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WTC
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Honorary Patronage of the President of the Republic of Poland Andrzej Duda

Tonndorf Lecture

Designing clinical trials for investigating treatment efficacy

Hall D.

University of Nottingham, Institute for Health Research (NIHR) Nottingham Biomedical Research Centre, UK

As resources become increasingly limited, allocations of both research and healthcare funding are dependent upon high-quality evidence.

Historically, tinnitus has been the poor cousin of a cinderella science, with low-quality clinical research providing unreliable estimates of effect, and with devices marketed for tinnitus without strong evidence for those product claims. However, the field is changing. A number of leading clinical and academic experts on tinnitus have recently made calls to the field to improve the design, implementation and reporting of clinical trials.

Since 2008, the Nottingham team has established itself as the UK's leading centre for early phase clinical trials on tinnitus, and we are engaging with many international experts to advance the field. This talk enables me to introduce some of important methodological considerations illustrated with specific examples and to describe an exciting project that aims to improve future tinnitus research by standardising what is measured when treatments are tested. Why not get involved?: *http: //www.hearing.nihr.ac.uk/research/tinnitus-online-survey-comitid-study.*

Presidential Lectures

On the way to understanding the cure of tinnitus

Ganz Sanchez T.[1,2]

[1] *Otolaryngology Department, University of São Paulo, Brazil*
[2] *Instituto Ganz Sanchez, Brazil*

There are several controversies about the ideal strategies for treating tinnitus patients and about specific subgroups that may present a better response. Instead of planning a randomized clinical (RCT) trial to evaluate the efficacy of a particular treatment on tinnitus thru analysis of future outcomes, we aim at interviewing "ex-tinnitus sufferers", those who had reached total tinnitus remission, in order to analyze their background.

This ongoing study takes place in Sao Paulo. Inclusion criteria are subjects who used to have daily tinnitus for at least 3 months of any etiology, who claimed themselves as cured. Exclusion criteria are spontaneous remission or comfortable level of masking/habituation. Subjects underwent a questionnaire that covers:

a) how tinnitus used to be and how it used to affect daily life;
b) what treatment attempt they assume that led to the cure;
c) how the process of tinnitus remission took place;
d) if temporary recurrences may have occurred and, if so, whether they were related to known factors.

So far, we found 41 ex-tinnitus sufferers; 20 consented to participate. Analysis of this preliminary database will be provided in the presentation. An expressive part of the sample assumes that a combination of treatments was responsible for their cure.

The gold standard researching treatments is the RCT. Its rigorous methodology is a clear advantage, but it may be expensive/time demanding. Useful information may come from other studies faster and in less costly way. Despite the crescent publications trying to manage tinnitus, phrases such as "tinnitus doesn´t have cure"/"you have to learn to live with it" are still common in professional offices, book chapters, researches, internet. Especially when they come from renowned professionals, they may have impregnated the common sense and demotivated clinicians and researchers to believe in cure.

Total remission of tinnitus may be achievable for a stable period through different strategies, isolated or in combination. Convincing and unique arguments are provided by the patients themselves. Future understanding of the "who, why, when and how" involved in the cure of these exception cases might drive future randomized clinical trials to study the combination of treatments.

Stress and Tinnitus

Mazurek B.

ENT Department – Tinnitus Center, Charite University Medicine Berlin, Germany

Better understanding of stress-related origins of tinnitus.

Emotional stress is defined as an organism's response to environmental challenges. This response involves activation of the hypothalamic-pituitary-adrenal (HPA) axis, with systematic release of cortisol and adrenaline. The stress responses are generally positive, that is, they lead to adaption or to escape from a new, unknown situation. The adaption process on a molecular level is mediated by cortisol-induced changes in the central nervous system (CNS, amygdala, hippocampus, and prefrontal cortex) via glucocorticoid and mineralocorticoid receptors.

When persistent, this situation can lead to negative consequences, such as decreased neurogenesis, neuronal atrophy, and death. Stress is sometimes reported as an etiology of tinnitus, and in the clinic, individuals often complain that their tinnitus is "louder" during stressful periods. Several studies have demonstrated an association between stress and tinnitus, either by examining psychometric instruments (questionnaires), physiological responses of stress tasks, or by measuring the levels of stress hormones.

Other studies show that tinnitus is associated with significant loss of control of the HPA axis, similar to other stress-related diseases. It is possible that the basal values of the cortisol value are initially increased and chronic stress exposure can lead to a reduced acute stress response and HPA-axis dysregulation due to an increased sensitivity against negative fee dBack.

The evidence causally linking emotional stress with tinnitus is still indirect – the main difficulty lies in the inaccessibility of human auditory tissues and the inability of directly measure tinnitus-induced psychological distress in animal models. However, we believe that translational research is the future way filling this gap.

EEG Based brain function Imaging

Shulman A.

Clinical Otolaryngology, SUNY Downstate Medical Center, New York, USA

It is proposed that a particular technology, EEG Based brain function imaging, Neurometric analysis, (QEEG/LORETA), be included in general for identification of brain functions activated in the presence of sensory stimuli, exteroceptive and/or interoceptive, and specifically for the identification in the tinnitus evaluation for moderate and severe disabling subjective idiopathic tinnitus patients (SIT).

The original technology, quantitative electroencephalography (QEEG), the spectral analysis of the raw EEG data was introduced in the 1980s and updated since 2002 with low resolution brain electromagnetic tomography (LORETA) for source localization in brain of electrical potentials recorded from scalp based electrodes.

The method and clinical applications of Neurometrics QEEG/LORETA data analysis have been identified and benefited the SIT patient:

a) to establish an accuracy for the tinnitus,
b) to identify, differentiate electro physiologically multiple ROIs of brain functions which are clinically manifested as components of the tinnitus signal individual for each patient,
c) to identify QEEG biomarker(s) in ROIs of the source localization narrow band analysis, to be targeted for formulation of clinical treatment protocols,
d) to identify the overlay of canonical and large scale core brain function network images based on identification ROIs reflective of auditory and non-auditory brain functions activated in the presence of the tinnitus signal,
e) to identify electrophysiologically chronicity based on identification of ROIs in source localization at a very narrow frequency band reflecting long term auditory memory,
f) outcomes determination- to monitor treatment efficacy electrophysiologically, based on comparison over time of zscores of ROIs of source localization at a very narrow frequency band reflecting a particular modality of treatment attempting tinnitus relief,
g) to monitor electrophysiologically the clinical course of components of the tinnitus signal.

Neurometrics QEEG/LORETA data analysis is not a test for tinnitus. The data is intended to be used adjunct to the clinical evaluation of the tinnitus patient. A case report is included.

Tinnitus and Hearing Implants

Skarzynski P.H.[1,2,3]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

Lately we observe an increasing number of patients complaining of tinnitus. Often these problems are related to impaired function of the auditory system. In this group of patients we can distinguish several sub-groups.

The largest of these groups are the elderly persons, in whom we observe a gradual degeneration of the cochlea. Other groups include people whose pathologies are caused by noise or trauma. Hearing implant technologies are dedicated to patients with various types of hearing loss. In recent years we have examined various groups of patients qualified for cochlear implants, middle ear implants, bone conduction implants or brainstem auditory implants. In all these groups we have noted improvement of coping with tinnitus. Results were dependent on the level of hearing loss, as well as on the type of questionnaire and tests performed.

In future this kind of retrospective and prospective studies will help patients by providing them with information about potential benefits after implantation. These benefits concern not only improvement of hearing and speech understanding, amelioration of tinnitus and finally, improvement of the quality of life.

Keynote Lectures

Intratympanic methilprednisolone injection to treat acute tinnitus in sudden idiopathic sensorineural hearing loss

Barreto M.A.S.C., Bahmad F. Jr, Oliveira C.A.

Otolaryngology Department, Brasília University Medical School, Brazil

Aim: To test the effectiveness of Methilprednisolone intratympanic injection as a treatment for acute tinnitus in sudden idiopathic sensorineural hearing loss.

Material and methods: Twenty three patients with sudden idiopathic sensorineural hearing loss and acute annoying tinnitus treated with systemic methilprednisolone injections (Group 1–13 patients) and 10 patients (Group 2) treated with intratympanic methilprednisolone injections following failure of the systemic treatment. Tinnitus annoyance was evaluated by tinnitus handicap inventory (THI) and visual analog scale(VAS) before and after treatment prospectively.

Results: Both THI and VAS showed significant reduction of tinnitus annoyance after steroids treatment. Group 1 had acceptable results only with systemic steroids and Group 2 showed significant improvement with intratympanic steroids injection after failure of systemic treatment.

Discussion: It is known that intratympanic steroids injection is not effective for treatment of tinnitus annoyance in chronic tinnitus. However, several papers have shown that this treatment is effective to improve acute tinnitus. We now show that tinnitus accompanying sudden idiopathic sensorineural hearing loss is also improved by steroids both systemic and intratympanic.

Conclusions: We strongly suggest that acute tinnitus is still restricted to the cochlea and therefore treatable by intratympanic steroids injection. Chronic tinnitus has already modified neuronal networks in the central pathways and is not amenable to intratympanic steroids injections anymore.

Results and impact of multimodal neurotologic and psychosomatic tinnitus therapy for severe cases of chronic tinnitus

Hesse G.

University of Witten-Herdecke, Tinnitus-Klinik, Bad Arolsen Hospital, Bad Arolsen, Germany

Background: Treating tinnitus for patients suffering from complex tinnitus with a high symptom severity, usually accompanied by a corresponding psychosomatic comorbidity, is a challenge. In general, normal strategies of retraining therapy or even cognitive behavioural therapy with a manualized approach is not sufficient, although there is good evidence for less affected patients. For patients with high comorbidity a multimodal approach with a dense intensity of therapeutic interventions is necessary with the resources offered such as a neuro-otologic psychosomatic tinnitus therapy (NPT). For these treatment option evidence can only be documented through evaluating long-term effects; however, reliable catamnesis studies are not yet available. I report here a review of existing studies and own data for long-term results of NPT, which consists of daily neuro-otologic counselling, the improvement of the concrete hearing ability, an audio-therapy as well as frequent individual and group psychotherapy based on neuro-otology.

Results: 53.8% of patients (n=169) experienced hearing loss which needed to be treated in addition to tinnitus. Both at the end of the therapy and the follow-up consultation, a significant improvement of the tinnitus stress and a continuing significant improvement of the depression and anxiety element could be achieved in the HADS with high effect levels ranging from 1 to 2.5. Patients who did not improve (n=7) or even deteriorated (n=2) demonstrated increased hearing impairment, requiring hearing-aids.

During the therapy, particularly the neuro-otologic counselling, the psychotherapy and the audio-therapy were experienced as effective. After discharge from hospital, especially the progressive muscle relaxation according to Jacobsen (PMR) was continued, as well as psychotherapy.

Conclusions: With corresponding symptomatic suffering, an inpatient hospitalisation and tinnitus therapy with neuro-otologic and psychosomatic alignment (NPT) can achieve medium to high grade therapeutic effects. This requires a disorder-specific approach, which also includes the elements of neuro-otologic counselling, psychotherapy as well as audio-therapy and the possibility of providing hearing aids and an approach which aims at the continuation of the therapies experienced as helpful.

Misophonia and its treatment

Jastreboff M.M.[1], Jastreboff P.J.[1,2]

[1] JHDF Inc., USA
[2] ORL Department Emory University School of Medicine, USA

Misophonia is present when negative reactions occur to a sound that has a specific for a given person pattern and/or meaning. The extent of the reaction can vary from mild to extremely strong. The strength of the reaction often depends on the situation in which the sound is presented. Misophonia develops, and is most frequently observed, in children and teenagers, however it affects people of all ages. While the concept of misophonia was proposed in 2001, recently it become the subject of intense discussion by various professionals. Audiologists, psychologists, neurologists, psychiatrists, and occupational therapists propose contrasting models of misophonia and different approaches to help those who suffer because of it.

Misophonia reflects an enhanced functional connection between the auditory and the limbic and autonomic nervous systems. As such, there is close analogy between tinnitus and misophonia and both phenomena share the same neuronal networks. Notably, tinnitus is accompanied by misophonia in about 60% of our tinnitus patients. Specifically adjusted tinnitus treatment, Tinnitus Retraining Therapy (TRT) is beneficial for misophonic patients. Moreover, our clinical observation has demonstrated that if misophonia coexists with tinnitus, the treatment of misophonia is crucial to achieve a successful outcome for tinnitus therapy.

The behavioral reactions to sound observed in misophonia and hyperacusis are alike, however their mechanisms and treatments are very different. Therefore, it is crucial to distinguish misophonia from hyperacusis as the treatment that is effective for hyperacusis is unsuccessful for misophonia, and the treatment for misophonia has a limited impact on hyperacusis. Loudness Discomfort Levels (LDLs) for pure tone alone cannot help to discriminate misophonia from hyperacusis and therefore specific and detailed interview is essential. Stress is placed on identifying sounds and situations that evoke a patient's negative

reactions, as well as sounds that are well-tolerated, to determine whether there are any discrepancies between the patient's reaction and the sound's intensity. Patients with misophonia react to specific patterns of sound, and the intensity of the sound is secondary.

Misophonia can be successfully treated with TRT. We published the results of TRT treatment for 184 consecutive patients with misophonia and showed an 83% success rate. Treatment consists of intensive counseling and specific sound therapy protocols. Ear level sound generators are frequently recommended as a part of sound therapy. While they are not essential for a successful outcome, sound generators facilitate process of recovery.

The most advanced protocol utilizes the principle of complex conditioning stimuli. It combines offensive sounds with positive reinforcement, achieved by introducing sounds and other sensory signals or environments that have a highly positive connotation to the patient. Subsequently, the strength of positive reinforcement is gradually decreased (e.g., by decreasing the level of positive sound). The length of treatment for misophonia is similar to the length of tinnitus treatment. Typically, patients notice some improvement in 3 months, and see further improvement with continuation of treatment. Most patient achieve a significant, positive outcome during the 9 to 18 months of treatment. In some cases, it is possible to achieve a cure for misophonia.

Cognitive aspects of tinnitus treatments

Jastreboff P.J.[1,2], **Jastreboff M.M.**[1]

[1] *JHDF Inc.*
[2] *ORL Department Emory University School of Medicine*

There is growing agreement that patient' problems with tinnitus are not due to tinnitus perception per se, but to negative reactions to tinnitus. Patients' complaints include decreased ability to enjoy life's activities as well as difficulty concentrating, relaxing and sleeping. Tinnitus patients frequently experience anxiety, depression and panic. Two methods have been shown to be effective in the managements of tinnitus: Cognitive Behavioral Therapy (CBT) and Tinnitus Retraining Therapy (TRT). The main premise of CBT is that thoughts evoke emotions. In CBT emphasis is placed on cognitive functions, selective attention, and the distorted perception of tinnitus. The Cognitive Behavioral model of tinnitus proposed by McKenna (2014) postulates that patients' interpretation of tinnitus and the behavioral changes caused by it play a central role in creating and maintaining tinnitus-evoked distress.

In the neurophysiological model of tinnitus, and consequently in TRT, all factors listed in Cognitive Behavioral model are taken into account; however, the role of the subconscious centers of the brain and the consequences of created conditioned reflexes that connect the auditory system with other systems in the brain are also included. In the initial stage cognitive processes (upper loop on the diagram of the neurophysiological model of tinnitus) play dominant role, but in the chronic stage of tinnitus the subconscious levels (lower loop) become dominant. Connections within the neural networks involved in the adverse effects of tinnitus are governed by the principles of conditioned reflexes. The primary goal of TRT is to disable the functional connections between the auditory and other systems of the brain and consequently to achieve habituation of tinnitus-evoked reactions.

Habituation is initiated and further facilitated by the method of modified passive extinction of these conditioned reflexes. This process involves: 1) teaching/counseling aimed at reclassification of the tinnitus signal to the category of neutral stimuli and 2) using sound therapy to decrease the strength of the tinnitus signal by increasing the level of background neuronal activity in the auditory system, achieved by providing an enhanced sound background. Note, that habituation of perception occurs automatically once a sufficient level of habituation of reaction is achieved.

It is proposed that because TRT targets both the conscious and subconscious levels of the brain and furthermore takes decreased sound tolerance and hearing loss into account, TRT seems to be more effective than CBT with regard to tinnitus management. This view is supported by the published results of clinical studies. The differences between the neurophysiological model of tinnitus and assumptions of CBT have a significant impact on how counseling is performed in these two approaches. Clinical observations indicate that tinnitus treatment is impaired or blocked if decreased sound tolerance is not treated concurrently with tinnitus. Further systematic clinical studies are needed to clarify specific postulates of CBT and TRT and through this to optimize the treatment of tinnitus patients.

Intratympanic treatment for inner ear tinnitus in the past, present and future

Meyer Th.

Auris Medical AG, Switzerland

Since the 1940's, various attempts have been made to treat tinnitus of inner ear origin by way of intratympanic administration. Due to highly targeted delivery to the site of action, this treatment approach requires only low concentrations of medication and results in minimal systemic exposure. Clinical use of intratympanic tinnitus therapy has remained limited to date. The past use and current status of intratympanic tinnitus therapy are reviewed and the potential for its future use is discussed.

A literature search was performed to identify completed clinical studies with intratympanic tinnitus therapy, review safety and efficacy outcomes and collect information on procedural aspects. Safety outcomes were compared with those from studies with other intratympanic inner ear therapies. In addition, clinical trial registries and other information sources were searched to identify and review any ongoing or planned intratympanic tinnitus studies.

Accumulating data confirm that procedure-related side effects of intratympanic therapy are generally only of transient nature. Besides the procedure, important determinants of tolerability are the choice of anaesthetic and the properties of the therapeutic. Intratympanic lidocaine shows the feasibility of pharmacologic modulation of tinnitus, however at the price of inacceptable side effects. No

evidence could be found for efficacy of intratympanic steroids and other off-label treatments. Specifically developed intratympanic glutamate receptor antagonists have shown promise in recent years.

Accumulating safety data support the use of intratympanic administration even over longer time periods, especially with therapeutics that are adapted for use in the middle ear as well as appropriate anaesthetics. The lack of truly effective therapeutics has been the most important impediment to a more widespread adoption of intratympanic therapy. Advances in inner ear pharmacology and drug formulation have led to targeted development of novel intratympanic therapeutics. However, the choice of appropriate outcome measures is a key challenge on the way toward effective treatments.

The perception whereas intratympanic injections can be considered a safe procedure for tinnitus therapy has been confirmed by systematic data collection from prospective clinical trials. Based on the development of specific therapeutics and recent progress in clinical trials, the first intratympanic treatments for tinnitus may become available in the coming years.

Ototoxicity and tinnitus

Szczepek A.J.

Research Laboratory, Department of ORL, Head and Neck Surgery, Charite Universitätsmedizin Berlin, Germany

The term „OTOTOXICITY" relates to a toxic effect of substances on the auditory system – particularly that affecting the inner ear.

Ototoxic substances comprise between others medications such as aspirin, loop diuretics, cisplatin or aminoglycoside antibiotics. In the recent years, several new medications have been developed, often for chronic diseases.

Evidence about the ototoxic action of these new drugs accumulated over the time and will be presented. The up-to date ototoxic characteristics of immunosuppressive (cyclosporine A, tacrolimus), anti-viral (reverse transcriptase inhibitors, pegylated and non-pegylated interferons) and cardiovascular (phosphodiestherase 5 inhibitors) medications will be presented with a special emphasis on incidence of tinnitus.

Vagus-Nerve Stimulation Paired with Tones for the Treatment of Tinnitus

Tyler R.

Department of Otolaryngology-Head and Neck Surgery, University of Iowa, USA

Chronic tinnitus is a debilitating condition that significantly interferes with quality of life of the individual. Several counseling and sound-based therapies have been developed to help some patients manage tinnitus symptoms. However, many patients with chronic tinnitus continue to remain refractory to treatments. Based on preclinical studies, we developed a therapy in which vagus nerve stimulation was paired with tones over several weeks. The hypothesis was that this paired stimulation would decrease tinnitus symptoms by decreasing the pathological plasticity associated with tinnitus.

Subjects with chronic refractory tinnitus were enrolled in the study. 30 were implanted with a VNS device, consisting of an implantable pulse generator and lead. The lead was wrapped around the cervical vagus nerve in a surgery performed by an otolaryngologist. Subjects were randomized to receive either VNS paired with tones or unpaired VNS (control) for six-weeks. Subjects performed the therapy at home for 2.5 hrs/day. All subjects received paired VNS after the 6-week randomized phase.

The device was used on 96% of days with good compliance. Adverse events included incision pain, hoarseness, and coughing and in one situation, a fractured electrode lead. Two patients had partial vocal cord paralysis lasting longer than 6-weeks that slowly improved over time. At the end of 6 weeks, the paired VNS group showed a significant improvement on the Tinnitus Handicap Inventory (THI) (–17.7%; 95% confidence interval, –28% to –7.3%, p=0.0012) compared to the control group (–7.3%; 95% confidence interval, –27.5% to 12.7%, p=0.1561). There was no significant difference between the two groups at this time-point. Fifty percent of the subjects in the paired VNS group exhibited clinically meaningful improvements in their tinnitus compared to 28% in controls at 6 weeks, based on the THI questionnaire. At one-year follow-up, 50% of participants had a clinically meaningful response to the treatment (47% reduction on the THI). Furthermore, we observed that patients who had a hissing quality to their tinnitus and/or blast-induced tinnitus did not respond as well to the therapy.

VNS is feasible and safe in adults with chronic tinnitus. Further studies will help tease out the various subgroups and sensitivity to treatment. The study will provide information for a larger study that will support regulatory approval in the US.

Round Tables, Discussion Panels and Workshops

Round Table

Music-Based interventions in tinnitus

Argstatter H.

DZM e.V., Heidelberg, Germany

Music-based treatments have proven fruitful in tinnitus therapy. From a patients' perspective it is comprehensible to treat an auditory phenomenon on an auditory level. Therefore, music based devices and therapies are on the upswing. By now, music based interventions left the laboratories and score success in the healthcare sector. A number of spin-offs offers commercially available devices.

Most prominent are Desyncra® (based on CR® Neuromodulation), Neuromonics® (combining spectrally modified music, embedded within a broa dBand noise), Tinnitracks (implementing the Tailor-Made Notched Music Training (TMNMT)), Serenade® (using "patterned sounds"), and Widex® Zen (using "fractal music"). These approaches have in common that they use computer based musical stimuli but differ in their use of "music". Many interventions apply computer modified musical stimuli in a passive way, other require active involvement of the patients as part of computer-based auditory perceptual trainings. Some approaches are rather psychotherapeutic interventions supported by musical means.

Music therapeutic in the core sense, as defined by the World Federation of Music Therapy (WFMT) are the approaches by Annette Cramer "Tinnituszentrierte Musiktherapie" and the Heidelberg Neuro-Music Therapy (HNMT). Both approaches combine complementary receptive and active (auditory training) and receptive (exercises for mindfulness and relaxation combining soothing and distracting sounds) musical interventions.

The round table will bring together panelists representing different models of music-based interventions that will discuss pros and cons of these approaches. Apart from clinical impacts, the scientific background will be of importance as well as some pinpoints for possible future prospects in terms of tinnitus heterogeneity.

Panel Discussion

Challenging tinnitus patients – how we can help them ?

Bartnik G.

Audiology Department, Sensor Cliniq, Warsaw, Poland

The purpose of the panel discussion is to present the diagnosis and therapy for the most difficult, challenging tinnitus patients.

In the panel discussion dr Grazyna Bartnik will present three difficult, challenging cases of tinnitus. Each of them has a number of different symptoms and a high degree of suffering. After each presentation the panelists will be asked for their assessment and recommendations for how we can help the patients. Because the panelists represent different areas of expertise in treating tinnitus patients we will have the benefit of a comprehensive look at addressing the patients problems. We also welcome the participants to ask questions and discuss the presented cases.

The panel discussion is to widen the knowledge of how to use the diagnosis and what therapy to choose for those tinnitus cases that create problems in everyday clinical practice.

Round Table

Tinnitus and Hyperacusis in Children

Kennedy V.[1], Raj-Koziak D.[2]

[1] *Paediatric Audiology Department, Bolton NHS Foundation Trust, UK*
[2] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

A review of tinnitus and hyperacusis in children:

1. Tinnitus in children – overview, Raj-Koziak D.
2. Hyperacusis in children, Kennedy V.
3. Questionnaires on tinnitus in children, Hoare D.
4. Systematic review of the prevalence of tinnitus and hyperacusis in children, Nemholt Rosing S.
5. Clinical case of a child with tinnitus, Boboshko M.

Panel Discussion

The European TINNET COST Action – aims and goals

Kleinjung T.[1], Schlee W.[2]

[1] *Department of Otorhinolaryngology, University Hospital of Zurich, Switzerland*
[2] *Department of Psychiatry and Psychotherapy, University of Regensburg, Germany*

TINNET is the acronym for a European-funded action named "Better understanding the heterogeneity of tinnitus to improve and develop new treatments" (*http://www.tinnet.tinnitusresearch.net*). The European COST framework (*www.cost.eu*) specifically funds European networking activities in science and technology.

The global aim of the TINNET COST Action is the creation of a pan-European network to identify pathophysiologically and clinically meaningful subtypes of tinnitus together with their neurobiological and genetic underpinnings. This will be facilitated by standards for clinical assessment and outcome measurement, by large-scale multi-center data assessment and by data management in a quality-controlled database. Furthermore, the clinical data will be complemented by neuroimaging and by the search for genetic markers. The data analysis concentrates on the identification of meaningful tinnitus subtypes with the goal to improve the scientific understanding of the tinnitus heterogeneity and develop new treatments for tinnitus.

Five working groups have been formed to concentrate on the objectives. The specific objectives of the working groups will be introduced by members of the TINNET COST action:

1. Standardizing clinical and audiological assessments of tinnitus patients according to common standards across Europe (Cima R.).
2. Managing data in a central database and identifying meaningful tinnitus subtypes (Schlee W.).
3. Developing standards for neuroimaging studies and probing the neurobiological entity of the defined subtypes by large-scale analyses of neuroimaging data (Meyer M.).
4. Identifying the involvement of Biomarkers in the pathogenesis of the different subtypes of tinnitus (Mazurek B.).
5. Developing standards for the measurement of the outcomes of clinical trials and their central data collection (Kleinjung T.).

Workshop

Person-centered Care in Tinnitus Management

Fioretti A, Rutherford C.

Ida Institute, Nærum, Denmark

This workshop will provide the opportunity for the clinicians to discuss the challenges they face when dealing with Tinnitus patients. They will receive information about clinical tools developed recently with the aim of providing guidance on how to talk about Tinnitus with their patients and thus, convert current knowledge on psychosocial aspects of managing tinnitus into everyday audiological clinical practice.

The workshop will contain a variety of training methodologies, such as presentations, videos, discussions and exercises with active participation by the participants. The objectives of the workshop are to:

– Provide information about person-centered care and insights into the Tinnitus patient´s perspective,
– Promote an exchange of knowledge among hearing care professionals regarding Tinnitus management,
– Introduce clinical tools on how to communicate in an effective way with Tinnitus patients.

Even though tinnitus is a common symptom among hearing impaired individuals, many hearing care professionals find it challenging to treat tinnitus patients. Mostly treatment that works for one patient may not work for another. Because tinnitus management is focused on managing the negative reaction to tinnitus, rather than the tinnitus itself, many clinicians who do not specialize in tinnitus and are the first to encounter the tinnitus patient, may feel they do not have adequate counselling skills to support the patient.

After the workshop, participants will be able to use the Ida Institute tinnitus tools to structure conversations with patients about tinnitus, talk about possible coping mechanisms and instill hope in what may often feel like hopeless situations.

Workshop

Hyperacusis Induced Pain: Mechanisms and Treatment

Westcott M.

Dineen Westcott Moore Audiology, Heidelberg, Germany

Hyperacusis is defined as an abnormal intolerance, heightened volume and physical discomfort to sounds which are typically loud, sudden or unexpected. There is a strong comorbidity between tinnitus and hyperacusis.

Recent research documents hyperacusis in 46% (Westcott et al 2013) and 55% (Schecklmann et al 2014) of tinnitus patients. Hyperacusis patients can suffer from aural pain, typically from loud sounds, but also to softer sounds which are not capable of causing damage. This has been linked to tonic tensor tympani syndrome (TTTS) by Jastreboff and Hazell (2004) and Westcott (2006). TTTS is an involuntary condition where the threshold for tensor tympani muscle activity is lowered, resulting in a frequent spam (Klockhoff 1961, 1971, 1978–9). This causes subtle but noticeable fluctuations in eardrum tension and middle ear ventilation, and can lead to trigeminal nerve irritability (Ramirez et al 2008, Aristeguieta et al 2010, Westcott 2008, 2009, 2013, 2015, 2016). TTTS symptoms include: increased tinnitus; aural pressure/fullness; sharp stabbing aural pain; dull earache; pain around the ear, cheek, side of the neck; eardrum flutter; muffled/distorted hearing; mild vertigo. TTTS symptoms are commonly associated with TMJ dysfunction. However, sound-induced fluctuating TTTS symptoms are common in hyperacusis patients – with no underlying aural or TMJ pathology.

Data collected in eight tinnitus clinics on 345 patients with normal aural/TMJ function showed 81.1% of patients with hyperacusis developed ≥1 TTTS symptoms (Westcott et al, 2013). This rises to 91.3% in patients with severe hyperacusis. 74.0% of hyperacusis patients with dull earache, 66.7% with sharp aural pain, 75.9% with "muffled" hearing, 59.2% with eardrum flutter, 53.3% with aural pressure reported those symptoms developed from intolerable sound exposure. Once these symptoms develop, they can become increasingly severe in response to an

increasing range of everyday sounds. This can reinforce an incorrect belief that these sounds are causing damage to their ears/hearing.

Central pain sensitisation can develop from chronic trigeminal neuralgic TTTS-triggered pain, explaining why patients with severe hyperacusis report frequent or constant severe pain, exacerbated by everyday sounds. In some cases, patients trace their pain along the path of the trigeminal nerve (mandibular branch).TTTS symptoms are often misdiagnosed if no aural/TMJ pathology is identified. If patients are not given an explanation of their symptoms, their anxiety contributes to tinnitus distress and hyperacusis escalation. Explaining TTTS can have an immediate effect on easing the symptoms, indicating that sound induced pain is not consistent with damage.

This workshop will discuss the clinical presentation of hyperacusis induced pain, TTTS evaluation, symptom reduction using hyperacusis therapy and medical treatment which has been effective in patients with chronic hyperacusis induced pain.

Satellite Symposium
Dr. Willmar Schwabe Pharmaceuticals Satellite Symposium: Tinnitus – Ringing the changes with EGb 761®

Compensated and uncompensated chronic tinnitus

Yu L., Ma X.

ENT Department, People's Hospital of Peking University, China

Aim: To discuss possibilities of compensation mechanisms in chronic tinnitus treatment.

Material and methods: Data from China sudden hearing loss multiple centre clinical study, from Aug. 2008 to Nov.2011. Data on 1024 unilateral sudden hearing loss patients in 33 hospitals including 922 patients (90.04%) suffering from tinnitus were analysed. The patients were given standard treatment.

Results: The total improvement rate of tinnitus reached 85.03%, improvement rate of hearing reached 77.44%. A total of 192 patients were followed up for one year. Over time, approximately 90% of patients could adapt to the tinnitus combined with sudden hearing loss.

Conclusions: 1. Improvement of tinnitus is positively correlated with hearing recovery. 2. Acute tinnitus combined with hearing loss needs treatment as soon as possible. Early intervention can shorten the period required for tinnitus to improve. 3. Even if hearing does not recover over time, most tinnitus can be compensated for, which indicates that acute tinnitus caused by pure hearing loss will not develop into chronic tinnitus. 4. Tinnitus caused by pure hearing damage / loss such as sudden hearing loss will be self-compensated within around one year. Decompensated chronic tinnitus usually has multiple causal factors (e.g. sleeping disorders, migraine, OSAHS, GERD, etc.). 5. Improving the cognitive function of the central nervous system (CNS), stabilizing peripheral lesions and reducing the inhibition of the CNS will be effective in supporting tinnitus compensation. 6. EGb 761® and sound masking therapy can be effective and shorten compensation time in the CNS.

EGb 761® – tinnitus treatment with a plus

Procházková K., Hahn A., Skutil J., Šejna I.

ENT Clinic, Kralovske Vinohrady University Hospital, Czech Republic

We conducted a trial to compare the effects of two frequently prescribed drugs against tinnitus – gingko biloba extract EGb 761® and pentoxifylline. The treatment effects were assessed according to their ability to lower the tinnitus perception and also to reduce psycho-social disturbances such as anxiety, depression and overall disability symptoms of the subjects.

Two hundred patients with sub-chronic or chronic tinnitus were enrolled in this double-blind trial and randomized to receive 120 mg EGb 761® or 600 mg pentoxifylline, each twice a day and in double-dummy fashion over a 12-week period. Treatment effects were assessed as changes in 11-Point Box Scales for tinnitus loudness and annoyance, the abridged Tinnitus Questionnaire (Mini-TQ), the Hospital Anxiety and Depression Scale (HADS), and the Sheehan Disability Scale (SDS).

For both treatment groups, significant improvements were observed in the Mini-TQ, the 11-Point Box Scales for tinnitus loudness and annoyance, the HADS anxiety score and the SDS. There was no relevant difference regarding tinnitus-related outcomes between the two treatment groups. Twenty adverse events were documented for 19 subjects treated with EGb 761 ® and 36 adverse events were reported for 27 patients receiving pentoxifylline.

Patients suffering from chronic or sub-chronic tinnitus are very challenging to treat. Both investigational products were based on perfusion enhancement and prove their efficacy in decreasing the loudness and annoyance of tinnitus. EGb 761® demonstrated stronger effects in patients with depression and anxiety symptoms which we attribute to its nootropic activity.

EGb 761® and pentoxifylline were similarly effective in reducing the loudness and annoyance of tinnitus as well as overall suffering of the patients. The EGb 761® treatment group however showed better improvement in patients with elevated depression scores and provided higher incidence of improved patients in anxiety score categories. The incidence of adverse events was lower in the EGb 761® group, therefore the tolerability of EGb 761® was distinctly better.

Oral Presentations

O.001 • Dry needling on the treatment of chronic somatosensory tinnitus: An Open Pilot Study

Anauate J., Campagna C., Garcia L., Oiticica J.

Otorhinolaryngology Department, University of Sao Paulo-School of Medicine, Brazil

Aim: To determine the effectiveness of dry needling on the treatment of chronic somatosensory tinnitus patients.

Material and methods: Open label pilot studies with 19 chronic tinnitus patients attended at the Tinnitus Research Group HC- FMUSP, complaining of neck and/or cervical pain and with MTP in the head, neck and/or shoulder. They were subjected to a complete ENT evaluation and research of MTP. We used four dry needling sessions (once a week) to treat MTP. We used analog visual scale (AVS), THI, pitch, loudness, minimum masking level, and neck disability index (NDI) as measure variables.

Results: We found meaningful differences in AVS, THI, minimum masking level (MML) and NDI. Mean AVS was 6.7 (±1.6) and 4.2 (±2.4)[p=0.0004], mean THI was 44.5 (±18.6) and 29.3 (±15.1)[p<0.0001], mean NDI was 10.3 (±8.7) and 7.2 (±8.1) [p=0.015], respectively before and after dry needling treatment.

Discussion: The influence of the somatosensory system on auditory perception has already been demonstrated by several authors over the years. There are several ways to be approached, both with medications and with alternative methods such as local application of anesthetics, conventional physiotherapeutic treatments such as myofascial trigger points deactivation, local heat, massage, stretching and dry needling. We opted for dry needling because it is a technique that has not yet been studied and which presents excellent results in the improvement of pain in patients with myofascial pain syndrome.

Conclusions: The dry needling seems to be an effective therapy in patients with chronic somatosensory tinnitus. However double-blind studies need to be done before any final conclusions.

O.002 • Decreased speech-in-noise understanding in normal hearing young adults with tinnitus: Evidence for 'hidden hearing loss'

Annick G., Schlee W., Rabau S., Wouters K., Fransen E., Van de Heyning P.

Otorhinolaryngology, Head and Neck Surgery Department, Antwerp University Hospital, Belgium

Young people are often exposed to high music levels which make them more at risk to develop noise-induced symptoms of which tinnitus is the symptom perceived the most by young adults. Controversy exists on the underlying condition of young adults with normal hearing thresholds and noise-induced tinnitus due to leisure noise. The present study aimed to assess differences in audiological characteristics between noise-exposed adolescents with and without noise-induced tinnitus (NIT).

A group of 87 young adults with a history of recreational noise exposure was investigated by use of the following tests: otoscopy, impedance measurements, pure-tone audiometry including high-frequencies, transient and distortion product otoacoustic emissions, speech-in-noise testing with continuous and modulated noise (amplitude-modulated by 15 Hz), auditory brainstem responses (ABR) and questionnaires.

Nineteen students reported NIT due to recreational noise exposure, and their measures were compared to the non-tinnitus subjects (n=68).No significant differences between tinnitus and non-tinnitus subjects could be found for hearing thresholds, otoacoustic emissions and ABR results. On the other hand, tinnitus subjects had significantly worse speech reception in noise compared to non-tinnitus subjects for sentences embedded in steady-state noise (mean speech reception threshold (SRT) scores respectively –5.77 dB SNR and –6.90 dB SNR; p=0.025) as well as for sentences embedded in 15 Hz AM-noise (mean SRT scores respectively –13.04 dB SNR and –15.17 dB SNR; p=0.013).

Young adults with and without NIT did not differ regarding audiometry, OAE and ABR. However, tinnitus patients showed decreased speech-in-noise reception. The results are discussed in the light of previous findings suggestion noise-induced tinnitus may occur in the absence of measurable peripheral damage as reflected in speech-in-noise deficits in tinnitus subjects.

