        - *Suh MJY, Yi HJ., Kim HJ., et al.*
        - *Otology & Neurotology (2019): 40(10), 1339-1345..*
        - *This retrospective study examines whether hearing asymmetry was associated with a balance dysfunction across a large data set. It found that a low-frequency asymmetry is more likely to result in a vestibular dysfunction.*
- Page 13: Supriya Cherian – Australia:
    - Inflammation Associated with Noise Induced Hearing Loss.
        - *Frye MD., Ryan AF. & Liano A.*
        - *J. Acoust. Soc. Am. (2019):146(5), 4020-4032.*
        - *In the light of current available evidence, this study clearly explains the genetic and cellular pathways involved in the innate immune response of the cochlea following noise insult.*
- Page 15: Supriya Cherian – Australia:
    - Recovery from Tympanic Membrane Perforation: Effects on Membrane Thickness, Auditory Thresholds, and Middle Ear Transmission.
        - *Cai L., Stomackin G., Perez NM, et al.*
        - *Hearing Research (2019):384, 107813.*
        - *The focus of this animal study (gerbils) was to determine the effects on middle ear sound transfer function following the spontaneous healing of 50 % Tympanic Membrane perforation. The study found that due to increased thickness at the perforated site and adjacent areas following the spontaneous recovery, only a partial recovery is achieved in hearing levels compared to pre-perforation levels.*
- Page 18: Jo Ritchie – New Zealand:
    - Evidence-Based Recommendation for Bilateral Cochlear Implantation in Adults.
        - *Agnes, Au. & Dowell, RC..*
        - *American Journal of Audiology (2019): 28(3S), 775-782.*
        - *The results show that binaural hearing provides significantly better speech perception outcomes than monaural hearing (whether from bilateral cochlear implants or a bimodal fitting).*
- Page 20: Katrien Hoornaert- Belgium:
    - Understanding Variability in Individual Response to Hearing Aid Signal Processing in Wearable Hearing Aids.
        - *Souza P., Arehart K., Schoof T., et al.*
        - *Ear & Hearing (2019): 40(6), 1280-1292.*
        - *The aim was to test whether there was a relationship between participant characteristics and recognition of speech at different levels of signal modification. Strong processing provides better audibility and, one would think, better speech recognition, but this seems not to be the case: modification (distortion) outweighs audibility improvement.*

- Page 23: Paul Van Doren – Belgium:
    - The Role of Cognition in Common Measures of Peripheral Synaptopathy and Hidden Hearing Loss.
        - *Aryn M. Kamerer, Angela AuBuchon et al.*
        - *American Journal of Audiology Vol. 28, 843–856 (2019).*
        - *The outcomes confirm the growing consensus that one should assess the influence of cognition in test of peripheral auditory pathology, especially for aging persons.*

- Page 24: Paul Van Doren – Belgium:
  - Systematic Evaluation of Self-Reported Hearing Ability in Six Dimensions Before and After a Hearing Aid Trial.
    - *de Ronde-Brons I, Soede W and Dreschler W.*
    - *Journal of Speech, Language, and Hearing Research Vol. 62, 4150–4164 (2019).*
    - *The authors claim that their findings can serve as a new reference for listeners with a hearing impairment. The questionnaire can support in deciding which hearing aid properties or settings are required. The weaknesses of this way of working seems to be the non-specific approach.*

[Risk of Noise-Induced Hearing Loss due to Recreational Sound: Review and Recommendations.](#)

Neitzel RL. & Fligor BJ.

The Journal of the Acoustical Society of America (2019):146(5), 3911-3921

This article was written as a report for the World Health Organization Make Listening Safe Campaign. The authors carried out an extensive literature review in order to identify an appropriate exposure limit for recreational noise. Three questions were addressed.

What criteria are used to determine noise exposure limits? Most standards recommend an occupational noise exposure limit (LEX) of 85 dBA for no more than eight hours. However, using this limit, some workers run the risk of developing hearing loss (HL). The use of a 24-h equivalent continuous level (LEQ24h) of 70 dBA (equivalent to 75 dBA LEX) can eliminate the risk of HL.

Are there differences in the risk of HL from occupational noise versus recreational sound? Some limited evidence suggests that recreational noise is less harmful compared to energetically equivalent occupational noise. According to the authors, existing limits and calculation models for the risk of occupational noise are applicable for recreational noise. However, these models assume limited exposure of up to 40 years.

What recreational sound limits should be used? Environmental noise standards (e.g. WHO) specify a LEX of 75 dBA (assuming that the other 16 hours per day are < 60 dBA) so as to prevent any hearing loss in individuals over a 40-year exposure, including a safety margin of 5 dB. The EU directive, WHO recommendations and EPA (United States Environmental Protection Agency) specify an exposure action value of 80 dBA LEX, which is according to the authors a good balance between the occupational and nonoccupational limits..

