



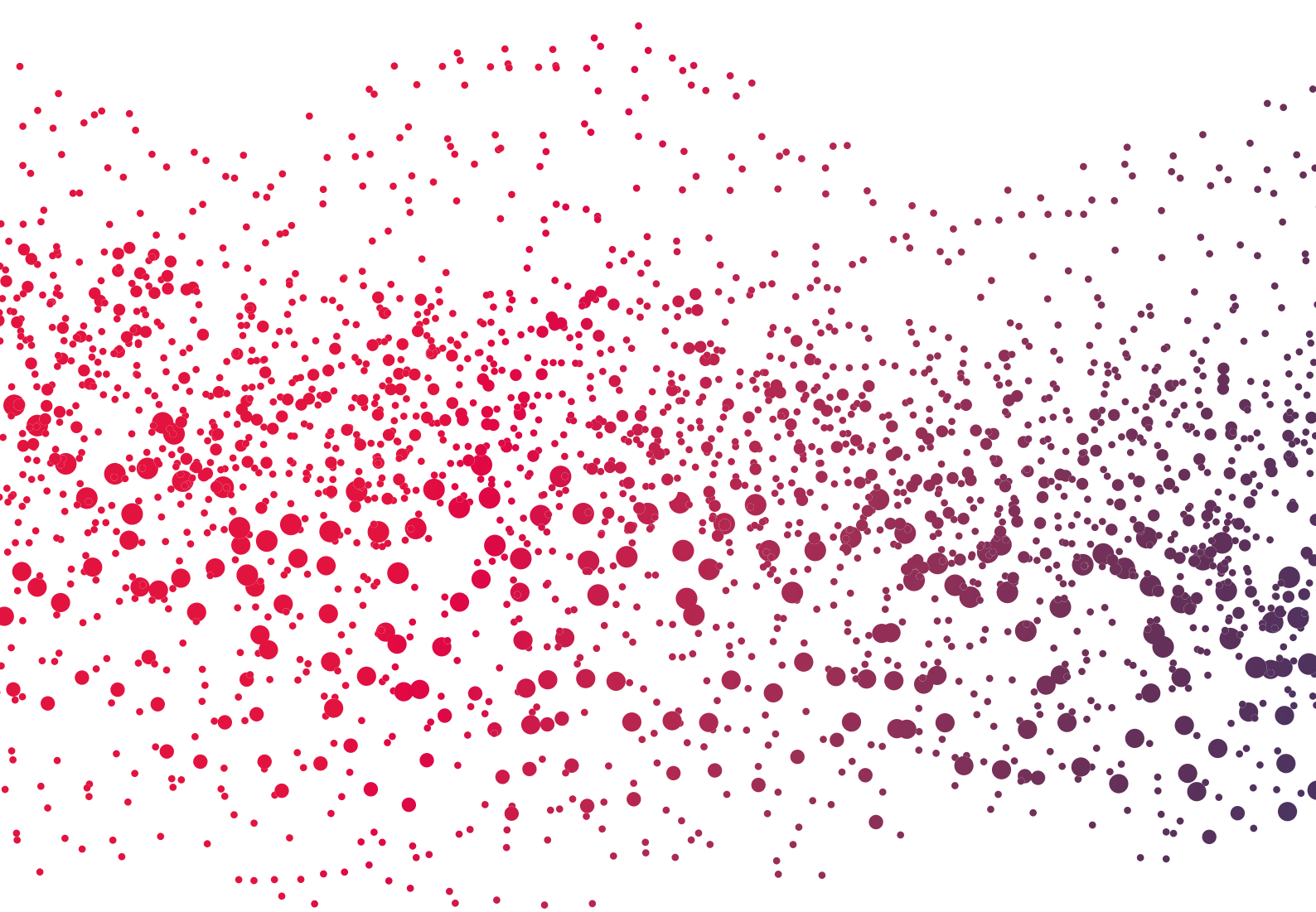
**AMPLIFON CENTRE FOR
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Otology & Audiology Article Review

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Source Localization in children
with Cochlear Implants

Tinnitus Suppression Effect of
Hearing Aids in Patients with
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EDITORIAL



Dear reader, I have 12 years of experience as audiologist in the Aalst Amplifon hearing centre in Belgium. Being the listening partner for people with hearing loss and facing the everyday challenge of improving their quality of life gives me great pleasure and satisfaction.

In order to provide my clients with the best possible service I am a member of the Belgian expertise group which tests and evaluates new technologies and new devices in the world of hearing care. Reviewing articles is another way of gaining insight into the future of the world of hearing care. I believe the best hearing care starts with listening to the experiences of clients and colleagues, and goes hand in hand with never stopping learning.

By writing reviews, I hope that I can share information with other hearing care professionals so they can use it to learn and improve the hearing care they provide.

In this edition, for example, one review shows that the ANL test, which we use in the hearing centre in our daily practice to predict hearing aid success and to provide counselling to our patients and their environment, can be used in hearing screenings to identify potential "hidden hearing loss".

The review about the tinnitus suppression effect of hearing aids in patients with high-frequency hearing loss is very interesting because tinnitus is a common problem (besides hearing loss), and for which good counselling is critical; but little is known about the effects of wearing hearing aids.

And the review of "Musician and nonmusician hearing aid setting preferences for music and speech stimuli" covers one of the persistent issues which arises when adjusting hearing aids: "How can we improve sound quality while listening to music?".

It is a good thing that studies talk about these challenges. They provide information which is important for us to know when adjusting hearing aids. However, we must always remember that every patient is unique, and each patient deserves an individual approach. As hearing care professionals, we have an important role in the hearing rehabilitation process. This is something which is highlighted in the review of "How do hearing aid owners acquire hearing aid management skills": the importance of the relationship between the hearing aid user, his or her family (environment) and the audiologist in order to achieve successful hearing aid use.

Sofie Peeters,
senior Audiologist, Amplifon Belgium.