O.003 • Tinnitus percept during altered states of consciousness – influence of two different, music based techniques

Argstatter H., Peschen E.

Tinnitus Outpatient Department, DZM e.V., Heidelberg, Germany

Mindfulness-based interventions and relaxation trainings are part of many tinnitus centered treatments. Vibroacoustically induced relaxation (VR) and music guided imagination (MI) are two music therapeutic relaxation methods that have proven effective in modulating the EEG signal complexity, indicating altered states of consciousness in psychosomatic patients.

The Heidelberg Neuro-Music Therapy (HNMT) consists of active auditory trainings modules but also incorporates music-based relaxation. The current trial compares the impact of MI vs. VR on tinnitus perception within and across sessions. MI conditions pre-recorded, soothing musical pieces as tension releasing stimulus by combining the music with positive mental images. VR uses a body monochord (string instrument with 21 chords tuned to one base tone producing rich overtones). 25 tinnitus patients received eight 15-minute-sessions of either MI or VR as part of their 5-day HNMT. Perception of tinnitus

loudness, grade of relaxation/tension as well as appraisal of the interventions were assessed by VAS. Relaxation was objectified by psychophysiological data (skin conductance, heart rate variability).

Data were processed using multivariate statistics. Generally, patients report less subjective salience of their tinnitus percept and a released tension both during and after each session. This effect consolidates across sessions. Overall, VR yields greater effects and is rated as more pleasing than MI. VR has a higher potency than MI to temporarily eliminate tinnitus perception. Psychophysiological data back up the subjective assessments. Co-variates such as prior experiences in relaxation techniques, gender or initial tinnitus strain will be taken into consideration.

Monochord sounds are very rich in overtones, foster deep relaxation and induce altered states of consciousness. VR allows for fairly reliable, temporary tinnitus deletion. MI is also effective in inducing relaxation and scores with better everyday suitability. Future directions will include tinnitus frequency specific adjustments of the monochord base tone.

Music based relaxation techniques promote both mental and physical regeneration and alleviate tinnitus saliency. Depending on the patients' needs, prior experiences and preferences, MI and VR are complementary interventions and form an integral part of the HNMT. However, relaxation as single intervention seems to be insufficient and should be integrated in a more complex treatment regime.

O.004 • **Manual Therapy. Treatment option in cervicogenic somatosensory tinnitus?**

Bakker I., Oostendorp R.A.B., Elvers H.

Pr voor ambulante tinnitus behandeling Rheden, Medical Centre Ra dBoud University Nijmegen, the Netherlands

The aims of this study are to focus on the role of cervical spine as take-off area for treatment and to evaluate the effects of Manual Therapy Utrecht (MTU) in patients with subjective tinnitus.

The databases PubMed and Cochrane Reviews were searched from 2000 to 2016. Twelve studies were included, investigating cervical spine treatment in relation to tinnitus. Five hundred and six patients with tinnitus were referred or referred themselves. All patients received manual therapy according to the method of MTU. Tinnitus intensity (VAS-tin 0–100 mm) was the pre-and post-outcome measure.

Eleven out of 12 articles from case study till rct emphasize spine treatment in subjective tinnitus. MTU (Gentle movements) are treatment basics with a max of 12 treatments. A cohort of patients with subjective tinnitus (N=506), MTU gives 60.8% stat sign ($p<0.001$), 45.5% clin relev (pre- post difference ≥10 mm VAS-tin) improvement. Tinnitus decrease is stable during at least two months' follow-up without treatment. A variable decrease occurs in the continuation of MTU mostly after 1 yr. About 10% of the patients have almost no tinnitus after 1 yr.

The idea that cervicogenic somatosensory tinnitus decreases by manual therapy is still controversial. Based on neural connections and integration of the auditory and somatosensory systems of the upper cervical region, selective stimulation of joint and muscle proprioceptors (large-diameter fibers) tends to inhibit the dorsal cochlear nucleus with decrease of tinnitus. In MTU manual techniques are proposed to inhibit transmissions and to close the gate. The results of this practical study support this underlying mechanism and is the basis for further research.

Manual therapy is a realistic treatment option for patients with cervicogenic somatosensory tinnitus. This study provides valuable information about on both the prevalence of patients with cerviciogenic somatosensory tinnitus in primary care and the potential effectiveness of manual therapy. Treatment modalities, particularly manual therapy, involving the (cervicogenic) somatosensory systems, should be reassessed in the subgroup of patients with cervicogenic somatosensory tinnitus.

O.005 • **Distortion Product Otoacoustic Emission Levels in Normal-Hearing Individuals with Tinnitus after Acoustic Trauma**

Bartnik G.[1], Lewandowska M.[2,3]

[1] *The Audiology Department at the Sensor Cliniq of the IBIS Hospital, Warsaw, Poland*
[2] *Bioimaging Research Center, Institute of Physiology and Pathology of Hearing, Warsaw, Poland*
[3] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

The purpose of this study was to determine whether Distortion Product Otoacoustic Emissions (DPOAEs) can be used to distinguish among group of patients with tinnitus after acoustic trauma with audiometrically normal-hearing sensitivity and control normal-hearing group without tinnitus.

The DP-grams with fixed primary levels as a function of frequency were measured in the group of patients (n=35) and controls (n=25) – both groups with audiometrically normal-hearing sensitivity.

The DP-grams clearly distinguish between the control and patient groups. There was a significant ($F(19.58)=29.95$, $p=0.000$, $\eta 2=0.341$) interaction between group (tinnitus patients vs non-tinnitus age- and gender-matched controls) and frequency (20 frequencies in the range from 0.5 to 12 k Hz) indicating increased average DP levels in tinnitus group at all used frequencies except for 1 k Hz, 8 k Hz, 9.515 k Hz and 12 k Hz.

In the patient group 60% of these individuals had DP levels that were outside of the 95% confidence range for the control group. Thus, DPOAE measures can be used with at least partial success to distinguish controls from normal hearing patients with tinnitus after acoustic trauma.

These findings suggest that the pathology represented among the patient group potentially responsible for the generation of tinnitus signal is consistent at the level of the cochlea.

O.006 • Audiology-guided Internet-delivered cognitive behavioural therapy for adults with tinnitus in the UK

Beukes E., Baguley D., Manchaiah V., Allen P., Andersson G.

Vision and Hearing Sciences Department, Anglia Ruskin University, Cambridge, UK

Additional cost and clinically effective tinnitus management routes are required in order to increase access to tinnitus care. An innovative way to improve access is providing Cognitive Behavioural Therapy via the Internet (iCBT). As iCBT is not available in the United Kingdom (UK), the purpose of this research was to develop and evaluate such an intervention to determine the intervention effects on tinnitus and associated comorbidities. A further aim was to determine whether this intervention could be guided by an Audiologist, as in the past it has been delivered by Clinical Psychologists.

The Internet intervention was adapted for a UK population and functionality testing was undertaken. This intervention was then evaluated in a three phase clinical trial for feasibility, efficacy and to compare to standard clinical care which is individual face-to-face tinnitus therapy. Standardised self-reported outcome measures for tinnitus distress, hearing disability, insomnia, anxiety, depression, hyperacusis, cognitive failures and satisfaction with life were used to assess outcome.

The intervention was rated highly by both professionals and tinnitus users. Feasibility was established in terms of recruitment potential and suitable attrition and compliance rates. Undertaking iCBT led to significant reduction in tinnitus distress and many of the associated problems with tinnitus. These results remained stable post-treatment and overall, participants reported positive experiences using the intervention.

Key intervention components that contributed to favourable outcomes as well as barrier to success were identified. Participants indicated which components they found more beneficial and rated the applied relaxation programme most highly.

Addressing barrier such as varied engagement and motivational levels are required. Attention should be given to ways of encouraging young adults and those in remote areas who were less likely to take up the intervention. Guided iCBT for tinnitus using Audiological support in the UK has indicated good efficacy at reducing tinnitus distress and associated symptoms. Further work should be directed to exploring moderators and mediators of outcome, comparing result when guided by an Audiology or Psychologist, and which specific aspects of iCBT result in positive outcomes, in view of dissemination of this intervention for those with tinnitus in the UK.

O.007 • Demographic, clinical and diagnostic description of tinnitus's patients diagnosed in Buenos Aires British Hospital 2013–2016: Retrospective Study

Binetti A.C., Castillo M., Bustamante M., Ricardo A., Varela A.

ENT Department, Buenos Aires British Hospital, Argentina

Aim: To describe demographic characteristics, final diagnosis and tinnitus features on a sample of patients of last three years from Buenos Aires British Hospital.

Material and methods: Observational, retrospective and descriptive study. Population: sample of patients diagnosed with tinnitus at the Otorhinolaryngology Department of Buenos Aires British Hospital from January 2013 to January 2016. Two hundred patients, Non – probabilistic sampling. Univariate descriptive analysis, PSPP program used for statistical analysis. Clinical records reviewed of patients attended at Otorhinolaryngology department.

Results: This study showed a mean age in sample of 56.9 ± 5.4 years old. Men were the most affected (51.5%). Main diagnosis in men were vestibular migraine, endolymphatic hydrops, acoustic trauma and sudden deafness. Most frequent diagnoses in women were vestibular migraine, endolymphatic hydrops, acoustic trauma, muscular-related tinnitus and presbycusis. Fluctuating tinnitus was described mainly in women. The most affected frequency was 8000 Hz on vestibular migraine, presbycusis and endolymphatic hydrops, 500 Hz in muscular- related tinnitus, and 4000 Hz for acoustic trauma.

Discussion: As Buenos Aires British Hospital is a reference center for dizzy and vertiginous patients, we have found coincidence between tinnitus and vestibular symptoms. The high prevalence in this population of vestibular migraine and Meniere´s disease shows that fluctuating tinnitus has been present in both diseases. The presence of tinnitus with an 8000 Hz frequency for chronic inner ear diseases with vertigo is different to previous results, and could have relationship with the evolution of each disease, and age of patients.

Conclusions: Main population affected were men. Mean age of affected population 56.9 ± 5.4 years old. The most frequent diagnosis were migraine associated to vertigo, endolymphatic hydrops and presbycusis in both gender. Fluctuating tinnitus was described mainly in females and 8000 Hz frequency the most affected one.

O.008 • Treatment of tinnitus after a traumatic injury of the middle ear

Boruta M.[1], Skarzynski P.H.[2,3], Kaczynska B.[2], Dziedziel B.[2], Skarzynski H.[1,2]

[1] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*

Aim: Available literature suggests that the most common causes of traumatic damages of the middle ear are head traumas (32.2%), traffic accidents (29%), isolated luxation of incus (25.8%) and isolated luxation of stapes (12.9%). Sometimes the cause of isolated damage cannot be ascertained, but the majority is related to head injury, ear injury or barotrauma. The aim of this report is to present a case of treatment of severe tinnitus with profound mixed hearing loss in one ear occurring immediately after traffic accident without any damage visible in otoscopy or radiological images.

Material and methods: Patient aged 34 years, qualified for exploration tympanotomy with possible reconstruction of ossicular chain or stapedotomy. Preoperatively performed tests included physical workup, pure-tone, speech and impedance audiometry tests as well as a CT and MRI scans.

Results: Exploration of the middle ear was performed via external ear canal. Intraoperatively it was seen that stapes crura are separated but not dislocated from the stapes plate. Consequently, stapedotomy was performed. Postoperatively, closure of the air-bone gap was observed.

Discussion: Postoperative results confirm that stapedotomy can be used to treat patients with tinnitus and many cases of middle ear damage, including trauma. Patient reported diminishment of his main source of distress, which was tinnitus, in operated ear immediately after removal of dressing. Tinnitus disappeared completely a few days later.

Conclusions: Tinnitus may arise in different mechanisms and can accompany many pathologies of a middle ear. Onset of these disorders after a head trauma may result from the ossicular chain trauma or a shaking injury to the middle ear.

O.009 • Tinnitus in the patient with neuroendocrine adenoma of middle ear (NAME)

Buksinska M.[1], Skarzynski P.H.[2,3,4], Skarzynski H.[1,2]

[1] *Department of Oto-Rhino-Laryngology, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Institute of Sensory Organs, Kajetany, Poland*
[4] *Department of Heart Failure and Cardiac Rehabilitation, Second Faculty, Medical University of Warsaw, Poland*

Neuroendocrine adenomas are tumors with double differentiation. Middle ear location of those tumors is rare. NAME causes various clinical signs. One of them could be tinnitus. This paper presents a case study of patient with tinnitus related to NAME.

A 23-years old patient was admitted to the World Hearing Center because of hearing loss and tinnitus in the right ear. Physical examination suggested tumor of the middle ear. Patient underwent surgical treatment (atticoantromastoidectomy) with excision of pathological tissues and myringoplasty. Tinnitus was evaluated using the battery of questionnaires (TFI, THI, THS). The postoperative period was uneventful. Patient reported hearing improvement and tinnitus reduction. Histological examination revealed neuroendocrine adenoma of the middle ear.

O.010 • ABR analysis in patients with unilateral tinnitus

Chen P-Y.[1], Hsu C.[2], Liu T-C.[2]

Department of Otolaryngology, National Taiwan University Hospital YunLin br, NTUH, Taiwan

The purpose of this study is to analyze the latency and amplitude of waveforms of ABR in patients with unilateral tinnitus. The tinnitus ears and non-tinnitus ears were compared for each subject.

ABR waveforms were retrospectively analyzed in 68 participants with single side tinnitus in terms of wave I, wave III and wave V absolute latency, wave I-III, wave III-V and wave I–V intervals latency, amplitude and amplitude ratio (III/I, V/I). Statistical analyses were performed within subjects. The subjects were further divided into two subgroups based on their hearing: symmetric group (n=45) and asymmetric group (n=23). The same comparisons were made in these two groups.

Our results revealed significantly greater wave V amplitude and V/I amplitude ratio and prolonged absolute latency (wave I, III and V) at the tinnitus side. For the subgroup analysis, we found greater V/I and III/I amplitude ratio, prolong absolute latency in all three waves, and enhanced wave V amplitude at the tinnitus side in the asymmetrical hearing group. In the symmetrical hearing group, our result showed prolonged absolute latency and enhanced amplitude of wave III and wave V at the tinnitus side. In terms of amplitude ratio, wave III/I and V/I ratio were enhanced at the tinnitus side.

Previous studies mainly emphasized on comparison between tinnitus and non-tinnitus patients and the results are inconclusive. The present study focused on the within subject comparisons for unilateral tinnitus. Our results are compatible with some prior studies that ABR waves were abnormally prolonged or enhanced in the tinnitus ears than non-tinnitus ears. There's no difference between two subgroups. ABR waves were abnormally prolonged or enhanced in the tinnitus ears than non-tinnitus ears. There's no difference between symmetric and asymmetric hearing group. This is also in line with the contemporary theory of tinnitus mechanism that the brainstem auditory tract is dysfunctional or hyperactive in tinnitus.

O.011 • Cochlear Implantation as a Treatment modality for Tinnitus in Subjects with Hearing Loss: A Preliminary Report

Chih-hui A., Kung-pai C.E., Lieber C., Li P.

Otolaryngology, Head and Neck Department, Cheng Hsin General Hospital, Taipei, Taiwan

Cochlear implants (CIs) have been reported as a standard method to rehabilitate severe-to-profound sensorineural hearing loss, hence improve speech and language significantly. In some studies, cochlear implantation also has its role in reducing tinnitus. The aim of this study is to present our experience in tinnitus management with cochlear implantation in patients with both tinnitus and asymmetrical hearing loss.

Subjects with profound hearing loss and tinnitus were recruited in this study. All subjects underwent implantation of a multichannel CI. The device was switched on 1 day after cochlear implantation. A visual analog scale (VAS), The Hospital Anxiety and Depression Scale (HADS) and the Tinnitus Questionnaire (Tinnitus Handicap Inventory, THI) were administered before implantation (within 1 day prior to surgery) and 1 day, 1 week, 2 weeks, 1 month, 3 months after the operation. The scores of the questionnaires were analyzed by paired t test.

The structural interview revealed that all patients (7/7) still wear their CI seven days a week after cochlear implantation. Given the relative small sample size, quantitative data are presented as median and range (minimum and maximum).

The data presented demonstrate a consistent reduction in tinnitus loudness with electrical stimulation via a CI in all of our subjects. In our study, tinnitus reduced significantly after 2 weeks of the first-matching and this condition remained stable in further follow-up periods, which is consistent with other recent studies. Another finding was that the THI, VAS and HADS scores were all increased one day after the operation, we hypothesize that is related to the post-operative stress and discomfort.

Significant reduction of tinnitus was noted after the initial matching and remained stable after then. Further study with larger population is needed to validate the long-term scenario of tinnitus reduction, and the effect of daily performance over time as well.

O.012 • Tonotopic organisation in tinnitus and partial deafness

Ciesla K.[1,2], Wolak T.[1,2], Lewandowska M.[1,2], Lorens A.[1,3], Rusiniak M.[1,2], Pluta A.[1,2], Skarzynski H.[1,4]

[1] *Bioimaging Research Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Implants and Auditory Perception Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

The main aim of the fMRI study was to assess tonotopic organisation in patients with partial deafness (PD, high-frequency sensorineural hearing loss) with and without chronic tinnitus, and in patients with tinnitus but normal hearing (NH).

There were 41 participants: 12 with PD and tinnitus (7F; 38±9), 14 with PD and no tinnitus (7F; 36±3), 15 with NH and tinnitus (6 women; 35±4). PD groups had comparable HL; PTA(0.5, 1, 2 k Hz)=60. Data collected in 32 healthy individuals served as reference. The stimulation was 5 complex tones of 8 s with central frequencies: 400 Hz, 800 Hz, 1600 Hz, 3200 Hz, 6400 Hz. Sounds were presented binaurally at 80 dB(A). Participants passively listened. A sparse data acquisition paradigm was applied to avoid confounds by the MR scanner noise. The study was performed on a Siemens 3T MAGNETOM Trio scanner.

Both groups with PD showed similar activation patterns in bilateral superior temporal planes (STP) (location of the primary auditory cortex) with no significant between-group differences. Activation was present for complex tones 400 Hz and 800 Hz, for which hearing levels were at 40–60 dB. Higher frequencies produced no responses in the brain ($p<0.001$, FWEc). The group with tinnitus but NH had significant activations in STP for the whole range of tones, i.e. 400–6400 Hzf0 with a visible bifurcation of gradients around Heschl gyri in response to 3200 Hz f0 and 6400 Hz f0 tones.

The outcomes of the study indicate that the tonotopic organization of the auditory cortex reflects peripheral phenomena, such as loss of outer and inner hair cells in HL. Since for 40–60 dB HL the inner hair cells are mostly preserved (for 400 Hz f0 and 800 Hz f0) all information is transmitted to higher areas of the auditory system. The active brain regions are relatively large due to the broadening of auditory filters. Tinnitus itself has not been found to affect the tonotopic organisation of the auditory cortex and be similar to that revealed in reference healthy individuals.

In summary, macroscopic tonotopic maps of the auditory cortex are affected by peripheral pathomechanisms in hearing loss but not by tinnitus per se. Further studies are necessary in subgroups of patients with tinnitus, with and without hearing loss.

O.013 • TRT long-term results in lost to follow up patients: Role of the timing and of the reasons of the dropout

Cipriani L., Del Zompo M.R., Lapenna R., Giommetti G., Molini E., Ricci G.

Department of Surgical and Biomedical Sciences, University of Perugia, Italy

Aim: To evaluate the TRT results in patients who did not complete the program, with particular reference to the timing and the reasons of their dropout.

Design: retrospective case-control study with a telephone survey of 90 patients divided into three groups on the basis of the time of TRT program attendance. A group of control cases (CC) who completed with efficacy the whole TRT program was included.36 patients completed only the first phase of the TRT program (Missing group; M), 34 patients attended additional counseling for less than six months (Non-Compliant; NC), 20 patients attended counseling for more than six months but did not complete the TRT program (Compliant; C). 28 patients (CC) completed with efficacy the whole TRT program.

Demographic factors and initial Tinnitus Handicap Inventory (THI) and tinnitus Visual Analogue Scale (VAS) for tinnitus score did not predict patients' dropout from the treatment. Telephonic THI and VAS were significantly lower than the initial ones in all the study groups, except for NC group. To have not shared the TRT program is a fundamental reason for TRT poor results.

A single counselling can be effective also in the case the TRT program is not shared, but to follow a part of the TRT program with poor motivations and wrong expectations lead to not satisfactory results.

O.014 • Tinnitus and Misophonia. A Tale of Two Cities

Danesh A.A., Porcaro C., Alavi E.

Communication Sciences and Biomedical Sciences, Florida Atlantic University, USA

Our aim is to discuss relationship between misophonia and tinnitus. Our current knowledge about misophonia is still limited and we continue to be in the "learning" stage. This presentation will review an up-to-date body of the relevant literature about misophonia and its relation to tinnitus.

We will review some of the underlying etiology(ies) and applied evidence-based management protocols to manage misophonia and tinnitus. Coexisting misophonia and tinnitus and management protocols will be discussed. This presentation will additionally address the future research needs about causal relationship between misophonia and tinnitus and will be followed by case presentations and management outcomes for cases with coexisting misophonia and tinnitus. Finally the current ongoing misophonia research at our center will be described.

O.015 • What is the content of cervical physical therapy in the treatment of cervicogenic disorders?

De Hertogh W., Van de Heyning P., Nieste E., De Pauw J., Michiels S.

Rehabilitation Sciences and Physiotherapy, University of Antwerp, Belgium

Patients with cervicogenic complaints such as cervicogenic somatic tinnitus can be referred for cervical physical therapy (CPT) treatment. The content of this CPT can vary widely and a combination of various techniques such as relaxation, stretching, articular mobilisations and exercises is used. Consequently, for a referring doctor, it is often unclear what kind of CPT is administered to a patient. We aim to provide an evidence-based overview of the content and underlying working mechanisms of CPT to allow future appropriate referral.

Studies investigating treatment effects and underlying mechanisms were selected via a literature search. A summary on the content of CPT for the treatment of cervicogenic complaints such as neck pain, cervicogenic headache, chronic tension type headache, migraine and cervicogenic somatic tinnitus is made.

Based on the findings of multiple systematic reviews and RCTs, it is clear that a combination of articular mobilisations and exercises is the treatment of choice to obtain improvement in patient reported outcome measures. Training of the deep cervical flexors is of particular interest.

During the congress, we will present a clear overview of the available data on effectiveness and working mechanisms. Based on the observed improvements in clinical trials, we will provide insight in the recommended number of treatments.

Interprofessional communication between medical doctors, physical therapists and other health care providers is necessary for excellent patient care. By providing information about the content and required dose (frequency) of CPT, we aim to contribute to an improved care.

CPT consisting of a combination of articular mobilisations and exercises can be beneficial for various cervicogenic disorders, such as cervicogenic somatic tinnitus. Appropriate referral can help to ensure the patient receives the required CPT.

O.016 • Bibliotherapy approach in tinnitus patients

de Oliveira V., Meneses R.F., Trigueiros N.

ENT Department, Hospital das Forças Armadas, Porto, Portugal

There are several approaches to deal with tinnitus patients, and the benefits obtained are not quite evident, which may be due to the great heterogeneity of tinnitus and the great difficulty in their intervention. Complements to the therapeutic strategies, both physical and psychological, are support materials such as small books

or manuals, with explanations concerning tinnitus problem and description of support strategies. Thus, the objectives of this study were:
a. to develop a manual with information on tinnitus and strategies to deal with it,
b. to evaluate its efficacy.

The sample was composed by 58 individuals, with an average age of 56.6 years, (27–66; SD=9.09), 37 men (63.8%), with an average hearing loss of 26.1 dB (11.9–40.0 dB; SD=7.16) and with tinnitus complaints with an average of 4.96 years (0.5–40.0; SD=7.37). Two groups were obtained, the control group (GCG – N=31), and the experimental group (EG – N=27), with access to a small manual, been informed about their propose, utility and use.

The values obtained in relation to the usefulness of the manual (M=5.81) are in moderate values as those found in the literature. The low schooling of the sample may be one of the aspects that justify this result.

From the results obtained, the individuals who had access to the manual showed the perception of a decrease tinnitus intensity and improvement of the Quality of Life. It will be useful to carry out further studies in order to understand the usefulness of these types of intervention with other individuals, for example with hearing loss and hyperacusis, and in other samples of tinnitus patients.

O.017 • **Listening effort in normal-hearing young adults with chronic tinnitus**

Degeest S., Keppler H., Corthals P.

Department of Speech, Language, and Hearing Sciences, Ghent University, Belgium

It has been hypothesized that tinnitus may impair cognitive processing, as tinnitus patients among others indicate concentration difficulties related to speech understanding. Research stated that non-auditory central aspects, such as working memory and selective attention, may influence hearing and speech understanding in various listening situations. Therefore, speech intelligibility may become more effortful for persons with tinnitus because their cognitive reserve is reduced by the presence of tinnitus. This study aimed to investigate the effect of chronic tinnitus on listening effort.

Thirteen normal-hearing young adults with chronic tinnitus were matched with a control group for age, gender, hearing thresholds and educational level. A dual-task paradigm was used to evaluate listening effort in different listening conditions. A primary speech-recognition task and a secondary memory task were performed both separately and simultaneously. Furthermore, subjective listening effort was questioned for various listening situations. The Tinnitus Handicap Inventory was used to evaluate the influence of tinnitus handicap on the amount of listening effort.

Listening effort was significantly higher in the tinnitus group across listening conditions. There was no significant difference in listening effort between listening conditions, nor was there an interaction between groups and listening conditions. Subjective listening effort did not significantly differ between both groups. No significant relations were found between the score on the Tinnitus Handicap Inventory and listening effort.

This study is a first exploration of listening effort in normal-hearing subjects with chronic tinnitus showing that listening effort is increased as compared to a control group. There is a need to further investigate the cognitive functions important for speech understanding and their possible relation with the presence of tinnitus and listening effort.

Listening effort appears to be increased in normal-hearing subjects with chronic tinnitus. Including a test for listening effort in clinical practice may therefore be useful to better understand the complaints about concentration related to speech recognition indicated by tinnitus patients.

O.018 • **Reproducibility of the residual inhibition response**

Deklerck A., Keppler H., Degeest S., Dhooge I.

Department of Otorhinolaryngology, Ghent University Hospital, Belgium

Psychoacoustic measures are part of a standardized protocol for clinical tinnitus assessment. Tinnitus masking and residual inhibition (RI) in particular demonstrate some form of tinnitus modulation and plasticity of underlying neural correlates. Further elaboration of RI could therefore serve as a stepping stone into new insights in tinnitus pathophysiology and treatment strategies. The purpose of this study was to assess reproducibility of the (partial) positive RI response duration; to gain insight in reliability of this measure and its utility in experimental paradigms.

At the ENT Department of Ghent University Hospital, adult tinnitus patients were prospectively included between January and August 2016. Only those who demonstrated a (partial) positive RI response during standardized psychoacoustic tinnitus measurements, were eligible for further analysis. RI response was then retested 3 times: immediately during initial testing, and twice during a retest of all psychoacoustic measures, 4–8 weeks after initial consultation. Patient and tinnitus characteristics in this subgroup were noted, and reliability of the test results was analyzed.

Data of 32 patients were analyzed. Mean tinnitus duration was 4.5 years, 25/32 patients suffered from bilateral or central tinnitus, and 81.3% mentioned an environmental masking effect. Initial testing showed a median pitch of 4.0 k Hz, and a loudness of 5 dBSL, minimal masking level using white noise of 16 dBSL, and RI duration of 33s on average. Test-retest reproducibility of RI duration was shown to be reliable with an ICC (3.4) of 0.866 (95%CI 0.728–0.944; F(1.948; 33.110)=1.452, p=0.249)) and SEM of 14.0s. Other psychoacoustic measures did not significantly differ between the two consultations.

To our knowledge, recent studies about reproducibility of psychoacoustic measures over time are scarce. The repeatability of RI gives great potential for RI to be used as a clinical therapeutic technique. Therefore, further studies

elaborating ideal parameters of acoustic stimuli to be implemented for tinnitus masking, and including more study patients over a longer period of time, are needed.

This study gives indication of good reliability of repeated RI duration measures over 4–8 weeks' time. Because of its nature of reproducible tinnitus modulation, RI thus can not only serve as an excellent counseling and therapeutic tool, but could also provide insight in underlying tinnitus mechanisms by its application in experimental paradigms.

O.019 • The effect of cochlear implantation on tinnitus perception

Deklerck A., Keppler H., Swinnen F., Dhooge I.

Department of Otorhinolaryngology, Ghent University Hospital, Belgium

Tinnitus occurs in 65–100% of patients with profound sensorineural deafness. Cochlear implantation has become a standard treatment for profound sensorineural hearing loss and has been shown to be effective in reducing concomitant tinnitus complaints. Although auditory masking is often postulated to explain tinnitus suppression in CI-users, the exact mechanism remains unknown. The purpose of this study is to assess the prevalence of tinnitus complaints in the adult cochlear implant population and to quantify the effect of implantation on tinnitus perception.

Adult patients, receiving cochlear implantation at the ENT department of Ghent University Hospital, were prospectively included since January 2016, regardless of any tinnitus complaint. Demographic, implant, pre- and post-operative tinnitus and audiometric data were collected. Tinnitus questionnaires were filled in before the operation, and 3 and 6 months post-implantation.

Until now, data of 40 patients were analyzed, with variable follow-up time. Tinnitus prevalence pre-implantation was 57.5%, with a mean TFI score at baseline of 47. 11/16 tinnitus patients showed a clinical significant tinnitus reduction 3 months after implantation, which persisted at 6 months follow-up. TFI score at baseline was significantly correlated with tinnitus reduction ($r=0.867$, $p<0.001$). No other included factors were found to be significantly associated with tinnitus change. Tinnitus complaints occurred or intensified in 12/27 patients, usually lasting a few days post-surgery.

To our knowledge, this is the first prospective study using TFI as a measure of CI effect on tinnitus, and including a broad selection of implant- and tinnitus-related, as well as personal factors in the analysis of possible effect-association. The finding that patients with more severe tinnitus at baseline show more benefit from implantation is in line with previous literature. Auditory masking, electrical stimulation, and central auditory system plastic reorganization could underlie the implantation effect on tinnitus perception.

Our study shows a reduction of tinnitus perception in 68.8% of the cochlear implant population, with suppression mostly occurring in close association with switch-on. Tinnitus Functional Index score at baseline is significantly correlated with tinnitus reduction by implantation.

O.020 • National linguistic validation of the THI. Assessment of disability caused by tinnitus in Chilean Spanish-speaking population

Der C., Alzerreca E., Román L., Zamorano I., Malhue J., Aliaga P., Coronelli L., Sarda S.

Otorhinolaryngology Department, Clínica Alemana, Santiago, Chile

We propose a linguistic validation of the THI, in order to obtain reliable answers in our country.

We performed a translation of the original English questionnaire and assessed its feasibility by applying it in a group of patients with tinnitus. Statistical analysis included internal validity (Cronbach's alpha) and linear correlation tests (Pearson coefficient).We evaluated 60 patients with a mean age of 59 years. We obtained a Cronbach's alpha index of 0.97 for the whole questionnaire.

This validation supposes an important help on having generated a tool to know the impact of this symptom in the quality of life of our patients, and providing criteria to measure the evolutionary control of the therapeutic interventions.

The adapted version of the THI shows satisfactory levels of internal consistency for the assessment of disability caused by tinnitus.

O.021 • Tinnitus therapy: Results of ZEN method in patients with and without hearing loss

Der C., Pons N., Aránguiz F., Escobar B.

Otorhinolaryngology Department, Hospital Luis Calvo Mackenna, Clínica Alemana, Santiago, Chile

This study aims to evaluate the effectiveness of the Zen method in the management of tinnitus in patients with and without hearing loss and to determine the effectiveness in each group and the possible factors that influence this result.

Retrospective descriptive study. A review of the data collected on the follow-up of patients treated with Zen method for tinnitus was performed, categorizing them into two groups according to the presence or absence of hearing loss. External and middle ear pathology was considered exclusion criteria.

We analyzed the data of patients with and without hearing loss. The majority of patients in both groups had received some kind of prior treatment. In the Group with hearing loss, an initial mean THI of 54 points was observed, which fell to 18 points after 1 month of ZEN use. 95% of the patients improved according to the THI result. In the group without hearing loss, an initial mean THI of 84 points was observed, which fell to 64 points after 1 month of ZEN use. 50% of the patients improved according to the THI result.

Improvement in tinnitus classification was observed according to THI in both groups: in patients with hearing loss in the initial THI, 47% had severe or catastrophic tinnitus. After 1 month of ZEN use 0% presented catastrophic tinnitus and 4% severe. In patients without hearing loss in the initial THI, 80% had severe or catastrophic tinnitus. After 1 month of ZEN use 0% presented catastrophic tinnitus and 60% severe. Although the improvement in quality of life is more evident in the group with hearing loss, the starting point in the group without hearing loss was worse.

The masking sound therapy is harmless for patients and is a very good alternative to improve the quality of life of patients with tinnitus. The ZEN method appears to be a useful therapeutic tool for palliation of tinnitus. The results of this study indicate that it is more significant in patients with tinnitus and hearing loss. A prospective study is needed to have more information.

O.022 • **Auditory evoked magnetic field signatures of dynamic range adaptation of sound level coding in tinnitus patients and healthy controls**

Diesch E., Hassel-Adwan A-M.

Department of Clinical and Cognitive Neuroscience, Central Institute of Mental Health, Mannheim, Germany

Across natural settings, the level of acoustic signals varies over the range of approximately 120–140 dB. The dynamic range of auditory system neurons is much smaller, typically between 20 and 40 dB. Animal studies show that the auditory system handles the conflict between sensitivity and accuracy arising from this mismatch by dynamically adjusting the response range of single neurons. Here we investigate (1) if dynamic range adaption of sound level coding may be demonstrated in steady-state auditory evoked magnetic field recordings and (2) if dynamic range adaptation is altered in tinnitus.

In a first study, the steady-state auditory evoked magnetic field was recorded in healthy subjects. An amplitude-modulated tone was presented continuously. Every ~2.1 s the stimulus ramped up or down in level. In a second study, the SSR was recorded in tinnitus sufferers and healthy controls matched for age, sex, stimulated ear, and hearing loss. Patients completed the German version of the tinnitus questionnaire (TQ). All subjects completed a measure of auditory sensitivity (GUF) and the hyperacusis questionnaire (HQ).

Patients earned higher scores on these tests than healthy controls. The first study demonstrated a response amplitude overshoot effect following ascending ramps and an amplitude undershoot effect after descending ramps. In the second study, the overshoot effect was weaker and the undershoot effect was stronger in patients than healthy controls. In a GLM analysis, this difference remained significant when GUF and HQ scores were entered as covariates. In the first study, both ascending and descending stimulus ramps elicited temporary loss of phase coherence. Recovery of coherence was extended in time beyond the amplitude overshoot peak and undershoot trough.

The overshoot and undershoot effects observed in both the first and the second study fit the hypothesis of dynamic range adaptation. The difference between patients and controls suggests that dynamic range adaptation is compromised in tinnitus. The temporal evolution of phase coherence in the wake of stimulus level transitions suggests that phase coherence mirrors both excitatory and inhibitory processes. Dynamic range adaptation may be the result of collaborative action of several auditory cortex fields.

Further analysis is needed to reveal alterations of stimulus-induced loss and recovery of phase coherence in tinnitus. The effects of tinnitus on response amplitude over- and undershoot suggest that stimulus-induced loss of coherence may be more pronounced in patients than in controls.

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O.023 • **Tinnitus and hidden lesions of the temporal bone**

Djeric D.

Otology Department, Medical Faculty University of Belgrade, Serbia

The aim of the paper is to present our experience in diagnosis and treatment of tinnitus in patients with hidden lesions of the temporal bone.

The study included patients who had otologic symptoms (tinnitus, hearing loss, vertigo) and presence of various hidden lesions in the temporal bone (cholesteatoma, osteoma, glomus tumour, vascular lesions, acoustic neuroma, cerebellopontine angle tumors and other (confirmed radiologically or pathologically).

Data were presented from the included patients with a recognized cause for their otological symptoms (tinnitus, hearing loss, vertigo) and a qualitative synthesis of the results undertaken.

The present study demonstrates that there is significant association between the presence of confirmed hidden lesions and otological symptoms.

Tinnitus is the perception of sound without an external stimulus. The symptoms effects approximately 15% of the population worldwide. It is a symptom of various lesions in the temporal bone.. Also, tinnitus is a symptom of many systemic diseases. In clinical practice, nonpulsatile longstanding tinnitus is more frequent but without proven etiology.

As a conclusion, if there is a complaint of tinnitus in patients with normal hearing, temporal bone tomography is not always cost-effective to perform it. A new concept in diagnosis include a multidisciplinary approach for identification of cause heterogeneity of tinnitus.

O.024 • Assessment of tinnitus oppressiveness with the TFI questionnaire after implantation of the CODACS system – a case study

Fludra M.[1], Ratuszniak A.[1], Krol B.[1,2], Osinska K.[1,2], Skarzynski P.H.[1,3,4], Skarzynski H.[1,2]

1 World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
2 Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
3 Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland
4 Institute of Sensory Organs, Warsaw/Kajetany, Poland

Assessment of TFI (Tinnitus Functional Index) changes in patients with severe to profound mixed hearing loss before and after implantation of the CODACS system – a preliminary study of two cases. The analysis was performed for two patients diagnosed with otosclerosis, who had severe to profound mixed hearing loss and tinnitus. The patients had undergone numerous surgeries in both ears before being referred for implantation of a CODACS device in the Institute of Physiology and Pathology of Hearing.

The TFI questionnaire and free-field audiometric tests were performed in order to evaluate the efficacy of the applied treatment solution with regard to changes in the tinnitus oppressiveness and improvement of hearing. Tests were performed before implantation and one month after activation of the system.