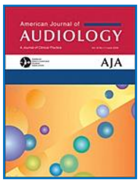
Critical note:
The authors succeed in providing a sound overview of the available standards and recommendations for noise at work and noise during leisure time.

This article gives pause for thought, since we have been exposing our hearing from a young age through our recreational habits (watching movies on tablets with headphones, using mp3 players, gaming, going to parties, etc.). This means our hearing is already at risk even before we start of our professional career, and the long-term consequences of which are difficult to estimate.

Current studies often only evaluate one of these activities in isolation of others and fail to take account of all the other aspects which affect our hearing before or after that activity. Take for example a worker who, after his eight-hour shift at the factory, puts in his earphones to listen to his mp3 player on the drive home on his motorcycle, and then spends the evening binge-watching shows on his tablet with his headphones.

This often makes it difficult to piece together the puzzle and to map out clearly the total noise load an individual is exposed to and to calculate the risk of noise damage. This overview article provides a good motivation for us to look at the bigger picture when our clients ask for advice at the hearing centre to protect their hearing during one specific activity.

Patients' Perspective About the Acceptability and Effectiveness of Audiologist-Delivered Cognitive Behavioral Therapy for Tinnitus and/or Hyperacusis Rehabilitation.



Aazh H., Bryant C. & Moore BCJ.

American Journal of Audiology (2019): 28, 973-985.

In 2019, the Tinnet-network (https://tinnet.tinnitusresearch.net/) published general guidelines for therapy options for tinnitus patients. Until now, one of the therapies which has proven most effective is Cognitive Behavioural Therapy (CBT) for tinnitus patients. CBT means that patients learn how to modify their unhelpful, incorrect cognitions of their tinnitus and how to change their safety seeking behaviours. Normally CBT is delivered by qualified psychologists. Previous research states that CBT led by audiologists, combining online and face-to-face contact, is helping patients with their depression, sleep quality, decreasing annoyance of their tinnitus loudness and its negative impact on their quality of life.

This study used self-report questionnaires across a cohort of 40 tinnitus patients to measure whether they experienced less anxiety, insomnia, depression, tinnitus and hyperacusis after CBT therapy delivered by audiologists. The authors also questioned whether patients accepted the fact that the therapy was led by audiologists instead of qualified psychologists.

All audiologists involved in these CBT sessions received intensive training comprising: 30 hrs of direct contact, 100 hrs of directed self-learning; 20 hrs of self-directed learning; and six months of supervised practice (observation of CBT sessions, clinical supervision, coaching, additional professional development and weekly team meetings).

Contrary to expectations, the results of this study showed that the majority of the patients reported that it was very acceptable to receive CBT focused on tinnitus and hyperacusis from a specialist audiologist as opposed to a qualified psychologist. An explanation for this might be patients' unawareness of what the standard protocol is. However, as pointed out by the authors, the research did clearly indicate to patients that their therapy was offered by an audiologist instead of a psychologist.

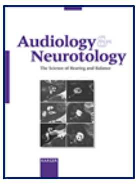
Critical note:
The most important implications of these findings for our practice:

- I believe that, more and more, our clients will be looking "fast" /over the counter solutions. This could be an opportunity for us as audiologists to carve out a "new role" for ourselves alongside the fitting of hearing aids for tinnitus patients.

- All audiologists who have a passion to help patients with tinnitus could follow this CBT program and deliver qualitative therapy.

- What do CBT qualified psychologists think of the fact that audiologists would lead those therapy sessions for tinnitus patients? This question could be addressed in future studies.

High Risk of Sudden Sensorineural Hearing Loss in Several Autoimmune Diseases According to a Population-Based National Sample Cohort Study.



Jeong J., Lim H., Lee K., et al.

Audiology & Neurotology (2019): 24(5), 224-230.

Sudden Sensorineural hearing loss (SSNHL) is a well-known cause and subtype of hearing loss (HL). Vascular, Viral and Immuno-mediated deficiencies have been offered as mechanisms underlying SSNHL. One of the limitations of the immuno-mediated SSNHL theory is that it fails to account for unilateral SSNHL, which is a very common clinical presentation. However, immune-mediated SSNHL was seen in known cases of systematic lupus erythematosus (SLE), rheumatoid arthritis (RA) and multiple sclerosis (MS). This study investigated the risk of SSNHL among various auto-immune diseases from the Korean national population data.

The study included subjects who had been diagnosed with any auto-immune disease and who were 20 or older. The control group (n=66250) was comprised of subjects presenting similar demographic attributes as those of the auto-immune group (n=13250).

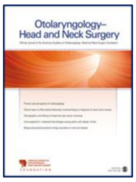
The analysis revealed that 1.09% of the auto-immune group and 0.73% of the control group were diagnosed with SSNHL. The incidence of SSNHL was significantly higher in the auto-immune group and was higher still for patients with Antiphospholipid syndrome (APS), MS, RA, Sjogren syndrome and Behçet disease. Further analysis with the Special Exception of Assessment codes (SEAC) technique showed that RA patients presented with the highest risk of SSNHL.