NOISE EXPOSURE AND BACKGROUND NOISE TOLERANCE IN LISTENERS WITH NORMAL AUDIOGRAMS



Camera S., Tufts J. & Skoe E.
*Journal of Speech, Language,
and Hearing Research (2019):
62, 2564-70*

By Sofie Peeters – Belgium

Higher levels of noise exposure (i.e. higher risk of noise induced hearing loss) was associated with lower background noise tolerance (i.e. poorer ANL results).

The background noise tolerance in listeners with clinically similar audiograms can vary greatly from one individual to another. This research examines the relationship between noise exposure levels and background noise tolerance in listeners with normal audiograms. The study was based on a population of 56 normal-hearing college students (aged 18 to 24) who were participating in college music ensembles. The researchers obtained pure-tone air-conduction thresholds bilaterally at octave and semi-octave frequencies (range 125 Hz-8000 Hz). The Acceptable Noise Level (ANL; Nabelek, Tucker, & Letowski, 1991) scores were obtained and the QuickSIN (Killion, Niquette, Gudmundsen, Revit & Banerjee, 2004) was used to measure the subjects' speech recognition in noise ability. Noise levels in their environment were continuously recorded thanks to noise dosimeters worn by the subjects for seven 24-hr days.

• RESULTS

All pure tone air-conduction thresholds and QuickSIN SNR scores were considered clinically normal. 22 participants were exposed to levels of noise exceeding recommended exposure limits (higher risk NIHL); the exposure for the remaining 34 subjects did not exceed recommended limits (lower risk NIHL). The average ANLs for both groups fell within the low ANL range (<7 dB; Nabelek et al., 2006). The lower-risk group had a mean ANL score of 3.1 dB signal-to-noise ratio, while the higher-risk group scored a mean ANL score of 5.4 dB signal-to-noise ratio. A small but significant relationship between the ANL and noise exposure was found, indicating that higher levels of noise exposure were associated with lower background noise tolerance. Finally, no relationship was found between the ANL score and the years of musical training, thus indicating that the period of noise exposure did not influence the outcome.

CRITICAL NOTE

Although the difference in ANL scores (2.3 dB) is under the threshold of what is considered a minimal clinically important difference, the findings of this study suggest ANL can be used as an index of early noise-induced changes to the auditory system. As such, it could be a valuable tool for identifying hidden hearing loss.

Future studies could fruitfully explore background noise tolerance with a wider age range and a greater array of sources of noise exposure.

• DISCUSSION AND CONCLUSIONS

This study suggests that young adults at higher risk for noise-induced hearing loss (NIHL) have a slightly lower tolerance for background noise when listening to speech. The researchers further hypothesise that the higher risk group may be exerting more listening effort than the lower risk group to achieve similar QuickSIN scores. This would indicate that background noise tolerance tests are preferable to speech in noise tests for identifying possible subclinical hearing loss. Extended high-frequency thresholds (above 8000 Hz) between the two groups should exclude whether the higher-risk group had elevated high-frequency thresholds compared to those of the lower-risk group. Furthermore, electrocochleography shows reduced cochlear output in the higher-risk group (Liberman et al., 2016).

These results, however, should be taken with caution. The ANL scores were obtained before the dosimetry started, and consequently, the authors cannot certify that the ANL scores were directly impacted by noise exposure. In order to determine possible relationships between environmental factors, ANL and subclinical stages of NHL effectively, testing should be performed both before and after noise exposure. •



TINNITUS SUPPRESSION EFFECT OF HEARING AIDS IN PATIENTS WITH HIGH-FREQUENCY HEARING LOSS: A RANDOMIZED DOUBLE-BLIND CONTROLLED TRIAL



Yakunina N., Lee WH., Ryu YJ. & Nam EC.

Otology & Neurotology (2019): 40(7), 865-71.

By Katrien Hoornaert – Belgium

HAs can be an effective tinnitus treatment for patients with High Frequency Hearing Loss, even without additional counselling.

To date, there is not enough evidence that the use of Hearing Aids (HAs) alone without any additional counselling is sufficient to achieve tinnitus suppression. Studies indicate there is a positive tinnitus-suppression effect with the use of HAs. However, the quality of evidence in these studies, as this paper highlights, is weak and unreliable due to the small sample sizes and poor test blinding. In this study, a double-blind randomised controlled clinical trial was performed with receiver-in-the-canal (RIC) HAs. A total of 94 subjects were divided into three groups: 31 in WDRC (wide dynamic range compression); 31 in FT (frequency translation); and 32 in LFT (linear frequency transposition).

The subjects with High-frequency Hearing loss (HFHL) were required to wear the HAs for three consecutive months. Hearing function was assessed at three moments: upon the beginning of the study; after three months; and three months after the HAs were removed. The assessment included a total Tinnitus Handicap Inventory (THI) score as a primary outcome measure. Additional outcomes included: matched tinnitus loudness and visual analog scale (VAS) scores for subjectively perceived tinnitus loudness; annoyance and awareness.

Nearly all variables had improved significantly at three and at six months; except for matched loudness, which only showed improvement at six months and only in

CRITICAL NOTE

It is particularly interesting that a double blind randomised-control design was used. Unfortunately, this concerned only the HA technology, regardless of whether or not counselling was provided. Since the evaluation is based on THI, matched tinnitus loudness and VAS scores for subjectively perceived tinnitus loudness, annoyance and awareness, it is open to debate as to whether this study evaluates exclusively the impact of the HAs or also that of counselling.

the WDRC group. There were no differences in outcome among groups across other criteria at three or six months. At the three-month follow-up, over 65% of the subjects declared that the devices alleviated their tinnitus and wanted to continue wearing the HAs.

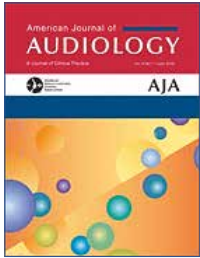
At six months, more than half of all subjects reported improvements of $\geq 20\%$ in THI score. This is all the more significant in that none of them received any tinnitus treatment during the final three months.