The results of the questionnaire assessment show significant improvement of the TFI rate in all tested areas, confirming reduction of the oppressiveness of tinnitus. The outcomes of audiometric evaluation performed in free field show decrease of the hearing threshold and improvement of speech discrimination while using the CODACS system.

The preliminary findings suggest that application of the CODACS system may be an efficiently solution to reduce the oppressiveness of tinnitus and improve hearing.

O.026 • Problems in treatment of tinnitus and hearing loss in a Pierre Robin syndrome

Fronczak P.[1], Skarzynski P.H.[2,3], Dziendziel B.[2], Skarzynski H.[1,2]

[1] Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[3] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland

Introduction: Pierre Robin syndrome (abbreviated to PRS, and also known as Pierre Robin sequence, Pierre Robin malformation, Pierre Robin anomaly) is a congenital condition of facial abnormalities in humans. The three main features are cleft palate, retrognathia and glossoptosis. A genetic cause to PRS was recently identified as anomalies at chromosomes 2, 11, or 17. The prevalence has been estimated at 1 in 10,000 births, but exact values are hard to know because patients presenting these symptoms rarely have Pierre-Robin sequence (without any other associated malformation). In this paper we discuss a question whether or not a Pierre Robin syndrome is a risk factor for conductive and / or sensorineural hearing loss has been discussed.

Material and methods: Several centers have tested patients with Robin sequence for hearing loss. Robin Sequence (PRS) was examined and compared to a sample exhibiting only isolated cleft palate (ICP).

Results indicate that there is no difference in the prevalence or degree of hearing loss in these two groups, although there was found a significantly higher ($p<0.01$) mean value of hearing loss for air conduction in speech frequencies (MHLSF=24.5 dB) in PRS patients compared to patients without PRS (MHLSF=17.8 dB). Hearing loss was more frequently found in PRS (73.3%) than in ICP (58.1%) patients ($p=0.02$). PRS patients had more ears with moderate (21–40 dB) and severe (> 40 dB) hearing loss, disturbing their social contact, with no tendency to normalization with age (Spearman $r=0.065$). In contrast to PRS, ICP patients showed a significant tendency to hearing level normalization with ageing (Spearman $r=-0.453$; $p=0.001$). Hearing loss in PRS is usually conductive and bilateral. The ears of the PRS patients with hearing loss were examined, revealing middle ear effusion and in all these cases hearing was restored to a normal level through suction and ventilation tubes. In some cases of Pierre Robin Sequence hearing loss may be of a sensorineural type. Subjective and objective methods such as Click Evoqued Otoacoustic Emissions and Auditory Brainstem Response were adopted for hearing level testing. Sensorineural hearing loss was found in 13.3% to 30.8% of subjects with Pierre Robin Sequence. In contrast 23% of patients with PRS presented with no hearing loss.

Conclusions: Pierre Robin Sequence is mostly a risk factor for conductive hearing loss. Sensorineural hearing loss in PRS patients can also be present therefore Pierre Robin subjects should be assessed as soon as possible after birth by otoscopy, click-evoked otoacoustic emissions, auditory brainstem response and audiometric tests for proper hearing level evaluation.

O.027 • Role of high-resolution MRI in the diagnostic algorithm of tinnitus – review based on one centre experience

Furmanek M.I.[1,2], Raj-Koziak D.[2,3], Piotrowska A.[2], Ciesla K.[1,2], Pluta A.[1,2], Wolak T.[1,2], Walecki J.[2], Skarzynski H.[2]

[1] Bioimaging Research Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[3] Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland

The evaluation of usefulness of high-resolution MRI in diagnostic process of tinnitus and review of organic causes of tinnitus.

Material consisted of 400 consecutive patients referred for MRI 3T because of tinnitus as a leading or coexisting problem. MRI examinations were performed with

high-resolution protocol including heavy T2-weighted images (0.5mm slice thickness) and T1-weighted post contrast images (1mm slice thickness).

Relevant to tinnitus, important findings localized within CPAs, inner ears or middle ears were revealed in 18.5% of the group. Relevant to tinnitus, important findings localized in other assessable anatomical regions were revealed in 14.5% of cases. In 21% of cases MRI results influenced the decision of therapeutical process.

Clinical assessment plays the key role in the work-up of patients with tinnitus. Diagnostic imaging is useful whenever there is suspicion of organic cause. Special attention should be paid to patient when tinnitus is unilateral and/or sudden and/or coexisting with other neurologic symptoms. High resolution MRI in protocol dedicated for cerebello-pontine angle/temporal bones is the method of choice in morphological assessment of VII+VIII cranial nerves and membranous labyrinth.

High-resolution MRI reveals important morphological findings relevant to tinnitus. In some cases the results influences the decision of therapeutical process. High-resolution MRI should be part of diagnostic algorithm of tinnitus whenever there is clinical suspicion of organic cause.

O.028 • **Management of Clinically Significant Tinnitus; Retrospective and Current Trends**

Gabriels P.

Pam Gabriels Audiology and Tinnitus Management, Nedlands, Australia

New technology has changed the way tinnitus patients are treated in 2017 and has given the clinician a pallet of new tools to use in the clinic.

Data from two sets of tinnitus patients are compared. The first from 537 patients collected from 1991 to 1995 are compared with a second data base of 206 patients from 2016/17.The two groups are compared and changes in treatment options examined.

The tinnitus clinic of the 1990's is nothing like the modern tinnitus clinic. The comparison highlights the advances that have been made in this area due to the development of new technology for assessment and fitting of devices. Long standing issues about the stigma of wearing hearing aids for treatment are addressed illustrating how new technology has made these issues no longer a barrier.

The results show that patients are more likely to try treatment involving tinnitus devices and new apps available on the Internet have revolutionized acceptance.

The discussion illustrates a revolution in new methods and treatment options possible due to the Internet, hearing aid manufacturers offering tinnitus treatment options in their software and changes in patient 's attitudes. The discussion is enriched with visuals and patient case histories and outcomes illustrating the change in direction for treatment.

There has been a recent revolution in assessing and recording data for tinnitus patients and providing new technology solutions.

O.029 • **The role of suppression of otoacoustic emissions with contralateral acoustic stimulation in tinnitus patients**

Georgescu M.

Audiology Department, IFACF-ORL, Bucharest, Romania

Tinnitus is the most frequency disturbance of the auditory system – almost 17% of West Europe's population and 33% of the elderly present tinnitus. The aim of this paper is to study the role of the efferent auditory system in tinnitus appearance.

For this, suppression of otoacoustic emissions with contralateral acoustic stimulation is measured, as value of functioning of the medial olivocochlear bund. We made a prospective comparative study on 20 normal hearing and no tinnitus subjects and 15 age and gender matched patients with normal hearing and tinnitus. TEOAE and distortion product DP OAE otoacoustic emissions were measured in all subjects. Click stimulus at 80 dB SPL was used for TE OAE and inner ear response in 1–6 k Hz domain was measured. For DP OAE we used two frequencies f2/f1=1.22, with constant intensities at 65 and 55 dB SPL respectively and 2f1–f2 DP in 0.5–8 k Hz domain was measured. In all subjects, suppression of otoacoustic emission with contralateral acoustic stimulation (65 dB click stimulus with contralateral broa dBand noise at 70 dB SPL) was measured, in 1–4 k Hz frequency domain.

In all subjects, transient OAE and distortion products were present, as well as suppression of otoacoustic emission with contralateral acoustic stimulation. Both TE OAE and DP OAE were present in all tested persons, regardless presence, or absence of tinnitus. It was a difference in DP OAE amplitude between control (20 dB SPL) and patients group (15 dB SPL), but without statistical significance (p=8.23).

Considering the literature, contralateral suppression test had normal values in the control group (diminishing with 3–3.5 dB SPL) and pathological values (1.1–1.8 dB SPL) in tinnitus patients.

Suppression of otoacoustic emissions with contralateral acoustic stimulus in tinnitus patients functions less, but without significant difference compared with control group (p=2.21).

O.030 • **A pilot Genome-wide Association Study identifies potential metabolic pathways involved in tinnitus**

Gilles A., Van Camp G., Van de Heyning P., Fransen E.

ENT and Head and Neck Surgery, University Hospital Antwerp, Belgium

In a previous Genome-Wide Association Study (GWAS) on age-related hearing impairment (ARHI), a highly

polygenic character of ARHI was shown, with no major genes involved (Fransen et al., 2014).

In this dataset, 18% of the participants reported to perceive tinnitus. The contribution of genes on the development of tinnitus is still under debate. The tinnitus phenotype was retrospectively tested for association with the genome-wide singe-nucleotide polymorphism (SNP) data from the ARHI population obtained in the previous study.

The current study performed a pilot Genome Wide Association Study (GWAS) into tinnitus, in a small cohort of 167 independent tinnitus subjects, and 749 non-tinnitus controls, who were collected as part of a cross-sectional study. After genotyping, imputation and quality checking, the association between the tinnitus phenotype and 4 000 000 SNPs was tested followed by gene set enrichment analysis.

None of the SNPs reached the threshold for genome-wide significance (p<5.0e-8), with the most significant SNPs, situated outside coding genes, reaching a p-value of 3.4e-7. By using the Genetic Analysis of Complex Traits (GACT) software, the percentage of the variance explained by all SNPs in the GWAS was estimated to be 3.2%, indicating that additive genetic effects explain only a small fraction of the tinnitus phenotype.

Despite the lack of genome-wide significant SNPs, evidence was found for a genetic involvement in tinnitus. Gene set enrichment analysis showed several metabolic pathways to be significantly enriched with SNPs having a low p-value in the GWAS. These pathways are involved in oxidative stress, endoplasmatic reticulum (ER) stress and serotonin reception mediated signaling.

These results are a promising basis for further research into the genetic basis of tinnitus, including GWAS with larger sample sizes and considering tinnitus subtypes for which a greater genetic contribution is more likely.

O.031 • Regenerative Feedback and the Cochlear Amplifier in the 21st Century: The Ideas of Thomas Gold re-visited

Hampton P.

Institution of Engineering and Technology, Worcester, UK

Thomas Gold's Positive Fee dBack explanation for the sharpness of Cochlear Tuning Curves has been suggested as a mechanism for the Cochlear Amplifier and possibly Tinnitus. However it is based on analogue Regenerative Wireless Detector theory dating from before WWI. Today, Software-Defined Radios (SDRs) operate in a way much more akin to observed cochlear function. Exploring the similarities may yield new insights.

A search of the literature on cochlear function, cochlear implant coding techniques, localization of sounds, tinnitus models and the role of the vestibular system was undertaken. Considering the physiology of the cochlea and applying some reverse-engineering may show us that if lateral modes of vibration of the basilar membrane (BM) exist, then amplification can take place but at a higher frequency than the traveling wave vibrations of the BM. The nature of the pulses driving the Outer Hair Cells (OHCs) and the requirements for a sampling or timing signal are discussed.

A high frequency overlay to current models is derived and a fast timing signal postulated. An up-converting, sampling model of cochlear function is consistent with many observed hearing characteristics: ultrasonic perception of sound, low-distortion and low-noise amplification and fine angular resolution of sound sources. It has been shown that an OHC has a frequency limit of around 25 k Hz in mammals. This would be fine for sampling pulses despite being limited to a much lower repetition frequency. Tinnitus can be presumed to be the outcome of OHC damage causing sampling to take place at audible sub-harmonics.

The notion of a central clock or timing signal within the brain – which is required for sampling the analogue sounds presented to each cochlea – is discussed. Such a signal may be essential to provide the differential phase information required for localization of sounds as well as providing the driving energy for the cochlear amplifier. Up-converting to an ultrasonic frequency band makes filtering of harmonic distortion products a relatively simple matter. The problem of aliasing may well be irrelevant given the geometry of the internal structures and the fluid flows within the cochlea.

A sampling theory for cochlear function is a possible explanation for many of the characteristics of hearing. Those with tinnitus due to outer hair cell damage may take some solace in understanding that the sampling may have been forced to take place at audible sub-harmonics of the usual ultrasonic sampling frequency. Such people can still hear and localize sounds (possibly those of predators) but with the trade-off of having to contend with some continuous high-pitched noise and reduced overall hearing resolution.

O.032 • Tinnitus: What can we learn from Reverse Engineering of the Cochlea?

Hampton P.

Institution of Engineering and Technology, Worcester, UK

The currently accepted view of the operation of the cochlea relies on a travelling wave (TW) whose peak amplitude excites positions along the basilar membrane (BM) between the base region and the apex. However, by considering the geometrical arrangement of hair cells on the Organ of Corti (OC) there is support for a model whereby lateral cochlear fibres may also resonate but at frequencies higher than the characteristic frequency of the TW at the same position along the BM. Sampling and timing are key themes in this model.

A literature search and study of cochlear mechanisms and physiology was undertaken. The Outer Hair Cells (OHCs) are attributed to providing the energy for the cochlear amplifier and their maximum frequency limit is known. The geometry and layout of the hair cells and their stereocilia are considered and comparisons made with similar but much larger antenna structures used in radio and astronomy for detection of radio and mobile phone signals and for determination of the location of stars. It is

deduced that the basilar membrane with the associated Organ of Corti (OC) has two vibrational states: firstly that caused by the travelling wave passing along its length and secondly a higher frequency lateral vibration due to the input from the active OHCs. The second may arise due to the non-linear piezo-electric nature of the OHCs being fed by „pumping" signals from the brain. These impulses may be considered to be sampling or clock signals used to configure the OC The emergence of a sampling or timing signal used for the transduction of sounds in the cochlea into impulses in the auditory nerve follows on from work done on the OHC as a parametric amplifier of sounds. Parametric amplifiers require a higher frequency pumping signal to operate and this can be added to the signal to be amplified to give an output at the sum frequency. This higher frequency is likely to be in the ultrasonic region and could account for the ultrasonic perception of sounds through bone conduction.

The above hypothesis can account for: tinnitus as a being sub-harmonic of a sampling signal; ultrasonic perception of sound; localisation of sound sources to an accuracy that the baseband acoustic signals cannot achieve on their own; a process whereby physical damage (including natural wear and tear) of OHCs can not only reduce the sensitivity of the ear to sounds but also gradually increase the chance of perceiving tinnitus.

O.033 • **Systematic Evaluation of a Cognitive Model of Tinnitus Distress**

Handscomb L.

Nottingham Hearing Biomedical Research Unit, National Institute for Health Research, UK

The cognitive model of tinnitus distress (McKenna, Handscomb et al. 2014) is a theoretical model which describes the interaction between thoughts, emotions, behaviour and attention that may cause tinnitus to become, and be maintained as, a distressing problem. It consists of a series of testable hypotheses and this project set out to investigate these systematically in order to test the model's accuracy. A survey was compiled from existing questionnaires which provided measures of each separate component of the model. This was made available online and on paper.

Members of the public with tinnitus were recruited from a volunteer database and from tinnitus organisations. The survey was completed by 342 adults who reported varying degrees of overall tinnitus distress. Factor analysis of all the questionnaires was carried out and 12 different versions of the cognitive model were created based on questionnaire results, existing literature and theory. These were then tested using path analysis.

A satisfactory factor structure was found for all questionnaires and the resulting 15 factor scores were used to test the full model. All 12 models tested were at least an acceptable fit to the data (RMSEA <0.080). The two best fitting models had comparable fit indices (model 1: RMSEA=0.071, CFI=0.982, TLI=0.966; model 2: RMSEA=0.066, CFI=0.991, TLI=0.975). They differed primarily in the placement of tinnitus magnitude, which was a product of attention in model 1, but an exogenous variable in model 2. Additionally, model 1 included tinnitus control beliefs while model 2 did not.

These findings add to existing evidence which indicates that emotional distress, negative thinking and avoidance behaviour contribute to a worse experience of tinnitus. They also shed new light on the role of attention and monitoring in tinnitus distress and increase understanding of how emotional, cognitive and behavioural responses to tinnitus interact. Questions remain as to the role of beliefs in tinnitus distress and as to whether and to what degree perceived magnitude is influenced by psychological processes. The predictions made by the cognitive model of tinnitus distress appear to be largely accurate and it is to be recommended as a solid foundation for psychological therapy for tinnitus.

The need for further research in the areas of beliefs and perceived magnitude is highlighted.

O.034 • **Acoustic Coordinated Reset Neuromodulation for the Treatment of Tonal Tinnitus**

Hauptmann Ch., Williams M., Qian R., Vinciati F., Haller M.

Desyncra Technologies Limited, London, UK

Primary tinnitus has a severe negative influence on the quality of life of a significant portion of the general population. Acoustic coordinated reset neuromodulation is designed to induce a long-lasting reduction of tinnitus symptoms. To test the clinical effectiveness of Acoustic Coordinated Reset neuromodulation as a treatment for chronic, tonal tinnitus in real–life conditions, several clinical studies were performed in the past five years.

In a randomized controlled proof-of-concept trial and two observational studies, more than 300 patients were treated and both statistically and clinically significant reduction of tinnitus symptoms (as measured by TQ, THQ, TBF-12 and VAS) was observed. In the first randomized controlled proof of concept study (RESET), which reported therapy outcomes in 63 subjects, baseline TQ scores were reduced by 28.8% ($p<0.01$) after 12 weeks of therapy. In a large scale observational trial (RESET REAL LIFE), with a study population of 200 patients, a reduction of 37.9% in TBF-12 score ($p<0.01$) was recorded after 12 months of therapy. At the London-based Tinnitus Clinic, 61 patients were studied and THQ scores significantly improved by 19.4% after 22–26 weeks of therapy. These findings are supported by data obtained from field use.

To optimally apply Acoustic CR neuromodulation we developed and evaluated an approach that adapts a consumer mobile device to implement a new automated pitch matching process, patient-controlled signal delivery and outcomes recording. The evaluation included laboratory measurements of five devices and two usability studies in 30 symptomatic and 15 healthy subjects.

This collection of data demonstrates that Acoustic Coordinated Reset Neuromodulation is a safe and well-accepted therapy for patients.

O.035 • A qualitative analysis of threads in online support groups for tinnitus

Hoare D.J., Ainscough E., Smith S., Greenwell K.

National Institute for Health Research (NIHR) Nottingham Biomedical Research Centre, Otology and Hearing Group, Division of Clinical Neuroscience, University of Nottingham, UK

With increasing recognition of the internet as a repository for health advice, information, and support, the online support group has become a popular coping strategy for those living with chronic conditions like tinnitus. Patients find that communicating with each other, providing encouragement and sharing information in the absence of physical and temporal boundaries, is valuable. The aim of this study was to explore the positive and negative consequences of participation in such groups.

Four popular public online support groups with embedded discussion forums, and messages posted between 1st February 2016 and 30th April 2016, were selected for analysis. Messages were randomly selected and coded by three separate analysts using an inductive approach to thematic analysis until data saturation was reached.

The complete data set included 1,012 conversation threads and a total of 9,089 individual messages. Of those, 641 randomly selected messages were analysed before data saturation was reached. Sixty-five independent codes and nine independent themes pertaining to aspects of participation in tinnitus online support groups were identified. Using the forums allowed users to exchange knowledge and experiences, express complex emotions, profit from a network of support, and engage in every-day conversation, away from the burden of their tinnitus. However, some experiences appeared to be compromised by negative messaging, limited communication, and informational issues such as conflicting advice or information overload.

Most tinnitus patients likely benefit from accessing online support groups, e.g. they discover they are not alone, they find new coping strategies. However, for those who are particularly vulnerable or prone to psychological stress accessing these groups could be detrimental.

O.036 • Redox status in salicylate-induced tinnitus

Hwang J-H.[1], Chan Y-C.[2]

[1] *Otolaryngology Department, Dalin Tzu Chi Hospital, Chiayi, Taiwan*
[2] *Food and Nutrition Department, Providence U., Taiwan*

To investigate the expression of antioxidant genes in the mouse cochlea and brain in salicylate-induced tinnitus and effect of treatment with Spirulina platensis water extract.

Eighteen SAMP8 mice were divided into three groups: to receive intraperitoneal injections of saline (control group), salicylate (300 mg/kg body weight [BW]) (tinnitus group), or salicylate plus oral S. platensis water extract (Spirulina group) for 4 days. Active avoidance task for tinnitus and mRNA expressions and/or enzymatic activities of manganese-superoxide dismutase (Mn-SOD) gene, catalase (CAT) gene, glutathione peroxidase (GPx), heme oxygenase-1 (HO-1) gene, and malondialdehyde (MDA) levels in the cochlea and various brain regions of mice were tested.

Salicylate increased Mn-SOD gene, but decreased CAT gene expression, in the cochlea and brain regions of mice. Spirulina reduced over-expression of the Mn-SOD gene, but increased down-regulation of the CAT gene. With the exception of increased SOD activity in the brainstem and inferior colliculus of the Spirulina group, SOD and CAT enzyme activities did not differ among the three groups. The tinnitus group had higher MDA levels in the temporal and the frontal lobes. Spirulina reduced salicylate-induced elevations of MDA levels in many brain areas.

High dose salicylate could induce tinnitus and result in oxidative damage in the brain, and alter the some antioxidant gene expressions (Mn-SOD and CAT genes, but not GPx and HO-1 genes), but not their enzymatic activities. We proposed that altered expression of antioxidant genes may reflect states of oxidative stress associated with tinnitus.

O.037 • Expressions of dopamine receptor 1A and cannabinoid receptor 1 genes in the cochlea and brain after salicylate-induced tinnitus

Hwang J-H.[1], Chan Y-C.[2]

Otolaryngology Department, Dalin Tzu Chi Hospital, Chiayi, Taiwan

To investigate the mRNA expressions of dopamine receptor 1A (DR1A) and cannabinoid receptor 1 (CR1) genes in mice with tinnitus.

Sixteen 3-month-old male SAMP8 mice were randomly and equally divided into two groups: control group (saline-treated) and tinnitus group (salicylate-treated). The mRNA expressions of DR1A and CR1 genes in the cochlea and brain of mice were evaluated after tinnitus was induced by intraperitoneal injection of sodium salicylate (300 mg/kg body weight).

Four-day salicylate treatment (unlike 4-day saline treatment) caused a significant increase in the tinnitus score and mRNA expressions of DA1AR gene in the cochlear, brainstem and inferior colliculus, hippocampus and parahippocampus, and temporal lobes, but not in the frontal lobes. Conversely, 4-day salicylate treatment caused significantly lower mRNA expressions of CR1 gene in the cochlear and all tested brain areas.

In addition to focusing on the activity or function of tinnitus-related receptors, tinnitus-related changes in gene expression have attracted more attention in these years.

Salicylate-induced tinnitus may be associated with increased mRNA expression of DR1A gene, but with decreased mRNA expressions of CR1 gene in the cochlear and many tinnitus-related brain areas.

O.038 • Results of an Interdisciplinary Day Care Approach for Chronic Tinnitus Treatment

Ivansic D., Dobel C., Volk G.F., Reinhardt D., Muller B., Smolenski U.C., Guntinas-Lichius O.

Department of Otorhinolaryngology, Tinnitus Center, Jena University Hospital, Germany

We developed a day care concept in which each patient was treated by an ENT doctor, a cognitive behavioral therapist, a specialist for medical rehabilitation and an audiologist for 5 consecutive days (Jena Interdisciplinary Treatment for Tinnitus, JITT). The aims of this study were:

a. to observe the changes of tinnitus related distress due to JITT,
b. to investigate in which patients tinnitus annoyance was most strongly expressed at the beginning of the treatment and
c. if treatment success can be predicted.

Tinnitus annoyance was measured using the Tinnitus Questionnaire (Goebel and Hiller, 1998) on 308 patients with chronic tinnitus. They were treated in the day care unit over five consecutive days between July 2013 and December 2014. Data were collected before treatment when screened (T0), at the beginning (T1) and at the end of the five day treatment (T2), as well as 20 days (T3) and 6 months after treatment (T4).

Tinnitus annoyance improved significantly from the screening day to the begin of treatment and to a much larger degree from begin to the end of treatment and then remained stable until 6 months after treatment.

Demographic, tinnitus and strain variables could only explain 12.8% of the variance of the change in tinnitus annoyance from T0 to T4. Only significant ones were 'sick leave 6 months before treatment' and 'tinnitus annoyance at T0'.

The newly developed JITT represents a valuable outpatient treatment for chronic tinnitus patients with improvement remaining stable for at least 6 months after treatment. Using a large number of variables did not allow predicting treatment outcome which underlines the heterogeneity of tinnitus.

O.039 • Effects of electrical stimulation in tinnitus patients: A comparison between t-DCS with two different electrode placements and HD t-DCS

Jacquemin L., Gilles A., Mertens, G., Fransen E., Van de Heyning P.

Otorhinolaryngology, Head and Neck Surgery Department, Antwerp University Hospital, Belgium

There is currently no effective therapy available for all tinnitus patients. Maladaptive plastic changes and altered activity in the auditory and prefrontal cortex underlie the tinnitus percept. Concerning transcranial direct current stimulation (t-DCS) as a treatment for tinnitus, contradictory results have been reported in literature. The present study compares t-DCS using two different electrode placements with high-definition t-DCS (HD t-DCS) in terms of their therapy effects. HD t-DCS is a recent technique that limits the broad excitation patterns of t-DCS by using smaller electrodes.

The first retrospective part of the study compares two t-DCS electrode placements. 39 patients receive bifrontal t-DCS, another 39 patients receive the alternative t-DCS positioning (SO-LTA), where the electrodes are placed at the right supraorbital area (SO) and the left temporal area (LTA). The second prospective part of the study administers HD t-DCS at the right DLPFC. The therapy effects are determined by the tinnitus functional index (TFI), visual analogue scale (VAS), and hyperacusis questionnaire (HQ) filled out at three visits: pre-therapy, post-therapy and follow-up.

The first part of the study shows a highly significant improvement determined with the TFI in both tDCS groups (DLPFC: p=0.002; SO-LTA: p=0.007). In 33% of the tinnitus patients a decrease of 13 points or more on the TFI from the pre-therapy visit to the follow-up visit is apparent, indicating a clinically significant improvement. The effect of t-DCS on the HQ or VAS over time is not significant in both groups (DLPFC HQ: p=0.71; DLPFC VAS: p=0.49; SO-LTA HQ: p=0.31; SO-LTA VAS: p=0.06). The two groups do not show differences on the outcomes measurements (TFI: p=0.16; HQ: p=0.85; VAS: p=0.06). The TFI scores decrease significantly in the patients who receive t-DCS, with 33% showing a clinically significant improvement. The two electrode placements for t-DCS do not differ in their therapy effect.

The lack of a sham group forms a limitation in the current study. Electrical stimulation with t-DCS improves significantly the TFI scores of patients with chronic tinnitus.

The results of the HD t-DCS group will be analyzed and presented at ITS 2017.

O.040 • Right insulo-parietal Operculum 3 (OP3) involvement in tonal auditory phantom perception

Job A., Schmerber S., Pons Y., Raynal M., Kossowski M., Gauthier J., Lombard B. Delon-Martin C.

Neurosciences Department, IRBA/INSERM U1216/Univ. Grenoble Alpes, France

According to our previous fMRI study, a small region in the parietal operculum 3 (OP3) was hyperactivated as a function of tinnitus periodicity in subjects with acoustic trauma tinnitus sequelae. This region was localized in the vicinity of neural correlates of middle-ear tympano-ossicular chain movements due to pressure variations. Disturbed proprioceptors are known to trigger illusory perceptions; therefore, we hypothesized that a disturbance of middle-ear proprioceptors may originate phantom sound perceptions.

We designed a 3T fMRI study that aimed to stimulate middle-ear proprioceptors by repetitive vibrations applied bilaterally using various rates of click trains. In all of the healthy subjects included in the fMRI protocol, the 30 Hz

vibration rate compared to 8 Hz vibration rate, systematically triggered a clear tonal whistling tinnitus-like aftereffect that was perceived in both ears. We studied the neural correlates of these various stimulation and there differential aftereffects using SPM12.

The fMRI neural correlates of the aftereffect inducing tinnitus were unequivocally localized in the same parietal region as in acoustic trauma tinnitus sufferers. This region is located at the insulo-parietal junction in OP3 [MNI: 42–18 22], after DARTEL acute registration this region was slightly shifted in antero-post plane [MNI: 40–13 17] but still in OP3. In addition DARTEL registration revealed an hyperactivation in the primary somatosensory cortex (area 3a/3b) in the face region [MNI: –54–13 40]. Somatosensory cortex area 3a and 3b and opercular regions are known to be involved in in proprioception and kinesthetic illusions. Activation of auditory areas were not elicited in this experiment beside the fact that subjects perceived tinnitus.

Our results strongly suggest that a middle-ear kinesthetic/proprioceptive illusion exists at the origin of acoustic trauma tinnitus via a somatosensory pathway encompassing the trigeminal system.

O.041 • Cross cultural adaptation of the Chinese Tinnitus Functional Index

Kam A.C.S

Department of Special Education and Counselling, The Education University of Hong Kong, Hong Kong

The objective of this study was to translate the Tinnitus Functional Index into Chinese and then validate its use in Chinese Hong Kong patients who are suffering from chronic tinnitus.

The Chinese version of Tinnitus Functional Index (TFI-CH) was administered to 124 patients with chronic tinnitus in the Audiology clinic in a hospital setting. Statistical analysis was performed to determine the psychometric properties of the questionnaire.

The TFI-CH showed good internal consistency reliability (α=0.97) and test-retest reliability (ICC=0.84). Confirmatory factor analysis revealed that the TFI-CH has eight factors which are exactly the same as the original version. The TFI-CH has good convergent and divergent validity as supported by the strong correlation of the overall scale with other tinnitus-related distress measures (r=0.86, P<0.01) and weaker correlation with the general health status measures. Moderate to strong effect sizes obtained 3 months after initial visit indicated that the TFI-CH is responsive in detecting change in tinnitus suffering.

The results of this study demonstrate that the TFI-CH is a reliable and valid measure which should be useful in both clinical and research settings for intake assessment and for measuring treatment-related changes in tinnitus.

O.042 • Clinical evaluation of customized filtered sound for tinnitus relief

Kam A.C.S

Department of Special Education and Counselling, The Education University of Hong Kong, Hong Kong

The objective of this study was to assess the efficacy of two sound therapy approaches, 1) customized tinnitus frequency notched sound therapy and 2) customized sound therapy.

This was a randomized controlled trial. Forty-five subjects, who had continuous tinnitus for a minimum of 6 months, participated in the study. They were randomized prospectively into 3 groups: (1) customized tinnitus frequency notched sound therapy (CNS); (2) customized sound therapy (CS); and (3) no treatment control group (NT). After 6 months of therapy, immediate outcomes were compared using the (1) Chinese Tinnitus Handicap Inventory,(2) Chinese Tinnitus Questionnaire, (3) self-rated visual analogue scale on tinnitus loudness, and (4) tinnitus loudness matches measured psychoacoustically.

The Chinese Tinnitus Questionnaire score was significantly lowered in the CNS and CS group as compared to the NT group. There was no significant difference in the score reduction between the CNS and CS group. No significant difference was observed among all three groups in psychoacoustic measures. Acceptance of such sound therapies was high. Further data collection is needed in a larger sample size.

Results suggest that both the customized sound therapy and customized tinnitus frequency notched sound therapy are effective for tinnitus relief.

O.043 • The effectiveness of Tinnitus Retraining Therapy and Notched Noise Therapy for tinnitus: A randomized cross-over study

Kamysz G., Lurquin P., Thill M.P., Lechien J.R., Coulon E.

ENT Department, CHU St. Pierre, Brussels, Belgium

Notched noise Therapy (NNT) is an effective procedure known to decrease the aberrant neural activity involved in tinnitus occurrence. The aim of the present study was to compare the efficiency of both tinnitus retraining therapy (TRT) and NNT in tinnitus management.

Study design: Prospective randomized cross-over trial. Forty patients complaining of chronic tinnitus were recruited and randomly allocated to the NNT (N=20) or TRT (N=20) arm. According to the cross-over methodology, after the first phase, patients with resistant tinnitus were reoriented to the second sound therapy arm for a treatment period of 15 or 75 days without break (second phase). Treatment efficiency was evaluated at baseline and after each therapeutic process by three psychometric measurements: the Tinnitus Handicap Inventory (THI), Intensity and Annoyance.

The mean values of THI, intensity and annoyance scales significantly improved in each arm from baseline to the end of the first phase (p<.024). Concerning the second phase, THI and annoyance scores significantly improved in each arm (p<.001). The intensity scale scores only improved in the first arm (p=.002) but an improvement trend is found in the second arm (P=.092). Best positive percentage results are obtained with TRT. As accommodation process is longer to obtain than residual inhibition the NNT seems interesting regarding time consumption.

Notched noise seems to be an interesting alternative therapy for people who don't succeed in TRT. Further studies with larger samples are needed to confirm our preliminary observations.

O.044 • **Tinnitus among patients with hypertension**

Kazmierczak W., Janiak-Kiszka J.

Department of Sensory Organs, Collegium Medicum in Bydgoszcz, Poland

To evaluate tinnitus as a complaint among patients suffering from hypertension.

There were two groups in this project. The first one consisted of 104 individuals with primary hypertension, almost the same number of men and women with average of age 56, the median time of illness 19 years and mean value of blood pressure 138/91 mm Hg. The second group consisted of 21 healthy persons with average blood pressure above z 120/80 mm Hg. The single sided tinnitus was present predominantly. About 67.3% of patients suffering from cochlear hearing loss presented tinnitus while only 10.6% of patients suffering from central origin of hearing loss suffered from this symptom. There was no connection between level of vestibular of disorder and tinnitus.

Diabetes and hyperlipemia are well known factors as a reason of tinnitus. The hypertension is less known. Some authors are saying that this symptom among hypertension patients is connected with different kind of medicaments. In this work authors tried to find out if there is any connection between hypertension, hearing and vestibular disorders and tinnitus alone.

We found that tinnitus among hypertension patients is connected with cochlear origin.

O.045 • **The evolution of hearing in young adults**

Keppler H., Degeest S., Corthals P.

Speech, Language and Hearing Sciences Department, Ghent University, Belgium

Young people expose themselves to high levels of noise during various leisure activities, and might thus be at risk of developing hearing-related problems due to leisure noise exposure. Besides cross-sectional studies regarding hearing-related problems in young adults, longitudinal studies are needed. The aim of the study was to compare hearing-related problems, leisure noise exposure, and attitudes toward noise, hearing loss and hearing protector devices in university students at the moment of their enrolment in higher education and after approximately three years.

Thirty-four female university students were tested at the moment of their enrolment in higher education and after approximately three years. Hearing was evaluated using pure-tone audiometry and transient evoked and distortion product otoacoustic emissions, in addition to a questionnaire.

There were significant differences after the three-year period: an increase in the occurrence of temporary tinnitus after leisure noise exposure, differences in attitudes and beliefs toward noise, hearing loss and hearing protector devices, an increase in noise exposure related to visiting nightclubs and music venues, and changes in hearing. However, there were no significant differences in hearing between subgroups with decreased, similar or increased leisure noise exposure in nightclubs and music venues.

More longitudinal studies are needed to evaluate the onset and progression of hearing loss due to leisure noise exposure. In the meantime, hearing conservation programs targeting young people and preferably adolescents should be optimized, hearing protector devices should be made more attractive to young people, and behavioral change should be aimed for not only at an individual's level.

There was a significant increase in the occurrence of temporary tinnitus after leisure noise exposure in young adults during a three-year period. There were also significant differences in attitudes and beliefs toward noise, hearing loss and hearing protector devices, as well as a significant increase in noise exposure related to visiting nightclubs and music venues. However, the latter could not be firmly associated with the significant deterioration of hearing thresholds, transient evoked and distortion product otoacoustic emission amplitudes.

O.046 • **A sense of disability in children with tinnitus**

Kedzierawska S., Niedzielski A., Al-Jazani A., Mielnik-Niedzielska G.

Clinic of Pediatric Otorhinolaryngology, Medical University of Lublin, Poland

The aim of the study was to evaluate the occurrence and nuisance of tinnitus in children.

The study involved a group of 30 patients aged 8 to 16 years (average age 13) with idiopathic tinnitus or tinnitus associated with otological disorders. Prior to audiometric testing (impedance audiometry, otoacoustic emission, pure tone audiometry), a laryngological examination was performed. Furthermore such questionnaires as Tinnitus Handicap Inventory (THI), Tinnitus Functional Index (TFI) and a questionnaire to assess the symptoms and characteristics of tinnitus were conducted. The results were statistically evaluated.

In the study group, 60% of patients were males, while 40% were females. Most of the patients (60%) described tinnitus as a squeaking sound and reported that it was

loud. Tinnitus was heard all the time in 40% of respondents. THI mean score indicated slight or no handicap. TFI mean score showed relatively mild tinnitus with little or no need for intervention. Majority of children (60%) has reported that the noise was not bothersome and did not affect their everyday life. Baguley et McFerran reported that children seem less likely to be distressed by tinnitus which is consistent with our study.

Based on our research 40% of respondents were disturbed by tinnitus. According to Shulman et al. there is 30% disturbance rate in children with profound hearing loss. Mills found that 9.7% of 93 normal hearing British children are troubled by tinnitus.

Children have problem with identifying tinnitus and usually do not report it to parents. In addition, children do not find tinnitus annoying and it does not interfere with their daily activities.

O.047 • **Identification of functional and molecular biomarkers in mildly hearing impaired subjects with and without tinnitus**

Knipper M., Hofmeier B., Aldamer E.S., Walter M., Wolpert S., Ruttiger L., Ernemann U., Thiericke J., Klose U.

Department of Otorlaryngology, University of Tubingen, Germany

Tinnitus is as a symptomatic malfunction of our hearing system, where phantom sounds are perceived without acoustic stimulation. Here we present a clinical pilot studies in hearing-impaired subjects with and without tinnitus that aimed to test our hypotheses in humans.