RA is an inflammatory disease known to affect diarthrodial joints, lungs, skin and eyes. Other known complications of RA are systemic vasculitis and vascular ischemia, which are caused, in particular, by autoantibodies known to affect the inner ear in an almost immediate fashion. The Authors recommend that hearing should be examined regularly in patients with RA.

Critical note

The sample size and the way they constructed the control group are strengths of the study. As highlighted by the authors themselves, these findings call for further research on this topic.

Association of Midlife Hypertension with Late-Life Hearing Loss.



Reed NS., Huddle MG., Betz J., et al.

Otolaryngology - Head & Neck Surgery (2019): 161(6), 996-1003.

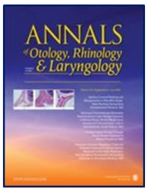
Hearing loss (HL) is a common phenomenon in the elderly, and some estimates show that about two thirds of the population in their 70s present with significant HL. Models on age-related HL identified insufficiencies in cochlear blood supply such as that caused by a disease or hypertension. Some studies suggest that hypertension affects the basal turn of the cochlea, thereby affecting high frequencies in particular. The literature review presented by the authors offers no conclusive evidence of an associated factor leading to HL. The study under review used the data from a hearing pilot study within an ongoing longitudinal Atherosclerosis Risk in Communities (ARIC) study in the U.S. This longitudinal study examined the association between the timing of the onset of hypertension (mid-life Vs late life) and HL as measured by standard pure tone audiometry. As a second axis, the authors also examined whether hypertension is linked to high-frequency HL rather than other configurations.

Longitudinal data of pure tone average (PTA) was available for 248 subjects, who had made five clinic visits between 1987 and 2013. Puretone and speech audiometry data was available for all five visits. Blood Pressure (BP) was measured three times every visit, and an average of the three was taken. If the BP was higher than 140/90 mm Hg, it was considered a case of hypertension. Age at enrolment was between 47-54 years of age.

Of the 248 subjects, 47 had hypertension at visit1 and the odds of having HL was 1.67. By visit5, 83 subjects had developed HL and 183 had hypertension; the odds of having HL with hypertension increased to 1.81. The relation between HL and hypertension was significant in visit1 but not significant in visit5. Puretone average increased by 1.01-1.48 dB per every 10 mm Hg increase in systolic BP. Analysis also indicated that odds were higher at high frequencies – 4 and 8 kHz – than at 250 Hz and 500 Hz. It is worth noting that these associations were statistically significant even after applying due corrections to account for anti-hypertension therapy. The authors conclude that a higher systolic BP in middle age was associated with a poor hearing in late age. They also posited that the results could be attributed to disturbed blood circulation in the inner-ear especially at the level of the cochlear basal region.

Critical Note:
The study offered significant insights and a new perspective on this developing area of a possible association between HL and hypertension. The longitudinal research design and the population size make the findings of this study relevant.

Clinical Approach After Complicated Ear Mold Fitting: A Case Series of Six Patients and Evaluation of Literature.



van den Boer C., van Spronsen E., Holland CTQ., et al.

Annals of Otology, Rhinology & Laryngology (2019): 128(12), 1141-1146.

Ear impression taking is a simple, low-risk procedure performed by trained professionals. However, if performed on high-risk ear canals such as those with ear drum perforation, PE tubes, etc, this procedure can lead to serious complications. The authors highlight that existing literature reports a variety of symptoms including tinnitus, ear pain, hearing loss, etc. in these high-risk groups. In extreme cases, the impression material is deposited in the middle ear, leading to further complications. However, as the authors point out, there is no published guideline on how to deal with these cases. This study presents a series of six cases, and based on their experience, proposes a clinical algorithm on how best to deal with such cases. Each of these patients underwent ear mould impressions for swimming plugs.

Case 1: A boy, aged 14, reported pain and HL in the right ear after the ear impression was taken. CT imaging showed a collapsed ear drum and presence of silicon material on all ossicles. A combined-approach tympanoplasty was performed under general anaesthesia to remove this material and the tympanic membrane was sealed. The patient underwent revision surgery two years later, which resulted in normal hearing.

Case 2: a CT scan on an eight-year-old girl showed presence of impression material all the way to the oval window niche in the right ear. Audiometry showed a maximum conductive hearing loss with a BC Carhart's notch. She had a history of tympanic membrane (TM) perforation. Here too, a combined-approach tympanoplasty was performed and the silicon material was removed in pieces. After surgery, the patient presented with complete conducive hearing loss. She is currently using a soft band Bone Anchored Hearing Aid Implant (BAHA).