Therefore, even without additional counselling, HAs can be an effective measure against tinnitus for patients with HFHL. No significant difference was found between conventional HAs and HAs with a frequency lowering technique. Surprisingly, the positive effects of HAs persists for at least three months after removing the HAs. •





MUSICIAN AND NONMUSICIAN HEARING AID SETTING PREFERENCES FOR MUSIC AND SPEECH STIMULI



*D'Onofrio KL., Gifford RH. &
Ricketts T A.*

*American Journal of Audiology
(2019): 28, 333-47.*

By Jo Ritchie – New Zealand

The results suggest that improving sound quality for speech and music inputs is not as simple as adjusting the gain or compression settings.

There is a long-standing practice of fitting hearing aids (HAs) by adjusting real-ear gain to meet prescriptive targets. These aim to maximise speech recognition and avoid excessive loudness. This means they may not be ideally suited for other sounds, such as music. There have been only a limited number of studies that have investigated the preferences users when listening to music, and those which do indicated that listeners prefer less compression.

The purpose of this research is to determine whether musicians and nonmusicians have different preferences in self-adjusted gain and compression settings for music and speech stimuli. The study also seeks to determine how performance and sound quality differ when hearing aids are set to NAL-NL2 targets as compared to self-adjusted settings.

• METHOD

The study covered a population of 12 musicians (aged 45-72 years) and 12 nonmusicians (aged 23-74 years) HA users with mild to moderate sensorineural hearing loss (on average). The participants were fitted with Starkey 3 Series i110 receiver-in-the canal (RIC) HAs with 50 dB receivers, and non-custom open vent ear tips were used because most participants had normal or near-normal hearing in the low frequencies.

The study consisted of several speech and musical stimuli. The speech stimulus included four variations of a three-sentence excerpt of the Connected SpeechTest (CST), which were played in quiet and in noise on continuous play back while participants adjusted their hearing aid settings. The two music stimuli consisted of a 45-second segment from Rihanna's "We Found Love" and Louis Prima's "Sing, Sing, Sing" played continuously until participants had completed their adjustments. The participants adjusted their hearing aid settings through Starkey's computer-based programming tool called SoundPoint.

CRITICAL NOTE

Overall, the study provided useful information for hearing health professionals regarding the listening preferences of musicians and nonmusicians. The findings suggest that validated prescriptive methods are the preferred method for initialising HA fittings for both musicians and nonmusicians. A limitation of the study is that the findings are generally confined to listeners who have sensorineural hearing loss with a configuration of: (1) either normal hearing or a mild hearing loss in the low frequencies; and (2) no worse than a severe hearing loss in the high frequencies. The results can also only be generalised to subjects who are fitted with large vents and hearing aids with compression systems similar to those used in the current study. Further research is needed to examine the preferences on the part of subjects with more low-frequency hearing loss and less hearing aid venting.

The CST was used for all speech recognition testing. Testing was completed in quiet and in noise, at the NAL-NL2 settings and the participant's self-adjusted settings. A mixed-model ANOVA was performed on the speech recognition data to determine whether speech recognition was different between groups on the one hand and between NAL-NL2 and self-adjusted settings on the other. The subjects assessed sound quality for each of the three stimuli (speech stimulus and the two music stimuli) in the NAL-NL2 setting and the self-adjusted setting across the following dimensions: clarity; pleasantness; naturalness; fullness; brightness; and overall impression. Paired comparisons were used to assess rating of sound quality and strength of preference for the NAL-NL2 and self-adjusted settings for each stimulus. A mixed-model

ANOVA was used to assess whether preferences were different between groups and across stimuli.

• RESULTS

There were no significant differences between the self-adjustments made by musicians and nonmusicians. These self-adjustments were small and quite consistent between the two trials. There was no significant difference in the gain and compression ratio self-adjustments for music and speech inputs for either group. Speech recognition was not significantly different for NAL-NL2 and self-adjusted settings for either group. There was no significant difference in preferences for NAL-NL2 and self-adjusted settings between musicians and nonmusicians or between speech and music stimuli, other than for naturalness. For naturalness, listeners

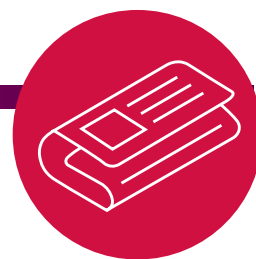
preferred the self-adjusted setting for the music stimuli and the NAL-NL2 settings for the speech stimulus.

• DISCUSSION

The results suggest that improving sound quality for speech and music inputs is not as simple as adjusting the gain or compression settings. Factors other than gain and compression ratios may be the cause of dissatisfaction when HA users are listening to music, and may include things like HA design and damage to the auditory system caused by hearing loss.

Listeners in both groups made adjustments that were not the preferred option. A possible explanation for this is that the adjustments were minimal and so participants may not have noticed a difference in sound quality. •

INDIVIDUALISED ACTIVE COMMUNICATION EDUCATION (I-ACE): ANOTHER CLINICAL OPTION FOR ADULTS WITH HEARING IMPAIRMENT WITH A FOCUS ON PROBLEM SOLVING AND SELF-MANAGEMENT.



Hickson L., Worrall L., Scarinci N. & Laplante-Levesque A. International Journal of Audiology (2019): 58(8), 504-09.

By Anjana Panikkar – Australia:

This paper outlines the I-ACE as an option for adults which can be used as an alternative or a complement to the use of hearing aids. The limitations of the study lie in the small sample size and the lack of a control group.

The fitting of hearing aids (HAs) is the most common treatment option offered in adult audiology clinics. However, if the client is unwilling or unable to proceed with HAs, clinicians often have no other option to offer them. The effectiveness of a group Active Communication Education as an alternative to or in conjunction with HAs had previously been evaluated by the researchers and found to be positive. However, this showed limitations as, often, clients would have preferred individualised guidance rather than group sessions, and some clients found it difficult to attend the group sessions over the required five-week period. For

these reasons, the I-ACE, i.e., the Individualised Active Communication Education, was developed. The I-ACE is similar to the ACE in all aspects except for the method of delivery. Whereas the ACE is a face-to-face group program moderated by a health professional, the I-ACE is a written program designed to educate clients to problem solve and self-manage their communication difficulties as a result of a hearing loss. The program was incorporated into a larger research project by the authors and this paper describes the I-ACE and the results obtained for the clients who undertook it.