We use audiometric measurements, the analysis of body fluids, and functional magnetic resonance tomography (fMRI)The results of this first pilot study in humans are discussed in the context of previous findings gained in animals. In recent years we have developed a fingerprint for tinnitus using a combination of behavior animal models for tinnitus and electrophysiological as well as molecular approaches in the peripheral and central auditory system. The characteristic features that distinguished equally hearing impaired animals with and without tinnitus are described through a failure to centrally maintain sound sensitivity after peripheral deprivation selectively in tinnitus animals (Knipper et al 2013, Prog. Biology; Ruttiger et al 2013, Singer et al 2013).

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O.048 • **Tinnitus-related neuronal hyperactivity caused by stochastic resonance controlled upregulation of internal noise after hearing loss**

Krauss P., Tziridis K., Metzner C., Schilling A., Hoppe U., Schulze H.

ENT Hospital Erlangen, Experimental Otolaryngology Department, Friedrich Alexander University Erlangen-Nuremberg, Germany

Numerous studies have indicated that tinnitus is correlated with pathologically increased spontaneous firing rates and hyperactivity of neurons along the auditory pathway. It has been proposed that this hyperactivity is the consequence of a mechanism aiming to compensate for reduced input to the auditory system by increasing central neuronal gain, a mechanism referred to as homeostatic plasticity (HP), thereby maintaining mean firing rates over longer timescales for stabilization of neuronal processing.

Here we propose an alternative, new interpretation of tinnitus-related development of neuronal hyperactivity in terms of information theory. In particular, we suggest that stochastic resonance (SR) plays a key role in both short- and long-term plasticity within the auditory system and that SR is the primary cause of neuronal hyperactivity and tinnitus. We argue in a computational model that following hearing loss, SR serves to lift signals above the increased neuronal thresholds, thereby partly compensating for the hearing loss.

In our model, the increased amount of internal noise – which is crucial for SR to work – corresponds to neuronal hyperactivity which subsequently causes neuronal plasticity along the auditory pathway and finally may lead to the development of a phantom percept, i.e. subjective tinnitus. We demonstrate the plausibility of our hypothesis using a computational model and provide exemplary findings in human patients that are consistent with that model.

Theoretical considerations and patient data point to a significant influence of SR on hearing thresholds and as a consequence on tinnitus development. We discuss several possible anatomical sites for SR to interfere with the auditory signal. We suggest, that the observed asymmetry in human tinnitus pitch distribution may be a consequence of asymmetry of the distribution of auditory nerve type I fibers along the cochlea in the context of our model.

In summary, we provide evidence that auditory phantom percepts may result from SR effects in the auditory pathway which have been evolutionary developed to counteract hearing loss. This alternative view opens up new perspectives for understanding the development of subjective tinnitus that will hopefully result in advanced therapeutic approaches to treat the condition.

O.049 • Tinnitus in a Multi-disciplinary Setting – a Danish approach

Kristensen R.B.

Hearing Department, Center for Communication and Welfare Technology CKV, Odense, Denmark

The aim of this presentation is to offer a comprehensive and detailed demonstration of a typical Danish rehabilitation setting. The listener will be presented with both a structured overview of the tinnitus rehabilitation system as well as descriptive case stories. We aim to be an inspiration to other tinnitus settings as well as supporting multi-disciplinary approaches elsewhere.

In Denmark the majority of people with bothersome tinnitus are referred to local hearing rehabilitation centres (Communication Centres) but the success must be supported by a medical-audiological investigation and diagnostics by ENT doctors in private practice and/or the dispensing of hearing aids/maskers at the Audiological departments in the public hospitals (National Hearing Services).

People with bothersome tinnitus are best helped by the following: Tinnitus is well investigated, explained and diagnosed by experts in ENT clinics or audiological departments. Masking devices available (hearing instruments, noise generators) have been fitted and tested in the patient's daily life. Audiologists have offered a tinnitus programme with an comprehensive programme including TRT or CBT, Mindfulness/relaxation, assistive listening devices. A Psychologist has offered a psychological support to the tinnitus patient, if he or she has issues related to tinnitus.

The presentation will discuss the pros and cons of the multi-disciplinary approach contrary to a one-setting approach e.g. solely targeting the masking of tinnitus.

The presentation will present a conclusion that supports the multi-disciplinary approach: People with bothersome tinnitus are best supported in their rehabilitation process being met by a multi-disciplinary panel of tinnitus experts, each with their special field of knowledge – and tools.

O.050 • Contemporary Trends in Telehealth In Hearing Health Care

Krumm M.

Speech Pathology and Audiology Department, Kent State University, USA

Telehealth (telemedicine) technology has been employed to provide health care services for patients in distant locations. Utilized since the 1800 's, telehealth solutions have grown dramatically over the past decade. This is also true for hearing health care professionals who will likely employ telehealth applications for patient centric solutions. Consequently, the presenter will describe effective contemporary and emerging telehealth trends for hearing health care service delivery. Implications for these services will also be discussed.

The presenter will describe contemporary telehealth, otology and audiology literature to describe concepts consistent with the aim of this session. Contemporary literature points to telehealth as a successful mode when patient access is limited. Also, in contrast to the past, programs are emerging which are self-sustaining and beneficial. Cost effectiveness continues to be uncertain but broadly implicated as a basis for telehealth services. Future technology development will likely permit greater consumer flexibility and individualized hearing health care solutions.

Novel and effective telehealth services in hearing health care will be discussed in this session. In addition, implications for future clinical practice and additional research will presented to the audience.

Research overwhelmingly supports the use of telehealth solutions in underserved communities. Also, as technology is evolving with remarkable speed, new telehealth paradigms will likely emerge in otology and audiology services. Such changes may create non-traditional consumer demand for innovative and personalized health care systems. The presenter will discuss these trends and suggest how clinicians may prepare for future technology paradigm shifts.

O.051 • Continuous positive airway pressure (CPAP) treatment outcome in chronic tinnitus of unknown: A preliminary study

Lai J-T.

Otolaryngology Head and Neck Surgery Department, Kuang Tieng Hospital, Taichung, Taiwan

Our latest study result of CT patients of unknown (CTOU) showed CTOU may closely contributed to hypoxemia in obstructive sleep apnea (OSA) patients.

We write individualized treatment plan to each CTOU patients focus on OSAS only according to each patient's severity and pattern in OSA present and micro adjust to increase s compromise. We collect questionnaire from confirmed CTOSA from October 2016 to February, 2017. Tinnitus Handicap Inventory (THI) and visual analog severity (VAS) questionnaire were collected. Each CTOU tinnitus severity in pre-treatment and post-treatment (>3 month) period were collected. Continuous Positive Airway Pressure (CPAP) Therapy were recommended for CTOU with OSA.

Short-term outcomes in these chronic tinnitus with OSA (CTOSA) 14 cases enrolled (12 men: 2 women). Pre-treatment and post-treatment THI (>3 months) show an average 23.6 points decline (Pre: 51.3, post: 27.7)avg. VAS showed 2.4 points decline (Pre: 7.2, post: 4.8)avg.

In our 14 CTOSA cases, 3 cases (21%) showed worse tinnitus condition. One case follow up over one year express his tinnitus improve a lot due to CPAP used. The short-term outcomes of tinnitus declines give us promising result that CTOSA can benefit from personal program to each individual CTOSA cases. From this encouraging preliminary 14 CTOU cases, we yield a different viewpoint in deal with CTOU.

O.052 • High prevalence of obstructive sleep apnea syndrome in patients with tinnitus

Lai J-T., Lin C-Y., Yan Y-H., Shen P-H.

Department of Otolaryngology, Kuang-Tien General Hospital, Taichung, Taiwan

The relationship between obstructive sleep apnea syndrome (OSAS) and tinnitus is unclear. Previous studies have proposed that OSAS-induced hypoxemia may have a negative impact on auditory function. Although auditory impairment can play an important role in the pathogenesis (or initiation) of tinnitus, the exact cause has never been found. In this study, we investigated the association between OSAS and chronic tinnitus at our Special Tinnitus Clinic.

This retrospective chart review study included 231 patients who visited our STC between July 2015 and August 2016. Each patient underwent detailed otorhinolaryngologic examinations to identify any possible cause of tinnitus. Polysomnography (PSG) was routinely arranged for our patients. A BMI>24 kg/m2 was considered to be overweight. An apnea-hypopnea index (AHI)>5 was considered to indicate OSAS. We also analysis the pure tone analysis for evaluate the average hearing loss of this patients.

This study was approved by the Institutional Review Board of Kuang-Tien General Hospital.

Forty-five patients were excluded due to incomplete data on the chart records and failure to obtain this information by subsequent telephone contact. One hundred and eighty-six chronic tinnitus patients (13 females and 173 males) with a mean age of 52.9 years completed this study. The mean BMI of these patients was 26.3 kg/m2. We found 90.9% chronic tinnitus patients had OSAS among 186 patients. We also analysis the average hearing loss (500, 1 K, 2 K, 4 K). The hearing result showed the average hearing loss is 25 dB.Previous research studies shows that patients whom suffer from hearing loss combined with tinnitus after a long period follow up, up to 70% of the symptoms will disappear on its own, so we can reasonably inference whether OSAS or other reasons that the body can 't eliminate tinnitus.

The newest study shows the accumbens and tinnitus has a huge connection, the caudate nucleus that connect to our sleep are very much close on the anatomy. So is our sleeping quality that affects the many reason that our body cannot eliminate tinnitus, is what we suspect.

There are an increasing number of studies found that tinnitus involves central network dysfunction somewhere between auditory-sensory and fronto-striatal circuits, and auditory-limbic interaction may play a critical role for involvement of „non-auditory" structures in tinnitus pathophysiology.

Further prospective studies are warranted to clarify whether OSAS is a cause of tinnitus, or whether OSAS is just a co-morbidity of tinnitus.

O.054 • Grey matter abnormalities in bothersome tinnitus

Lewandowska M.[1,2] Milner R.[2], Ganc M.[2], Niedzialek I.[2,3], Wojcik J.[1,2], Skarzynski H.[2], Wolak T.[1,2]

[1] *Bioimaging Research Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

The aim of the study was to investigate the pattern of grey matter atrophy in patients with chronic tinnitus.

Voxel-based morphometry (VBM) was employed to compare gray matter (GM) volume between 76 tinnitus patients (32 women, age range: 19–75 years) and 59 normal-hearing controls (30 women, age range: 21–74 years). Additionally, VBM was applied to magnetic resonance images of 37 individuals with bothersome tinnitus (THI>38 points) and 37 age-and gender-matched controls. The subjects' age and hearing loss were used as regressors in VBM analysis.

VBM analysis in all patients and controls did not show any significant between-group differences. VBM restricted to bothersome tinnitus revealed tinnitus-related decrease of GM volume in the anterior cingulate cortex including the subcallosal area. Both chronological age and hearing loss (8–16 k Hz) only slightly affected the results. Correlation between GM volume in the subcallosal region and hearing threshold at 8–16 k Hz in tinnitus group (n=37) was not significant but in both tinnitus and controls (n=74) GM volume in the subcallosal area decreased with increasing hearing threshold above 8 k Hz.

Our results confirm previous findings on GM volume decrease in the subcallosal area in tinnitus. This area is engaged in emotional and attentional processes. Unlike earlier reports we failed to show changes in the auditory areas. The latter effect could result from relatively good hearing of tinnitus group (hearing loss≥8 k Hz, at frequencies considered as not important for normal auditory behavior). Unlike Melcher et al. (2013) who found decrease of GM with increasing hearing loss above 8 k Hz in tinnitus patients, we observed this negative correlation irrespectively of the presence of tinnitus.

Our results support a role of the subcallosal area in tinnitus distress. The study did not provide further evidence on negative correlation between GM in the subcallosal area and hearing threshold above 8 k Hz in tinnitus.

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O.055 • Patterns of rsfMRI connectivity in tinnitus

Lewandowska M.[1,2], Wolak T.[1,2], Milner R.[1], Ganc M.[1], Niedzialek I.[1,2], Ciesla K.[1,2], Skarzynski H.[1,2]

[1] *Bioimaging Research Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

The aim of the study was to evaluate resting-state functional connectivity in subgroups of patients with chronic tinnitus.

52 patients were divided into 2 groups based on their hearing and tinnitus status and psycho-social well-being. 22 healthy controls (HC) participated (10 F, 42.1 ± 12.6). RsfMRI was 5 min with eyes open. The analysis was done with seed-to-voxel approach and Regions of Interest in various brain structures.

Group 1 (10 F; 41±10) had normal HL (<20 dB) for 0.125–16 k Hz, 12±5 points in BDI, 38±5 and 41±7 points in STAI, 51±14 points in THI, 53±67 months duration of tinnitus, 80±24% daytime with tinnitus. In Group 2 (8 F; 38±15) with HL >20 dB HL in 10–16 k Hz, all scores pointed to better functioning. When compared to HC, G1 had mainly increased rsfMRI connectivity: within frontal and occipital brain areas, between temporo-frontal and temporo-cereberal areas, as well as connectivity of subcortical regions with precuneus and occipital cortex. G2 had a comparable range of networks of increased (somatosensory / motor-frontal) and decreased (occipital-SMA, hippocampus-frontal) connectivity. The occipito-temporal and occipito-DMN connectivity for G1 and intra-occipital and temporal-occipital connectivity for G2, respectively, was found both increased and decreased.

Tinnitus patients with worse psycho-social well-being and larger handicap due to long durations of tinnitus had increased rsFMRI connectivity, e.g. within and between brain regions related to executive functions, audition, vision and attention. Among others, patients who perform better had decreased connectivity between regions related to movement and tactile experience and vision, as well as regions associated with executive functions and processing of emotions.

The outcomes of the study show abnormal resting state functional connectivity (rs-fcMRI) patterns in tinnitus but distinct with respect to certain psycho-social and medical factor. Normalization of abnormal rs-fcMRI patterns in tinnitus subgroups could potentially be an effective method of tinnitus treatment.

BDI-Beck Depression Inventory, STAI-State-Trait Anxiety Inventory, THI-Tinnitus Handicap Inventory.

O.057 • The relationship of tinnitus recovery and hearing improvement in idiopathic sudden sensorineural hearing loss

Lin P-H., Liu T-C.

Department of Otolaryngology, National Taiwan University Hospital, Taipei, Taiwan

Tinnitus is one of the common symptoms associated with idiopathic sudden sensorineural hearing loss (ISSHL). The aim of this study was to analyze the relationship between the recovery or progress of tinnitus and the improvement of hearing in patients with ISSHL.

A total of 47 patients diagnosed as ISSHL and newly-onset concurrent tinnitus from November 2015 to October 2016 were enrolled in this prospective cohort study. Serial pure-tone audiometry, Tinnitus Handicap Inventory (THI) scores, and Visual Analogue Scale (VAS) scores for tinnitus before and after treatment were recorded. Paired t test, ANOVA, and Pearson correlation were used for statistical analysis.

The overall hearing improvement rate was 78.7%, and the overall tinnitus recovery rate were 53.2% in THI score and 57.4% in VAS score, respectively. The initial hearing loss levels were correlated with the initial THI scores but not with the initial VAS scores. On the other hand, the improvement of hearing level was correlated with the recovery of THI score at 3 months after treatment but not at 1 month after treatment. Also, the improvement of hearing level was not correlated with the recovery of VAS score both at 1 month and 3 months after treatment.

In our series, the initial tinnitus handicap was parallel to initial hearing loss level, while the initial tinnitus loudness was not. The THI scores kept improving 3 months after hearing level has stabilized, but the VAS scores did not. The hearing improvement rate was proportional to THI score recovery, but not to loudness recovery 3 months after treatment.

The initial ISSHL-related tinnitus handicap is related to the hearing loss level. The hearing improvement rate is a good prognostic factor for the recovery of tinnitus handicap but not for tinnitus loudness.

O.058 • Low-dose of hormone replacement therapy (HRT) might help in managing chronic tinnitus in postmenopausal woman

Liu C-L., Lai J.T.

Otolaryngology Department, Kuang Tieng Hospital, Taichung, Taiwan

Tinnitus is a common complaint among patients visiting an ENT clinic. In our tinnitus special clinic, we encountered a special group of subjects: women in their menopausal period or in the immediate postmenopausal period, whose tinnitus responded exceptionally well to hormone replacement therapy (HRT).

The THI and VAS scores were evaluated at pre-treatment and post-treatment at least 3 month later, during their

first follow-up visit. Estrogen [0.625 mg, 1 tablet QD to QOD] plus conjug medroxyprogesterone [5 mg, 1 tablet HS]) to treat their tinnitus and other menopause-associated symptoms.

The average pretreatment THI score was 57.6 and the post-score was 17.5. The average pre VAS score was 7.2, and the postscore was 3.2. 18 of the 44 (40%) patients had THI scores below 10 after treatment, and 11 patients (25%) even had a THI score of 0. 43 patients showed tinnitus improvement in the post-treatment THI score. Only 1 patient showed no improvement at all.

The use of HRT for menopausal syndrome is still controversial. However, emerging evidence shows that low-dose HRT does not increase the incidence to malignancies, and can instead reduce composite deafness and heart failure9. It can also improve the sleep quality and prevent osteoporosis10. We emphasize here that, for this particular group of patients, their consent, close collaboration with gynecologists, and careful monitoring are all very important.

Our short-term outcome 44 case series showed that menopausal women with chronic tinnitus could benefit by HRT. The treatment produces rapid, effective, and safe results. However, HRT is not recommended as a standard treatment for chronic tinnitus now.

O.059 • Cochlear implant as a treatment for tinnitus in unilateral hearing loss

Lorens A.[1,2], Kruszynska M.[1,2], Obrycka A.[1,2], Pastuszak D.[2], Skarzynski P.H.[2,3], Raj-Koziak D.[2,4], Skarzynski H.[2]

[1] *Implants and Auditory Perception Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[4] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

For several years, cochlear implants (CIs) have been successfully applied in UHL situations for suppressing tinnitus. Studies indicate that a CI has a positive effect on both tinnitus distress, tinnitus loudness, and reduces complaints, demonstrating a reduction in perceived tinnitus disability. What's more a lack of binaural hearing produces deficits in hearing function, particularly speech discrimination in noise. The aim of this study was to evaluate whether cochlear implant can facilitate tinnitus suppression and evaluate binaural hearing abilities after cochlear implantation for patients with unilateral hearing loss.

A group of 15 patients with unilateral hearing loss and tinnitus, implanted at the Institute of Physiology and Pathology of Hearing who achieved 14 months of CI follow-up, were included in the study. Visual Analogue Scale (VAS) was used for measurement tinnitus loudness and annoyance. VAS was administrated pre-implantation and after 9 months of using cochlear implant. All subjects with preoperative tinnitus were evaluated with a monosyllabic word test under difficult listening situations after 14 months of using cochlear implant.

All patients had pre-implantation score equal or greater than 6 out of 10 on the Visual Analogue Scale. After 9 month all group reported subjective benefit from cochlear implant. Mean tinnitus loudness reduced from 7.8 to 2.4 on the VAS and mean tinnitus annoyance reduced from 7.1 to 2.4 on the VAS. The mean score for the quiet speech test in the group was 75.6%. For the same (SNR) in implanted ear (IE) and non-implanted ear (NE) scored was 65.3%. For more favourable SNR at the IE (IE>NE) scored was 66.7%. For less favourable SNR at the IE (IE<NE) scored was 51.6%.

Patients with unilateral hearing loss and tinnitus can benefit from using a CI. Cochlear implant can reduced tinnitus in deaf ear and restore binaural hearing.

O.060 • Cognitive Behavioural Therapy for Insomnia in the Context of Chronic Tinnitus

Marks E., McKenna L.

Clinical Psychology Department, RNTNEH and Uni of Bath, UK

Sleep disturbance affects 50–70% of tinnitus patients. People with tinnitus and poor sleep experience may be more distressed than those who sleep well. Yet there is little research into sleep management in tinnitus and few treatment studies specifically address insomnia. However, there is a strong evidence base that CBT for insomnia (CBTi) is an effective treatment for sleep disturbance when it presents both as a primary problem and when it is co-morbid with other physical (and mental) health problems, for example, chronic pain.

Patients with chronic and distressing tinnitus and significant sleep disturbance were offered group-delivered CBTi as part of routine clinical care. They attended six, two-hour sessions, led by two clinical psychologists. Primary outcome measures included the Insomnia Severity Index and measures of total sleep time and sleep efficiency based on sleep diaries. Secondary outcome measures included tinnitus distress (measured on the Tinnitus Questionnaire – TQ) and psychological distress (CORE-OM, GAD7 and PHQ9). All participants were assessed pre and post therapy. Results are reported from patients completing CBTi, delivered in three separate groups.

Results demonstrate that patients completing the treatment showed a significant improvement in sleep measures as assessed by sleep diaries and questionnaires. We will present final analyses of the secondary outcome measures and of qualitative data from patients regarding their experiences of the group.

This clinical evaluation pilot suggests that CBTi can offer real improvements for patients with chronic tinnitus and sleep disturbance. This offers a promising avenue for future research as very little evidence exists about the most effective ways of managing sleep problems in tinnitus. We will give an overview of a Randomized Controlled Trial that we are currently conducting to better assess the efficacy of CBTi compared to existing standard interventions.

Many patients with tinnitus are plagued by problems sleeping but at this time there are no standardized interventions with a strong evidence base. Our initial exploration of the use of CBTi in routine clinical care suggests that we may be able to offer a new approach to insomnia in tinnitus that is effective and acceptable.

O.061 • Mindfulness Based Cognitive Therapy for tinnitus: Results of a Randomized Controlled Trial

Marks E., McKenna L., Hallsworth C., Schaette R.

Clinical Psychology Department, RNTNEH and University of Bath, UK

An estimated 10–14% of the population report chronic tinnitus and 1–2% develop clinically significant distress. Standard treatment focuses on Tinnitus Retraining Therapy, Relaxation and CBT. Recently 'acceptance' approaches have been incorporated, for example Mindfulness Based Cognitive Therapy (MBCT). These offer a very different treatment approach from mainstream audiology practice. Early studies of mindfulness-based approaches report beneficial effects. This novel study describes a randomized-controlled trial of standard MBCT, adapted for tinnitus, compared to an active control group.

Patients with chronic, distressing tinnitus were randomized to MBCT or Relaxation Training (RT). Both groups had eight weekly sessions of 2-hours, led by two clinical psychologists (LM and EM). Primary outcome measures included tinnitus-distress (measured on the Tinnitus Questionnaire – TQ) and psychological distress (measured on the CORE-OM). Secondary outcomes included measures of anxiety, depression, tinnitus loudness, acceptance and mindfulness. All participants were assessed at baseline (8-weeks pre-therapy), at week 1 and week 8 of therapy and at 1 and 6 month follow-up points. There were 75 patients randomly allocated to MBCT or RT.

Both groups showed significant reductions in tinnitus severity and loudness, psychological distress and disability. MBCT led to a significantly greater reduction in tinnitus severity compared to RT and this persisted 6 months later. MBCT also led to greater reduction in tinnitus catastrophizing and greater gains in tinnitus acceptance and mindfulness.

Treatment was effective regardless of initial tinnitus severity, duration or hearing loss. Group MBCT is effective in reducing tinnitus severity in chronic tinnitus patients and it is more effective than intensive RT. It reduces psychological distress and disability. Considering evidence that tinnitus-catastrophizing and tinnitus-acceptance are associated with long-term outcomes in tinnitus distress, the significant differences between the two groups on these measures suggest that MBCT may lead to deeper changes. The inclusion of acceptance-based approaches into standard treatments such as CBT are becoming increasingly popular in the management of chronic symptoms and illness.

Our results suggest that approaching tinnitus in this way may lead to changes in cognitive and behavioural correlates of tinnitus that can reduce distress and aid habituation to this difficult condition.

O.062 • Cochlear Implantation as a Long-Term Treatment for Ipsilateral Incapacitating Tinnitus in Subjects with Unilateral Hearing Loss up to 10 years

Mertens G., van de Heyning P.

Otorhinolaryngology, Head and Neck Surgery Department, Antwerp University Hospital, Belgium

The authors previously demonstrated that tinnitus resulting from unilateral hearing loss (UHL) can be treated with electrical stimulation via a Cochlear Implant (CI). The study aimed to do a long-term (LT) evaluation of CI in subjects suffering from UHL and accompanied incapacitating tinnitus up to 10 years.

LT evaluation was derived from 23 CI recipients suffering from UHL and accompanied incapacitating tinnitus. Subjects were categorized into two groups: a Single-Sided Deaf (SSD) and an Asymmetric Hearing Loss Group (AHL). In order to obtain a LT structural overview of the CI use in UHL subjects, a structured interview was conducted. The VAS tinnitus loudness and the Tinnitus Questionnaire were obtained pre-operatively, one, three, six, 12, and 36-months post-operatively and at the long-term test interval (8 (3–10 years) post-operative).

The structural interview revealed that all patients still wear their CI seven days a week, eight (3–10) years after cochlear implantation. In the SSD group, tinnitus suppression is still the primary benefit reported, whereas in the AHL the majority of the subjects report that the primary benefit shifted to improved hearing. The VAS and TQ scores significantly improved up to three months after the first-fitting and remain stable up to the LT test interval. Structured interviews shows that 100% of the subjects wears their CI seven days a week.

The tinnitus reduces significantly up to three months after the first-fitting and the tinnitus reduction remain stable up to the LT test interval. The SSD group reports that tinnitus reduction is still the primary benefit of CI, whereas the majority of the AHL group reports improved hearing as the primary benefit, eight (3–10) years after implantation.

Cochlear implantation is a durable treatment for tinnitus in patients with Unilateral Hearing Loss.

O.063 • Evaluation of standard versus tomographic neurofeedback protocol as tinnitus treatment

Meyer M., Guntensperger D., Neff P., Thuring C., Weidt S., Kleinjung T.

Psychology, ORL-Clinics, Psychiatry, University and University Hospital of Zurich, Switzerland

Due to recent neurophysiological studies subjective tinnitus has been associated with a change of ratio between differential EEG frequency modulations. While usually the slower δ- and the faster μ-oscillations appear to be

abnormally increased, α-waves tend to be significantly suppressed for tinnitus sufferers, presumably in auditory regions. Application of standard neurofee dBack treatment (SNF) aiming for increase of α- and decrease of δ-band activity has been formerly proven successful for tinnitus treatment (Dohrmann et al. 2007, Hartmann et al. 2013). Our study evaluates sLORETA-based ToNF vs. SNF for treatment of subjective tinnitus.

While half of the participants (n=24) underwent ToNF, the remaining half (n=26) takes part in SNF protocols. All participants use neurofee dBack for 15 weeks. They train an increase of (individual) α-band activity and a downregulation of δ-power (3–4 Hz). We investigated whether the ToNF protocol using 31 electrodes that seek to modulate EEG activity with higher spatial resolution in distinct brain regions (f.e. auditory cortex) may be even superior towards the SNF that only records data from four electrodes. For ToNF we combined the tomographical sLORETA-based approach with the Cygnet software (EEGinfo). We collected psychometric data, audiometric testing and resting-state EEG prior and after training.

Data analysis indicates that both ToNF and SNF resulted in improvement of subjective tinnitus measured by standard questionnaires (THI ToNF Δ=–5.1, p=.049; TQ ToNF Δ=–2.6, p=.130; THI SNF Δ=–5.46, p=.001; TQ SNF Δ=–2.19, p=.037). While a majority of participants demonstrated an improvement of tinnitus symptoms some individuals showed no alteration or even an increase of symptoms. Next steps of data analysis will include resting-state EEG obtained prior and after the training period, behavioral follow-up investigation three and six months after the completion of training, and a closer look to individual behavioral and neurophysiological patterns, which enables us to identify responders and non-responders and variables that will help predict the success of training, in particular with respect to the applied protocol.

This project can be seen as a first step towards the long-term goal of identifying different forms of subjective tinnitus and developing individually tailored neurofee dBack protocols based on individual neurophysiological brainprints for each of these subtypes.

O.064 • Prognostic indicators for decrease in tinnitus severity after cervical physical therapy in patients with somatic tinnitus

Michiels S., Van de Heyning P., Nieste E., De Hertogh W.

Translational Neurosciences Department, University of Antwerp, Belgium

This study aimed to identify prognostic indicators for decrease in tinnitus severity after cervical physical therapy in patients with somatic tinnitus (ST).

Patients with subjective tinnitus and neck complaints were recruited in a tertiary tinnitus clinic. All patients received cervical physical therapy for 6 weeks. Tinnitus Functional Index(TFI) and Neck Bournemouth Questionnaire (NBQ) scores were documented at baseline, after treatment and after 6-weeks follow-up. Tinnitus analysis and impairments in cervical spine function were identified at baseline and after follow-up. The relationship between TFI decrease after treatment and potential prognostic indicators was evaluated and a multivariate model for the prediction of TFI decrease was created.

All patients (n=38) suffered from moderate to severe tinnitus at baseline with an average TFI-score of 49 (SD: 21) and NBQ-score of 33 points (SD: 12). Co-variation between TFI and NBQ-scores—meaning that tinnitus and neck complaints decrease or increase together – could be noted in 49%. The presence of this co-variation and a combination of low pitched (<1000 Hz) tinnitus and increasing tinnitus during inadequate cervical spine postures are prognostic indicators for a decrease in TFI-scores after cervical physical therapy (adjusted R^2=0.357).

All patients meeting these criteria experienced substantial improvement of their tinnitus. Although these conclusions are based on small numbers, the co-variation and low-pitched tinnitus with an 'increase of tinnitus during inadequate postures while resting, walking, working or sleeping' seem to be suitable criteria for referring patients for cervical spine treatment. Larger RCT's are however needed.

Patients who will experience a decrease in tinnitus annoyance from cervical physical therapy are those with co-varying tinnitus and neck complaints and those with a combination of low-pitched tinnitus and increasing tinnitus during inadequate cervical spine postures.

O.065 • The effect of physical therapy treatment of cervical spine dysfunctions on somatic tinnitus. A randomized controlled trial

Michiels S., Van de Heyning P., Nieste E., De Hertogh W.

Translational Neurosciences Department, University of Antwerp, Belgium

The aim of this study was to investigate the effect of a multimodal cervical physical therapy treatment on tinnitus complaints in patients with somatic tinnitus (ST).

Patients with subjective tinnitus and neck complaints were recruited. All patients received physical therapy for 6 weeks, which contained a combination of manual mobilizations and exercises of the cervical spine. Patients were randomized in an immediate-start and a 6-week delayed-start group, that received the therapy after a wait-and-see period. The data from the delayed-start group were used to create a control group. Tinnitus Functional Index(TFI) and Neck Bournemouth Questionnaire(NBQ) scores were documented at baseline, after wait-and-see, after treatment and after 6 weeks follow-up.

In all patients(n=38) TFI and NBQ-scores decreased after treatment(p=0.04 and p<0.001). NBQ-scores remained lower after follow-up (p=0.001). Six weeks after baseline, 58% of the patients in the immediate-start group experienced substantial improvement of the tinnitus compared to no improvement in the delayed-start group that had ended the wait-and-see period. Immediately after treatment, 53% of the entire study population experienced substantial

improvement of tinnitus compared to baseline. This effect was maintained 6 weeks after the last treatment session in 24% of the patients.

A lot of patients with ST are not referred for physical therapy because of lack of evidence of physical therapy for ST complaints. We assume that more evidence will result in better referral of these patients, who are now often left without treatment. Future studies, investigating prognostic factors, will also contribute to the referral of those patients that are most likely to benefit from physical therapy treatment.

Cervical physical therapy can have a positive effect on subjective tinnitus complaints in patients with a combination of tinnitus and neck complaints. Larger studies, using more responsive outcome measures, are however necessary to confirm this effect.

O.066 • **Auditory and non-auditory resting-state functional connectivity in normal-hearing individuals with and without tinnitus: RsFMRI study**

Minami S.B., Oishi N., Watabe T., Uno K., Ogawa K.

National Institute of Sensory Organs, National Tokyo Medical Center, Japan

Although tinnitus is commonly associated with hearing loss, some patients have tinnitus without hearing loss. Tinnitus cases with normal hearing have been hypothesized that they are associated with hidden hearing loss. We have reported that the tinnitus patients with hearing loss showed less levels of statistically significant connectivity between the right and left auditory cortex than the control. The purpose of the present analysis was to compare the auditory and non-auditory functional connectivity in normal hearing individuals with and without tinnitus.

Nineteen volunteers with normal hearing and 11 tinnitus patients without hearing loss were enrolled in this study. The subjects were evaluated with resting-state fMRI and region of interest (ROI) based correlation analyses were performed using the CONN toolbox version 14 of SPM version 8. Based on the individual level results, the correlation coefficients were converted into beta values and an unpaired t-test was carried out on each connection to determine whether there was a significant difference between groups.

Focusing on the auditory-related (Heschl's gyrus, planum temporale, planum polare, operculum, insular cortex, superior temporal gyrus) connections, all but only 4 (2%) pairs of ROIs were significantly correlated in control group. Between the auditory-related ROIs, 91% of all possible in control group remained intact at beta>0.2 threshold, whereas it is reduced to 66% of connections in normal hearing tinnitus group. On the other hands, between non-auditory-related ROIs, the intact rate in control group and tinnitus group were 17% and 15%, respectively, at beta>0.2 threshold.

These data suggest that the association of ROIs within control group as defined in the auditory-related networks architecture is generally stronger than normal hearing tinnitus group. On the other hand, focusing on non-auditory-related FC, the control group and the tinnitus group showed almost same levels of functional connectivity. According to this study, tinnitus itself is related to a reduction in the balance of excitatory and inhibitory inputs conveyed to the central auditory system, surprisingly even in the cases of tinnitus without hearing loss. The control group showed higher levels of functional connectivity than the tinnitus group between the auditory-related connections.

These data suggest that the association of the auditory-related networks within tinnitus patients is weakened even they have normal hearing.

O.067 • **The clinician might be more helpful than the protocol!**

Mohr A-M., Tyler R.S.

Hearing and Tinnitus Department, House of Hearing, Denmark

When making research on what is most helpful for the tinnitus patient coming to terms with tinnitus, the focus of research most often is on method, i.e. which method helps most patients the best. Very seldom the focus is on the clinician and how he/she is being (acting) when trying to help the tinnitus patient. The aim to be explored here is whether the clinician might be the most important factor during the tinnitus patient's process of coming to terms with tinnitus and how.

Scott D. Miller, Ph.D. and founder of the International Center of Clinical Excellence, USA has studied the importance of the method such as CBT, compared to the ability of individual clinicians, in creating a relationship with the patient. We review this data applying it to clinicians working with tinnitus patients. We consider the significance of the clinician's ability to create a relationship and how this can be used to improve outcome. We present The SR-Scale (by Scott D. Miller) that allows for the patient to rate how he/she experienced the being of the clinician during a session.

The studies on the outcome of psychological counselling (undertaken by Scott Miller) have shown that the relationship as rated by the patient, is the most powerful predictor of outcome. The psychologist's ability to create a constructive relationship with the patient is 9 to 10 times more important to the outcome of therapy than is the choice of method. This result is relevant to Three Track Tinnitus-Therapy as this way of working includes focus on how the professional is being during the sessions: One track is on the tinnitus itself, one track explores how the tinnitus patient lives his life (which is highly important to the degree of tinnitus annoyance) and one track continuously explores the relationship between the clinician and the patient. During therapy the three tracks are wound together, yet at the same time each of the tracks is very carefully attended to by the therapist depending on the needs of the patient.

We should re-think the importance of the individual clinician's ability to connect with the patient and thus support

clinicians working with tinnitus patients to continuously be attentive to whether their way of working with the patient matches the patient's needs and expectations. The Session Rating Scale is a good way to rate the patient's experience of whether the clinician is attending to the needs of the patient.

O.068 • Relationship of stress and anxiety-related characteristics to the tinnitus handicap and impact on life

Moon K.R.[1], Chun Y-M.[1], Lee Y.H.[2]

[1] Department of Otology, Soree EarClinic, Seoul, South Korea
[2] Department of Psychiatry, National Center for Mental Health, Seoul, South Korea

This study was to compare the clinical variables in stressor related and non-stressor related tinnitus patients. Moreover, it was of interest in this study to evaluate the relationships of psychiatric characteristics to tinnitus severity and handicap.

We collected data from patients with tinnitus who had visited the Soree Ear Clinic. Patients underwent a self-reported questionnaires including demographic/clinical information, Visual Analogue Scales(VAS) for tinnitus symptoms, Tinnitus Handicap Inventory(THI), Hospital Anxiety and Depression Scale(HADS), Anxiety Sensitivity Index(ASI). Pure-tone audiometry was performed to identify the presence of hearing loss. We used the Analysis of Covariance(ANCOVA) for group comparisons and the multiple regression analysis. A total of 1674 patients (mean age 52.88±15.32, 53.6% female) were participated in this study.

The individuals with tinnitus caused by stressful events showed greater THI, ASI, anxiety and depressive symptoms than those with other causes. In multiple regression analysis, the THI and influence on life were significantly associated with both greater current anxiety and ASI. We found a strong interaction between sex and ASI on THI. Male group showed a stronger association between ASI and THI compared to female group.

Our study revealed that stressor-related tinnitus patients could experience greater psychiatric symptoms and handicap in their life. Furthermore, current anxiety level and anxiety sensitivity could significantly impact on the tinnitus severity and quality of life. Interestingly, the association of anxiety sensitivity with tinnitus handicap may be stronger in male than female patients. Our findings have implications for the understanding of the role of stress and anxiety-related characteristics in tinnitus.

O.069 • Demographic data, referral patterns and interventions used for children and adolescents with tinnitus and hyperacusis in Denmark

Nemholt Rosing S., Kapandais A., Hvass Schmidt J., Baguley D.M.

Department of Clinical Research, University of Southern Denmark, Denmark

The aims of this study are:

– To investigate whether children and adolescents with tinnitus and/or hyperacusis are seen in Ear-Nose-Throat (ENT) clinics and to report the clinical data, treatment and referral patterns of these children.
– To describe the population of children and adolescents with tinnitus and/or hyperacusis found in Educational-Psychological Advisory services (EPAs) and Centres for special Education for Adults (CEAs) and to identify the referral patterns and interventions used for the children in these settings.