Case 3: a five-year-old boy with a history of persistent otitis media and myringitis granulomatosa, presented with persisting HL in the right ear three months after an impression had been taken, and the procedure had been painful for the young boy. A CT scan showed opacification of middle ear. A combined-approach tympanoplasty was performed, which surprisingly found a pressure equalization (PE) tube as well as ear impression material around the incudo-stapedial joint. The incus had to be removed and a prosthesis was introduced. Post-operatively, he had a conductive hearing loss of 15 dB.

Case 4: a 14-year-old boy with a pre-existing ear drum perforation, who underwent ear mould impressions when material was introduced into the middle ear. He presented with ear pain and conductive HL. A CT scan found an opacified middle ear. The impression material, which had reached various ossicles and the round window niche, was removed via the hypotympanum by means of a limited bony canal plasty. This approach offered a positive outcome with improved HTLs to 20 dB conductive loss.

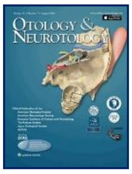
Case 5: a nine-year old girl with existing PE tubes. During the impression procedure, the silicon material fused with the tubes, leading to conductive hearing loss. The CT scan showed impression material in the middle part of the middle ear on the left side. Using tympanoplasty, the PE tube and the material were removed as one piece. The perforation was sealed which resulted in normal hearing.

Case 6: a 39-year-old woman who already had deafness in the left ear underwent ear impressions. As evidenced by a CT scan, the silicon material had deposited in different parts of the ear, including the incus. Due to chronic infection and the pre-existing HL in the left ear, a subtotal petrosectomy was performed.

The authors found 22 publications covering a total of 49 ears (including the six cases mentioned in the study under review), most of which concerned impressions for hearing aids (as opposed to swimming plugs as is the case for the six cases reported here). Further analysis of the data showed that it was unsuccessful to remove the material without CT scan in 12 cases, all of which except one resulted in adverse outcomes. Based on the literature and their own experience, the authors were able to present a flowchart of clinical approaches which can be used so as to take the right clinical decisions based on the extent of the damage.

Critical note
This study not only presents various complicated cases, but duly analyses existing publications on the subject. One of the main benefits of this article is the flowchart the authors produced.

Is Asymmetric Hearing Loss a Risk Factor for Vestibular Dysfunction? Lesson From Big Data Analysis Based on the Korean National Health and Nutrition Survey.



Suh MJY, Yi HJ., Kim HJ., et al.

Otology & Neurotology (2019): 40(10), 1339-1345.

There is ample evidence today to support that there is a strong correlation between the risk of falling and vestibular disorders. This risk affects up to 30-50% of patients with this type of disorder; and research shows that this risk is three to six times higher in these patients compared to that seen in healthy adults. Since the vestibular system and cochlear system share anatomical spaces both at the end organ and the peripheral nerve level, hypotheses of shared pathologies between these systems have been proposed. For example, the vestibular symptoms seen in Meniere's disease, labyrinthitis, auditory neuropathy spectrum disorder (ANSD) among others present both hearing and balance pathologies. However, to date, as the authors report, there is not sufficient evidence to support these hypotheses based on large data samples.

This study proposes to examine whether hearing asymmetry is associated with balance asymmetry, which can lead to a balance disorder, using data from the Korean National Health and Nutrition Survey (KNHNS).

The authors accessed data comprised data for the 2010-11 period. For their study, they randomly selected subjects aged 40 or older and who had undergone a hearing test and vestibular screening test (modified Romberg test). This yielded a population of 4,126 which was then studied further. Hearing loss was defined as HTLs greater than 40 dB in at least in one ear; asymmetry was defined as a difference of at least 15 dB. Those who failed the Romberg test were considered to have vestibular dysfunction.

Statistical analysis showed that 3.3% of the subjects had a vestibular dysfunction. Further analysis showed that vestibular dysfunction was associated with various health, age, demographic factors including hearing loss.

The study offers three significant findings:

1. *Balance dysfunction was significantly associated with both unilateral and bilateral hearing loss.*
2. *The odds of vestibular disorder is approximately three times greater when the hearing threshold asymmetry is greater than 30 dB.*
3. *The odds of having a balance problem was two times higher when the asymmetry of low frequency thresholds was greater than 15 dB.*

The authors identified several limitations, including the fact that data lacked causative mechanisms in all these patients who presented a vestibular dysfunction.

Critical Note

The major strength of the study lies in its large set of data regarding the basic hearing and balance tests along with various health, demographic and age factors which are helpful in the analysis of a complex problem such as a balance dysfunction.

Inflammation Associated with Noise Induced Hearing Loss.

Frye MD., Ryan AF. & Liano A.

The Journal of the Acoustical Society of America. (2019):146(5), 4020-4032

Introduction

For a long time, it was believed the inner-ear was an immune privileged system, due to the fact that it was thought to be deprived of lymphatic drainage, and to its positional advantage, which means the inner ear is separated from the general circulation. However, theories relating to cochlear immunoprivilege are gradually being challenged as recent studies have demonstrated correlation between noise stress and cochlear immunity and inflammatory responses.

