handicap Inventory for the Elderly (HHIE), which assesses the emotional and social effects of hearing impairment (Ventry & Weinstein, 1982). A reduction in score of 36 points is considered clinically significant (Weinstein, Spitzer & Ventry, 1986). Data logging information was also documented throughout the study. Each of these three patients demonstrated excellent compliance wearing the hearing aids, as measured by the data logging during their two-week hearing aid check. Patient A continued her high levels of use throughout the study, while Patients B and C reduced their use, though they continued to wear the hearing aids at least part-time. A summary of these results is shown in Table 2.

A number of interesting observations can be made when comparing the experiences and outcomes among these three patients. Despite being randomized to different treatment groups, Patients A and B both showed great acceptance of their hearing aids and demonstrated clinically significant improvements in their TFI and HHIE scores at three months post-fitting. Patient A had Multiflex Tinnitus Technology enabled, which she desired at a fast modulation rate. She found this noise improved her concentration when talking with clients at work, and it provided relief from her tinnitus that was above and beyond that of the hearing aids alone. Additionally, she reported her tinnitus no longer caused social gatherings within her community to be overwhelming. Patient B, alternatively, found comparable relief from his tinnitus by wearing the hearing aids without the Multiflex Tinnitus Technology feature enabled. This individual was extremely satisfied with being able to better hear his wife, friends and the television. He found that this increased audibility resulted in his tinnitus no longer being noticeable. Furthermore, during his final study visit he was provided a demonstration of Multiflex Tinnitus Technology, yet declined it. He founded the added noise impeded his ability

### Table 1: Hearing aid fitting summary.

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Ear Mold</th>
<th>TFI</th>
<th>HHIE Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient A</td>
<td>Closed Dome</td>
<td>83</td>
<td>86</td>
</tr>
<tr>
<td>Patient B</td>
<td>Open Dome</td>
<td>86</td>
<td>52</td>
</tr>
<tr>
<td>Patient C</td>
<td>Open Dome</td>
<td>80</td>
<td>68</td>
</tr>
</tbody>
</table>

### Table 2: Summary of the outcome measures and data logging information for each patient.

<table>
<thead>
<tr>
<th>Post-Fitting: TFI</th>
<th>Post-Fitting: HHIE Total</th>
<th>2-Week Post-Fitting Data-Log</th>
<th>3-Month Post-Fitting Data-Log</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient A</td>
<td>83</td>
<td>86</td>
<td>14 hours/day</td>
</tr>
<tr>
<td>Patient B</td>
<td>86</td>
<td>52</td>
<td>9 hours/day</td>
</tr>
<tr>
<td>Patient C</td>
<td>40</td>
<td>30</td>
<td>12 hours/day</td>
</tr>
</tbody>
</table>

### Individual Differences in Outcomes of Tinnitus Intervention

The second outcome measure administered to the three patients was the Hearing Handicap Inventory for the Elderly (HHIE), which assesses the emotional and social effects of hearing impairment (Ventry & Weinstein, 1982). A reduction in score of 36 points is considered clinically significant (Weinstein, Spitzer & Ventry, 1986). Data logging information was also documented throughout the study. Each of these three patients demonstrated excellent compliance wearing the hearing aids, as measured by the data logging during their two-week hearing aid check. Patient A continued her high levels of use throughout the study, while Patients B and C reduced their use, though they continued to wear the hearing aids at least part-time. A summary of these results is shown in Table 2.

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to listen to others, while reporting that additional measures to improve his tinnitus would be unnecessary.

Patient C demonstrated lower levels of tinnitus severity at baseline relative to Patients A and B, and this may in part be due to his 60-year history of tinnitus and having developed a personalized strategy for coping with it. He was randomly assigned to the group that had the Multiflex Tinnitus Technology feature enabled, which he preferred at a slow modulation rate. After wearing the hearing aids for three months, he reported that they provided him with better speech understanding; however, he found many outdoor sounds to be unpleasant. Given the amount of time this patient enjoyed being outside, this had a negative impact on his full acceptance of the hearing aids. Programming adjustments were made throughout the study to facilitate the acclimatization process, but this patient was not able to achieve full satisfaction. He also reported that the hearing aids and the Multiflex noise did not have a positive effect on his tinnitus. It is noteworthy that during his final study visit, this patient was given the chance for success.

These case studies demonstrate how individuals with comparable conditions respond very differently to tinnitus intervention. Patients A and B were selected for examination because they were similar in age, audiological history, and baseline severity of tinnitus and hearing handicap as measured by the TFI and HHIE, respectively. Both obtained relief from using the ear-level devices, but only one needed the additional broadband noise. While it was not readily apparent through the test measures used in this study, subjective observations suggested that personality and lifestyle demands may have contributed to their different needs. Patient C, alternatively, was not able to find effective relief through counseling, hearing aids and Multiflex Tinnitus Technology collectively. It is possible that factors such as his strict daily regimen, 60-year history of tinnitus and lower scores on the TFI and HHIE all contributed to the limited benefit this patient experienced. Examining patient variables— including demographics, tinnitus characteristics, hearing ability and overall health— might offer insight as to why individuals such as Patient C responded so differently in terms of treatment needs. A prospective study examining how these factors are associated with treatment benefit would shed light on these differences and aid in the overall clinical decision-making process. This information could then potentially be used to develop a treatment plan having the best chance for success.

Conclusion

Hearing aids and combination hearing aid-tinnitus therapy devices can be very beneficial for tinnitus sufferers. The case studies described in this article illustrate the unique nature of each patient with respect to how they respond to intervention for their tinnitus. Certain patient-specific factors may clearly indicate the need for treatment, but little is known regarding how these factors should influence clinical decisions in the management of tinnitus. Identifying the relationship between patient-specific factors and outcomes requires targeted research, which will ultimately improve the clinical services that are offered to these patients and maximize their opportunities for success.

References


Addendum

This study was supported by Starkey Hearing Technologies. As a disclaimer, the Department of Veterans Affairs (VA) does not endorse the products mentioned in this article, and the views expressed do not represent those of the VA.

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* Xino® is a Starkey brand name.