A prospective study within 15 ENT clinics was conducted from June 2014 to February 2015. All children with a primary complaint of tinnitus and/or hyperacusis was reported. No changes in daily practice regarding diagnostics, treatment or referral were made. A retrospective case review was undertaken during a five-year period from 01/01/2009 to 31/12/2013 in each Danish municipality and region.

In the prospective ENT study, 12 children were identified and in the retrospective CEA/EPA study, 69 children were identified. Tinnitus was the primary complaint for the majority of the 69 children seen by CEA/EPA (n=50, 72.5%), hyperacusis in 9 cases (12.8%), and both tinnitus and hyperacusis in 11 cases (15.7%).

The findings of this study indicate that a majority of children with tinnitus and/or hyperacusis are seen in settings designed for adult audiological rehabilitation. Counselling, including explanations and discussion of coping strategies was the most commonly reported intervention. In the ENT study, almost all children were onward referred to an audiology department. Referral from EPAs to CEAs occurred because healthcare professionals at the EPA felt that managing tinnitus in a child was beyond their scope of practice. Referral from CEAs to EPAs was related to funding approval. The use of this pathway potentially prolongs the time period before the child can receive help. However, an increase of referral from 2009 to 2013 may indicate a raising awareness of children having tinnitus and/or hyperacusis by health care professionals working in the field of audiology.

Overall only a small number of children with tinnitus and/or hyperacusis were identified in this systems, suggesting that either the children are seen at general practitioner level or not being referred at all. It may also be the case that the incidence of troublesome tinnitus in childhood is lower than the epidemiological data proposes. Referral pathways indicate a general uncertainty about which services provide acquire sufficient intervention.

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O.070 • Hyperacusis – manifold experiences of the same phenomenon?

Neubert K.

Department of Nordic Studies and Linguistics, University of Copenhagen/ Aarhus University, Denmark

This research is rooted in an audiological understanding of hyperacusis. It defines hyperacusis as an unusual tolerance to ordinary environmental sounds (Vernon, 1987). The aim of this study was to gain a deeper understanding of how individuals with hyperacusis in Denmark experience and construe the characteristics related to hyperacusis. Secondly, this research aimed for an understanding of similarities and differences in themes being experienced by individuals with hyperacusis and hearing professionals counseling people with hyperacusis.

The qualitative method of focus group interviews was used as study design. One focus group included four female subjects with hyperacusis, and the other focus group included five hearing professionals counseling individuals with hyperacusis. Interviews were analyzed using the Grounded Theory method.

Based on the focus group interview analyses 15 final categories and a number of sub-categories were developed. The majority of themes were common for both groups. Common themes concerned e.g. reactions to sound, irritation and pain, helpful reactions from others and the responsibility for one´s own well-being. Additionally, hearing professionals focused on themes concerning high demands to oneself, and mindfulness as a coping strategy. Individuals with hyperacusis discussed the impact of hyperacusis on memory and energy levels, feelings of being alone and inappropriate reactions from others.

The service provided by health care institutions can vary substantially, and individuals with hyperacusis may benefit from sharing their experiences with others in a similar situation. Regarding a further development of psychological approaches, e.g. the Acceptance-and-Commitment Therapy (ACT), individual background factors and prominent themes in life of individuals with hyperacusis yield important information concerning e.g. the accept of loss, and focusing on own resources. They are furthermore of significance for the integration of both audiological, medical and psychological insights.

A range of different themes had been discussed and, accordingly, was relevant for the understanding of hyperacusis. Mainly, focus was on the emotional and bodily impact of hyperacusis. The two groups of respondents had many themes in common. Themes concerning both the immediate and long-term impact that hyperacusis may have on the personal life, had primarily been discussed by the respondents with hyperacusis. Themes concerning own hypotheses and broader reflections on different aspects of hyperacusis had primarily been discussed by professionals who guide individuals with hyperacusis.

O.071 • Somatic tinnitus: A prevalence estimate in a tertiary center population

Nieste E., Van de Heyning P., Michiels S., Braem M., Visscher C.M., Gilles A., Hesters M., De Hertogh W.

Medicine and Health Sciences Department, University of Antwerp, Belgium

Information about the prevalence of somatic tinnitus among patients with tinnitus is currently lacking. By this screening we aim to estimate the prevalence of somatic tinnitus (ST) in a sample of patients with subjective tinnitus and to describe their clinical characteristics.

A retrospective cohort was collected by screening all patients that presented themselves at the tinnitus clinic in the past six months. All patients were investigated by means of medical history, ENT examination, pure tone audiometry, tinnitus assessment, the presence of cervical spine dysfunctions, temporomandibular disorders (TMD), oral parafunctions and the levels of anxiety and depression. The diagnosis of ST was made when, after exclusion of other causes, the predominant feature was the temporal coincidence of onset or increase of either neck pain or TMD and tinnitus.

The cohort contained 150 adults with tinnitus, (age: 49 years (SD 14)). ST was diagnosed in 34%. The ST-group contained more women ($p<0.05$) and suffered more frequently from headaches ($p<0.05$). Sixty-seven percent of the ST-group had neck complaints, 41% had TMD, 49% reported bruxism and 47% clenching, which was significantly more ($p<0.05$) than in the non-ST-group (NST). There was no difference in tinnitus modulation by neck or jaw movements between both groups. No significant differences in tinnitus parameters were found between ST and NST patients. Neck complaints, headache, TMD and oral parafunctions were more frequently present in the ST-group.

Further research is needed to understand why patients with ST display more comorbidities. Since TMD is 4 times more prevalent in women, this may explain the higher proportion of women in the ST-group. ST is present in 34% of a subjective tinnitus population in a tertiary center setting. These patients show significantly more neck and temporomandibular complaints and oral parafunctions than patients with other types of tinnitus. Contradictory, there are no differences in the ability to modulate the tinnitus by neck or jaw movements.

Since one third of our population suffered from ST, we suggest to question every tinnitus patient about the presence of neck or temporomandibular complaints and oral parafunctions during anamnesis.

O.071 • Temporomandibular disorders and oral parafunctions in patients with somatic tinnitus: Preliminary results of a pilot study

Nieste E., Van de Heyning P., Michiels S., Braem M., Visscher C.M., Gilles A., Hesters M., De Hertogh W.

Medicine and Health Sciences Department, University of Antwerp, Belgium

To inventory typical clinical characteristics of patients with somatic tinnitus (ST) and co-existence of temporomandibular disorders (TMD) or oral parafunctions. This pilot study was performed in the start-up phase of a larger clinical trial.

Patients with moderate to severe tinnitus (Tinnitus Functional Index (TFI)-score: 25–90) and TMD or oral parafunctions, were recruited. All patients were investigated by means of medical history, ENT examination, audiometry, tinnitus assessment (tinnitus loudness using visual analogue scale (VAS), hyperacusis using Hyperacusis Questionnaire (HQ) and tinnitus annoyance using TFI and Tinnitus Questionnaire (TQ)), pain pressure thresholds (PPT) of masticatory muscles and the presence of TMD or oral parafunctions.

9 adults with ST, averagely 41±16 years old, were screened. All patients suffered from non-pulsatile tinnitus, with a mean TQ-score of 37±9, TFI-score of 45±8, HQ-score of 18±7 and VAS of 40±24 mm. 8 patients were diagnosed with TMD, mainly myogenic. Clenching was reported in all patients, bruxism in 89%. Neck complaints were found in 78% and 67% suffered from headaches, while this was only 23% and 36%, respectively, in patients with other types of tinnitus. Tinnitus modulation by jaw movement was present in 78%. PPT's tend to be lower in patients with ST in comparison with healthy subjects.

In these preliminary results we could confirm the frequent co-existence of TMD, neck symptoms and oral parafunctions in a group of patients with tinnitus. Due to the small sample size, tinnitus modulation by jaw movements should not be overestimated. In patients with tinnitus and co-existence of TMD, more comorbidities, such as neck pain and headaches, are present. Further analysis of the PPT values is necessary. Results from a larger group will be presented at the conference.

In a population with tinnitus and co-existence of TMD, neck complaints, clenching, bruxism and headaches appear to be more common than in other types of tinnitus. Modulation of tinnitus by jaw or neck movements is present in more than half of the patients. Masticatory muscles seem to be more sensitive in patients with somatic tinnitus with co-existence of TMD when compared with healthy subjects.

Further research is needed to understand the underlying mechanisms.

O.073 • Temporal bone histopathology and tinnitus

Oliveira C.A.

Otolaryngology Department, Brasília University Medical School, Brazil

To find out a pathologic correlate for tinnitus in the temporal bone.

83 temporal bones from the Massachusetts Eye and Ear Infirmary collection from patients with significant tinnitus complaint during life were reviewed. 83 temporal bones with the same histopathologic diagnosis but without tinnitus during life were also reviewed and the histopathologic findings were compared with those of the tinnitus patients.

Tinnitus patients had more bacterial or viral infections (9.4), sudden deafness (3.0), drug ototoxicity (8.2), acoustic trauma (6.3), sensorineural hearing loss (3.0), endolymphactic hydrops (18.5), otosclerosis (11.6) and normal temporal bone histology (11.4).

Sensorineural hearing loss is associated with tinnitus and therefore it is not surprising that diseases causing sensorineural hearing loss are also associated with tinnitus. However, normal histopathology, endolymphatic hydrops and otosclerosis seem to have a close association with tinnitus.

Tinnitus is associated with sensorineural hearing loss from a histopathologic stand point. Diseases that affect the endolymph (Menière`s disease, otosclerosis) are commonly associated with the symptom and normal histopathology in the temporal bones may be compatible with changes in the composition of endolymph that progress to endolymphatic hydrops.

O.074 • Diagnostic problems and tinnitus treatment in Susac syndrome

Olszewska-Staron A.[1], Oldak M.[2], Dziendziel B.[3], Skarzynski H.[1,3]

[1] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Genetics Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

Aim: Susac syndrome is a rare disease known also as retinocochleocerebral vasculopathy. It is associated with occlusions of pre-capillary arterioles of the brain, retina and cochlea. For the first time this syndrome was described in 1977 by professor John Susac. Its causes are still not fully explained, however, autoimmune background is the most presumable. The condition is often under-recognized but such symptoms as encephalopathy, blurred vision due to branch retinal artery occlusions, and sensorineural hearing loss may lead to correct diagnosis. Brain magnetic resonance imaging, retinal fluorescein angiography, cerebrospinal fluid analysis, visual field test and audiometry findings can be used to recognize Susac syndrome. The extent and multifariousness of symptoms are the reason for active involvement of many specialist in diagnostic

and treatment procedures. Susac syndrome also needs to be considered in the differential diagnosis of a broad variety of diseases for example multiple sclerosis, SLE, encephalitis, Meniere's or Creutzfeldt-Jakob disease. The aim of the study was to introduce range of difficulties in diagnosing Susac syndrome and also to present tinnitus as one of the problems of patients with Susac syndrome.

Material and methods: Report of two cases of patients with Susac syndrome consulted and treated in World Hearing Center.

Results: An interdisciplinary cooperation enabled Susac syndrome diagnosis. Treatment of sudden hearing loss improved hearing status. Patients are monitored by audiology and phoniatrics clinic due to tinnitus and difficulties in speech recognition in noise.

Conclusions: To provide early and effective treatment of Susac syndrome there is a need of close cooperation among many specialist such as otorhinolaryngologist, ophthalmologist, audiologist, neurologist and radiologist. Furthermore to prevent long-term effects of sudden hearing loss or retinal disorders the treatment should be implemented as soon as possible.

O.075 • Subcortical plasticity in tinnitus subjects following exposure to short and intense notched music training

Omidvar S., Jafari Z., Mahmoudian S., Khabazkhoob M., Ahadi M.

Shiraz University of Medical Sciences (SUMS), Iran

Tailor-made notched music training (TMNMT) is a novel treatment approach that aims to reverse maladaptive plasticity by inducing lateral inhibition (LI) at the level of the auditory cortex. By considering the possible role of the inferior colliculus (IC) in tinnitus due to the distribution of LI and receiving input from top-down pathways, it has been hypothesized that the short-term application of TMNMT can also reverse maladaptive subcortical plasticity resulting from tinnitus.

Auditory brainstem responses to complex stimuli (cABR) were recorded in nine normal-hearing individuals with tinnitus (4 males). The TMNMT was accomplished compressively during 5 contiguous days. The effects of short-term intensive TMNMT on the cABR component, tinnitus loudness, and tinnitus handicap inventory (THI) scores were investigated.

The latency of cABRs in wave V ($p=0.041$) was shorter after music training than before, however, there was no significant difference in other components of cABR ($p\geq0.086$). There was a significant difference in visual analog scale ($p=0.027$) and loudness matching ($p=0.011$) measurements before versus after TMNMT. No significant difference was observed in THI scores ($p=0.307$) before and following the musical intervention.

The possible explanation for cABR changes following TMNMT is the reverse hierarchy theory (RHT). The RHT argues that top-down processes can influence neural encoding at the level of the brainstem and therefore sensory processing. Following frequent exposures, the higher levels which generally receive input from lower levels will also affect the encoding of stimuli by lower levels.

This finding indicated prompt neural reorganization of the brainstem in tinnitus patients with exposure to TMNMT. It seems that TMNMT may partially reverse maladaptive plasticity at the subcortical level; however, the recovery was partial.

O.076 • Auditory Brainstem Responses with Simple and Complex Stimuli in Tinnitus

Omidvar S., Jafari Z., Mahmoudian S., Khabazkhoob M., Ahadi M.

Audiology Department, Shiraz University of Medical Sciences (SUMS), Iran

Tinnitus can cause functional or even structural changes at cortical regions. Given the possible role of the inferior colliculus (IC) in tinnitus due to the distribution of lateral inhibition and receiving input from top-down pathways, we investigated whether tinnitus can also affect subcortical regions, mainly the IC.

Auditory brainstem responses to click (cABR) and speech stimuli (sABR) were recorded in 18 individuals with tinnitus and 22 controls without tinnitus matched based on their ages and genders. All subjects had normal hearing sensitivity.

Latencies of cABR in waves V and Vn, as well as interpeak latencies (IPLs) of III–V and I–V were significantly longer in individuals with tinnitus compared to the controls. Individuals with tinnitus presented significantly longer latencies of all sABR waves than the control group. The tinnitus patients also presented significant decrease in the amplitude and slope of the V-A complex and declined encoding of the first and higher formants.

A combination of bottom-up and top-down processes were involved in the impaired timing in the individuals with tinnitus. The deficits in the auditory processing at the subcortical level (presumably the mi dBrain) could be caused by abnormal bottom-up inputs (i.e. those from more peripheral auditory structures) or abnormal top-down inputs (i.e. abnormal modulations from more central structures through efferent pathways.

As a main possible generator of late waves of cABR and all waves of sABR is the IC, these findings indicate that the subcortical regions, particularly the IC, may undergo maladaptive plasticity following tinnitus. The consistency between the results of cABR and sABR indicated that tinnitus might affect the processing of simple and complex stimuli in the same manner.

O.077 • The Relationship between Ultra high frequency Thresholds and Transient Evoked Otoacoustic Emissions in Adults with Tinnitus

Omidvar S., Jafari Z., Mahmoudian S., Khabazkhoob M., Ahadi M., Yazdani N.

Shiraz University of Medical Sciences (SUMS), Iran

The possible role of cochlear function in tinnitus generation is still a matter of debate. To assess the role of outer hair cell dysfunction in tinnitus and its possible relationship with ultra-high frequency (UHF) hearing sensitivity, transient evoked otoacoustic emissions (TEOAE) and UHF hearing thresholds were investigated in normal hearing individuals with and without tinnitus.

Eighteen individuals with tinnitus and 22 without tinnitus participated in this study. TEOAE was recorded with click stimulus at 80 dBpeSPL. UHF pure tone audiometry was performed at 10, 12.5, 16, and 18 k Hz.

The individuals with tinnitus had significantly poorer UHF hearing sensitivity compared to the control group at 12.5 and 18 k Hz ($p \leq 0.048$). TEOAE was significantly abnormal in 72.2% of the tinnitus, and 18.2% of the control groups ($p=0.001$). There was a stronger correlation between increasing UHFs hearing threshold and decreasing SNRs of TEOAEs in the tinnitus group compared to the controls.

The results support the deafferentation hypothesis, which suggests that the cochlear damage triggers tinnitus incidence, even in patients with normal hearing sensitivity on conventional audiometry, and considers a deafferentation as the underlying cause that elicits central reorganization and eventually leads to tinnitus. The deafferentation hypothesis provides a rationale for performing UHF threshold and OAE assessments in subjectively normal hearing patients with tinnitus.

Our study revealed poorer UHF hearing thresholds and more TEOAE abnormalities in normal hearing individuals with tinnitus compared to the controls. Perhaps the alterations in the basal cochlea, following a decrease in UHF hearing sensitivity, affect OAEs that are originated from more apical cochlear parts in tinnitus ears more than non-tinnitus ears.

O.078 • Cervicogenic somatosensory tinnitus: An indication for manual therapy? Part 1: Theoretical concept

Oostendorp R.A.B., Bakker I., Elvers H., Mikolajewski E., Michiels S., De Hertogh W., Samwel H.

[1] *Department of Manual Therapy Vrije Universiteit Brussels, Belgium*
[2] *Medical Centre Radboud University Nijmegen, the Netherlands*

The conceptual phase of this study aims to uncover underlying mechanisms linking the auditory and somatosensory systems in relation to subjective tinnitus through review of the literature (part 1).

Part 1: Theoretical concept Tinnitus can be evoked or modulated by input from the somatosensory and somatomotor systems. This means that the loudness or intensity of tinnitus can be changed by sensory or motor stimuli such as muscle contractions, mechanical pressure on myofascial trigger points, transcutaneous electrical stimulation or joint movements. The neural connections and integration of the auditory and somatosensory systems of the upper cervical region and head have been confirmed by many studies. These connections can give rise to a form of tinnitus known as somatosensory tinnitus. Today there are only a handful of publications that have focused on (cervicogenic) somatosensory tinnitus and manual therapy. Broadening the current understanding of somatosensory tinnitus would represent a first step towards providing therapeutic approaches relevant to manual therapists. Treatment modalities involving the somatosensory systems, and particularly manual therapy, should now be reassessed in the subgroup of patients with cervicogenic somatosensory tinnitus.

The conceptual phase of this study aims to uncover underlying mechanisms linking the auditory and somatosensory systems in relation to subjective tinnitus through:
i. review of the literature (part 1) and
ii. through design of a practice test that will explore characteristics of the study population and identify relevant components and outcomes of manual therapy in patients with cervicogenic somatosensory tinnitus (part 2).

This manuscript focusses the theoretical concept of (cervicogenic) somatosensory tinnitus, either with or without secondary central tinnitus or tinnitus sensitization.

O.079 • Cervicogenic somatosensory tinnitus: An indication for manual therapy plus education? Part 2: A pilot study

Oostendorp R.A.B., Bakker I., Elvers H., Mikolajewska E., Michiels S., De Hertogh W., Samwel H.

[1] *Department of Manual Therapy Vrije Universiteit Brussel, Belgium*
[2] *Medical Centre Radboud University Nijmegen, the Netherlands*

The aim of this study was to evaluate the efficacy of Manual Therapy Utrecht (MTU) plus education on patients with cervicogenic somatosensory tinnitus (CeT).

Five hundred and six patients were referred or referred themselves. A subgroup of patients was identified with CeT, and within this a subgroup with tinnitus sensitization (TS). Two CeT groups were created based on the presence or absence of TS. Both groups underwent manual therapy combined with tinnitus education. Tinnitus intensity (VAS-tin 1–100 mm) was the primary outcome measure. Number of treatments and adverse effects were the secondary outcome measures.

CeT (N=122, 24.1%) were included (average age 53.3 yrs [±9.8], female 38.5%, tinnitus duration 7.3 yrs [±8.9]. Patients were divided: n=55 (45.1%) +TS (CeT+TS), n=67 (54.9%) – TS (CeT-TS). Pretest /posttest differ: CeT-TS: VAS-tin 5.9[p=0.01]; CeT+TS: VAS-tin 18.2[p=0.00]),

between gr: just CeT+TS: VAS-tin 12.3 [p=0.01]). Pretest /posttest: CeT+TS: Clin Sign (VAS-tin 18.2 [MCIC=≥10 mm VAS-tin]), between gr (just CeT+TS: VAS-tin 12.3). The average treatments: 9.6 (±2.6) in CeT-TS, 10.3 (±2.5) in CeT+TS, not-significant. No other adverse effects.

Despite its limitations, this study provides valuable information on both the characteristics of patients with CeT and TS in a Dutch primary care manual therapy practice and on the potential effectiveness of MTU combined with tinnitus education for the subgroup of CeT+TS patients. The results of the pilot study provided valuable information on both the characteristics of patients with CeT and TS and on the potential effectiveness of MTU combined with tinnitus education for the subgroup of patients with CeT+TS.

O.080 • Neuro-modulatory sound treatment of tonal tinnitus based on "inhibition-induced" cortical plasticity

Pantev C.

Institute for Biomagnetism and Biosignalanalysis, University of Munster, Germany

Tinnitus is a result of hyper-activity/hyper-synchrony of auditory neurons coding the tinnitus frequency, which has developed due to lack of inhibition. A neuro-modulatory sound treatment by removal of the tinnitus frequency region from a complex auditory stimulus will cause the brain to reorganize around the tonotopic regions coding the tinnitus frequency through inhibition-induced cortical plasticity. Based on this approach, we introduced a novel treatment for tonal tinnitus – "tailor-made notched music" (TMNM) and tested it in series of randomized, placebo controlled studies.

A randomized controlled trial in parallel group design was performed in a double-blinded manner. We included 100 participants with chronic, tonal tinnitus who listened to tailor-made notched music for two hours a day for three consecutive months. Our primary outcome measures were the Tinnitus Handicap Questionnaire and Visual Analog Scales measuring perceived tinnitus loudness, awareness, distress and handicap. Participants rated their tinnitus before and after the training as well as one month after cessation of the training.

After the training cessation we found in the target group as compared to the placebo group a tendency of reduction of the tinnitus loudness, which at the follow-up one month after the training was significantly reduced for the treatment group as compared to the placebo group. Post hoc analysis showed a significant reduction of the overall Visual Analog Scale mean score in the treatment group even at the post measurement.

The results of the clinical trial on 100 patients with tonal tinnitus demonstrate the positive effects of the three months TMNM training, especially with respect to the tinnitus loudness. This central tinnitus parameter was significantly reduced and the effect was long lasting. Also one month after TMNM training cessation it was still present and significant. The current work is one more step towards a final evaluation of TMNMT.

O.081 • Myoclinic Tinnitus: Diagnosis and Management Based on 12-year Experience of Tinnitus Clinic

Park S.N.[1], Choung Y.H.[2], Park J.M.[1], Han J.J.[1], Yeo S.W.[1]

[1] *Otorhinolaryngology-HNS Department, The Catholic University, Seoul, South Korea*
[2] *Ajou University, Seoul, South Korea*

Myoclinic tinnitus consists of tinnitus due to middle ear myoclonus, middle ear myoclonic tinnitus (MEMT) and palatal myoclonic tinnitus (PMT). It is rare but can be curable which needs to be known well to many otologists.

We reviewed our own clinical experiences of MEMT and PMT in large case series. Clinical characteristics, diagnostic and therapeutic modalities of myoclonic tinnitus will be introduced based on our data. Therapeutic response to surgical intervention and botox injection will be discussed.

One hundred and fifty patients diagnosed as MEMT and 48 patients diagnosed as PM tinnitus in a tinnitus clinic of tertiary referral center from Jan 2003 to Dec 2015 were included in this study. Their medical records were retrospectively reviewed to evaluate the clinical and audiological characteristics and the therapeutic responses to conservative management, botox injection and surgery.

Patients with MEMT and PMT were relatively young and had a tendency of female predominance. In children, MEMT associated with forceful eyelid closure were more frequently observed than in adults. Over 50% of PMT accompanied with MEMT. Impedance audiogram and otoendoscopic examinations of the tympanic membrane were helpful tools for diagnosing MEMT. Voluntary or involuntary myoclonic motion of the soft palate was observed in all of the PMT patients.

With medical therapy and counseling, more than 70% of patients exhibited complete or partial remission of their tinnitus. Patients with intractable MEMT who underwent sectioning of the middle ear tendons (n=27) had very good surgical outcomes with no remarkable complications. Botox injection of the soft palate in patients with intractable PMT(n=9) showed complete remission of symptoms with acceptable short term complications of hypernasal voice and velopharyngeal insufficiency.

Deep understanding of the clinical characteristics and therapeutic responses of myoclonic tinnitus will help to diagnose and to treat the patients with these rare types of tinnitus. Surgical resection of middle ear tendons and botox injection seem to be viable and safe treatment option for intractable MEMT and PMT.

O.082 • Prevalence of tinnitus in school-age children

Piotrowska A.[1,2], Raj-Koziak D.[1,3], Tarczynski K.[1,2], Skarzynski H.[1,4]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Department of Epidemiology and Screening, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

The aim of this study was to analyse the frequency of tinnitus reported by 7 and 12 years old children from Warsaw primary schools.

Observational cross-sectional study. 15 199 first (6–7-year-old) and six grade (12-year-old) students from 173 primary schools in Warsaw in school year 2012/2013 were included into the study. All children from the study group had performed pure tone audiometry. Tinnitus appearance was assessed with the use of audiological questionnaire administered to children.

The prevalence of tinnitus in the study group was found to be 6.0%. The frequency of tinnitus was statistically higher in children with hearing loss comparing to those with normal hearing.

Tinnitus in the study group was not a very common symptom comparing to other studies. The high prevalence of tinnitus reported by some authors may be the result of different tinnitus criteria and/or different way of administration of the questionnaire.

Results obtained in this study with a large sample size suggest that hearing loss and young age can be considered potential risk factors for tinnitus in school aged children. A consensus on how to define tinnitus is needed in order to enable a direct comparison between data from different studies.

O.083 • Revision surgery after unsuccessful surgical treatment of hearing loss and tinnitus in otosclerosis

Plichta L.[1], Skarzynski P.H.[2,3], Krol B.[1], Skarzynski H.[1,2]

[1] *Department of Oto-Rhino-Laryngology, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Institute of Sensory Organs, Kajetany, Poland*
[4] *Department of Heart Failure and Cardiac Rehabilitation, Second Faculty, Medical University of Warsaw*

Surgical treatment for otosclerosis after previous interventions is always a challenge for otosurgeon. Intraoperative findings is such cases are usually difficult to predict, including the extent of mobility of the ossicular chain, which may include immobilized stapes or all the ossicles. The aim of this report is to present the course of treatment in a patient after two previous procedures of stapes mobilization in one ear.

First procedure was performed in the ear which had not been previously operated, as it had lower bone conduction threshold and patient reported greater tinnitus in this ear. A typical stapedotomy was performed. Intraoperatively noticeable was a very narrow external auditory canal. Postoperatively, complete closure of the air-bone gap was achieved with bone conduction curve raised by 5–10 dB as was as resolution of tinnitus in this ear. The next step was the procedure in the other ear after previous interventions. Intraoperatively, we observed a solid connective tissue mass in the oval window niche. Most probably it was a fragment of a homogenous tissue underlying a fragment of stapes plate. After its removal and cutting of the remaining adhesions we performed a typical stapedotomy. In the postoperative assessment the hearing threshold in this ear was slightly lower than in the other ear, but the air-bone gap has been closed. The patient stopped experiencing tinnitus also in this ear.

Surgical treatment of otosclerosis after previous operations is always a challenging procedure, but it gives the opportunity to improve patient's hearing and resolve tinnitus.

O.084 • Shared Decision Making in the tinnitus clinic – what are patient preferences for treatment?

Pryce H., Culhane B-A., Swift S., Claesen B., Shaw R., Hall A.

Audiology Department, Aston University, Birmingham, UK

Our aim was to identify patient preferences in coping with tinnitus, in order to develop an Option Grid decision aid for use in a clinical setting. Option Grids are simple documents that facilitate shared decision making by explicitly weighing up the pros and cons of different interventions. This enables patients to match their individual values and preferences to options that suit them best.

41 interviews were conducted to identify patient preferences for outcomes and treatment. All participants who attended a tinnitus clinic were invited to attend. Semi-structured interviews were conducted with participants who had worked with medical consultants, audiologists and hearing therapists to identify their preferences. Transcripts were coded according to grounded theory methods and a framework of recurring codes was applied to describe how preferences occur and what influences them. An expert in qualitative methods reviewed the data in order to achieve triangulation.

All discussions of preferences displayed a tension between the medical model and coping, with patients feeling unsupported in coping with tinnitus during the process of medical investigations. The preferences for treatment were for curated information and support. Participants described adopting cognitive and behavioural approaches to manage the tinnitus and using sound to provide distraction. Therapeutic support (including group interaction with peers) was valued. The preference for choice in intervention was clearly expressed. The pathway and range of care options

available across the NHS in England can result in a number of different pathways for patients entering the service.

This research has shown that regardless of the route taken, the needs of the patients remain the same, highlighting the need for both medical and non-medical clinicians to have conversations with patients using a shared decision making approach. An Option Grid would facilitate these conversations. Preferences for treatment remained the same across all sites, regardless of the patient pathway and clinician seen.

The findings of this study supports the need for a decision aid to ensure consistency of patient centred care across NHS services in England.

O.085 • Psychometric Evaluation of the Polish version of Tinnitus and Hearing Survey

Raj-Koziak D.[1,2], Rajchel J.[2], Pilka A.[2], Skarzynski H.[2,3], Skarzynski P.H.[2,4], Karpiesz L.[1,2], Niedzialek I.[1,2]

[1] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*

Introduction: Tinnitus and Hearing Survey was created by Henry at al. in 2015 as a tool allowing quickly differentiating patients whose problems are due to tinnitus from those whose communication problems are due to hearing loss.

Aim: The original version of THS questionnaire underwent adaptation into the Polish language.

Material: Thirty women (41.7%) and forty two men (58.3%) were included in the study. The participants have completed the final Polish version of THS (THS-POL) questionnaire two times over a period of three days.

Methods: Psychometric analyses of test – retest reliability, structural validity and internal consistency reliability were performed. Convergent validity was evaluated between THS-POL (Subscale A nab B) and Tinnitus Handicap Inventory (THI-POL).

Results: Reliability of the Polish THS version in terms of test-retest correlations (Subscale A r=0.89, Subscale B r=0.9) was extremely strong. The reliability of THS through measurement of Cronbach's alpha coefficient was shown in Time 1 (alpha=0.86 and 0.95 for A and B subscales respectively) and Time 2 (alpha=0.91 and 0.94) for A and B subscales respectively. Results of the CFA indicated the following values: $\chi 2(19)=16.38$; $p>0.05$; CFI=1.00; NFI=0.7; RMSEA=0.00. Strong strength of correlation between Subscale A of THS and THI and moderate correlations between Subscale B and THI were observed.

Conclusions: The Polish version of the THS questionnaire (THS-POL) is a valid and reliable screening tool to assist in assessing how much of patients' complaint about tinnitus is due to hearing problems and how much is specifically due to tinnitus, which determines further decisions about intervention tailored to patients' needs.

O.086 • Visual Analog Scales as a Tool for Tinnitus Measurement: Psychometric evaluation

Raj-Koziak D.[1,2], Skarzynski H.[2,3], Skarzynski P.H.[2,3], Gos E.[1,2], Rajchel J.[1], Karpiesz L.[1,2], Niedzialek I.[1,2]

[1] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*

Introduction: The most popular worldwide questionnaires for measurement of tinnitus severity are THI (Tinnitus Handicap Inventory) and TFI (Tinnitus Functional Index) questionnaires. Visual Analog Scales (VAS) could be used as another tool useful in obtaining information relating to tinnitus loudness and annoyance, tinnitus related distress and possibility of coping with this problem.

Aim: Psychometric evaluation and assessment of cut-off points of Visual Analog Scales (VAS) for measuring a subjectively perceived tinnitus loudness and annoyance, tinnitus related distress and possibility of coping with it.

Material: Seventy adult patients (30 women and 40 men) who underwent diagnostic evaluation for tinnitus.

Methods: Patients filled in the THI, THS and TFI questionnaires. Then after appropriate instruction patients completed the Visual Analog Scales (VAS) marking their annoyance with tinnitus, its loudness, tinnitus-related distress and possibility of coping with this problem respectively on the VAS annoyance (VAS-A), VAS loudness (VAS-L), VAS tinnitus related distress (VAS-D) and VAS coping (VAS-C) scales. The test-retest reliability of VAS scales was assessed and convergent validity between VAS scales and the THI, TFI and THS subscale A was evaluated. The results of TFI questionnaire were used as a criterion to designate the cutoff points of VAS scales.

Results: The test-retest reliability of VAS-L, VAS-A, VAS-C and VAS-D scales showed between strong and extremely strong strength of coefficient correlation (r=0.67 to r=0.91). Strong and extremely strong correlations between four VAS scales and results of 25 items of THI were found (r=0.64 to r=0.84). Convergent validity between TFI and VAS scales was evaluated; it showed from moderate to strong correlations except for VAS C where correlations were moderate and weak. Correlations between VAS scales and subscale A THS questionnaire were also strong except for VAS-C. Designated cutoff scores for VAS-L, VAS-A and VAS-D were at 62, 62 and 71 respectively.

Summary: VAS L, VAS A and VAS D scales are another option for obtaining reliable information about tinnitus loudness, annoyance and tinnitus related distress. Established cutoff scores can serve as a criterion of tinnitus

severity qualifying a patient to a tinnitus specific intervention. VAS scales could be useful in diagnosing patients unwilling to fill in time consuming questionnaires.

O.087 • Nucleus® Cochlear Implants as Treatment Option for Patients with Unilateral Hearing Loss and accompanying Severe Tinnitus and Hyperacusis

Ramos Macías Á., Falcon González J.C., Manrique M., Morera C., García- Ibáñez L., Cenjor C., von Wallenberg E., Coudert-Koall C., Killian M.

Otorrinolaringología, CHU Insular Materno-Infantil de Canarias, Las Palmas de Gran Canaria, Spain

Tinnitus is an incapacitating condition commonly affecting cochlear implant (CI) candidates. The aim of this clinical study is to assess the long-term effects of CI treatment in patients with severe to profound sensorineural Unilateral Hearing Loss (UHL) and incapacitating tinnitus.

A prospective Cochlear™ company sponsored multi-center study in 5 Spanish centers. Sixteen patients with UHL and incapacitating tinnitus (THI>58%) received a Nucleus® cochlear implant in their deaf ear. The study design includes repeated within-subject measures on tinnitus (THI, VAS on tinnitus loudness), quality of life (HUI3), hearing (speech perception, SSQ), hyperacusis (THS) up to 12 months after initial CI fitting.

The group average showed: pre-op THI total score of 75% decreasing to 40% at 6 months (M) and 35% at 12 M post-implantation. Pre-op VAS on tinnitus loudness score of 8.2 decreasing to 2.4 at 6 M and 2.2 at 12 M with implant ON and 6.7 at 6 M and 6.5 at 12 M with implant OFF. Pre-op HUI3 total utility score of 0.45 increasing to 0.57 at 6 M and 0.63 at 12 M. re-op SSQ total score of 4.2 increasing to 5.1 at 6 M and 6.3 at 12 M. Pre-operative THS total score of 57% decreasing to 37% at 12 M. No unanticipated adverse events were reported during the study period.

Most patients had a sudden UHL and received a CI within 2 years after their hearing loss. Analysis of the group data showed a significant subjective benefit from CI treatment. Patients indicated they were using their CI device on a daily basis for tinnitus suppression, hearing or both.

Cochlear implantation is a safe and effective treatment option for patients with UHL and accompanying severe tinnitus. Treatment results in a significant improvement in quality of life, a significant reduction in tinnitus and hyperacusis handicap and a significant improvement in spatial hearing.

O.088 • Change of the tinnitus pitch with the tinnitus sound therapy

Sakamoto H., Kato S., Kosugi Y., Haruta Y., Sakashita T., Iguchi H.

Otolaryngology Head and Neck Surgery Department, Osaka City University Graduate School of Medicine, Japan

Before and after sound therapy, how does the pitch of the tinnitus change? Determine the change of the tinnitus pitch and THI, VAS, SDS (depression degree), relations with STAI (anxiety degree).

Give sound therapy for the chronic tinnitus in our department; 206 patients with chronic tinnitus passed more than 12 months after the start of therapy (127 men, women 79). The age distribution was 15–78 years old, an average of 60.9 years old. We evaluated evaluation, THI of the pitch of the tinnitus by the pitch match test, tinnitus VAS, SDS (depression degree), STAI (anxiety degree) by sound therapy using the following instruments enforcement initiation time and 12 months later. We evaluated the effect of treatment of the sound therapy with five phases of subjective degree of improvement.

The tinnitus pitch before and after the sound therapy – 84 patients in decrease group (more than a decrease 1.5 octave: 38, lower than decrease octave: 46), 78 in immutability group, in increase group 44. The tinnitus pitch and the subjective improvement were 59.1% for 90.5% of decrease group, immutability case 75.6%, increase case. Concerning THI, tinnitus VAS, SDS (depression degree), STAI (anxiety degree) and the tinnitus pitch, all showed the percent improvement that was higher than increase group in pitch decrease group. About 206 chronic ringing in the ears cases, we can put it one year after sound therapy.

We examined the change of the tinnitus pitch. As for tinnitus pitch one year later, an improvement example was found a lot in the decrease group that was 44 increase (21.4%), decrease 38 (18.4%), mild decrease 46 (22.3%), immutability 78 (37.9%), increase 44 (21.4%). In the decrease group, THI degree of improvement, the SDS score one year after the SDS degree of improvement shop were better than a constant group, and VAS, THI, SDS, THI one year after the degree of improvement shop of STAI (state anxiety), SDS score were better than increase group.

O.090 • Suppression of Tinnitus after Cochlear Implantation

Savvas E., Heslinga K., Knief A., Rudack C.