Inflammatory cells in the cochlea

The current trend in research related to noise-overexposure and cochlear damage focuses on the degeneration of the sensory and supporting cells as the presence of immune cells with hematopoietic origin has been detected following noise insults.
Recent literature shows the presence of macrophages in most of the cochlear structures soon after cochlear stress and acoustic trauma. Permeated phagocytes were reported to be seen in scala vestibuli, modiolus, Reissner's membrane and beneath the basilar membrane. It has been proposed that these monocytes originate from the general circulation ultimately reaching the cochlea. However, evidence is lacking to support this theory. Some researchers reported that 80% of the cochlear immune system is made up of macrophages, and that and inflammation of these structures combined with minor noise levels could lead to temporary threshold changes. Numerous researchers have reported that macrophage-related protein has been identified in the cochlear tissues. Macrophages underneath the basilar membrane in the scala tympani are reported to respond to stress on the cochlear tissues because of their proximity to the sensory cells and auditory nerve synapses. Where non-cochlear tissues are concerned, the immune activities are performed by macrophages. In the Central Nervous System (CNS), microglia carry out these functions. The immune-related activities in the cochlea with macrophages resemble the activities of microglia in the Central Nervous System (CNS). Both these entities pose an intricate protection against injury by devouring dead cells and debris. Both microglia and macrophages appear prenatally and mature into distinct phenotypes within the local tissue site and remain throughout adulthood.

Rapid penetration of monocytes into cochlea usually occurs within two to seven days after the initial noise stress. The highest number of monocytes has been reported to be at the level of spiral ligament and scala tympani. Once they enter the cochlea, they grow into macrophages and develop features of inflammatory cells. In the event of cochlear tissue damage, cell signalling proteins, Cytokines and chemokines, trigger chain reactions which, in turn, modify the behaviour of cells in the surrounding tissues, thereby altering local environment.

Mechanisms of inner ear inflammation following noise trauma.

Although, to date, there is little information on how inflammatory mechanisms are activated in the cochlea soon after the noise exposure, significant research does evidence the presence of native immune receptors in other tissues. Since noise-related cell damage takes place in a sterile environment, it is merely an inflammatory response and can easily be tracked by identifying the pattern of this response in other organ systems.
When there is tissue damage, Damage- Associated Molecular Patterns (DAMPs) are released to activate Pattern Recognition Receptors (PRR) which releases numerous pro and anti-inflammatory molecules contributing to healing and repairing damaged tissues. Identifying the PRRs expressed by cochlear cells and assessing their role in Noise-Induced Hearing Loss (NIHL) could determine possible treatments to alleviate the noise induced cell damage or reinforce recovery.

Numerous recent studies demonstrate that an immune response has been linked to all major causes of acquired HL. Some studies indicate an immunological constituency ought to be suspected when there is a deterioration in thresholds in bilateral SNHL cases (minimum 30dBHL) between two audiometric assessments within a three-month period. Diseases such as Meniere's, Wegener's granulomatosis, Cogan syndrome, Lupus and Crohn's disease have shown some evidence of immune-mediated factor for cochlear tissue deterioration leading to SNHL. Due to numerous side effects of corticosteroid therapy in the treatment of SNHL, further research into alternative pharmacological approach targeting the immune cells of the inner ear is required. Biopharmaceuticals are now focusing on molecule-specific immunotherapy to control the inflammatory responses in the noise-induced inner ears. However, the efficacy of such treatment in not clear due to limitations of the study design.

Conclusion

Noise-induced cochlear damage results in the production of inflammatory molecules in the inner ear. Several studies have attempted to explain the mechanism of innate immune responses following acoustic trauma. However, more research is needed to order identify the activities contributing to NIHL which would illuminate the focus of immunotherapy in the right direction.

Critical note:

In the light of current available evidence, this study clearly explains the genetic and cellular pathways involved in the innate immune response of the cochlea following noise insult. Future investigation aimed at identifying critical components of immune response activities in NIHL seems warranted to propose potential pharmacological solutions.

Recovery from Tympanic Membrane Perforation: Effects on Membrane Thickness, Auditory Thresholds, and Middle Ear Transmission.

Cai L., Stomackin G., Perez NM, et al.

Hearing Research (2019):384, 107813.