• METHOD

Participants: 23 participants with a mean age of 68 years (ranging from 53 to 81), and with a highest level of education ranging from secondary school to postgraduate degrees, mainly presenting with mild bilateral hearing loss. Only one participant had a moderate loss and two had an asymmetrical loss.

Materials Used: The I-ACE was created by converting the ACE modules into written chapters and offered free of charge. The program was tailored to each client based on their Client Oriented Scale of Improvement (COSI) results. Several chapters prompted the participation of significant others in the program. There were no time frame constraints and the participants were encouraged to finish the program at their own pace. Following completion of a chapter, participants gave their feedback to the facilitator at which point the next chapter was sent.

Qualitative feedback was obtained via a questionnaire containing four open-ended questions.

Quantitative results were obtained using the COSI, the Hearing Handicap Questionnaire (HHQ) and the International Outcome Inventory-Alternative Interventions (IOI-AI)

Data Analysis: Statistical analysis (descriptive statistics and T-tests) were calculated to measure the quantitative measures obtained on the COSI, HHQ and IOI-AI and the written qualitative feedback received from the participants was separately studied and recorded.

• RESULTS

1. On COSI, following completion of the program, no participant reported their hearing ability to be worse off, four reported their ability to be no better, 10 participants reported it to be slightly better, six participants reported it to be better and two participants reported it to be much better. The results were similar three months later.
2. On the HHQ, the mean hearing disability prior to the program, following the completion of the program and three months later remained significantly unchanged.
3. On the IOI-AI, most improvement was reported in the dimension of the impact of hearing impairment on others

CRITICAL NOTE:

In adult clinical practice, having a treatment option to offer clients besides HAs is extremely useful. A self-administered program capable of increasing patient awareness of their hearing difficulties along with providing information on how to manage these could be beneficial to clients in the process of just coming to terms with their hearing loss and not quite ready to address it in a group situation or to proceed with the use of hearing aids. This study uses both quantitative and qualitative measures to analyse the efficacy of the program. The limitations lie in the small sample size and the lack of a control group. Therefore, repeating this study with a larger number of participants and including a control group (who receive a placebo training or no training) would provide stronger reasons for clinicians to consider offering this to clients.

and the least improvement was on the quality of life dimension. Similar results were seen both immediately post program and three months later.

4. Participants' responses to the qualitative questionnaire were summarised and revealed that participants recognised that the greatest benefits from the program lie in its ability to draw their attention towards their specific hearing difficulties and become more proactive in managing these. In fact, this improved awareness and proactive approach also prompted some of the participants to start using HAs towards the end of the program.

• DISCUSSION

This paper outlines the I-ACE as a possible option for adults which is an alternative to or a complement to the use of HAs. Positive results were found on both the COSI and IOI-AI questionnaires. The qualitative feedback from the participants was also positive. There was no statistically significant change on the HHQ, but this could be due to the small sample size of only 23 participants. •



PERIPHERAL AND CENTRAL HEARING IMPAIRMENT AND THEIR RELATIONSHIP WITH COGNITION: A REVIEW



Nixon GK, Sarant JZ. & Tomlin D.

International Journal of Audiology (2019): 58(9), 541-52.

By Supriya Cherian – Australia

Out of eight studies investigating a relationship between cognitive decline and central hearing loss outlined in the review, six demonstrated that participants with cognitive impairment obtained poorer scores in CAP tests.

With the rise in elderly population, two major health conditions—hearing impairment and cognitive impairment—are more likely to become predominant in the next few decades. This review was undertaken to determine the relationship between cognition and both peripheral and central hearing impairment using existing evidence.

• DESIGN

A narrative overview of existing literature synthesising the association between hearing impairment and cognitive function in the aging population was carried out.

• RESULTS

Studies have demonstrated that age-related hearing impairment and cognitive impairment involves morphological changes to neural structures, suggesting that a better understanding of the interrelation of these pathologies could result in an integrated approach in the evaluation and rehabilitation of both conditions in future clinical practice.

The conclusion of a recent meta-analysis study of 33 journal articles published between 1991 and 2014 is that there is a positive correlation between hearing loss and cognitive deficits, with the treatment of hearing impairment slowing down the progression of the latter. However, due to differences in methodology and studies conducted to date, it was also concluded that it is too early to assume a causal relationship between them. Another research into 12 studies investigating the links between peripheral hearing loss and cognitive decline summarised that 10 studies found a relationship between the two, whereas two studies failed to find such a correlation. A recent longitudinal population-based study involving 3,654 subjects also failed to find any supporting data to

link sensory impairment and cognitive impairment after considering external factors like age.

Over the years, several theories have been proposed to explain the correlation between cognition and sensory impairment. The sensory deprivation hypothesis argues that the lack of sensory input over time could result in permanent cognitive decline at the neuronal level. If the sensory impairment were to precede cognitive impairment, as the theory suggests, then this would fail to justify the incidence of dementia in people with normal hearing. A second hypothesis, the resource allocation theory, states that heightened sensory deprivation results in an overload of cognitive functions, subsequently restricting higher order functions. A third theory, the cognitive load on perception hypothesis, on the other hand states that cognitive decline precedes sensory impairment. The common cause hypothesis suggests a third, common age-related factor is what contributes to the hearing and cognitive deficits. Yet another theory argues that low scores on cognitive tests may be a by-product of sensory deficits (auditory/visual). None of these studies found sufficient high-quality evidence to support a possible relationship between the two domains. A recent review emphasised the importance of using high-order listening tests in addition to recording the type of hearing loss may provide a better understanding of the two disabilities.