Otorhinolaryngology Department, CI Center Muensterland, University of Muenster, Germany

The purpose of this prospective study was to analyze the possibility of tinnitus manipulation on cochlear implant patients with preexisting tinnitus. External processor adjustments were performed based on several acoustic parameters of the tinnitus and the progress was evaluated.

A total of 121 adult patients arbitrarily selected after CI implantation (all implants were manufactured by Cochlear, Ltd.) were sent a tinnitus questionnaire. 58 patients

(46%) replied to the questionnaire. 25 patients with tinnitus agreed to take part in the study. In patients with monotone tinnitus, the frequency and pitch were measured. Thereafter the external processor was adjusted to either reduce or turn off the involved frequency. A follow up visit was conducted after four to six weeks with a new tinnitus measurement and questionnaire assessment.

Approximately 50% of the patients had a persisting preoperative tinnitus after CI implantation. The CI implantation had a positive effect on 73.5% of these patients with persisting tinnitus. In 11 patients with monotone tinnitus processor adjustments were performed. The majority of patients showed an improvement in tinnitus discomfort after processor adjustment.

It can be shown that the CI implantation positively reduces tinnitus severity in the majority of patients. The individual processor adjustment in cases of monotone tinnitus can further reduce tinnitus complaints in refractory patients. Further investigation with an increasing cohort is necessary and ongoing to confirm these results.

O.091 • Combined amplification and sound generation for tinnitus: Survey of UK clinical practice

Sereda M.[1,2], Hoare D.[1,2], Brady J.[3]

[1] *NIHR Nottingham Biomedical Research Centre, Nottingham, UK*
[2] *Otology and Hearing group, Division of Clinical Neuroscience, School of Medicine, University of Nottingham, UK*
[3] *Nottingham Audiology Services, Nottingham, UK*

Combination devices provide both amplification and sound generation, and new generation devices offer the same amplification features as their 'standard ' hearing aid counterparts. A recent British Tinnitus Association service evaluation showed that 74% of UK audiology clinics can offer combination hearing aids. There is lack of any clear recommendations about candidature and prescription options for combination hearing aids. The purpose of this survey was to determine current clinical practice and the level of knowledge about combination hearing aids for tinnitus amongst clinicians in the UK.

An online survey consisted of 20 closed and 10 open questions. The survey gathered the opinions of UK hearing professionals regarding the criteria for candidacy and fitting practices for combined amplification and sound generation for tinnitus. Ninety hearing professionals responded. They have either fitted (77%), considered fitting (18%), or would never fit (5%) combination aids for tinnitus patients.

Main barrier for those who have not fitted combination aids was lack of expertise. Clinicians would consider fitting combination aids for those patients for whom amplification alone was not sufficient for managing tinnitus (81%) or if patients requested to try them (64%). There were differences in opinions regarding:
1. the level of noise to use;
2. time to wait between fitting amplification and adding noise;
3. use during the day.

While most of respondents consider that combination aids can be effective management option for some patients with tinnitus they would welcome more research looking at effectiveness. They would also be willing to follow guidelines for candidacy and fitting if those were available.

The survey is a first step towards development of recommended procedure for fitting of combination hearing aids for tinnitus that will aid clinical practice.

This work was initiated by the British Society of Audiology Tinnitus and Hyperacusis Special Interest Group and is currently ongoing.

O.092 • Mobile applications for management of tinnitus

Sereda M.[1,2], Stockdale D.[3], Newton K.[4], Smith S.[1,2]

[1] *NIHR Nottingham Biomedical Research Centre, Nottingham, UK*
[2] *Otology and Hearing group, Division of Clinical Neuroscience, School of Medicine, University of Nottingham, UK*
[3] *British Tinnitus Association, Sheffield, UK*
[4] *Division of Audiology, Faculty of Health and Life Sciences, De Montfort University, Leicester, UK*

Sound therapy is a core component of many tinnitus management programmes. In recent years there has been a substantial increase in the use of mobile technology. This has provided an additional medium via which sound therapy can be delivered. Despite the increasing popularity of mobile applications (apps) in general it is unclear what proportion of people use apps for tinnitus management and which apps are the most popular. The purpose of this study was to identify apps that people use for tinnitus management, identify reasons for using and not using apps and evaluate their content and quality.

An online survey consisting of 33 questions gathered people's views about mobile apps used for tinnitus management, including reasons for use/non-use, factors important when choosing an app, which are the preferred apps, the perceived help for tinnitus and the positive/negative aspects of the apps. We have also looked at the content of those apps identified by people who completed the survey to identify the options and management techniques included in the apps. The Quality of the apps was assessed using the Mobile Application Rating Scale (MARS; Stoyanow et al., 2015).

Of 643 people who responded to the survey, 25% used an app and 75% have never used an app to manage their tinnitus. The main reason for not using apps was lack of awareness (79%). Important factors when choosing an app were ease of use (87%), trustworthy source (44%), reviews (39%) and cost (39%). Respondents identified 53 different apps, of which 13 were listed by at least two people. Content of the apps included: 1) various sound options; 2) relaxation/meditation; 3) information and advice; 4) psychological approaches. MARS quality scores varied between 1.6 and 4.2 (out of 5).

There is a wide variety of apps that people use to manage their tinnitus. Some of those apps were developed specifically for tinnitus management while the majority were developed with other problems in mind (e.g. sleep difficulties, relaxation difficulties, stress). People who tried apps tended to find aspects that helped with their tinnitus or accompanying problems. However, lack of awareness was the main barrier to use of apps by people with tinnitus.

Further research should consider the place of apps in the tinnitus management (standalone self-management intervention vs part of the management by a hearing professional). As the content of the apps varies in respect to sound options, information and management strategies it seems that the choice of the best management app should be guided by individual patient needs and preferences, as well as quality of available apps.

O.093 • Optimization of Transcranial Direct Current Stimulation for Tinnitus Management

Shekhawat G.S., Vanneste S.

Section of Health Systems/Audiology, University of Auckland, New Zealand

Neuromodulation is defined as the process of augmenting the plasticity of the brain by using invasive or non-invasive methods. Neuromodulation has been used for transient tinnitus suppression for a decade. The aim of the present study was to optimize the parameters of transcranial direct current stimulation (tDCS) of dorsolateral prefrontal cortex (DLPFC) for tinnitus suppression. This study was the first attempt at investigating the number of sessions needed for optimum tinnitus suppression.

One hundred one participants (average age 59.87 years) with average tinnitus duration of 5.9 years underwent tDCS of DLPFC. The following factors were optimized in the dose-response design: current intensity (1.5 mA or 2 mA), stimulation duration (20 min or 30 min) and number of stimulation session (2 or 4 or 6 or 8 or 10) with 3 to 4 days washout period between each session. Participant underwent minimum of 2 sessions in 1 week or maximum of 10 sessions in 5 weeks' time. Tinnitus loudness was measured in pre-post design using 10 point tinnitus loudness numeric rating scale.

There was a significant reduction in the tinnitus loudness after the tDCS of DLPFC compared to before the treatment. There was no significant difference between the intensity (1.5 mA or 2 mA) and duration (20 min and 30 min) of stimulation. As the number of session increased there was a higher reduction in the tinnitus loudness, however it reached a plateau after 6 sessions. There was a nonlinear cumulative change in the cerebral function as a result of multi session tDCS.

Present study revealed a non-linear cumulative change in the cerebral function as a result of multi session tDCS. Researchers have made few attempts to investigate the impact of multi session tDCS on tinnitus suppression; however these attempts did not result in tinnitus relief. The likely reason for this could be due to the difference in research design and lack of optimization.

The optimum setting for repeated tDCS stimulation of DLPFC to reduced tinnitus loudness would be: intensity – 1.5 mA, duration – 20 minutes, sessions – 6 sessions over 3 weeks' time with a washout period of 3 to 4 days.

O.094 • Steady-State Auditory Evoked Fields (SSAEFs) and Hemispheric Asymmetry after Repeated Transcranial Magnetic Stimulation (rTMS) in Tinnitus

Shiao A-S., Hsieh J-C., Li C-T., Lee P-.L, Li L. P-H.

Department of Otolaryngology, Cheng Hsin General Hospital

Instant effect of repetitive transcranial magnetic stimulation (rTMS) on steady-state auditory evoked fields (SSAEFs) in tinnitus has been proven. This study aimed to explore the long-term consequence of rTMS on SSAEFs. Besides, the contingency between plastic changes and inventory scales before as well as after courses of rTMS will also be addressed.

This is a three-arm study design: twelve tinnitus patients were treated with rTMS, twelve tinnitus patients were treated with sham stimulation, and another twelve participants served as normal hearing control. Patients responded to tinnitus handicap inventory (THI) before the 1st session and one month after the final session of rTMS/sham treatment. Changes in brain activities were assessed by measuring SSAEFs in tinnitus before and one month after treatments of rTMS/sham.

SSAEFs remained decreased one month after rTMS over stimulated (i.e. left) hemispheres than before rTMS, paralleled by a significant reduction of THI. There was no correlation between the index of hemispheric asymmetry (R/L) and THI in tinnitus patients, except for that between R/L before rTMS and THI before rTMS with a borderline effect.

The increased SSAEFs in tinnitus patients remained decreased one month after rTMS. Since there was yet no evidence of persisting consequence for rTMS regarding evoked signals observed by modalities of functional brain imaging in human beings, our study highlighted an objective clue in terms of SSAEFs for the long-term effect of rTMS on tinnitus noted in previous researches.

A longitudinal research was invited for the development of an objective index made from SSAEFs correlating the subjective severity of tinnitus.

O.095 • Effectiveness of fractal tones on improvement of THI functional score among chronic tinnitus patients: An open-label pilot study

Simonetti P., Garcia Vasconcelos L., Oiticica J.

Otorhinolaryngology Department, University of Sao Paulo, Brazil

The aim of this study was to determine the benefits of fractal tones as unique sound therapy to chronic tinnitus sufferers.

We recruited 12 participants; however 6 could not be assigned. Participants answered THI and HHIA questionnaires and AVS scale at baseline, 1-, 3- and 6-months. The Tinnitus pitch and loudness match were performed before fitting and after 6 months of use.

Neither VAS, pitch, loudness or minimal masking levels showed significant statistic differences of improvement at the end of treatment. The mean THI measured at baseline was 45 (range 30 to 66) and the final THI was 25 (range 18 to 30). A paired sample t-test showed that the 20-points difference were statistically significant ($p<0.05$). We traced the individual contribution of fractal tones on chronic tinnitus sufferers and found out the main contribution on THI functional domain which includes concentration, read, attention, consciousness, sleep, social activities, household job.

We could say that every time we face patients with bothersome chronic tinnitus with high scores on THI functional scale, than fractal tones should be considered as a good initial sound therapy strategy.

Current findings from this open-label pilot study are preliminary ones and other trials must be run in others trials before these results could be generalized to a larger tinnitus population.

O.096 • **Stapedotomy in the only hearing ear with persistent tinnitus**

Skarzynski H.[1,2], Plichta L.[1,2], Wawszczyk S.[1,2], Skarzynski P.H.[2,3,4]

[1] *Department of Oto-Rhino-Laryngology, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Institute of Sensory Organs, Kajetany, Poland*
[4] *Department of Heart Failure and Cardiac Rehabilitation, Second Faculty, Medical University of Warsaw*

The treatment of the only hearing ear is always a challenge for the otosurgeon and even more so for the patient, especially if previous surgery in the other ear had been with complications. However, many years of experience with such cases suggests that indications for stapedotomy in conductive hearing loss should be the same whether we making a decision about surgery in the only hearing ear or in both ears. The aim of this study was to present a case of a patient with only one hearing ear with additional atypical intraoperative finding and to demonstrate the such findings do not warrant resigning from performing a stapedotomy.

The patient was a 62 years-old woman admitted to the clinic due to hearing problems and tinnitus, who had undergone surgeries in both ears 19 and 22 years earlier. The audiometry showed total deafness in the left ear and profound mixed hearing loss in the right ear. Hearing thresholds in the right ear in the past 22 years from the surgery were deteriorating gradually and presently the air conduction was at the level of 60 dB, and bone conduction at 25–30 dB with tenacious tinnitus. It has been decided to perform the stapedotomy in the right ear under general anesthesia. An intrameatal incision was performed in the narrow external auditory canal. The external ear canal was observed to be widened during a previous surgery that failed to improve patient's hearing. Intraoperatively surgeons had observed disconnection of the stapes suprastructure from the plate and very narrow oval window. The divulsion of the stapes occurred most probably during a previous operation which involved stapes mobilization. The stapes suprastructure was removed and a 0.5 mm diameter hole was drilled in the stapes plate. A titanium prosthesis KURZ Skarzynski Piston 0.4 mm was applied. After removal of the ear canal packing full closure of the air-bone gap was achieved with improvement of the bone conduction curve by 5–10 dB.

The patient reported immediate diminishment of the tinnitus and after 2 months tinnitus was completely resolved.

The only hearing ear cannot be nowadays a contraindication for surgical treatment. In each of such cases it is essential to assure that patient has full knowledge and understanding of possible complications. Surgeon must have adequate experience in such procedures. In our patient's case the surgery had been mandatory due to lowering of the bone conduction curve and burdensome tinnitus.

O.097 • **Preoperative assessment of tinnitus in adult patients qualified for stapes surgery**

Skarzynski P.H.[1,2,3], Dziendziel B.[1], Penar K.[1,4], Rajchel J.[1], Swierniak W.[1], Kutyba J.[1], Bienkowska K.[1], Skarzynska M.B.[1,3]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

Subjective tinnitus is a common symptom occurring with the hearing loss caused by otosclerosis. The aim of this study was evaluation of the prevalence and severity of preoperative tinnitus among adult patients with otosclerosis.

Study included 129 cases of clinical otosclerosis (89 women, 40 men). All of them were classified o to stapes surgery in World Hearing Centre Institute of Physiology and Pathology of Hearing in Poland between 10.2016 and 02.2017. The preoperative prevalence and severity of tinninus was tested by three questionnaires: Tinnitus and Hearing Survey (THS), Tinnitus Handicap Inventory (THI) and Tinnitus Functional Index (TFI). Additionally was utilized semi – structured questionnaire to help assess tinnitus.

The preliminary study results showed that 83 of 129 patients (64.3%) with otosclerosis have preoperative tinnitus. 41 (49.4%) patients have unilateral tinnitus, only in the ear qualified to stapes surgery and 42 (50.6%) patients have bilateral tinnitus. The THS results showed that about 70% of patient with tinnitus reported greater problem with hearing loss than tinnitus. The average results of the questionnaires respectively for TFI – 31.6 and THI – 39.4 points. In our study 64% of patients with otosclerosis experienced preoperative tinnitus. The participation of

women with otosclerosis was twice higher than men, confirming increased incidence of otosclerosis among women. 46.9% patients with preoperative tinnitus experienced dizziness and/or balance disorders.

The average results for the questionnaires TFI and THI showed a moderate level of severity preoperative tinnitus. Preliminary study showed that 64% of adult patients with otosclerosis suffer not only from preoperative hearing loss but also tinnitus. Severity of tinnitus was mostly moderate. Many of the patients experienced episodes of dizzness and/or balance disorder.

O.098 • A Polish adaptation of the Tinnitus Handicap Inventory: A study of validity and reliability

Skarzynski P.H.[1,2,3], Rajchel J.J.[1], Raj-Koziak D.[1], Pilka A[1]., Rostkowska J.[1], Skarzynski H.[1]

1 World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland
[3] Institute of Sensory Organs, Warsaw/Kajetany, Poland

Aim of this study was to present the translation process and psychometric data on Polish version of Tinnitus Handicap Inventory in the clinical tinnitus sufferers population (THI-POL).

A group of 167 adults filled in THI-POL twice over their three-day hospitalization period. The reliability of THI-POL was investigated using test–retest, Cronbach's alpha, endorsement rate, and item–total correlation. Construct validity and convergent validity were also assessed based on confirmatory factor analysis, inter-item correlation and Pearson product-moment correlations using subscale A (Tinnitus) of the Tinnitus and Hearing Survey (THS-POL); divergent validity was checked using subscale B (Hearing) of THS-POL. Statistical analyses were conducted using SPSS and Amos v. 24.The THI-POL successfully underwent the translation process, confirmed by positive patients' and experts reviews. Test–retest reliability for the total THI-POL scores was strong (r=0.91). Cronbach's alpha coefficient for the total score was high (r=0.95), confirming the questionnaire's stability. Confirmatory factor analysis and inter-item correlation did not confirm the three-factor model. Convergent validity from showed a positive strong (r=0.75) correlation. Divergent validity showed only a moderate correlation. All analyses were statistically significant ($p<0.01$).

As there is no consensus with regard to the process of cross-cultural adaptation of questionnaires our study protocol was based on a careful review of the existing literature and methods expected to produce the most reliable outcomes were implemented. The reliability measurements were similar to those obtained by authors of previous adaptations. The convergent and divergent validity were also confirmed. Only construct validity using CFA did not confirm the original three-factor structure, indicating rather an unidimensional design, what is also in agreement with previous research.

THI-POL can be successfully administered in the research and clinical practice to measure overall tinnitus handicap.

O.099 • Surgical treatment of tinnitus in the youngest boy with otosclerosis in the world

Skarzynski H.[1,2], Boruta M.[1], Plichta L.[1], Raj-Koziak D.[3], Dziendziel B.[4], Skarzynski P.H.[2,5]

[1] Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[3] Tinnitus Department, World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[4] Department of Teleaudiology, World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[5] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland

Aim: Otosclerosis is the disease manifesting as a unilateral or bilateral hearing deterioration occurring practically at every age. In this study we report the results of surgical treatment of the youngest boy (age 5 years) described in literature. The aim of this study is to show that progressive bilateral moderate hearing loss accompanied by tinnitus can be an indication for surgical treatment even in the youngest patients.

Material and methods: Patient aged 5 years with otosclerosis and persistent tinnitus was referred for surgical treatment. Procedure involved frontal tympanotomy performed through the external ear canal. Intraoperatively was observed immobilized crus of stapes and otosclerotic concretions of a thickened stapes plate. Then stapes superstructure was removed and a calibrated hole diameter 0.6 mm was drilled in the stapes plate. Titanium piston of the KURZ Skarzynski Piston prosthesis, diameter 0.5 mm, was placed in the hole.

Results: Postoperative results show complete closure of the air–bone gap in the operated ear and increase of the bone conduction threshold on 3 frequencies from 5 to 10 dB. After the removal of dressing, the child does not complain anymore on tinnitus in the operated ear. In the other ear, which was not operated, tinnitus is variable and periodic; it has been scheduled for tinnitus treatment.

Conclusions: Surgical treatment of otosclerosis is indicated regardless of patient's age. Additional indications for surgical treatment in small children besides hearing loss are tinnitus and deterioration of a bone conduction threshold.

O.100 • Tinnitus evaluation method in adult patients with otosclerosis

Skarzynski P.H[1,2,3], Dziendziel B.[1], Swierniak W.[1], Bienkowska K.[1], Raj-Koziak D.[1,4], Krol B.[1,5], Skarzynska M.B.[1,3]

[1] *World Hearing Center, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*
[4] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[5] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

Subjective tinnitus is a common complaint among patients with otosclerosis. It can exacerbate the negative impact of hearing loss on people's daily life. Hence, distinguishing patients with bothersome and nonbothersome tinnitus is a diagnostic challenge with a possible impact on postoperative benefits. The aim of the study is to present a protocol for evaluating severity of tinnitus in adult patients with otosclerosis. The secondary objective is to assess the hearing benefit and quality of life in patients with and without tinnitus.

Patients over 18 years of age are included in the study. The eligibility criteria are occurrence of tinnitus and first-time scheduled for the operation in the investigated ear. The participants are asked to fill in the following questionnaires: Tinnitus Functional Index (TFI), Tinnitus and Hearing Survey (THS), Abbreviated Profile of Hearing Aid Benefit (ABHAB) and Assessment of Quality of Life (AQoL-8D). The protocol of the study includes completing the questionnaires before surgery and after 3 and 6 months. Additionally, pure-tone audiometry is conducted to evaluate the hearing benefit.

There are a few scientific publications on the prevalence and severity of tinnitus in patient undergoing stapes surgery. Nowadays, there is still a tendency to report only postoperative hearing outcomes based on pure-tone audiometry. The preliminary study carried out in our department showed that tinnitus affects a substantial group of stapes surgery candidates. Among 157 adults qualified for surgical treatment of otosclerosis, 64% suffered from chronic tinnitus. This finding prompted us to create the comprehensive protocol of assessing tinnitus in relation to both subjective and objective hearing benefit and quality of life.

The study allows the development of an original protocol to evaluate the original protocol to evaluate severity of tinnitus in the course of otosclerosis and their impact on the subjective assessment of hearing and quality of life.

O.101 • Assessment demandingness tinnitus with patients qualified to implantation to Vibrant SoundBridge. Evaluation of the results before and after surgery

Skarzynski P.H.[1,2,3], Kutyba J.[1], Gos E.[1], Skarzynska M.B.[1,3]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*

[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

A people of all ages and around a world have a problem with tinnitus. This phenomenon frequently appears with hearing loss. The aim of the study was showed demandingness and occurrence tinnitus with patients who qualified to Vibrant Soun dBridge implantation.

At the moment we have a group 9 people but material is continuously collect. The people in the research group were operated in the Institute of Physiology and Pathology of Hearing on 07.2016–02-2017. The study included only adult person at the age of 19–72. The assessment of the demandingness was employed 3 questionnaires: Tinnitus Hearing and Survey (THS), Tinnitus Functional Index (TFI) and Tinnitus Handicap Inventory (THI). All patients filled in questionnaires pre operation, 1 month after operation and 2 month after operation. The statistical analyses were conducted with SPSS v.24.

The results obtained before operation: THS part A score was 25 (SD 2.6) points, part B was 120 (SD 4.1) and part C was 11 (SD 1.1). The average with overall score THI was 52.3 (SD 25.4). The average with overall score TFI was 38.6 (SD 12.4).

The results obtained 1 month after operation: THS part A score was 41 (SD 3.6) points, part B was 117 (SD 4.6) and part C was 7 (SD 0.8). The average with overall score THI was 37.6 (SD 20.9). The average with overall score TFI was 39.2 (SD 14.2).

The results obtained 2 months after operation: THS part A score was 29 (SD 3.7) points, part B was 85 (SD 4.8) and part C was 3 (SD 0.5). The average with overall score THI was 38.3 (SD 15.6). The average with overall score TFI was 26.6 (SD 13.3).

The results of THS questionnaire shows that patients have bigger problem with hearing loss than tinnitus. In this group of patients, only a few person have results indicating problem with hyperacousis. The results of TFI suggest that tinnitus is gradually decreasing after operation. Overall results of TFI questionnaire suggest that tinnitus increasing marginally but 2 month after operation decrease to less than the preoperative.

Patients who were qualified to Vibrant Soun dBridge haven't significant problems with tinnitus and hyperacousis. They didn't demandingness after operation was decreased. Implantation of Vibrant Soun dBridge affects tinnitus. After surgery tinnitus affected has their life.

O.102 • Assessment of tinnitus in patients with Bonebridge hearing implant before the implantation of the device

Skarzynski P.H.[1,2,3], Kutyba J.[1], Penar K.[1], Dziendziel B.[1], Swierniak W.[1], Rajchel J.[1], Bienkowska K.[1], Skarzynska M.B.[1,3]

[1] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland
[3] Institute of Sensory Organs, Warsaw/Kajetany, Poland

Tinnitus has become a global issue. A lot of studies indicates on correlations between tinnitus and hearing loss. The purpose of this work is to evaluate severity of tinnitus in patients who are classified to the implantation of Bonebridge hearing implant.

The study involved eighteen subjects who were classified to the implantation of Bonebridge. Before the operation patients were asked to fill in three questionnaires evaluating tinnitus – Tinnnitus and Hearing Survey (THS), Tinnitus Handicap Inventory (THI) and Tinnitus Functional Index (TFI).

This preliminary study reveals that 50% of participants suffers from tinnitus. General average result of TFI questionnaire points to minor issue in this group of participants. Loudness of tinnitus was moderate problem in this group. Impact of tinnitus on ability of hearing and patient's quality of life was also moderate. Nine of patients had a preoperative scores higher than zero on both questionnaires. The results of THS questionnaire present that tinnitus is not significant problem as hearing loss. Patients qualified to Bonebridge implantation have moderate problem with tinnitus.

Analysis of the results of the questionnaires shows that tinnitus affects the quality of patient's life. Half of the participants of the study struggle with tinnitus. The next step of this preliminary study will be comparison of the preoperative and postoperative results.

O.103 • Depressive symptoms, quality of life and tinnitus handicap in a clinical group of tinnitus patients

Skarzynski P.H.[1,2,3], Rajchel J.[1], Raj-Koziak D.[1], Bienkowska K.[1], Gos E.[1], Skarzynska M. B.[1,3]

[1] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland
[3] Institute of Sensory Organs, Warsaw/Kajetany, Poland

Aim: The aim of the study was to evaluate the tinnitus handicap, depressive symptoms and quality of life in a clinical group of Polish patients.

Material and methods: The study included 142 consecutive patients reporting to the Audiology and Phoniatrics Department due to their tinnitus complaint. The main eligibility criteria were: age≥18 years, primary tinnitus, no diagnosis of serious mental and physical disorders and tinnitus lasting minimum of 3 months. The participants were asked to complete a battery of questionnaires: Polish Tinnitus Handicap Inventory (THI-POL), Beck Depression Inventory (BDI) and World Health Organisation Quality of Life – 26 item version (WHOQOL-BREF).

Results: Mild depressive symptoms were noted in 33% patients, moderate in 17.6% and severe in 2.8% patients. Statistically significant, moderate positive correlations were observed between THI and BDI ($r=0.632$; $p>0.01$) and significant, moderate negative correlations were observed between THI WHO-QOL BREF total and subscale scores (from $r=-0.42$ for Social subscale to $r=-0.595$ for total score; $p<0.01$). Age, gender, tinnitus duration and hearing loss level were not correlated with depressive symptoms or quality of life.

Discussion: Our results suggest that the tinnitus patients experienced moderate tinnitus handicap and mild depressive symptoms on average. Similar results were obtained in other studies. However, due to the cross-sectional design, no conclusions could be drawn regarding the precedence of tinnitus handicap or depressive symptoms. A strong point of our research, omitted in other studies, is the analysis of gender, age, tinnitus duration and hearing levels influence on depressive symptoms and quality of life.

Conclusions: Tinnitus handicap seems to be considerably related to reduced quality of life and depressive symptoms. The relationship between THI and BDI suggest that this tool can help physician in evaluating the risk of comorbid depressive symptoms in patients, providing the benefits of the necessary psychological help.

O.104 • The pre- and postoperative assessment of frequency and severity of tinnitus distress among adult patients qualified for cochlear implant in WHC IFPS

Skarzynski P.H.[1,2,3], Swierniak W.[1], Dziendziel B.[1], Kutyba J.[1], Rajchel J.[1], Penar K.[1], Skarzynska M.B.[1,3]

[1] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland
[3] Institute of Sensory Organs, Warsaw/Kajetany, Poland

Tinnitus is a symptom of high prevalence in patients with severe to profound sensorineural hearing loss. That hearing impairment can be treated with electrical stimulation via a Cochlear Implant (CI). The purpose of study was assessment the effect of cochlear implantation on pre- and postoperative tinnitus perception, which was evaluated, before, during implant activation visit and 1 month after activation.

Between July 2016 and March 2017, we included fifty two adults with unilateral CI in the study. The sample comprised 25 male and 27 female, with mean age of 51.3 years (range 18–85) at implantation. All patients underwent CI surgery at the IFPS in Kajetany. They were asked to complete three questionnaires concerning tinnitus perception:

Tinnitus and Hearing Survey (THS), Tinnitus Handicap Inventory (THI) and Tinnitus Functional Index (TFI). Of the approached patients, 39 completed the full sets of questionnaire and 13 only THS.

Before implantation, the tinnitus prevalence was 67.31% (35 of 52) in the whole study group. Prior to implantation, the total result THI was 51.1 (SD=22.9) and TFI score was 40.5 (SD=18.6). Postoperatively, the THI scores decreased to 39.3 (SD=25.8) and TFI score reduced to 31.7 (SD=21.7). 39 patients had a preoperative score higher than zero on both questionnaires. After implantation but before activation CI, the severity of tinnitus in both questionnaire increase. Although on next follow-up (1 month) tinnitus is significantly reduced. However, we report also a negative influence on tinnitus in some patients.

Results of THS show that 95.15% of patients have bigger problem with hearing than tinnitus distress. Moreover, before CI 26 adults have hyperacusis. One month after activation only 10 CI users have problem with sound tolerance.

In conclusion, these findings show that prevalence of tinnitus in CI patients is relatively high. Moreover, our analysis indicate a positive result cochlear implantation on perceived severity of tinnitus. In addition, CI improve quality of life and hearing ability. Although in some cases tinnitus burden change to the worse.

O.105 • Psychological experiment: How can psychologist help adults tinnitus sufferers? The role of attention

Skarzynski P.H.[1,2,3]., Bienkowska K.[1], Swierniak W.[1], Rajchel J.[1], Raj-Koziak D.[1], Gos E.[1], Niedzialek I.[1], Karpiesz L.[1], Ludwikowski M.[1], Dziendziel B.[1], Skarzynska M.B.[1,3]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

Tinnitus effect on cognitive processes primarily on attention. In some cases chronic sounds can interfere daily activity because of the difficulties with concentration of attention. The aim of this study is to assess whether redirecting attention during testing lowers tinnitus nuisance.

The study includes fifty adults tinnitus sufferers (normal and hearing impaired) who will be hospitalized in World Hearing Center in Kajetany. During the test patients will be asked to fill out two standardized questionnaires: Attention and Perceptivity Test, The Coping Inventory for Stressful Situations and authorial tinnitus survey. The statistical analyses will be conducted using SPSS v.24.

It is supposed that adults tinnitus sufferers will obtain significantly worse results than general population. Additionally, tinnitus nuisance will decrease during the test. It is recommended to create multimedia training program based on doing particular exercise. The purpose of this is to redirect the attention in tinnitus cases.

O.106 • Impact of stapes surgery on tinnitus in patient with osteogenesis imperfecta – a case study

Skarzynski P.H.[1,3,4] Osinska K.[1,2] Dziendziel B.[1], Rajchel J.[1], Skarzynska M.B.[1,4]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[4] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

Osteogenesis imperfecta (OI) is the most common hereditary disorder of connective tissue. It is associated with defect of the osteoarticular system, dentinogenesis imperfecta and progressive hearing loss. The aim of study was to retrospectively evaluate tinnitus and hearing of patient with osteogenesis imperfecta after stapes surgery.

A 60 – year old woman has undergone bilateral sequential stapes surgery. She was asked to complete the Tinnitus Finctional Index (TFI) to assess the annoyance tinnitus and Abbreviated Profile of Hearing Aid Benefit (ABHAB) to subjective assess hearing. Questionnaires consisted of two sets. The first set was about preoperative state, the second about postoperative state. The audiological findings of this patient have been described earlier.

Patient reported progressive hearing loss and constantly tinnitus over 35 years before first operation. Preoperative TFI results showed, that tinnitus was the biggest problem in subscales: intrusive, sense of control, sleep and relaxation. She reported a completely disappearance of tinnitus after surgery. Preoperative audiometric tests showed bilateral mixed hearing loss. After surgery, closure of the air – bone – gap in left ear and significant reduction in right ear was observed. The APHAB results confirmed the reported improvement of hearing after stapes surgery.

Osteogenesis imperfecta is characterized by disorders of bone metabolism, with hearing loss being a frequently reported factor. Patients with this disorder often have malformation of stapes, which may influence the postoperative hearing results. There are many publication which present exclusively postoperative hearing result. Little is known about annoyance of tinnitus in this group. This case shows that there is an opportunity to obtain improved hearing and also reduction of tinnitus. This effect maintained in 5 year follow-up period.

As a result of sequential stapedotomy in both ears, a patient reported subjectively improved hearing and total reduction of tinnitus.

O.107 • Relationship between tinnitus handicap and life satisfaction, emotional control and illness acceptance

Skarzynski P.H.[1,2,3], Rajchel J.J.[1], Raj-Koziak D.[1], Bienkowska K.[1], Pilka A.[1], Skarzynska M.B.[1,3]

[1] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland
[3] Institute of Sensory Organs, Warsaw/Kajetany, Poland

The aim of the study was to assess the relationship between tinnitus handicap, life satisfaction, emotional control and illness acceptance among adult tinnitus sufferers.

The study included 72 consecutive patients seeking help in the Institute of Physiology and Pathology of Hearing due to their tinnitus complaint. The participants were asked to fill in four questionnaires: Tinnitus Handicap Inventory (THI-POL), Satisfaction with Life Scale (SWLS), Courtauld Emotional Control Scale (CECS) and Acceptance of Illness Scale (AIS). To establish the relationship between the tinnitus handicap, life satisfaction, emotional control and illness acceptance, Pearson correlation coefficient was used. The statistical analyses were conducted with SPSS v.24.

The mean THI score was 54 (SD 27) points. The mean SWLS score was 21 (SD 6). The mean CECS score was 16.4 (SD 16.4) for the Anger subscale, 17.5 (SD 3.5) for the Depression subscale, 18.4 (SD 4.8) for the Anxiety subscale and 52 (SD 10.5) for the total score. The mean AIS score was 30 (SD 8). Strong negative correlation were found between the THI score and AIS score ($r=-0.65$; $p<0.001$). Moderate negative correlation were found between the THI score and SWLS score ($r=-0.39$; $p<0.001$). No correlation was found between the THI and CECS scores, both total and subscales.

The results suggest that tinnitus handicap is not related to emotional control. Patients with tinnitus expressed the same level of control as general population. The average life satisfaction in our study group was also similar to these obtained in control groups from the literature, but it was a significant, moderate reduction in the life satisfaction in people with more severe tinnitus handicap. Although the overall illness acceptance was quite high in our population in comparison to studies on other diseases, a strong decrease was observed in people more handicapped by their tinnitus. Tinnitus handicap is strongly related to lack of illness acceptance and it also affects the satisfaction with life negatively. Emotional control seems to be unrelated to the handicapping impact of tinnitus.

O.108 • The comparison of tinnitus distress and handicap among subjects with normal hearing and hearing impairment – a preliminary study

Skarzynski P.H.[1,2,3], Rajchel J.J.[1], Raj-Koziak D.[1], Dziendziel B.[1], Swierniak W.[1], Skarzynska M.B.[1,3]

[1] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland [3] Institute of Sensory Organs, Warsaw/Kajetany, Poland

The aim of the study was to check the difference in tinnitus distress and handicap in patients with normal hearing and hearing impairment.

Every patient filled in a battery of test including an initial semi-structured tinnitus interview, Polish versions of Tinnitus Handicap Inventory (THI-POL) and Tinnitus Functional Index (TFI-Pl). The participants underwent also a pure tone audiometry (PTA) testing. Based on the criteria proposed by International Bureau for Audiophonologie (BIAP), they were divided into two groups: normal hearing – NH (PTA ≤20 dB HL) and hearing impairment – HI (PTA >20 dB HL). Student t-tests were conducted with the SPSS v.24.

The groups differ significantly in terms of overall tinnitus handicap measured with total score of THI ($t=2.95$; $p=0.004$), general tinnitus distress measured with total score of TFI ($t=3.53$; $p=0.001$). Significant differences were also noted in every TFI subscale, with the exception of Sense of Control and Sleep subscales. Additionally, the groups did not differ significantly in the time of tinnitus awareness ($t=1,.57$; $p=0.12$), but there were differences in the subjectively perceived tinnitus annoyance ($t=2.14$; $p=0.033$).

Although many people deal with their tinnitus effortlessly, it is a strong evidence in the literature that this condition can have a distressing and handicapping impact on an individual. Tinnitus etiology is still unclear and this phenomenon can be met in both normal and hearing impaired individuals. The results of our study suggest that tinnitus distress and its handicapping impact are more pronounced in patients with hearing loss than normal hearing, although no differences in the time of tinnitus awareness were noted. Our findings are consistent with other author's report.

Tinnitus is more distressing and handicapping condition for patients with hearing loss compared to normal hearing individuals.

O.109 • Patient acceptance of novel invasive treatments for tinnitus

Smit J.V., Pielkenrood B.J., Arts R.A.G.J., Janssen A.M.L., Temel Y., Stokroos R.J.

Department of ENT and Neurosurgery, Maastricht University Medical Center, Netherlands

Currently, new invasive treatment options for tinnitus are being investigated. These invasive treatment options are for example cochlear implantation, deep brain stimulation

and cortical stimulation. In the last years several preclinical trials, case reports or case series in humans have been published. However, surveys to obtain insight in the patients' willingness to undergo these treatments are scarce. The aim of this survey study was to find out whether tinnitus patients are willing to undergo invasive neuromodulation with regard to risks, costs and outcome.

In 2014 an internet survey was distributed among 415 tinnitus patients who are members of Dutch Society of Hard of Hearing People. A Visual Analogue Scale (VAS, 0–10) was used to measure the patient acceptance of novel invasive treatments. Other questions related to patient characteristics included age, sex, tinnitus loudness and burden (VAS) and number of attempted tinnitus treatments. Furthermore, acceptable risks of potential complications and the willingness to pay for treatment were evaluated. A correlation analysis was performed between patient characteristics and acceptance rates.

Around one fifth of the patients were reasonable willing to undergo invasive treatment and around one fifth was fully willing to undergo invasive treatment. Hearing aids, used as a control, were best accepted (61–65%), followed by cochlear implantation (41–47%), deep brain stimulation (39–42%) and cortical stimulation (35–42%). Acceptance rates were slightly higher when the chance of cure was higher. Almost half of patients would accept a risk of more than 0.1% of severe side-effects and about one-fourth is willing to pay over 20 times their monthly income for a treatment.