Introduction:
Tympanic membrane (TM) perforations can not only impact the unique physical properties of the tympanic membrane but also the vibratory patterns of the sound and its transmission. This study conducted in gerbils aims to establish the changes in auditory thresholds, middle-ear sound transmission and TM thickness using Auditory Brainstem Response (ABR), Middle Ear Pressure Gains (MEPG) and Optical Coherence Tomography (OCT) respectively

Methods:
Young adult gerbils were anesthetised by a ketamine/xylazine cocktail before mechanically perforating the left tympanic membrane by removing 50% of the pers tensa without damaging the pars flaccida and the ossicular chain. The right ear in all animals served as a control for the study. Following this step, animals were kept in autoclaved cages for infection control and weekly recovery observations were carried out over a period of four weeks. A Stryker video-picture endoscope device coupled with Karl Storz 0-degree Hopkins1218 scope was used to monitor the recovery process of the pars tensa. The endoscopic pictures helped to identify gerbils who developed infection or wax impaction post tympanic membrane perforation and also to eliminate such animals from the study.

Auditory Brainstem Response (ABR) thresholds were measured before and soon after the perforation, in addition to the weekly tests during the recovery post perforation. Single Tone burst was used as stimulus in 5dB steps to obtain the lowest level of the wave I for frequencies of 0.5,2,4,5.68,11.3,16,22.6,32 and 45KHz at 0-80dB SPL.

The MEPG, which is the absolute ratio between the scala vestibuli (SV) pressure near stapes and TM pressure (MEPG = Psv/Ptm), was measured after the recovery phase in order to calculate the middle-ear sound transmission time. For this experiment, a micro pressure sensor was surgically inserted into the SV and placed close to stapes, while a Sokolich ultrasound microphone probe tube was positioned next to the TM. Each of the other two ends of the microphone tube (Y-shaped) was connected to a speaker, and the ear canal was coupled with the sound system.

The animals were euthanised using Pentobarbital 390 mg/ml in order to harvest both the perforated and non-perforated tympanic membrane in fresh condition and to obtain quick OCT 3D images within 30 minutes. Thickness measurements and other statistical analysis were calculated using MATLAB

Results:
On visual inspection, all the areas of the normal TMs appeared to be smooth and relatively homogeneous. However, the OCT images show the thickness of the membrane is more concentrated around the peripheral rim and at the umbo/manubrium attached region compared to the other regions. It was observed that thickness gradually increased from the inferior(9-23μm) to the umbo(9-26μm) to the superior(10-35μm) region of the TM. It was

also observed that the anterior side of the region superior to the umbo was thinner than the posterior part; whereas no such difference was noted in the inferior region to the umbo. On the other hand, the spontaneously-recovered TMs appeared to be rough and uneven compared to normal TMs. The thickness measurements show an increase in thickness at the damaged area, by two times the average thickness (30-40μm) and even extends to the non-perforated area. No significant changes in thickness were observed even after fixation process of the healed TM.

Before conducting the experiment, the ABR thresholds of the gerbils were around 10dBSPL at 2-22kHz with elevated thresholds at higher and lower frequencies. Following the 50 % perforation of the TM, the ABR thresholds dropped by approximately 30 dB across all frequencies. During the recovery phase, the healing of perforation progressed remarkably, so much so that by the end of week four, the thresholds were back to normal levels at frequencies below 16KHz. However, the responses remained unchanged for frequencies above 20 kHz.

Interestingly, the average 20 dB MEPG measured with normal TMs dropped by 20-40dB post 50 % TM perforation at all frequencies consistent with the elevated ABR thresholds. And the MEPG measured at the end of four-week healing process showed recovery back to normal levels in MEPG between 2-8kHz while lower and higher frequencies were non-recovered. This pattern shows the significance of ABR thresholds in determining the effects of sound transmission through the middle-ear due to TM pathology.

Discussion:
The focus of the study is to determine the effects on middle ear sound transfer function following the spontaneous healing of 50 % TM perforation. The study found that due to increased thickness at the perforated site and adjacent areas following the spontaneous recovery, only a partial recovery is achieved in hearing levels compared to pre-perforation levels. This alteration in TM thickness can also make the ME transmission longer.

Post-perforation otoscopic examination of the gerbils' TM revealed a speedy recovery after the first week, with only 10% remaining to be healed. By the end of the second week the hole on the TM was completely closed and remained almost the same until after the fourth week. By week four, the ABR thresholds had also recovered to near-normal levels at frequencies below 16 kHz, whereas higher frequencies remained approximately 20db elevated. Since few changes were observed after four weeks throughout the study, the researchers defined four weeks after perforation as the terminal measurement point.

The 3D imaging techniques used by OCT system played an important role in mapping the TM thickness distribution under normal conditions and during the spontaneous recovery stage. Correlating with 3D FE model predictions, this study concludes the mechanical changes in the middle ear transmission after spontaneous recovery is due to the combined effects of an increase in mass and non-symmetrical distribution of fibres. The study also suggests the use of 3D printing and stem cell techniques in the near future to improve the precision of tympanoplasty as well as the hearing levels.

Critical note

The OCT system used for thickness mapping shed light on the middle ear sound transmission in normal condition as well as post perforation of the TM. The variations in thickness distribution after spontaneous recovery explains the changes in middle ear sound transmission and elevated ABR thresholds at high frequencies which also correlates with model predictions.