The central auditory system plays a vital role in discriminating and processing auditory information, and it shares neural networks with the centre for higher order functions. Therefore, it is very relevant to focus on possible relationships between them. One of the major challenges for the elderly population is to distinguish

speech in situations with background noise; three theories have attempted to explore its causes. The peripheral hypothesis relates speech perception difficulties to the aging cochlear and/or auditory nerve dysfunction, whereas the central hypothesis suggests morphological changes to the auditory system due to aging. A third hypothesis, the cognitive hypothesis, argues that it is the cognitive decline associated with aging that contributes to poor listening and discriminating skills in challenging situations. Several studies have highlighted that a proper functioning of all three of these modalities is required for effective communication.

Central auditory processing skills, such as binaural integration, binaural interaction and temporal processing, provide important cues for processing speech in demanding listening environments and their interaction with cognitive skills are focused on examining the relationship between them. A systematic review of literature contends that pre-existing deficits in the Central Auditory Processing (CAP) skills can pre-date the diagnosis of Alzheimer's disease (AD) by at least five to ten years. Out of eight studies aimed at investigating a relationship between cognitive decline and central hearing loss outlined in the review, six studies demonstrated that participants with cognitive impairment obtained poorer scores in CAP tests. Another recent study in the same area suggested that the Gap In Noise test provided a measurement of temporal cortical thinning associated with the transition between Mild Cognitive Impairment to AD. However, central auditory evoked potential studies are required, in order to gain more understanding of the links between the two conditions.

CRITICAL NOTE

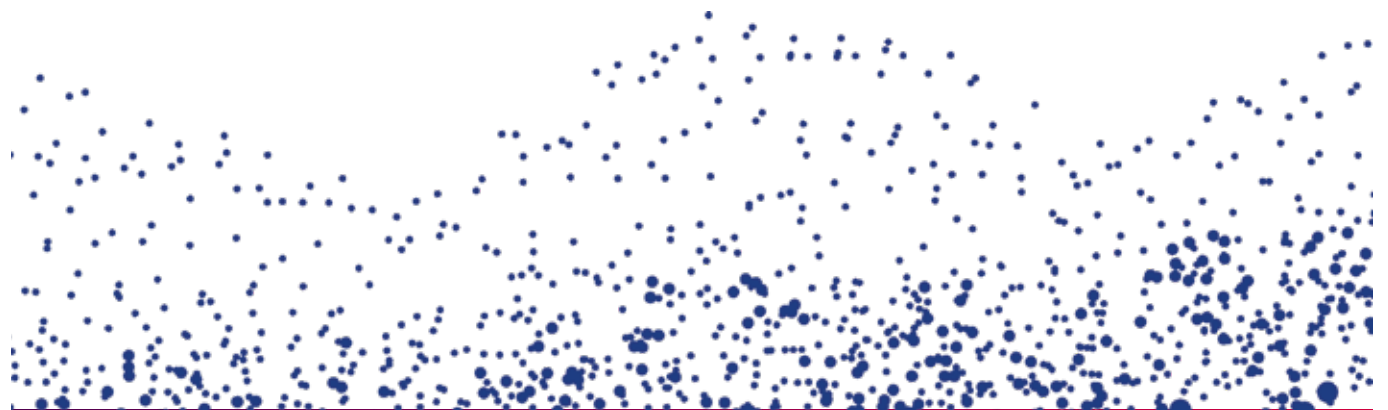
Overall, this narrative review examines a wide range of studies so as to investigate the relationship between hearing loss at the peripheral and central level and cognitive decline. Over the decades, several studies have suggested a significant relationship between peripheral hearing impairment, CAP dysfunction and cognitive impairment.

However, further research into detailed case history explaining the nature of hearing loss, electrophysiological tests and higher order listening function test is required to explain clearly how the two domains are linked.

Furthermore, studies to date have considered both peripheral and/or central hearing impairment and cognitive impairment as two separate entities. A holistic approach in the assessment and intervention of hearing loss and dementia would be of great benefit to hearing care professionals for prescribing and managing rehabilitation devices and for appropriate timely referrals as well.

• DISCUSSION

This review highlights the relationship between peripheral and central hearing impairment and cognitive impairment, thanks to several supporting studies. However, there are inconsistencies in the methodology of the different studies included for the review. Different theories were proposed to explain the relationship between cognition and central and peripheral hearing without high-quality evidence to support them. •





HOW DO HEARING AID OWNERS ACQUIRE HEARING AID MANAGEMENT SKILLS?



Bennett RJ., Meyer CJ. & Eikelboom RH.

Journal of the American Academy of Audiology (2019): 30, 516-32

By Tali Bar-Moshe – Israel

Although this study has some limitations (such as participant self-selection and sample size), its findings shed light on the methods enabling patients to acquire HA management skills, the role of hearing healthcare clinicians in achieving successful HA use and the involvement of the patient's surrounding in the hearing rehabilitation process.

Fitting new hearing aids (HAs) during the hearing rehabilitation process requires having to learn and master a great deal of new information, skills and tasks on the part of patients for successful HA usage. The purpose of this research was to investigate the acquisition of HA management skills and knowledge as well as the effectiveness of existing training methods used to teach these skills, from both the perspective of HA owners as well as hearing health clinicians.

In this study, the researchers used group concept mapping, which is a segmentation method approach using qualitative and quantitative techniques for data collection and multidimensional scaling and hierarchical cluster analysis. 24 Australian HA owners (aged 56-91; 54.2% male) and 22 Australian clinicians (aged 32-69; 9.1% male) participated in the research.

HA owners were split into two groups (two locations) and attended face-to-face sessions; all the clinicians attended the sessions via an online portal.

All participants were required to attend two data collection sessions.

During the first session, the groups were invited to take part in a brainstorming activity in order to generate statements that described: "How hearing aid owners learn the skills required to use, handle, manage, maintain, and care for their hearing aids". This yielded 136 statements. The results of the HA owners and clinicians were similar, and combined. The researchers then edited all these statements into a list of 75 statements.

In the second session, the participants were asked to divide the resulting 75 statements into groups that made sense to them, and to rate each statement based on the extent to which HA owners currently use each training mode and how beneficial it is to successful HA management.