The results obtained are comparable to previous studies on the acceptability of invasive treatment for tinnitus. Slight differences can be explained by differences in study population.

It can be concluded that a considerable proportion of tinnitus patients accept a variety of invasive treatments, despite the associated risks or costs. When invasive treatment for tinnitus is to be performed, particularly attention should be given to the informed consent including thorough explanation of the potential risks and providing a realistic outcome expectation.

O.110 • Hearing loss may induce tinnitus by strong auditory memory and increased vigilance: A qEEG study on the relationship between hearing loss and tinnitus

Song J-J., Chang M.Y., Koo J-W., De Ridder D., Vanneste S.

Otorhinolaryngology-Head and Neck Surgery Department, Seoul National University Bundang Hospital, Korea

Peripheral hearing loss (HL)-induced changes in the central auditory system is a prerequisite for the generation of subjective tinnitus. However, there are cases with considerable amount of HL without any development of tinnitus and this question on the differences between HL with our without tinnitus with regard to the cortical activity has never been addressed. In this regard, we compared resting-state quantitative electroencephalography (rs-qEEG) findings between the HL with tinnitus (HL-T) group and with no tinnitus (HL-NT) group to reveal cortical activity differences between the two.

Sixty-one HL-NT subjects were enrolled prospectively, and 61 HL-T subjects were selected from our database. The hearing thresholds were strictly matched between the two groups, and only subjects with low distress level (grade 1 or 2) were enrolled for the HL-T group. Rs-qEEG was measured in all included subjects and compared between the 2 groups with regard to source- localized activity and functional connectivity. As compared with the HL-NT group, the HL-T group showed increased activity in the parahippocampus (PHC) for the beta 2 and 3 frequency bands and in the inferior parietal lobule (IPL) for the gamma band. Also, the HL-NT group showed increased connectivity between the PHC and the auditory cortex (A1) as compared with the HL-T group.

The PHC is an area where auditory memory is stored, and the IPL is an area that has circuit-breaker activity and makes a subject vigilant when an external stimulus is presented. In this regard, HL may induce tinnitus when auditory memory is strong enough to generate phantom auditory perception and the circuit-breaker activity of the IPL is high enough to make the subject with HL vigilant.

Based on the current study, HL may induce tinnitus if the PHC-based auditory memory is strong enough to generate tinnitus and the circuit-breaker activity of the IPL is high enough to make the subject with HL vigilant.

O.111 • Changes in the resting-state cortical oscillatory activity 6 months after modified tinnitus retraining therapy

Song J-J., Jang J.H., Koo J-W., Vanneste S., De Ridder D.

Otorhinolaryngology-Head and Neck Surgery Department, Seoul National University Bundang Hospital, Korea

Although tinnitus retraining therapy (TRT) is efficacious in most patients, cortical activity changes responsible for the improvement of tinnitus are still enigmatic. In this regard, we compared pre- and post-TRT quantitative electroencephalography (qEEG) findings to identify cortical activity changes that may explain improvements after TRT.

Thirty-six patients with severe tinnitus were prospectively enrolled, and qEEG data were recorded before their initial TRT sessions and 6 months later and compared. Also, changes in the qEEG findings were correlated with the percentage improvements in the Tinnitus Handicap Inventory (THI) scores, and numeric rating scale (NRS) scores of tinnitus loudness and tinnitus perception.

As compared with the pre-TRT state, post-TRT qEEG data showed decreased activities in the left primary and secondary auditory cortices for the gamma frequency band. The activity changes in the posterior cingulate cortex for the beta 2 and 3 bands were positively correlated with improvements in NRS distress, while there were no significant correlations between the activity changes and improvements in the NRS loudness or perception scores.

As the posterior cingulate cortex is a component of the default mode network, the improvements in NRS distress may be explained by the decreased activity in the default mode network after TRT.

TRT may improve tinnitus by reducing the auditory cortical activity, and the distress may be abated by reducing the activity of the default mode network. Taken together, TRT regulated abnormally active cortical areas and thus quiets tinnitus.

O.112 • Objective diagnosis of tinnitus using resting-state EEG big data-based support vector machine learning

Song J-J., Lee D., Choi I., Lee K.

Otorhinolaryngology-Head and Neck Surgery Department, Seoul National University Bundang Hospital, Korea

Although tinnitus is a subjective symptom, it would be highly desirable to diagnose the presence of tinnitus in an objective way. Recently, scientists have developed support vector machine learning (SVML) techniques that can learn to recognize patterns by classifying seen data. By using SVML, based on the known properties learned from the trained data, these algorithms may predict the presence or absence of tinnitus. We therefore combined resting-state quantitative electroencephalography (rs-qEEG) with SVML to develop a brain-based electrophysiological signature for the presence of tinnitus.

One hundred and twenty-nine tinnitus patients and 233 healthy controls underwent rs-qEEG measurements for 5 minutes. Using these data as training sets, feature extraction was performed both by principal component analysis (PCA) and by NMF, and a classification model was developed by the linear-kernel SVML with 10-fold cross-validation. The accuracy of classification and the area under curve (AUC) were calculated for each method.

As compared with PCA-SVM approach (accuracy 0.85, AUC 0.94), NMF-SVM approach yielded better classification performance (accuracy 0.92, AUC 0.96). When compared to upper-10% baseline activity of the control group, that of the tinnitus group showed relatively higher activity at the left auditory cortex, inferior frontal cortex, dorsal anterior cingulate cortex, and parahippocampus. The classifier developed in the current study distinguished tinnitus or no-tinnitus with high fidelity. Also, the main areas that classified tinnitus or no-tinnitus replicated previously reported areas that are involved in the generation of tinnitus or tinnitus-related distress.

NMF-SVM-based diagnosis of the presence of tinnitus has yielded an accuracy of 92%. Also, relatively increased baseline activities in the tinnitus group as compared with the control group in areas that were repeatedly found in previous tinnitus research may reconfirm the validity of the current approach. Future study using bigger database may raise the classification accuracy and eventually enable us to develop an objective diagnostic tool of tinnitus.

O.114 • A psychologically informed, audiologist-delivered, manualised intervention for tinnitus

Taylor J., Thompson D., Hall D., Walker D-M., McMurran M., Casey A., Stockdale D., Featherstone D., MacDonald C., Hoare D.

Otology and Hearing Group, Clinical Neuroscience, NIHR Nottingham BRC, University of Nottingham, UK

In the UK National Health Service specialist tinnitus care is increasingly the domain of the audiologist yet there is no standard tinnitus protocol in use and treatment varies. Also, there is no evidence for the efficacy of psychological interventions for tinnitus when delivered by audiologists. The aim of this study was to develop a psychologically informed guidance manual to support audiologist management of tinnitus and conduct a feasibility randomised controlled trial (RCT) to establish whether this manualised care versus treatment as usual (TAU) can be evaluated in a fully powered RCT.

From a scoping review and Delphi survey, core attributes of tinnitus counselling were identified. These were incorporated into a guidance manual underpinned by a cognitive model of tinnitus and the use of relational skills. Across 3 sites, 30 patients are being randomised to either 1) psychologically informed management from an audiologist trained in the manual or 2) TAU from an audiologist not trained in it. The feasibility and acceptability of the manualised treatment will be evaluated with patients and audiologists via qualitative interviews and completion of quantitative outcome measures.

The manual comprises the following treatment areas which can be selected from dependent on individual need: tinnitus education, the emotional consequences of tinnitus, relaxation, fear and avoidance, unhelpful thinking, physical exercise, sleep, attention, monitoring and acceptance, and sound therapy. Recruitment to the feasibility trial and intervention delivery are in progress. The feasibility of a fully powered RCT will be assessed via compliance with the manual, willingness to be randomised, number of eligible participants, rate of recruitment, retention, and collection of quantitative outcome measures and qualitative data.

This research offers a first step to an evidence-based, standardised and accessible approach to tinnitus care.

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O.115 • An outcome selection process for a psychological tinnitus intervention

Thompson D.M.[1,2], Taylor J.[1,2], Hall D.A.[1,2], Walker D-M.[1,2], Hoare D.[1,2]

[1] NIHR Nottingham Biomedical Research Centre, UK
[2] Otology and Hearing Group, University of Nottingham, UK

There is a lack of consensus concerning the selection of outcome domains and instruments for use in tinnitus clinical trials. This has led to variation in outcome selection, impeding synthesis of research and decision-making in clinical care. This study presents an example of the outcome selection process for an audiologist-delivered psychologically informed tinnitus intervention.

Template analysis was used to identify outcome domains referred to in the intervention manual. Potential domains were selected from a list that was constructed by grounded theory using existing tinnitus questionnaires. A primary outcome instrument was identified if it was designed to be responsive to therapeutic change and possessed good content validity and internal consistency. Secondary instruments were included if they possessed good content validity and internal consistency in relation to domains identified in template analysis that were not measured by the primary outcome instrument.

Template analysis identified emotional impact and negative cognitions as domains of interest. The TFI was identified as the only instrument designed to be responsive to therapeutic change. The TFI possesses good content validity and internal consistency to measure the emotional impact of tinnitus. However, it does appear to measure negative cognitions. The TCQ represents the only an additional instrument specifically designed to measure negative cognitions with good content validity and internal consistency.

Our audiologist-delivered psychologically informed tinnitus manual is predicted to affect change in emotional impact and negative cognitions. This would appear to be best measured by the TFI and TCQ in the context of a clinical trial. It may not be feasible to use both in routine clinical care.

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The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

O.116 • What we talk about when we talk about a psychological intervention for tinnitus

Thompson D.M.[1,2], Taylor J.[1,2], Hall D.A.[1,2], Walker D-M.[1,2], McMurran M.[1,2], Casey A.[1,2], Stockdale D.[1,2], Featherstone D.[1,2], Hoare D.[1,2]

[1] NIHR Nottingham Biomedical Research Centre, UK
[2] Otology and Hearing Group, University of Nottingham, UK

Psychotherapies are effective in improving tinnitus-related distress, and though some audiologists deliver psychological interventions, these are not standardised across the UK. Our aim was to determine which components of psychological therapy are most important to include in an audiologist-delivered psychological intervention for tinnitus.

A 3-round Delphi survey was conducted to identify consensus across patients and clinicians. The panel included 18 patients and 21 clinicians (audiologists, hearing therapists, and psychologists). In round 1, panelists were asked an open-ended question, 'what are essential components of an audiologist-delivered psychological intervention for tinnitus'. Responses were coded using thematic analysis to produce a list of components presented in subsequent rounds as closed questions asking how important these are to include in an audiologist-delivered psychologically informed intervention tinnitus.

Consensus (>80% agreement) was reached that 76 components were important to include. These components were predominantly common therapeutic skills such as Socratic questioning and active listening, rather than specific CBT techniques like exposure and cognitive restructuring.

Efforts to develop a treatment manual should consider including important common skills, and the inclusion of any specific techniques should be justified.

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The views expressed are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.

O.117 • Prospective Assessment of an innovative and multidisciplinary Treatment Protocol for Chronic Tinnitus in 660 patients

Timsit A.-C.[1], Fain G.[1], Lamas G.[2], Bebear J.-P.[3], Gatignol P.[1], Penkala F.[4]

[1] Otorhinolaryngology and Head and Neck Surgery, Centre Medical Jack SENET, Paris, France
[2] ENT-HNS Unit, Hopital Lariboisiere, Paris, France
[3] Bordeaux University, France
[4] Audioprothesist, Paris, France

Aim: Offer to patients with chronic tinnitus, disoriented and prone to medical nomadism, an innovative and standardized therapeutic approach with a multidisciplinary team in which otorhinolaryngologist remains the

coordinator, and fight against the dogma „There is nothing to do, learn to live with it".

Material and methods: 660 adults included after initial assessment with interrogation, clinical examination, evaluation of the impact of tinnitus on daily life through personal evaluation, visual analogic scale (VAS) and THI Questionnaire, characteristics of tinnitus, tonal and vocal audiometry including high frequencies, blood sample analysis, CT or MRI investigation. After having explained to patients the mechanisms of tinnitus, similar to pain, and obtained his/her adherence for good compliance, therapeutic protocol is proposed, consisting of four components: medical treatment using exclusively antiepileptic drugs, early hearing aids in case of moderate or severe hearing loss (or isolated notch>45 dB), listening of personal coloured noise stimulus surrounding frequency bands of the tinnitus, and emotional support by a multidisciplinary team. Medical treatment is based on prescribing in a specific order and for a defined period, four different antiepileptics (successively gabapentin, carbamazepine, lamotrigine, topiramate) at low dosages, the failure of the first molecule leading directly to interruption of treatment in progress and prescription of the next molecule of the list. If unsuccessful, neurologist may prescribe clonazepam in addition.

Results: 58 patients (9%) were lost to follow-up or unable to receive the treatment. Concerning the remaining 602 patients (91%), we had very good (28%) and good (43%) results (430 cases and 71%) with the full protocol. These results were confirmed by patient 's personal evaluation, scores of VAS and THI, respectively improved in 78% and 84% of cases. Failure was observed in 29% of the patients. All the data have been analyzed. Very good and good results are obtained in 92% of cases for recent tinnitus (<3 months), 85% with normal standard audiometry, 74% when standard audiometry was altered.

Discussion: Significant results are obtained with low doses of antiepileptics and very few side effects. Treatment duration did not exceed six months. High frequencies were altered in 84% of cases for 143 patients with normal standard audiometry, pointing the importance of measuring systematically high frequencies. Correlation between side of the tinnitus and hearing loss was found in 84%. Predictive factors of good recovery are: normal standard audiometry, deafness well equipped, progressive beginning, tinnitus located Inside ears, initial VAS between 5 and 7 and hearing aids. Age and length of evolution have no consequence on results. Although prescribing antiepileptic drugs remains the center of this protocol, importance of hearing aids for moderate losses, and listening of personalized coloured noises stimulus should be emphasized.

Conclusions: Concerning 209 patients treated with antiepileptics and equipped with hearing aids, we reach 90% of very good and good results. Rate of success of the complete protocol (71%) allow us to suggest it for adults with chronic tinnitus.

O.118 • Usher Syndrome: Treatment of hearing loss and tinnitus

Tomanek E.[1], Osinska H.[1,2], Skarzynski P.H.[1,3,4] Dziendziel B.[1], Skarzynska M.B.[1,4]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[4] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

Introduction: Usher syndrome is a genetic disorder inherited in an autosomal recessive manner. Disease is defined by the association of sensorineural deafness and visual impairment due to retinitis pigmentosa. Other signs of Usher syndrome may include tinnitus and problems with balance. It is a rare disease but at the same time the most common cause of deaf-blindness. Researchers have identified three major types of Usher syndrome that are distinguished by their severity and the age when symptoms appear. The main aim of study is to present current methods of diagnosis and treatment in patients with Usher syndrome and to evaluate the results and benefits of cochlear implantation in that group.

Material and methods: We describe a typical case of patient with the Usher syndrome, who has been qualified for cochlear implantation due to bilateral sensorineural hearing loss.

Results: Cochlear implantation surgery was performed according to 6 steps surgery by Skarzynski to preserve the residual hearing and the structure of the inner ear. After the operation and optimum settings the speech processor programming parameters achieved satisfactory for the patient's auditory effects.

Conclusions: Cochlear implantation is the only and the optimal solution of treatment of the profound hearing loss or deafness. Due to the accompanying loss of vision, a second ear should be operated as quickly as possible to allow the patient better orientation in different environments.

O.119 • Prevalence of tinnitus in occupational noise induced hearing loss population in Hong Kong

Tong M.C.F., Yeung K.Y.

Otorhinolaryngology, Head and Neck Surgery Department, The Chinese University of Hong Kong, Hong-Kong

Aim: To assess the prevalence of tinnitus in occupational noise induced hearing loss population in Hong Kong.

Material and methods: Subjects working in noisy occupations were invited to participate in the study. Audiological assessment, including standard pure tone audiometry, tympanometry and otoscopic examination, were carried out. Subjects were required to fill out 3 questionnaires: history questionnaire, the Chinese Tinnitus Questionnaire (TQ-CH) and the Chinese Tinnitus Handicap Inventory (THI-CH). Five hundred and forty-four adults, aged from 18 to

70, with 495 males and 49 females from normal hearing to profound hearing loss from August 2014 to May 2015.

Results: 10.8% out of 544 subjects had tinnitus, with 6.2% of them aged between 51 and 60. The mean total score for the TQ-CH was 48.9 (SD=18.4). Scores obtained from male and female subjects were not significantly different. The THI-CH score showed 45% of tinnitus subjects indicated severe tinnitus-related handicap, 19% moderate, 22% mild and 14% with no tinnitus-related handicap. The average VAS on tinnitus loudness was 6.2 (SD=0.43).

Discussion: Tinnitus is defined as spontaneous auditory sensations perceived by a person that are not produced by external acoustic signals. The prevalence of tinnitus ranges from 10% to 30% in different studies worldwide. Age-related hearing loss and noise exposure were reported as common risk factors for tinnitus. Many occupational deafness claimants complained about the negative impacts of tinnitus on their daily lives, as tinnitus may affect people in different ways, including sleep, emotional distress and activities involving hearing.

Conclusions: Tinnitus is known to affect individuals to varying degrees and in different ways. Many occupational deafness claimants complained about the negative impact of tinnitus on their daily lives. Management to help them release the stress or reduce the negative effects caused by tinnitus should be provided and explored.

O.120 • **Cochlear Implants and Tinnitus Treatment**

Tyler R.

Department of Otolaryngology-Head and Neck Surgery, University of Iowa, USA

Review of the clinical evidence to make use of electricity presented to the cochlea as a treatment option for tinnitus treatment. Review of available clinical evidence including acute laboratory studies and clinical studies in cochlear implant patients with tinnitus.

Laboratory trials demonstrated that a range of analog and pulsatile stimuli can effectively suppress tinnitus when applied to the cochlea. The effectiveness of different electrical stimuli varies considerably amongst patients. Besides restoring hearing cochlear implants can effectively suppress tinnitus and nowadays they are clinically applied in patients with unilateral deafness and a primary tinnitus complaint. Case studies showed that sound therapy can effectively be applied in cochlear implant patients.

Cochlear implants offer opportunities to treat tinnitus and further exploration of background stimulation patterns and sound therapy in cochlear implant patients will open new opportunities to further improve the tinnitus suppressive effect of cochlear implants. It is anticipated that future cochlear implants will include strategies to optimize tinnitus suppression.

O.121 • **Tinnitus Activities Treatment**

Tyler R.

Otolaryngology Department, University of Iowa, USA

Tinnitus Activities Treatment focuses on the four Primary functions affected by tinnitus; thoughts and emotion, hearing, sleep and concentration. In this study we compare the effectiveness of TAT with total and partial masking in groups with and without hearing aids.

We evaluated different components of TAT comparing the effectiveness of the partial masking, total masking and counseling alone. Binaural broa dBand noise generators were used. The Tinnitus Activities Treatment (TAT) picture- based counseling protocol (which included CBT and Acceptance) provided similar counseling among all three groups. The Tinnitus Handicap Questionnaire, designed for clinical trials and translated worldwide was administered before and after about 12 months of treatment.

For the group without hearing aids; the average decrease in the handicap questionnaire was 15% for the Counseling group, 25% for the total mask group, and 14% for the partial mask group. In the study with patients who did use hearing aids, the average decrease in the handicap questionnaire was 12% for the counseling group, 13% for the total mask group, and 16% for the partial mask group. No significant average differences among groups were observed.

Many patients, but not all, will benefit from sounds therapy. TAT counseling was effective in all groups. Different masking levels can be effective in different patients.

O.122 • **The Meaning of Life for Tinnitus and Cochlear Implant Patients**

Tyler R.

Communication Sciences and Disorders Department, University of Iowa, USA

How is your quality of life? Is it better than your neighbors? Is it worse than last year? How would it change if you went deaf, or blind, couldn't talk, or had tinnitus?

For years people have attempted to measure the quality of life, particularly for allocation of limited health care resources and for compensation to injured workers. I have been disenchanted with quality of life scales and their application to hearing loss and tinnitus, and therefore have developed a new one.

Through group and individual discussions with several clinicians involved in tinnitus, we developed a 24 item questionnaire covering broader range, with specific questions on sensory abilities and also on health, friendship, finances and sex. 116 people with tinnitus and 196 people using cochlear implants completed a preliminary online survey.

Both tinnitus and cochlear implant subjects scored low on the hearing question. Tinnitus subjects scored low on sleep. Females were more satisfied with hobbies and with sex, compared to males. Subjects over the age of 60 years were

more satisfied with their financial situation that those less than 60, but were more likely to report memory problems.

We think the current quality of life scales under-represent the important of hearing, and the primary functions affected by tinnitus – thoughts and emotions, hearing, sleep and concentration.

We believe this preliminary Meaning of Life questionnaire represents a more valid questionnaire than other "quality of life" scales. It certainly captures the ramifications of hearing loss and tinnitus.

O.123 • The Impact of Tinnitus on N-back Performance in Normal Hearing Individuals

Waechter S., Hallendorf L., Malmstein E., Olsson A., Brännstrom K. J.

Department of Logopedics, Phoniatrics and Audiology, Clinical Sciences Lund, Sweden

This study investigates whether there are any differences between individuals with tinnitus and controls in terms of response time and accuracy on a visual n-back task, and whether high-frequency hearing thresholds correlates with n-back task performance.

Participants had their hearing thresholds measured (0.125 to 16 k Hz) and performed a visual n-back test. All participants then completed the Hospital Anxiety and Depression Scale, in addition tinnitus participants filled out the Tinnitus Questionnaire. Sixty-two individuals participated. 31 had tinnitus (tinnitus group) and 31 had not (control group). Groups were age- and sex matched and all participants had normal hearing thresholds (20 dB HL or better at 0.125 to 8 k Hz).

Results are being analyzed at the time of writing, will be presented at I World Tinnitus Congress and the XII International Tinnitus Seminar on 22–24 May 2017 in Warsaw.

O.124 • Examining the Validity of a New Tinnitus Pitch Matching Method

Williams M.[1], Hauptmann Ch.[2]

[1] The Tinnitus Clinic, UK
[2] DESYNCRA, Germany

Authors have proposed a variety of tinnitus pitch matching protocols; however, a universally recognised standardised method for pitch matching the does not exist in clinical practice. The present study proposes a new mixed methods approach to pitch matching that combines the utilisation of bracketing, similarity grading, two-alternative forced-choice (2AFC) paradigm and individual fine tuning.

50 pitch match recordings (left and right ear) were carried out with 25 normal hearing subjects with simulated tonal tinnitus, of a known frequency. Their simulated tinnitus was matched using a modified protocol by Vernon and Meikle. This was subsequently compared to the mixed methods approach for validation and comparison. Repeatability was investigated by executing successive pitch match measurements with 10 subjects with primary tonal subjective tinnitus. For subjects attempting to pitch match a simulated tinnitus frequency a range of ±5% was chosen to represent a threshold of accuracy.

76% of subjects matched the artificial tinnitus tone within the required accuracy range using the mixed methods protocol with only 32% of subjects achieving this level of accuracy with the Vernon and Meikle method. The mean deviation from the known artificial tinnitus frequency was recorded as being 10.4% (SD: 4.4) for the Vernon and Meikle method and 3.8% (SD: 6.1) for the mixed methods protocol. Repeatability testing in subjects with primary tinnitus revealed that 75.5% of recorded pitch matching values to deviate by no more than ±5% during inter / intra sectional testing.

It is clear from this small sample of data that the newly proposed pitch matching method is capable of achieving a more accurate tinnitus pitch match result than the current proposed clinical standard of investigation. The repeatability of the new method has also been demonstrated in over 75% of tested subjects both inter and intra sessionally.

In this study the proposed mixed methods tinnitus pitch matching protocol appears to be a promising option for obtaining an accurate tinnitus frequency value.

O.125 • Application of the proton magnetic resonance spectroscopy to measure levels of glutamate in patients with tinnitus

Wojcik J.[1,2], Lewandowska M.[1,2], Karpiesz L.[2,3] Raj-Koziak D.[2,3], Niedzialek I.[2,3], Wolak T.[1,2], Skarzynski H.[2], Skarzynski P.H.[2,4]

[1] Bioimaging Research Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[2] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[3] Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[4] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland

Animal studies indicate that changes in the brain of animals with tinnitus are also present at the molecular level. The main neurotransmitter in outer hair cells is the glutamic acid. In tinnitus, glutamatergic neurotransmission is disturbed. Proton magnetic resonance spectroscopy (HMRS) is the techniques whose task is to indicate the level of neurotransmitters in a specific region of the examined tissue. The aim of this study is to assess the level of concentration of glutamine in selected locations in patients with tinnitus.

Proton magnetic resonance spectroscopy was performed using the single voxel technique in patients with unilateral and bilateral tinnitus in four locations: the right and left temporal lobe and right and left frontal lobe. Each participant (n=15) took part in audiometric and psychological tests (Tinnitus Questionnaire, THI, TFI, KPD and STAI). In each of the four locations the concentration of glutamate metabolites including glutamic acid and the relative concentration ratios of these metabolites creatine was evaluated.

For patients with unilateral tinnitus a relative ratio of the concentrations of glutamine and glutamate relative to creatine was lower on the side of tinnitus than on the other side. Different levels of glutamate and relative glutamate to creatine concentration ratio for the right and left side were observed in patients with unilateral tinnitus. These differences are likely the result of the presence of unilateral tinnitus. A correlation were observed between the presence of tinnitus and the level of relative glutamine concentration. A correlation was also found for the glutamine to creatine ratio in patients with unilateral tinnitus.

O.126 • Role of stressful life events as the precipitating factor for chronic tinnitus

Yıldırım N., Aksoy S., Erdoğan O.

ORL-HNS Department, Dumlupinar University Medical Faculty, Turkey

Chronic subjective tinnitus (CST) affects 5–10% of adult population. Although it is an auditory phenomenon, there is an undeniable psychological aspect that is apparently connected to the level of tinnitus related distress. This interdependence is mostly described as a vicious circle, and mostly it is not evident which one precedes the other: physiological co-morbidity or tinnitus. Here in this study, we aimed to evaluate the effect of stressful life events as a precipitating or an exacerbating factor for tinnitus sensation.

200 consecutive patients with CST as the presenting symptom were evaluated by the Tinnitus Handicap Inventory (THI). They were also questioned about any event that coincides with the onset or worsening of their tinnitus. Questions of THI were subcategorized into functional, emotional and catastrophic groups and the test scores were summed up under these headings. The patients were divided into two groups according to having history of certain occurrence as the starter of their tinnitus or none. The scores of total THI and of the subcategories were statistically compared between groups.

Twenty-seven (13.5%) of the patients clearly described one particular occurrence that induced or worsened their tinnitus complaints. These unpleasant experiences can be categorized under "loss or serious illness of a family member", "other family related problems", and health problems "and" work related problems". Six of the patients had also been diagnosed having psychological co-morbidities. Statistically, total THI scores of the study group patients were significantly higher, when compared with the scores of the control group, especially in the "functional" and "emotional" subcategories.

The interrelationship between idiopathic tinnitus and stress or psychological co-morbidities has been well known. However, "cause and effect" relations between these two clinical entities are somewhat blurred, as it is not always possible to determine" which one precipitated the other".

This is one of the few studies pointing out that psychological factors initiated the tinnitus related complaints, at least in some of the patients. Stressful life events have been proved to be one of the important factors in the chronic tinnitus etiology.

O.127 • Tinnitus: A new therapeutic approach

Martínez-Monche G., Fernández C., Cardoso I., Gual X., Ramírez C.

Ototech, Barcelona, Spain

Tinnitus is defined as the perception of sound by the central nervous system without an external stimulus. Generally, tinnitus is subjective, can vary in intensity for an individual, and can be single or multi-tone, making it difficult to assess.

Traditionally, and schematically, tinnitus has been treated with medication, vasoactive drugs,drivers of brain arousal and anxiolytics, TRT, muscle rehabilitation and tinnitus maskers.

In this paper we present a new therapeutic alternative for tinnitus via Cochlear Transmastoid Electrostimulation.

From July 2013 to January 2017 we treated more than 1000 patients using this new technique.

Patients underwent 15 sessions of radiofrequency conducted twice a week for a total of 7 weeks. During the course of the study, and given the reporting of cases where improvements in hearing were during the treatment, we included patients presenting with sudden hypoacusia of cochlear origin, severe longstanding hypoacusia of cochlear origin and bilateral tinnitus. In all cases, radiofrequency was administered as an adjuvant therapy according to established protocols.

The patients underwent a full audiological study by audiometry at the start, mid-treatment, at the end and a month later, auditory evoked potentials of the brainstem, nuclear magnetic resonance when appropriate, informed consent and a test to assess the severity of the tinnitus at the beginning and end of treatment (THI).

In this paper we summarise the methodology and review the cases treated. 65% of patients improved in their perception of tinnitus. 70% showed improvements on their audiogram. No side effects were reported.

O.143 • Tinnitus in patients with genetically determined hearing loss

Lechowicz U.[1,3], Pollak A.[1,3], Raj-Koziak D.[1,3], Rydzanicz M.[2], Skarzynski H.[1], Ploski R.[2], Oldak M.[1,3]

[1] *Department of Genetics, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Medical University of Warsaw, Warsaw, Poland*
[3] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

To contribute new insight into the field of genetic background of tinnitus we analyzed the patients harboring causative for hearing loss mutations and suffering from tinnitus.

We have searched our database for tinnitus patients with genetically determined hearing loss. Search for HI mutations was performed by various molecular methods such as sequencing of the entire mitochondrial genome using next-generation sequencing, Sanger sequencing or real time PCR.

Our preliminary study may suggest that the genetic cause of tinnitus might be due to the mutations located in the nuclear and/or mitochondrial genome. It is believed that pathogenicity of tinnitus combines both: hereditary and environmental aspects. To support progress in finding the best therapies for tinnitus, it is essential to characterize the genetic contributors to the pathophysiology of this condition, but heretofore the genetic of tinnitus is poorly understood. There are few genes (e.g. KCNE1, GDNF, SLC12A2) reported to be involved in tinnitus, but no strong evidence for their pathogenicity was given.

There is still a challenge to find harmless and effective therapy for tinnitus. The molecular insight into tinnitus not only improve the data and expand knowledge of the pathways regulating the disease, but also may bright the biological processes involved, leading to the improvement or inventing new effective drugs.

This study was supported by National Science Centre grants: 2011/03/D/NZ5/05592, 2012/05/N/NZ5/02629 and 2013/09/D/NZ5/00251.

O.161 • **Tinnitus management for patients with Meniere's syndrome – a novel protocol using latest technology to address hearing fluctuation**

McNeill C.

Audiology Department, Healthy Hearing and Balance Care, Australia

To disseminate a novel approach to manage tinnitus of patients with Meniere 's syndrome by using available technology to address eventual hearing fluctuation.

Patients diagnosed with Meniere 's syndrome who came to the audiology clinic for tinnitus management were given a mobile phone app to measure their own hearing and to monitor their symptoms of tinnitus, aural fullness and dizziness at home prior to considering an appropriate hearing device.

Every patient with Meniere 's syndrome experiences tinnitus although not all are distressed by it.Our results revealed 2 groups of patients; those with stable hearing (group 1) and with hearing fluctuation (group 2). Patients in group 1 were fitted with conventional hearing aids with a volume control and group 2 with hearing aids plus portable hardware and proprietor 's software with in-situ audiometry capabilities. All patients fitted with hearing aids experienced significant reduction in tinnitus perception while wearing their devices.

Patients received immediate tinnitus relief during hearing aid fitting. They also reported a greater sense of control over their condition once they started monitoring their own symptoms under professional guidance. The patients' own hearing measurements helped to assess the presence of hearing fluctuation facilitating the hearing aid selection and fitting process. It also gave patients a greater understanding of their syndrome which promoted a „less medical" and more efficient self- management of their condition.

Hearing aids are effective in reducing tinnitus perception of patients with Meniere 's syndrome. Audiological expertise combined with mobile technology, hearing aid programming software and hardware, are very useful in the management of patients with Meniere 's disease. Systematic research is required to estimate optimum time required for self-monitoring prior to selecting and fitting hearing aids to patients with Meniere 's syndrome.

Poster Session

P.01 • The effect of repeated presentation of masker on Residual Inhibition

Adjamian P., Holding M., Hall D.A.

School of Medicine, MRC Institute of Hearing Research, Nottingham, UK

Residual inhibition (RI) refers to the putative neurophysiological mechanism responsible for a temporary suppression of tinnitus following the presentation of a continuous broa dBand noise. While many people with tinnitus experience this temporary relief through a reduction in tinnitus loudness, in others it has no effect, while some experience a temporary increase in loudness.

In this study, we investigated whether this perceptual phenomenon adapts over repeated presentations of the noise. 26 participants with tinnitus completed the experiment. Participants were asked to rate their tinnitus loudness and subsequently listen to their tinnitus for 1 minute. A white noise was presented for 1 minute and the participant was asked at 10 second intervals over the course of a minute to rate how their tinnitus had changed on a scale from –5 (tinnitus gone) to +5 (tinnitus much louder than normal). This procedure was repeated for 10 trials and in three successive blocks, between which participants were given a rest.

Participants were grouped according to the average score of their first tinnitus loudness rating. 12 participants reported a tinnitus loudness reduction (RI), 12 reported no change, and 2 reported a worsening (RE). For the RI group, tinnitus loudness decreased initially but returned towards initial levels before the next presentation of the masker. For the RE group, tinnitus loudness increased but again returned towards initial levels. There was no effect of trial, signifying that ratings were consistent regardless of how many times the masker had been presented before in that block.

Contrary to a previous prediction from the animal model, we found no effect of repeat presentations of the masker on RI effectiveness, suggesting an added value to noise based therapies and using RI as a model to study tinnitus. Findings have significant implications for understanding the neural mechanism of tinnitus and for developing sound therapies to alleviate tinnitus.

P.02 • Revisiting the interpretation of a clinically meaningful treatment-related improvement in tinnitus using the Tinnitus Questionnaire (German version)

Argstatter H.[1], Mehta R.L.[2], Hall D.A.[2]

[1] DZM e.V., Heidelberg, Germany
[2] University of Nottingham, UK

Reporting of clinical significance is welcomed because findings can be statistically significant without being relevant to patients. There is little information on which to base estimates of the minimal clinically important change to aid clinical interpretation. To address this question, we conducted a comprehensive analysis of retrospective clinical data on the German Tinnitus Questionnaire.

We assessed pre- and post-intervention scores for 202 patients receiving Heidelberg Neuro-Music-Therapy. Multiple statistical estimates were triangulated to determine a minimal clinically important difference. These took into account not only patients' experience of clinical improvement, but also measurement reliability.

Six different anchor- and distribution-based methods estimated the range of minimal clinically important difference between 4.6 and 21 points in global TQ change score from pre- to post- intervention. The size of the measurement error was conspicuous, as was a systematic bias towards a reduction in TQ score even in the absence of any noticeable improvement.

We recommend a change of at least 21 points, especially for interpreting individual patients and in the context of non-randomised or unblinded studies when patients can select or know which intervention they have received. Previous estimates may be too optimistic because they have not accounted for measurement error or bias.

P.03 • Heidelberg Neuro-Music Therapy enhances Resting-state Network Activity in Tinnitus Patients

Argstatter H., Krick C.M., Grapp M., Plinkert P.K., Reith W.

DZM e.V., Heidelberg, Germany

Suffering from tinnitus causes mental distress in most patients. An impaired activity of the brain's resting-state network (RSN), is held responsible for the tinnitus-associated distress. The compact Heidelberg Neuro-Music Therapy (HNMT) has proven to effect a considerable improvement of tinnitus distress by a one-week short-term treatment. The current study intended to measure the related activity levels in RSN before and after the therapy by means of functional MRI (fMRI).

The RSN activity was estimated by analyzing the task-negative activation during long inter-trial intervals in a word recognition task. The RSN level was evaluated twice, before and after a one-week study period, in 18 treated tinnitus patients (TG), 21 passive tinnitus controls (PTC), and 22 active healthy subjects (AC), respectively. During the study week the participants from TG and AC were treated with HNMT, whereas PTC patients did not receive any tinnitus-specific treatment. Tinnitus distress was assessed by the Tinnitus Questionnaire TQ (German version).

The HNMT application over 5 days resulted in a significant decrease in TQ-scores by 17.7 (SD 13.6) TQ scale points in the TG group while in PTC the TQ score did not significantly change over the observation period of

one week. Imaging results revealed an augmented activity in RNS (especially in PCC/precuneus, LP, and MPF) in the TP group but not the PTC group. The treated patients TG exhibited also a rising RSN activity compared to the "treated" healthy participants AC. This result signified the additional tinnitus-related effects among participants with identical HNMT experience. The enhancement of the RSN activity in the precuneus was correlated with a reduction in psychological tinnitus distress as induced by the HNMT.

The localization of increased activity in the precuneus area corresponds with previous finding of structural increase in GM by HNMT. One can assume that the treatment with HNMT initiated a reorganization procedure with opposite direction to the tinnitus effects. The convergence of functional and structural effects in the precuneus confirmed the role of RSN in tinnitus and its relationship to changes in tinnitus-related distress by means of tinnitus treatment.

P.04 • Saccule and tinnitus: Is a possible connection?

Barozzi S., Del Bo L.

Fondazione Ascolta e Vivi, Università degli Studi di Milano, Italia

The saccule is the most mysterious organ of the labyrinth and, for this reason, one of the most fascinating. The aim of this poster is to explain why the saccule should be considered in certain forms of tinnitus.

A review of the anatomic, embryologic and physiologic characteristics that explain why the saccule is the connecting link between the vibratory energy and the vestibular response.

The saccule is a bridge between the anterior and the posterior labyrinth; the saccule has a common embryologic origin with the cochlea in the pars inferior of the labyrinth. The anatomical proximity of the saccule to the stapes suggests that an excessive pressure on the footplate may damage the saccular neuroepithelium which lies close to the oval window. Actually, chronic noise exposure has been associated with saccular dysfunction; a possible role of a tonic tensor tympani contraction is discussed.