Another implication is that it is important to monitor a child's localization accuracy over several years following BiCIs so that failure to develop localization skills can be identified and appropriate measures can be taken to initiate targeted rehabilitation.

Evidence-Based Recommendation for Bilateral Cochlear Implantation in Adults.

Agnes, Au. & Dowell, RC.

American Journal of Audiology (2019): 28(3S), 775-782.

Introduction
Bilateral hearing generally improves speech perception and localisation. Binaural fittings can be completed with bilateral cochlear implants or a cochlear implant and a hearing aid (bimodal fitting). Research has suggested that binaural fittings (whether bilateral cochlear implants or bimodal fittings) provide significant benefits to speech perception and localisation over a unilateral cochlear implant. A recent study has indicated that there is binaural benefit for bilateral cochlear implant users, but only when compared with bimodal users who have an aided pure tone average > 55dB HL at frequencies ≤ 1 kHz in the nonimplanted ear. The purpose of this study was to compare the speech perception of adults who have bilateral cochlear implants with that of adults who have a bimodal fitting. The aim was to provide some guidance for making evidence-based recommendations regarding the benefits of a second cochlear implant, particularly when there is some useful hearing in the nonimplanted ear.

Method
The researchers reviewed the speech perception scores of 1,394 adults with acquired hearing impairment who received a cochlear implant at the Royal Victorian Eye and Ear Hospital Cochlear Implant Clinic in Australia between 2000 and 2015. The group comprised: 487 adults who used their cochlear implant only; 640 who had bimodal fittings; and 267 who received a second cochlear implant. Pre-operative and three-month post implantation speech perception measures were compared. Speech perception was evaluated using a phonemically balanced list of 50 monosyllabic consonant-vowel-consonant words in Australian English which were scored for the percentage that was correct. Post-operative speech perception outcomes were assessed with a cochlear implant alone for all three groups and binaural speech perception was measured for the bimodal fittings and bilateral cochlear implant users.

Hearing aid benefit was calculated by comparing the speech perception scores in the cochlear implant and hearing aid condition with the cochlear implant only condition for the bimodal users. The benefit of a second cochlear implant was assessed for a smaller group who were bimodal users who later received a second cochlear implant. Researchers could directly compare the two different methods of binaural fitting by analysing the speech perception results following the second cochlear implantation with those when the adult had a bimodal fitting.

Results
The results show that binaural hearing provides significantly better speech perception outcomes than monaural hearing (whether from bilateral cochlear implants or a bimodal fitting). A second cochlear implant may be beneficial for postlingually deaf adults where their best preoperative word score is < 42% or the difference between their word scores when

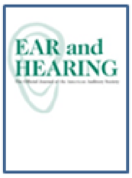
they have a bimodal fitting as compared to word scores with a single cochlear implant is < 19%.

Discussion
The study provides guidance on when a second cochlear implant is recommended for adults with acquired hearing loss based on speech perception measures. Other factors such as medical conditions, age, cost, individual preferences and the risk to residual hearing may also be relevant to the decision of whether a second cochlear implant is desirable.

Critical note:
There are some positive aspects to the study design. The sample size is large and the methodology of a direct comparison between the speech perception outcomes of adults with bimodal fittings and then their results when they later progressed to bilateral cochlear implants is sound.

The study has some limitations. There were some differences in the characteristics of the groups, with the bimodal group having been deaf for a longer duration and the bilateral group being significantly younger, which limits the ability to determine which method of binaural hearing provides more benefit. Other limitations include that tests of spatial listening were not completed, and patient preference was not evaluated. The study also used speech perception scores from three months following the second cochlear implant being implanted and this may not be a representative outcome of the long-term speech perception outcomes for bilateral cochlear implant users.

Understanding Variability in Individual Response to Hearing Aid Signal Processing in Wearable Hearing Aids.



Souza P., Arehart K., Schoof T., et al.

Ear & Hearing (2019): 40(6), 1280-1292.

Signal processing in real hearing aids (HA) causes modifications that can influence speech recognition. This article explores how these modifications interact with individual factors such as working memory, age and degree of hearing loss (HL).

Participants all had a bilateral symmetric sensorineural hearing loss with PTA4 (0.5. 1, 2, and 3 kHz) in each ear of at least 30 dB HL. The dataset comprised a total of forty adults of 54 to 90 years of age. After baseline measures and earmold impressions, they were fit with a HA. After approximately five weeks of wearing the HAs in the listeners' everyday environment, the outcome measures were conducted. Then, the second fitting was performed and again evaluated after five weeks. The study was designed as a double-blind study: the participant and the experimenter who did the measures did not know which fitting (mild or strong signal processing) had been applied to them.