The statements were divided into six concept groups (example statements are in parentheses):

CRITICAL NOTE

Although this study has some limitations (like participant self-selection and sample size), its findings shed light on the methods with which patients acquire HA management skills, on the importance of the role of hearing healthcare clinicians to successful HA use and of the involvement of the patient's surrounding in the hearing rehabilitation process.

The findings provided by this study are very important to our daily practice.

They emphasize the significant role we, as audiologists, have to play/can play in a successful customer journey.

HAs are only a technological tool in the hearing rehabilitation process. The services we provide to our patients – building a patient-clinician relationship, designing a personalised rehabilitation plan, offering professional support, guidance, training and counselling – can make all the difference to our patients' rehabilitation and help them become successful HA users. It is in our professional hands!

- a. **Relationship with the clinician** (statement #51. Having a good relationship with their clinician, especially open lines of communication to be able to ask for support).
- b. **Clinician as a source of knowledge and support** (statement #68. Knowing that they have someone to go to with questions, that is, the clinician).
- c. **Hands-on experience** (statement # 39. Making time to practice at home while in a relaxed environment).
- d. **Seeking additional information** (statement # 34. Repeatedly asking questions until they get an answer that makes sense to them).
- e. **Asking support people for help** (statement #11. Asking nursing staff [both in general hospitals and care facilities]),

although they usually don't know how to help).

- f. **External resources** (statement #58. Viewing videos that demonstrate/explain the different skills they need to use hearing aids, available on some clinic websites).

The main three skill-learning methods are those connected to the role and contribution of hearing healthcare clinicians in the hearing rehabilitation process; the importance of finding the right clinician and developing a good patient-clinician relationship; and the patient's self-training and hands-on practicing. This finding should encourage clinicians to continue using those methods and to find more strategies related to these success factors that could contribute to increasing patients' learning and mastering HA management skills.

The findings further indicate that clinicians attribute greater importance to the "relationship with the clinician" criteria than HA owners. This finding may suggest that HA owners are unaware of the role hearing healthcare clinicians play in the rehabilitation process and may be related to the emphasis clinicians give to the HA technology rather than on the rehabilitation services they provide to the patient during the rehabilitation process.

Lastly, this systematic review also highlights that it is important that hearing healthcare clinicians pay attention to the learning methods which involve external players including family members, friends, care givers, general practitioners etc. and try to include them in the hearing rehabilitation process. •



FACTORS AFFECTING SOUND-SOURCE LOCALIZATION IN CHILDREN WITH SIMULTANEOUS OR SEQUENTIAL BILATERAL COCHLEAR IMPLANTS



Killan C., Scally A., Killan E., et al.

Ear & Hearing (2019): 40(4), 870-7.

By Sheeja Govindan – Australia

Sequential implantation (inter-implant interval) and congenital profound hearing loss both lead to worse accuracy in sound-source localisation for children using bilateral cochlear implants.

Spatial listening skills play a critical role in a child's social development, as do educational progress, recreational interests and more importantly their personal wellbeing. An individual with normal hearing localises sounds easily due to the fact that s/he relies on interaural intensity and temporal differences, along with spectral cues, which are more of a central auditory processing phenomenon. An individual with hearing impairment suffers disruption in acquiring these cues.

Auditory rehabilitation aims at re-establishing these binaural spatial cues in children by delivering appropriate hearing amplification to both ears, with the expectation that, despite the impairment in their hearing, they will acquire and develop this spatial listening skill to some extent. However, numerous contributing factors can influence

the acquisition of this skill in children. Therefore, a greater understanding is required in this area. The objective of the study under review is to ascertain the effect of inter-implant interval and the onset of profound deafness on sound localisation with bilateral cochlear implants. These effects were investigated, while controlling several variables, namely the manufacturer of the CI, age and time since the second implant on both simultaneously and consequently implanted children.

• **METHOD**

127 subjects, children aged four years or older using a cochlear implant on both ears. The study design was an observational retrospective, based on routinely collected

clinical data for these subjects. The children were tested 12-month post second implant. The implants that the children wore were from Advanced Bionics, Cochlear or Med-El. One group was implanted simultaneously (51% of the total group/n=65):

- 43% had congenital profound deafness (2 and 4 kHz)
- 57% had acquired or progressive hearing loss.

The other group was implanted sequentially (49% of the total group/n=62):

- 77% with congenital deafness (2 and 4 kHz)
- 23% had acquired or progressive bilateral profound deafness at 2 and 4 kHz.
- The median time between the two sequential implantations was 2.8 years (0.3 to 11.9 years)

• TESTING ENVIRONMENT

A sound source localisation test was performed. The stimuli utilised were pre-recorded voice memos in a female voice between 65 to 75 dB (A), randomly increased or reduced in level (roving). The stimuli were produced through five loudspeakers. The stimuli were presented in no specific order at 300, 330, 0, 30 and 60 degrees azimuth from each loudspeaker. Root mean square (RMS) errors of the test were then assessed.

The localisation data collected was then analysed using multivariable linear regression models. This analysis was applied to the group as a whole, and to the simultaneously implanted children.

• RESULTS

- The results range from perfect localisation (0° RMS error) to chance level (defined as 62° RMS error). The mean performance for the whole group was 25.4° RMS error.
- The RMS error increases with increasing inter-implant interval.
- The simultaneous groups had a mean performance of 21.6° RMS error, while the sequential group scored 29.5° RMS error.
- The localisation error increased 0.14° RMS error for each month inter-implant interval.
- Children with acquired hearing loss had better accuracy (20.7° RMS error) compared to the congenitally hearing-impaired group (28.6° RMS error).
- Every year post-second implant resulted in better accuracy (-1.6° RMS error/year).
- Significant differences were also observed between manufacturers. Children fitted with Med-El implants had the best accuracy in localisation:
 - 5.8° RMS error better than Cochlear.
 - 9.2° RMS error better than Advanced Bionics.