The hearing aids were 20-channel, behind-the-ear (BTE) devices, using slim tubes and custom earmolds with 2 mm venting. Noise reduction, feedback management, directionality, push buttons and volume controls were all disabled. Mild signal processing setting was with slow WDRC time-constants and no frequency compression. Strong signal processing setting was with fast WDRC time constants and frequency compression enabled. Gain was fit to target using REAR with the NAL-NL2 prescribed response, while using the mild signal processing setting. In the strong signal processing setting, frequency compression was set to a compression ratio between 3:1 and 2:1 and a cut-off frequency between 1.9 and 2.2 kHz.

The baseline measures applied in this study are: Working Memory (reading span test); Spectral and Temporal Resolution (gap detection task and spectral ripple detection task); and Loudness Discomfort Levels. The outcome measures were Speech Recognition tasks: low context sentences; fixed signal to noise ratios of 0, 5 and 10 dB. (speech fixed at 65 dB SPL)

The results of the baseline measures: Working Memory (not related with age); Spectral and Temporal Resolution (poorer hearing is poorer spectral resolution, no relation with temporal resolution found), Hearing Aid Use (nine hours per day)

For the outcome measures: only 35 participants had valid outcome data for both signal processing settings. Regarding signal modification, as can be expected, the two hearing aid fittings resulted in different amounts of signal modification, with significantly less modification for the mild signal processing fitting.
For the speech recognition criterion, significant interactions between HA processing and age; between HA processing and RST and between HA processing and PTA were found.

Critical note:

The aim was to test whether there was a relationship between participant characteristics and recognition of speech at different levels of signal modification. Strong processing provides better audibility and, one would think, better speech recognition, but this seems not to be the case: modification (distortion) outweighs audibility improvement. Especially for listeners with higher working memory capacity: these show the largest differences between strong and mild processing.

[The Role of Cognition in Common Measures of Peripheral Synaptopathy and Hidden Hearing Loss.]

Aryn M. Kamerer, Angela AuBuchon et al.

American Journal of Audiology Vol. 28, 843–856 (2019).

In this study, the authors tried to link the variance in several measurements, indicating the presence of cochlear synaptopathy and hidden hearing loss, with the individual cognitive capacity.
32 adults (20y-74y) where tested.

In 3 visits, the participants where tested for: thresholds in quiet (at 1,5Khz and 4 Khz. with intervals), thresholds in noise with broadband noise, frequency modulated thresholds and speech perception in quiet, in noise, time compressed (45%) and time compressed and reverberation (0,3s).
In addition, objective measurements (ABR, Speech ABR, and measures of cognitive functions (short term memory, working memory, selective attention, executive function and processing speed.

The outcomes confirm the growing consensus that one should assess the influence of cognition in test of peripheral auditory pathology, especially for aging persons.

Critical note:
Cognitive capacity is not a auditory function, but can have a significant influence on the variation of the results of psychoacoustic tests, aiming to detect hidden hearing loss and peripheral synaptopathy.
Including cognitive tasks should get us a better understanding of the results.

Systematic Evaluation of Self-Reported Hearing Ability in Six Dimensions Before and After a Hearing Aid Trial.

de Ronde-Brons I, Soede W and Dreschler W.

Journal of Speech, Language, and Hearing Research Vol. 62, 4150–4164 (2019)

In this large-scale survey (#740) the auteurs would like to evaluate a modified version of the Amsterdam Inventory for Auditory Disabilities and handicap in pre- and post-fitting. Questionnaires were answered by 337 experienced and 403 first time users. The purpose behind the questionnaire is to asset real live auditory functioning as an evaluation tool for the success of the treatment. The initially questionnaire evaluated 5 dimensions, namely: detection of sound, speech in quiet, speech in noise, localization and focus. Afterwards, 4 questions were added to evaluate the tolerance for noise.

Findings showed that for first time users, one can see that in most case at least 16 of the 30 questions showed improvement. In cases where less than 16 answers showed improvement, some questions were "not applicable". In case of 16 points of improvement, the improvement was called "a true change". When less improvement was observed, the recommendation is to return to the audiologist to check if the patient needs additional technology or a different way to use algorithms in the hearing aids.

For subjects, already wearing instruments, improvement was compared with the situation with hearing aids. This showed obvious less improvement, compared with the first time uses.
Interesting is that first time users seem to underestimate their disability.

The authors claim that their findings can serve as a new reference for listeners with a hearing impairment. The questionnaire can support in deciding which hearing aid properties or settings are required.

Critical note:
The weaknesses of this way of working seems to be the non-specific approach. Questionnaires are not covering all the issues a hearing-impaired person has to deal with, but at the same time can have items that are not applicable for the subject himself.
There are also no guidelines included about the preferable settings in the hearing aids. E.g.: "Are all hearing aids fitted according to the factory settings?".
The authors mention the additional information of the COSI questionnaire to get a more personal feedback. This relationship was not included in this article.