• DISCUSSION

In this study, the researchers focused on exploring the factors which affect patients' ability to localise sound,

CRITICAL NOTE

Overall, the study provided useful information for hearing health clinicians about the factors that need to be considered in auditory rehabilitation for children with binaural cochlear implants, especially for restoring sound localisation skills. The researchers did report that one limitation was that RMS error scores cannot be the only criteria to measure sound localisation. It could be argued that this is not sufficient to depict the delicate aspects of a person's spatial localisation skills. Furthermore, the testing methodology may also prove to represent a limitation, such as the loudspeaker separation and other variances. In spite of the variances reported, the study does provide evidence that minimising the time gap between implantations for children with bilateral severe to profound hearing loss, along with consideration of the age of onset of deafness, can be useful information for clinicians.

This information is crucial in selecting candidates for binaural cochlear implantation. Moreover, it provides guidance for clinicians on what should be the focus of counselling, and how better to plan rehabilitation for children. We could also infer that it is important to track implanted children's localisation accuracy over their developing years following cochlear implantation, which could prove beneficial in identifying the cause of the failure to develop these localisation skills and appropriate measures can be taken to initiate targeted rehabilitation.

The difference in localisation accuracy between manufacturers should be evaluated in greater depth, since the number of implanted children, the age at the time of implantation and the time-interval between both implants differed significantly between the CI brands used in this study.

with an emphasis on the interval between the implants and onset of profound hearing impairment.

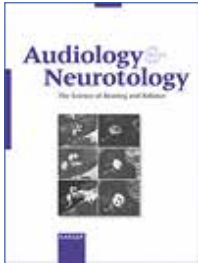
Manufacturer of the Cochlear implant, age, and time gap between the second implant for the simultaneously and sequentially implanted children were regulated factors.

There is adequate evidence to demonstrate that the longer the time interval between implantation and congenital profound hearing loss both then the worse are the results in accuracy in sound-source localisation for children using bilateral cochlear implants. Therefore, the delay for implanting the second CI should be minimised for children with bilateral profound hearing loss.

Children with acquired or progressive hearing loss can be anticipated to localise sound more effectively with binaural fitted cochlear implants than the congenitally hearing-impaired group. •



FLUCTUATING SENSORINEURAL HEARING LOSS



Liu H., Zhou K., Zhang X.
& Peng, KA.

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(2019):24, 109-116

By Reddy Sivaprasad – India

This review provides an up-to-date review of existing literature on three major causes of fluctuating SNHL. Pathophysiology, pathology and other related findings are well summarised. Most medical treatment options are covered in this review.

Sensorineural hearing loss (SNHL) is often described as a permanent and progressive inner-ear condition resulting from a variety of inner ear pathologies. Schuknecht's classification of sensorineural hearing loss does not include fluctuating SNHL, the clinical incidence of which seems to be growing. Fluctuating SNHL is now known to result from various inner-ear conditions. This literature review focuses on fluctuating SNHL as it pertains to Menière's disease (MD), autoimmune inner ear disease (AIED) and enlarged vestibular aqueduct syndrome (EVA), as well as on possible treatment options.

The authors retrieved electronic information through several search engines for the above three conditions. They then identified articles which discussed treatment options for a qualitative summary.

One of the triad of symptoms of MD is fluctuating hearing loss. The aetiology of MD is not clearly understood, though it is considered by many to be a viral infection or an autoimmune inner-ear disease. Studies have suggested that the fluctuations are due to the repeated rupturing of endolymphatic membranes. An alternative view is that the symptoms may be caused by oedema of the membranous inner ear, first in the vestibular organ followed by that of the cochlea. The glycerol or mannitol dehydration test is often used to confirm the presence of MD. Electrocochleography shows an elevated SP/AP ratio, which is often used to confirm MD. Recently, Gadolinium enhanced MRI with 3D analysis tools have been used to estimate labyrinthine oedema and fluid amount which are correlated with the degree of hearing loss. Over time, hearing ultimately stabilises, meaning that the need for treatment is controversial. However, studies show that in the long run, early pharma treatment results in better hearing over the long-term period. Existing literature lists treatment options that are medical and surgical, as well as ablative and non-ablative. Diuretic therapy resolves symptoms by reducing pressure in the cochlea. Betahistines is a vasodilator which reduces

CRITICAL NOTE

This article provides a good academic review and update of current knowledge on three major known causes of fluctuating SNHL and the variety of available treatment options. One of its limitations, however, is that the study does not mention the use of hearing aids in the treatment of fluctuating SNHL even though that is one of the most common approaches in dealing with conditions like MD and EVA.

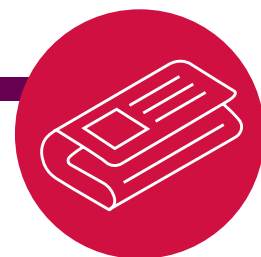
both balance and hearing symptoms. Pressure equalisation tubes are used but the outcomes are not clear. Intratympanic gentamycin show 96% effectiveness in reducing balance symptoms. Surgical therapies show good improvement in case of severe symptoms.

EVA is another cause of fluctuating SNHL. The proposed mechanism behind this seems to be that fluctuating intracranial pressure directly affects the inner function in a way much similar to what happens in MD. However, in most EVA cases, the hearing loss is progressive. It can be genetic, as in the case of Pendred syndrome. Non-expression of the SLC26A4 gene leads to an enlargement of the endolymphatic sac associated with pigmentation abnormalities. The most common treatment option is the use of corticosteroids to deal with sudden hearing loss and 80% of EVA patients respond positively showing good improvement. In cases of profound hearing loss with EVA, cochlear implantation shows satisfactory results. However, there are reports with fluctuating performance even with CI. AIED is associated with systemic autoimmune conditions and viral infections. Antigen-antibody interactions in the inner-ear usually lead to bilateral hearing loss with rapid worsening. Hearing is shown to fluctuate both in early and later stages of the disease. Corticosteroids are commonly used to control fluctuations in hearing. Standard dosages include 60 mg/day tapered over two to three weeks.

Intratympanic administration is shown to result in lesser side effects. The authors summarise that even though medical therapy is effective in the initial stages, most

conditions ultimately result in profound hearing loss; whereas the use of cochlear implantation may provide significant improvement. •

SERUM BILIRUBIN LEVEL AS A POTENTIAL MARKER FOR THE HEARING OUTCOME IN SEVERE-PROFOUND BILATERAL SUDDEN DEAFNESS



*Bing D., Wang DY., Lan L., et al.
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40, 728-35
By Reddy Sivaprasad – India*

Recently defined characteristics of the bilirubin molecule led the authors to conduct this study. They found that increased total bilirubin levels were seen in subjects with bilateral sudden sensorineural hearing loss (BSSHL) and that the hearing recovery was directly proportional to their levels. Total bilirubin (TBIL) can be used as a prognostic indicator in BSSHL patients.

Bilateral sudden sensorineural hearing loss (BSSHL) has a rare prevalence and is thought to have causative mechanisms similar to unilateral SSHL. Among other theories, those centred around vascular dysfunction or viral infection are the most accepted, as there is growing evidence for these two schools of thought. Bilirubin molecules are known to have anti-oxidant, anti-inflammatory, vasodilatory, anti-mutagenic, immune-modulatory, anti-proliferative, and anti-apoptotic properties. High levels of serum bilirubin in the blood are known to be a potential risk factor for hearing loss, especially in neonates. However, in adults, bilirubin levels and the risk of cardiovascular disease are negatively correlated. The present study was undertaken with a hypothesis that serum bilirubin levels can serve as an indicator for the risk of BSSHL in patients with cardiovascular disease. A total of 113 patients were admitted between 2008-2015 with BSSHL. Various health-related habits were studied along with serum studies on total (TBIL) and direct bilirubin (DBIL) levels. All subjects received intravenous steroids on intravenous Ginkgo Biloba extracts for up to five days. A complete audiological evaluation was carried out at the time of admission and also at the time of discharge. The final hearing thresholds, absolute hearing gain (difference in initial and final HTLs) and relative hearing gain (hearing gain normalised by initial HTLs) were calculated. Five patterns

CRITICAL NOTE

This study was conducted on a significantly large sample and involves very straightforward tests. This should be replicated and can be easily achieved in other setups.

of recovery based upon the previous studies were applied: Low Freq higher recovery; High Freq higher recovery; No recovery (Descending, Flat and Cophosis). No statistically significant effects of age, medication, use of tobacco and alcohol, incidences of hypertension, diabetes, DBIL and dyslipidemia were associated with the recovery type. However, higher TBILs were seen in patients with better hearing recovery. In the subgroup of those with Severe to Profound initial hearing loss, 1 µmol/L increase in TBIL was associated with -1.9 dB recovery. With these findings, the authors claim that this is the first study to demonstrate effectively that Bilirubin has an otoprotective function. The authors propose that high normal or mildly elevated bilirubin could help inner-ear structures experiencing oxidative stress at the time of a vascular dysfunction. Therefore, TBILs could be a prognostic predictor in case of BSSHL. The authors also propose that treatments designed to increased bilirubin levels should be considered as a treatment option for BSSHL. •



INTRATYMPANIC STEROID FOR MENIÈRE'S DISEASE: A SYSTEMATIC REVIEW



Daventier L., Djurhuus BD.,
Hougaard DD., et al.

Otology & Neurotology (2019):
40(5), 806-12

By Reddy Sivaprasad – India

This study examined systematic reviews and individual randomised control studies on this subject. The authors found four systematic reviews and three RCTs on this topic. Studies have shown that this therapy improves vertigo and tinnitus conditions. This paper employed a Cochrane quality measurement tool and found that the quality of evidence from these studies is very low.

Menière's disease (MD), or endolymphatic hydrops, is often thought to be the result of an immune system reaction in the endolymphatic sac. Many treatment options are available because the mechanisms of MD are not yet clearly understood. Administering steroids intra-tympanically is the popular treatment of choice because of the more effective absorption into the inner-ear and easy setup within a regular ENT setting. This systematic review was aimed at identifying, summarising, and critically appraising the current evidence concerning the usage of intratympanic steroid in the treatment of patients with MD.

The authors carried out an electronic search between 2017 and 2018 of published work on systematic reviews and randomised controlled trials (RCTs). They then applied the Population, Intervention, Comparison and Outcome (PICO) framework to further categorise the resulting studies. Four relevant publications using systematic reviews were identified, including one high quality Cochrane study. After screening, three RCTs were used as the foundation for the systematic review proposed by the authors, covering a total of 220 subjects. Across all these studies, intratympanic dexamethasone administration was compared with a placebo.

These studies measured different outcomes: frequency and intensity of vertigo attacks; tinnitus severity; quality of life; and hearing threshold levels. All showed that vertigo and tinnitus decreased over a three months period, though the effective dosage (3 mg/ml, 4 mg/ml and 12 mg/ml) differs from one author to another. Vertigo attacks reduced in

frequency and intensity over the three-month time. Tinnitus was measured using the tinnitus handicap inventory (THI) and showed improvement in scores as a result of therapy. However, the quality of life and hearing threshold levels did not improve significantly after three months of therapy. No study reported tracking the symptoms post three months.

The Cochrane risk of bias tool was applied to verify the bias involved in these studies. Results showed that none of the studies had used random sequencing and allocation concealment, which are critical in an RCT-type study. This led to the quality of evidence being rated as very low for these studies. Each of the studies had included only a small group of subjects, leading to reduced precision and scope of the reported outcomes.

The authors noted that the absence of consensus on outcome measures is also one reason why the treatment effects were not studied. Using a standard quality rating process, the authors found that there is very low evidence available on intratympanic steroid usage as a treatment method, even though it is very popular. •

CRITICAL NOTE

This study respected the necessary due diligence for a systematic review, and also measured the evidence of studies using transparent methods. This sets a new standard for systematic review-based studies.