Gussen reported that a suffering saccular macula dislodges otolith debris that could reach the cochlea through the ductus reuniens and cochlear duct, thus also affecting the cochlear base and the high frequency hearing thresholds. While the effects of detached utricular otoconia are generally accepted as the cause of BPPV, what happens to the saccular otoconia is not well known yet. An intermittent tinnitus has been described in patients with by BPPV, in the same ear affected by the lithiasis. A new theory of Menière's disease based on detached saccular otoconia has been recently proposed.

Based on these considerations, a cooperation between specialists of various disciplines would be beneficial to fully characterize the role of the vestibular organ on tinnitus.

P.05 • Effects of Transcranial Techniques of Neuromodulation on Tinnitus Perception and Distress: A Systematic Review

Bastos S., Ganz Sanchez T.

Department of Otolaryngology, Ganz Sanchez Institute, Brazil

Aim: Systematically review the literature on the effects of repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) on tinnitus perception and distress/annoyance.

Material and methods: Literature search on PubMed in January 2016 database using the terms "Tinnitus and Transcranial Magnetic Stimulation" and "Tinnitus and Direct Current Transcranial Stimulation". A six-year filter was employed and 254 articles were found.

Results: After applying the selection criteria for randomized clinical trials (RCT) and crossover trials (CrT), 16 articles addressed rTMS (11 RCT + 5 CrT) and 9 tDCS articles (6 RCT and 3 CrT). The Tinnitus Handicap Inventory (THI) was the most used questionnaire in studies on both techniques (16/25, 64%), being administered in 14/16 (87.5%) rTMS studies and 3/9 (33.33%) tDCS studies. The VAS was used in 18/25 (72%) studies on both techniques, being administered in 10/16 (62.5%) rTMS studies and 100% of tDCS studies.A) rTMS: THI dropped 0–30 points B) tDCS: VAS dropped 0–1.2 points. Sustained effect after active stimulation: A) rTMS: 0–26 weeks; B) tDCS: 0–24 weeks.

Discussion: Although some authors consider rTMS a promising therapy, others emphasize its limitations. tDCS seems to transiently suppress tinnitus loudness and annoyance, but no consensus was reached to apply it in routine clinical use. The lack of agreement about the best instrument to evaluate the outcomes, as well as the discrepant criteria for considering an improvement as significant have made the analyses more difficult. Further researches on non-invasive techniques of neuromodulation in tinnitus patients may clarify the present doubts and add available information.

Conclusions: So far, there is not enough evidence that rTMS and tDCS are effective treatments to manage tinnitus perception and distress, particularly because of disagreement regarding the optimal frequency and intensity, as well as short and long-term effects.

P.06 • Validation of the Portuguese Version of Hyperacusis Questionnaire and Comparison of its Diagnostic Skills with Loudness Discomfort Levels

Bastos S., Ganz Sanchez T.

Department of Otolaryngology, Ganz Sanchez Institute, Brazil

The present study aims to validate the Portuguese version of Khalfa's Questionnaire on Hyperacusis (HyperQ) and to check its usefulness in clinical practice by comparing its results with the Loudness Discomfort Levels.

Phase 1: 4 steps: 1) translation of original questionnaire from English into Brazilian Portuguese; 2) original and translated versions analysis and final version with linguistic quality; 3) the final Brazilian version back translated into English; 4) patients' self-application and reapplication of the questionnaire. Data was further analysed for establishing the validation of the questionnaire and the cut-off score matching for diagnosing hyperacusis. Phase 2: recalculation of cut-off score considering Loudness Discomfort Levels results as reference, in a sample of 136 consecutive patients.

Phase one showed that HyperQ is a highly reproducible and consistent questionnaire (Cronbach alpha>0.8). The cut-off score for diagnosing hyperacusis was 14.2 points. In Phase two, considering the classification of hyperacusis according to the LDL values, 72 (52.9%) patients had values compatible with mild, moderate or severe hyperacusis. Among them, the cut-off of HyperQ was decreased to 11.5 points.

In terms of convergent and discriminant validity, there was a progressive correlation between HyperQ and LDL measures. This is in agreement with the literature, which has previously demonstrated that there is a partial correlation between both. As this sample enrolled consecutive patients to be applicated HyperQ, few had severe hyperacusis through LDL. However, it was possible to demonstrate that the lower the LDL results, the higher the correlation with the HyperQ. Future studies with larger samples of patients with severe hyperacusis could demonstrate an even stronger correlation.

The Portuguese version of HyperQ is a valid and reliable tool for diagnosing hyperacusis, and it can be an alternative tool to LDL in clinical practice. The comparison with LDL results showed a reverse correlation between both instruments.

P.07 • Castelli Index among Patients with Tinnitus

Bogacz A., Kazmierczak H.

Otolaryngology Clinic, University Hospital No. 1 in Bydgoszcz, Poland

The aim of the present study is to evaluate the association between lipid disorders and generation of tinnitus among patients presented with tinnitus compared to normal controls.

All patients were having good hearing in tonal audiometry. A case control study concerned with 20 patients presented with tinnitus who underwent lipid profile evaluation. The lipid profile of these patients was compared with corresponding results of 20 persons without tinnitus. All patients were collected from the University Hospital number 1 named dr. A. Jurasz in Bydgoszcz. The average of patients was 41.3 years with a range of 22–60 years. The study included 8 male patients and 12 female. Meanwhile, the average age of the control group was 41 years with range of 25–65 years with 4 males and 16 females.

Statistical analysis showed that there isn't significant difference between lipid profile in all undergo examination patients.

Our results revealed that there wasn't significant difference of Castelli Index between the patients with and without tinnitus.

Concluding, results of Castelli Index seems not to be correlated with the occurrence of tinnitus according to the study.

P.08 • Evidence for a positive association between tinnitus and cervical spine and/or temporomandibular disorders: A systematic review

Bousema E.J., Koops E.A., van Dijk P., Dijkstra P.U.

Department of Otorhinolaryngology, Head and Neck Surgery, University of Groningen, UMCG, the Netherlands

To systematically review the level of evidence and strength of association between subjective tinnitus and cervical spine disorders (CSD) or temporomandibular disorders (TMD).

A systematic literature search of the 'Medline', 'Embase' and 'Pedro' databases was carried out on papers published up to September 2016.

Titles and abstracts were assessed for their relevance by the first author. In the next round selected full text papers were assessed independently by two observers. Inclusion criteria were a 'cross sectional' ' or 'longitudinal' design in which the association between tinnitus and CSD/TMD as a primary or secondary outcome. Associations were expressed as odds ratios. Included papers were assessed for 9 methodological criteria by two observers independently.

In total 2048 papers were identified of which twenty studies met the inclusion criteria. The association with tinnitus ranged from 2.3 (95% CI; 1.5 to 3.6) for arthrogenous TMD to 6.4 (95% CI; 1.9 to 21.6) for patients having unspecified TMD. Funnel plots suggest publication bias. After adjusting for this the odds ratio's decreased, but the association persisted. There is a moderate level of evidence for an association between tinnitus and TMD compared to a low level of evidence for CSD. The level of evidence was generally limited by a lack of blinding, recruitment from different populations and invalidated instruments for assessing CSD. A regression analysis was performed to explore the association between quality sum-scores and odds ratios. A negative trend was identified, but it is not a significant effect.

A positive association between tinnitus and CSD or TMD was found, but some restraints are necessary because of probable publications bias and use of non-validated instruments. Further research should focus on improving methodological quality and diagnosing tinnitus and CSD using validated instruments.

P.09 • Take on Tinnitus: Development of an e-learning portal for people with tinnitus

Carr D., Stockdale D.

British Tinnitus Association, UK

The aim of the Take on Tinnitus project was to design and deliver online concise accurate information to people who were new to tinnitus in a timely and reassuring manner.

After an initial scoping exercise an e-learning programme was developed based on training provided to BTA helpline volunteers, underpinned by BTA information resources. A specialist e-learning company worked alongside BTA staff to develop a series of modules each focusing on a common area of tinnitus. For each module a storyboard and script was produced.

To date the Take on Tinnitus site has received over 1700 registrations from people with tinnitus and quantitative fee dBack from GPs, hearing therapists and audiologists has been extremely positive.

E-learning has become an important part of the support provided to tinnitus patients. An e-learning site such as Take on Tinnitus can provide immediate reassurance to someone experiencing tinnitus for the first time, give basic information on the condition prior to visiting a GP and provide a useful support if waiting for a referral on from the GP to other NHS services.

P.10 • Steroid Intracochlear Distribution Differs by Administration Methods: Systemic vs. Intratympanic Injection

Choo O.-S.[1], Lee J.J.[1], Jang J.H.[1], Han G.[2], Choung Y.-H.[1]

[1] *Department of Otolaryngology, Ajou University, South Korea*
[2] *Department of Otolaryngology, Gachon University, South Korea*

Steroids have been widely used to treat inner-ear diseases including sudden sensorineural hearing loss, tinnitus, and Meniere's disease. They can be given via either systemic or intratympanic (IT) injection. The purpose of the present study was to explore differences in intracochlear steroid distribution by the administration method employed (systemic vs. IT injection).

Twenty-three Sprague-Dawley rats were given fluorescein isothiocyanate-labeled dexamethasone (FITC-DEX) three times (on successive days) via intraperitoneal (IP) or IT injection. Cochlear uptake of FITC-DEX was evaluated via immunohistochemistry and flow cytometry at 6 h, and 3 and 7 days after the final injection.

FITC-DEX uptake was evident in spiral ganglion cells (SGs), the organ of Corti (OC), and the lateral walls (LWs), the basal turns of which were stained relatively prominently in both groups. Animals receiving IP injections exhibited higher FITC-DEX uptakes by the SGs and OC, whereas IT injection triggered higher-level FITC-DEX accumulation by the OC and LWs. Flow cytometry revealed that intracochlear FITC-DEX uptake by IT-injected animals was higher and more prolonged than in those subjected to IP injections.

The preservation of residual hearing, especially in the low frequencies, became one of the main interests in cochlear implantation, because it is known to be important for speech in noise perception, sound localization, and music perception. Combined therapy using both IP and IT steroid injections may be optimal to ensure full cochlear coverage in some cases. In that sense, targeted therapies using steroid could be a future direction for the treatment of hearing loss in the clinical field.

We thus describe differences in cochlear steroid distributions after systemic and IT injections. This finding could help our understanding of the pharmacokinetics of steroids in the cochlea.

P.11 • How to best measure physiologically tinnitus induced by salicylate in rats?

Cosnier-Pucheu S., Larroze-Chicot P., Marie A., Baudoux V., Montejo N., Cardoso M., Laboulais A., Coillot C., Dupont G., de Pellegars P., Alibert E., Cazals Y., Norena A., Goze-Bac C., Gonzalez S.

R&D Department, CILcare, Montpellier, France

The objective of this study is to search for reliable and valid experimental measures of the presence of tinnitus in order to promote the development of treatments against tinnitus. Salicylate consistently induces tinnitus at high doses. Using this salicylate model, we explored three different techniques to detect salicylate-induced alterations: Gap Prepulse Inhibition of Acoustic Startle reflex (GPIAS), auditory cortex electrophysiology and MRI in vivo imaging.

Salicylate is administered in male Long Evans rats by i.p. injection at 300mg/kg/day during 4 days for behavioral and MEMRI studies and a single administration for electrophysiology studies. The GPIAS method was used as behavioral test (Turner et al., 2006). We examined electrophysiological alterations at the auditory cortex using recordings of spontaneous activity and evoked responses from microelectrodes in ketamine anesthetized rats. We used MEMRI together with local 0.2mg/kg transtympanic MnCl2 administration (24h before) at the cochlear round window.

In control animals, a silent gap in a constant acoustic background inhibited the subsequent startle response to a very loud sound burst. Two hours after salicylate treatment we observed less inhibition of this response. We also showed an increase in amplitude of cortical responses evoked by tone bursts over a wide range of frequencies and intensities, changes in spectral profile of local potentials, and an increase of spontaneous spike rates after salicylate administration. Finally, we observed that salicylate increased MRI signals in different brain structures as compared with controls.

The combination of behavioral test, electrophysiology recording and MEMRI in vivo imaging allows to measure putative signs of tinnitus in salicylate rat model and open

the door for screening and characterization of new drug efficacy. Moreover, psychophysical equivalents of GPIAS may be used in humans. And the development of new chemical compounds in order to replace manganese for administration in MRI suggest a putative translation to humans.

Taken together, these preliminary results validate our rat tinnitus-induced models and open the door to the further development of biomarkers and innovative tools for tinnitus assessments.

P.12 • **Comparison of Minimum Masking Level and Residual Inhibition for two types of noise: Adapted White Noise and Windowed White Noise**

Coulon E., Lurquin P., Thill M.P., Lechien J.R.

ENT Department, CHU St. Pierre, Brussels, Belgium

Aim: To determine and assess the efficiency of two tinnitus sound therapies: Adapted White Noise and Windowed White Noise Two specific noises can be provided in order to diminish the neural correlates of tinnitus: 1) Adapted White Noise. In this case the noise is only stimulating the hearing loss region. Improvement of tinnitus severity is primarily due to neuronal adaptation and homeostatic plasticity 2) Windowed White Noise. Built by removing the octave centered on the tinnitus frequency, its improvement is mainly due to lateral inhibition.

Material and methods: Pitch match frequency, Minimum Masking Level (MML) and Residual Inhibition (RI) were measured on twenty six patients for each specific noise.

Results: Significant differences between both therapeutic noises (Manova Test, $F(3.23)=3.80$, $p < .05$) and between both MML ($t25=-2.63$, $p \leq 0.05$) were found. Conversely no significant difference between both RI ($t25=-0.979$, $p > 0.05$) was obtained. A weaker effect of both therapeutic noises was also observed for high frequency tinnitus.

Discussion: Based on our results, the Matched Noise Stimulation seems more efficient mainly with regards to the MML. Nevertheless with those measurement, it remains impossible to foresee the eventual efficiency of one of the two noises in the scope of a long term sound therapy.

Conclusions: The Matched Noise Stimulation seems more efficient mainly according to the MML.

P.13 • **Epidemiology and risk factors for tinnitus after leisure noise exposure in Flemish young-adults**

Degeest S., Keppler H., Corthals P., Clays E.

Department of Speech, Language and Hearing Sciences, Ghent University, Belgium

Young people expose themselves to loud music during leisure activities and therefore are at risk for acquiring tinnitus. The aim of this study was to examine the prevalence of leisure noise-induced tinnitus among Flemish young-adults as well as to examine the relation with baseline sociodemographic factors, hearing-related symptoms and attitudes and beliefs towards noise.

A self-administered questionnaire was completed by 517 subjects (18–30 years). The questionnaire evaluated the prevalence and characteristics of noise-induced tinnitus, the amount of leisure noise exposure as well as attitudes towards noise and hearing protection using the Youth Attitudes to Noise Scale and the Beliefs About Hearing Protection and Hearing Loss instrument. First, the univariate relation of each variable with the presence of tinnitus was evaluated and second, a logistic regression model was tested to examine which variables were related to the presence of chronic tinnitus.

Transient and chronic tinnitus occurred in 68.5% and 6.4% of the sample, respectively. Chronic tinnitus showed similar characteristics as transient tinnitus regarding type of sound, localization and pitch. Chronic tinnitus was more prevalent in male subjects and associated with poorer subjective hearing and with more frequent occurrences of dullness. Furthermore, subjects with chronic tinnitus were more aware of the risks of loud noise and the importance of wearing hearing protection. Finally, a higher life-time accumulated level of leisure noise was associated with chronic tinnitus.

Leisure noise-induced tinnitus is frequently observed in young Flemish adults. Results also indicate that persons with chronic tinnitus were exposed to a higher noise dose during their lives. However, they are more aware of the risks of loud noise and more often wore hearing protection. Longitudinal studies are needed to evaluate whether the experience of chronic tinnitus has led to these behavioral changes.

The findings of this study underpin the importance of educating youth about the risks of leisure-noise exposure.

P.14 • **Turkish Adaptation of Khalfa Hyperacusis Questionnaire**

Erinç M., Derinsu U.

Department of Audiology, Marmara University, Turkey

The aim of this study is to adapt Khalfa Hyperacusis Questionnaire into Turkish for the use of diagnosis and treatment of people with hyperacusis complaint.

The Turkish translation of Khalfa Hyperacusis Scale and Beck Anxiety Inventory were applied to randomly selected 529 adults from the general population. For the evaluation of the data, confirmatory and exploratory factor analysis, correlation analysis, descriptive statistics, t-test, ANOVA and Sidak correction were used. In the reliability analysis, Cronbach's Alpha internal consistency coefficient was determined as 0.81.

Three sub-dimensions (attention, social and emotional) were identified as the result of factor analysis applied to determine the sub-dimensions. The total variance of these 3 dimensions were 63% and the internal consistency of the sub-dimensions was also high (0.75, 0.77, 0.73). Confirmatory Factor Analysis and Structural Equation Modeling

results indicated that a three-factor solution with 14 items met the criteria standards for adequacy of fit among Turkish adults. A new criterion, "Likelihood hyperacusis", has been added to the interpretation of the scores obtained in order to consider patients with different types of hyperacusis complaints.

As a result of the measurements, 14 questions and 3 factors solution were concluded to be valid and reliable tool.

P.15 • Alexithymia and strategies of coping with stress in people with tinnitus and in people with postlingual deafness – a comparison study

Fludra M., Kobosko J., Karendys-Luszcz K., Gos E., Geremek-Samsonowicz A., Skarzynski H.

World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland

Alexithymia is a significant inability to access own emotions – both in relation to their mental representation and behavioral and physiological markers. It manifests through difficulties in recognizing and naming emotions, problems with differentiating physiological from emotional arousal, paucity of imagination and operational thinking style. This deficit of emotional regulation is involved also with limited ability to cope with stress. The aim of this study was to compare people with tinnitus and postlingually deafened cochlear implant users with regard to the intensity of alexithymia, used stress coping strategies and relation between alexithymia and used coping strategies.

In the study participated people with tinnitus (n=53) and postlingually deaf cochlear implant users (n=37). The level of alexithymia was measured using the TAS-20 questionnaire, while assessment of typical methods of coping in situations of strong stress was performed using the Stress Coping Inventory Mini-COPE. Study participants have filled in also a sociodemographic survey. Studies have been performed during rehabilitation retreats organized by the Institute of Physiology and Pathology of Hearing.

People with tinnitus have lower levels of alexithymia compared to postlingually deaf cochlear implant users. Statistically significant differences are related to the component of that construct that is operational thinking. In people with tinnitus higher levels of alexithymia are related to increased use of such stress coping strategies as disengagement and self-blame. In people with postlingual deafness using cochlear implants higher levels of alexithymia are ties to less frequent use of planning as a stress coping strategy, while increased difficulty with identifying emotions in this group is related with more frequent use of denial strategy.

People with tinnitus and postlingually deaf cochlear implant users differ in terms of alexithymia levels and used stress coping strategies. It is worth to make use of the alexithymia level assessment if patient has problems in the course of treatment and therapy.

P.16 • Tinnitus development is associated with synaptopathy of inner hair cells in Mongolian gerbils

Forster J., Wendler O., Buchheidt-Dorfler I., Krauss P., Schilling A., Sterna E., Schulze H., Tziridis K.

ENT Hospital Erlangen, Experimental Otolaryngology, Friedrich Alexander University Erlangen-Nurnberg, Germany

Hearing loss (HL) in humans is often accompanied by comorbidities like tinnitus. This perception of a phantom sound without external stimulation is affecting up to 15% of the adult population and can lead to psychological disorders like depression to the point of suicide. Animal studies in rodents could show that tinnitus may not only be a result of HL due to cochlear hair cell damage but can also be a consequence of a synaptopathy at the IHCs already induced by moderate sound traumata (hidden HL).

We aimed to reproduce the synaptopathy shown in mice in our animal model, the Mongolian gerbil, and relate it to tinnitus.

Tinnitus was induced by a mild monaural acoustic trauma leading to monaural noise induced HL (NIHL) as quantified by auditory brainstem response (ABR) audiometry. Behavioral signs of a tinnitus percept were detected by pre-pulse inhibition of the acoustic startle response in a gap-noise paradigm. 14 days after trauma the cochleae of traumatized and non-traumatized ears were isolated and IHC synapses were counted for several spectral regions of the cochlea.

We found a tinnitus (T) percept in hidden or apparent hearing loss animals (72.7%) and no tinnitus (NT) in 27.3% animals. The main finding is a frequency specific reduction in IHC synapse counts, most prominently one octave above the trauma frequency in T animals only and independent of the kind of hearing loss. Animals with apparent hearing loss but without tinnitus showed a reduction in amplitudes of auditory brainstem response waves I/II (cochlear nerve and dorsal cochlear nucleus) but no significant changes in the number of synapses at the IHC.

The rate of tinnitus in the animals is well in the range of previous results as are the differences in ABR amplitudes between T and NT animals. A 25% reduction of synapses in T animals was located one octave above trauma frequency, a range frequently reported to reflect the perceived tinnitus frequency in Mongolian gerbils. The exact cause of NT animals not showing this reduction remains elusive, but a number of possibilities are conceivable, like stereocilia damage to high threshold hair cells or the animals' noise protection efferent system being more efficient.

Taken together, we conclude that at least in our animal model, a hearing threshold increase induced by mild acoustic trauma is associated with synaptopathy at the IHC and/or OHC damage, while tinnitus seems to be associated with IHC synaptopathy only, independent of threshold increase.

P.17 • Analysis of audiometric differences of patients with and without tinnitus in a large clinical database: Does tinnitus have a functional benefit?

Gollnastt D., Tziridis K., Krauss P., Schilling A., Hoppe U., Schulze H.

ENT Hospital Erlangen, Experimental Otolaryngology, Friedrich Alexander University Erlangen-Nurnberg, Germany

Human hearing loss (HL) and comorbidities like tinnitus pose serious problems for people's daily life which in most severe cases may lead to social isolation, depression and suicide. Here we investigate the relationship between hearing deficits and tinnitus.

To this end we conducted a retrospective study on anonymized pure tone and speech audiometric data from patients of the ENT hospital Erlangen in which we compare audiometric data between patients with and without tinnitus. Overall data from 37661 patients with sensorineural (SHL) or conductive hearing loss (CHL) with (T, 9.5%) or without (NT, 90.5%) a tinnitus percept in different age groups and with different tinnitus pitches were included in this study.

The pure tone audiometry comparisons showed significant differences in T patients compared to NT patients. In young patients, we generally found lower hearing thresholds (HT) in T compared to NT patients. In adult patients, differences were more heterogeneous: HT in T patients were lower in low frequency ranges, while they were higher at high frequencies. Furthermore, lower thresholds were more often found in CHL patients and could rarely be detected in SHL patients. In speech audiometry only CHL patients with high pitched tinnitus showed lower thresholds compared to NT patients' thresholds.

The results of this study may point to a biologically plausible functional benefit on hearing thresholds in HL tinnitus patients. We hypothesize that the physiological mechanism of stochastic resonance counteracts HL by adding neuronal noise to the system. This neuronal noise may induce changes in the auditory pathway and finally – as a side effect of threshold improvement – lead to the development of a tinnitus percept.

We propose a general model of changed hearing thresholds in T patients, being either decreased or increased compared to NT patients.

P.19 • A good practice guideline for translating questionnaires in ENT and Audiology

Hall D.A.[1,2], Domingo S.Z.[1,2], Hamdache L.Z.[1,2], Manchaiah V.[1,2], Thammaiah S.[1,2], Evans C.[1,2], Thompson D.[1,2], Wong L.[1,2]

[1] NIHR Nottingham Biomedical Research Centre, UK
[2] Otology and Hearing Group, University of Nottingham, UK

When a patient-reported questionnaire is not available in the required language, translating existing instruments and exploring their psychometric properties are usually the preferred options when selecting patient-reported measures. Best practice in the process of translation of patient-reported questionnaires is still a developing field, and numerous guidelines have been published for adapting questionnaires to cross-cultural settings. Such international guidelines do not appear to be widely known or universally applied in the field of ENT and Audiology.

We are synthesizing existing knowledge to describe good practice for those who seek to increase confidence in accomplishing a high-quality translation. The selection of the precise method will eventually depend upon the competences, resources and timelines of the project. But our recommendations are based on common elements of several existing well-known guidelines that have drawn in the past on expert working party recommendations. We illustrate with published examples how the underlying steps have been applied in the translation of hearing loss and hearing-related questionnaires.

This project raises awareness of international progress in ENT and Audiology for creating local language-specific new versions of existing validated questionnaires for use in a different language communities, countries or cultures.

Acknowledgement: This project is supported by the International Collegium of Rehabilitative Audiology (ICRA) and the COMiT initiative (Core Outcome Measures in Tinnitus).

P.20 • The background noise tolerance in hearing-aided patients with tinnitus who underwent Tinnitus Retraining Therapy

Huang C.-Y., Chang Y.-C.

Department of Otolaryngology Head and Neck Surgery, Taipei Veterans General Hospital,Taiwan

This study was intended to explore the relationship between tinnitus perception and background noise tolerance in hearing-aided subjects with tinnitus who underwent Tinnitus Retraining Therapy (TRT).

Twenty hearing-aided subjects with tinnitus who underwent TRT were recruited as experimental group (EX). The control group (CO) contained twenty tinnitus subjects with only high-tone hearing loss. The tinnitus distress of both groups was evaluated using the Tinnitus Handicap Inventory (THI) before and after 6 months of TRT. Background noise tolerance was parameterized as follows: most comfortable level (MCL), acceptable background noise level (BNL), and acceptable noise level (ANL). Changes in THI, MCL, BNL and ANL before and after TRT were analyzed utilizing the paired t-test in both groups.

Before and after TRT, there were significant differences in THI scores in both groups. There were no significant changes in background tolerance in the EX group. But the BNL and ANL values in the CO group were significantly changes after TRT. The difference in the functional subscale of THI in CO group showed a significant correlation with the change in BNL and ANL.

The effect of TRT and sound therapy on background noise tolerance may be different in different hearing status. Our

results demonstrated that TRT could effectively improve tinnitus stress in our subjects of both groups. But the effect of TRT on their background noise tolerance were different between the hearing-aided and high-tone loss subjects.

P.21 • The Update of Clinical Tinnitus Classification and Management

Huang C.-Y., Lai J.-T.

Department of Otolaryngology-Head and Neck Surgery, Taipei Veterans General Hospital, Taiwan

The origin of tinnitus was first thought to come from the ear itself, i.e. cochlea or inner ear. However, after accumulation of more than 20 years in clinical experience, we found chronic tinnitus concomitant with a variety of undetected patho-physiological disturbances such as Eustachian tube dysfunction, silent paranasal sinusitis, gastro-esophageal reflux, menopause associated syndromes, obstructive sleep apnea syndromes, drug addiction, insomnia and depression.

This notion (the 1st generation) makes tinnitus equivalent to hearing loss, which consequently developed the treatments focused on hair cell reactivation and tinnitus-masking with external sound. But their clinical results were unsatisfactory.

In 1990s, through the hypothesis neurophysiological model, tinnitus was postulated (the 2nd generation) to come from the central nervous system, i.e. the brain and a variety of clinical symptoms, or even a vicious cycle, could be ignited while the tinnitus aversive reaction arousing our limbic and autonomic systems. During this period, Tinnitus Retraining Therapy-TRT was introduced to treat tinnitus with direct counseling and sound therapy.

In late 90s, more psychologists and psychotherapist were involved in tinnitus treatment with Cognitive behavior therapy-CBT, which clinically merited as good and effective results as TRT. This experience summarized into a new notion (the 3rd generation) of tinnitus treatment in 2000s – through a positive, encouraging and informative explanation to eliminate patients' dread for tinnitus and to inhibit the over-compensation for tinnitus in the central system.

Recently, a new hypothesis about a tinnitus control system – frontostriatal gating– was developed to explain the co-existence of chronic tinnitus and other pathologic disturbances. By rebalancing the tinnitus control system and eliminating the undetected disorders, tinnitus might be well-controlled even it is still perceived or existed (the 4th generation).

P.22 • Comparisons of wave I amplitude and uncomfortable loudness level between the tinnitus ears and non-tinnitus ears in subjects with a normal audiogram

Hyun Joon Shim H.J., An Y.-H., Kim D.H.

Department of Otorhinolaryngology, Eulji University, Eulji Medical Center, Seoul, South Korea

Recently, several studies demonstrated that in subjects with tinnitus and normal audiograms, auditory brainstem responses (ABRs) showed significantly reduced amplitudes of the wave I potential compared to those of control subjects but normal amplitudes of the wave V (so-called "hidden hearing loss"). We aimed to reconfirm the differences of amplitude of wave I or V between tinnitus ears (TEs) and non-tinnitus ears (NTEs) within same subject, and to evaluate whether the uncomfortable loudness level (UCL) would be decreased in TEs of unilateral tinnitus subjects with normal audiograms.

Subjects included 40 unilateral tinnitus subjects (33.35 ± 13.93 years, 21 males, 19 females) with normal and symmetric hearing thresholds (<20 dB HL at 0.25, 0.5, 1, 2, 3, 4, and 8 k Hz), and 36 control subjects with normal audiograms. The amplitudes of wave I and V from peak to following trough were measured two times at 90 dB nHL (13.3 per sec click, 1500 sweep), and UCLs were checked at 500 Hz and 3000 Hz in each TEs and NTEs separately.

The within-subject comparison between the TEs and NTEs showed no significant differences of mean amplitude of wave I or wave V or wave V/I ratio in both male group and female group. Four cases of increased V/I amplitude ratio over 2 standard deviations were found. There was not significant difference of mean UCL at 500 Hz or 3 k Hz between the TEs and NTEs (110.88±6.90 vs. 108.82±9.11 dB HL at 500 Hz and 104.12±7.75 vs. 103.53±11.15 dB HL at 3 k Hz respectively), but UCLs of both TEs and NTEs were significantly lower than UCLs of controls.

"Hidden hearing loss" seems to occur when there is a minimal cochlear damage or synaptic ribbon loss not giving rise to a threshold shift but inducing tinnitus. However, our results suggest that "hidden hearing loss" is not a common case in tinnitus subjects with normal audiograms. We hypothesized that if reduced neural output from cochlea compensated in brainstem by increased central gain in tinnitus subjects with normal audiograms, their UCLs might be decreased, but it was not true.

Although several TEs showed extremely high V/I amplitude ratios implying increased central gain, we could not find meaningful evidence supporting the hypothesis of "hidden hearing loss" in overall ABR data of tinnitus subjects with normal audiograms. In general, tinnitus subjects with normal audiograms had reduced sound level tolerances than control subjects.

P.23 • Vestibular system aspects in tinnitus patients

Jozefowicz-Korczynska M., Pajor A.

ENT Department, Medical University of Lodz, Poland

The aim of the study was to investigate the current evidence regarding relationship between tinnitus and balance system.

A search of the online databases PubMed, Web of Science, and Embase was performed up until November 2016. The search strategy was based on the combination of the tinnitus and search terms: videonystagmography, electronystagmography, oculomotor tests, eye movement, saccades, smooth pursuit, gaze-evoked, dizziness, vestibular system, balance system. Only original research articles written in English concerning adults and when some oculomotor or video or electro nystagmography vestibular tests were performed in the study were included in the review.

From 533 articles ten studies were included in the review, eight of them investigate oculomotor system and two – gaze-evoked tinnitus. These studies show increase in the degree of distortion and a reduction in the gain, dysmetry and disconjugation in oculomotor tests in comparison with control group. Despite the different methodological approach in the included studies they show that tinnitus can lead to dysregulation auditory, oculomotor and vestibular interactions. Different tinnitus clinical patterns show up the central involvement.

Tinnitus is frequently associated with hearing loss, but uncommonly with vertigo and dizziness. However there is a hypothetical possibility that abnormalities may arise in the balance system in tinnitus patients, due to anatomical proximity of the structures of the inner ear and some connections between central auditory pathways, cerebellum and limbic system. Particularly deficits for vertical pursuit eye movements and fixation instability in line with cerebellar signs.

The authors conclude that the results suggest mild dysfunction of cortical–subcortical and cerebellar structures involved in the control of eye movements in tinnitus patients.

P.24 • Development of musical skills after cochlear implantation

Kaczynska B.[1], Skarzynski H.[1,2,3], Skarzynska M.B.[1,4], Wanatowska O.[1]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Faculty of Audiology and Phoniatrics, Fryderyk Chopin Academy of Music, Warsaw, Poland*
[3] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

Introduction: The main goal of cochlear implantation in cases of congenital or acquired total or partial deafness is to enable development of hearing, speech and communication skills. Excellent results of rehabilitation in a very large group of implant users in different ages have led to inclusion of musical abilities' development as a measure of evaluation of the progress of therapy. This shows clearly that music can provide an outstanding support for both hearing and artistic development, as well as for a tinnitus therapy. The goal of this study is to present a unique case study of a teenage boy operated because of severe sensorineural hearing loss.

Material and methods: Material is a patient with severe congenital hearing loss with preserved non-functional residual hearing in low frequencies and with tinnitus. The patient has been implanted with a Med-El type cochlear implant with a flexible electrode according to the Skarzynski surgical procedure. One of the decisive aspects of in his hearing and speech rehabilitation was music.

Results: Effective process of hearing, speech and language development has been overtaken or accompanied by the development patient's music skills. During the first period of rehabilitation, the work consisted in acquiring music skills necessary for replaying iconic classical melodies, with emphasis placed on low and medium hearing frequencies. At next stage of patient's musical development, his ability to create new musical forms, supported by practical achievements has been observed. It had a significant influence not only on speech development, but also on the elimination of tinnitus.

Conclusions: Treatment of various types of deafness and severe sensorineural hearing loss with help of cochlear implant provides possibilities of hearing, speech and language development, reduction of tinnitus and finally musical development of implant users.

P.25 • Music therapy programme and tinnitus after cochlear implantation

Kaczynska B.[1], Skarzynski H.[1,2,3], Szkielkowska A.[2], Skarzynska M.B.[1,4], Wolujewicz K.[1]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Faculty of Audiology and Phoniatrics, Fryderyk Chopin Academy of Music, Warsaw, Poland*
[3] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

Introduction: Long-term rehabilitation after cochlear implantation in various types of deafness and severe sensorineural hearing loss concerns not only hearing and speech development or language communication. One of the important problems, in which music has a significant influence, is therapy of tinnitus that is a concurrent symptom particularly common in partial deafness. Music therapy programme comprises several stages of artistic development of cochlear implant users. The goal of this report is to evaluate the role of music in a standard rehabilitation process after cochlear implantation.

Material and methods: Study group consisted of patients with partial deafness and preserved non-functional residual hearing. All patients were operated according to Skarzynski's 6-step surgical procedure with application of

flexible electrodes of adequate length from 24 to 31 mm accordingly to the level of preoperative hearing.

Results: Programme of postoperative rehabilitation, standardized in form and yet individualized in content, has been enriched by music classes for all of patients. According to the patients themselves and their closest environment – parents and family members, incorporation of the music classes has contributed to intensification of the rehabilitation process and quick acquisition of hearing and language skills. Simultaneously, among the group of teenage and adult patients whose hearing loss had progressive character and involved both ears, a significantly positive music influence on decreasing or eliminating tinnitus was observed.

Conclusions: Supplementing the traditional programme of postoperative rehabilitation after cochlear implantation in various types of deafness and severe sensorineural hearing loss with appropriate musical elements has a significant influence on acquisition of hearing and language skills and tinnitus reduction.

P.26 • Clinical evaluation of neuronavigated repetitive transcranial magnetic stimulation for tinnitus relief: Preliminary findings

Kam A.C.S.

Department of Special Education and Counselling, The Education University of Hong Kong, Hong Kong

The objective of this study was to assess the efficacy of neuronavigated low-frequency repetitive transcranial magnetic stimulation (rTMS) on tinnitus.

This was a randomized controlled trial. Fifteen subjects were randomized prospectively into 3 groups: 1) real rTMS of the right dorsolateral prefrontal cortex (DLPFC), 2) real rTMS at the left primary auditory cortex (LA) and 3) sham rTMS at the left primary auditory cortex (SA). After 10 sessions of therapy, immediate outcomes were compared using the 1) Chinese Tinnitus Handicap Inventory, 2) Chinese Tinnitus Questionnaire, 3) self-rated visual analogue scale on tinnitus loudness, and 4) tinnitus loudness matches measured psychoacoustically.

The Chinese Tinnitus Questionnaire score was significantly lowered in the LA group as compared to the DLPFC and SA group. No significant difference was observed among all three groups in psychoacoustic measures. No adverse effect was observed or reported in the subjects. Data collection in a larger sample size is needed.

Preliminary results suggest that rTMS at the left primary auditory cortex may be effective for tinnitus relief.

P.27 • Interpersonal support of adults suffering from tinnitus compared to cochlear implant users with postlingual deafness. The role of socio-demographic variables

Kobosko J., Fludra M., Gos E., Geremek-Samsonowicz A., Skarzynski H.

World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland

Introduction: Social support received from other people has huge impact on quality of life and health, especially in situations related to health problems, such as tinnitus or acquired disability like postlingual deafness.

Aim: To investigate if people with tinnitus but with no accompanying hearing loss are different from people with postlingual deafness who are cochlear implant (CI) users, in terms of received social support and the role of socio-demographic data.

Material and methods: Study participants were people with tinnitus (n=52) and CI users with postlingual deafness. Mean age was 55 years. Interpersonal support was measured using the ISEL-40 scale (Cohen et al., 1985). Socio-demographic and health-related information was collected with an information questionnaire. Measures were conducted during rehabilitation retreats organized by the Institute of Physiology and Pathology of Hearing.

Results: People with tinnitus receive significantly more interpersonal support than postlingually deaf CI users overall and in different subscales: tangible support, self-esteem support, belonging support and appraisal support. The perceived strength of support received by people with tinnitus is similar to general population. No significant differences were observed in terms of interpersonal support intensity within each group with regard to sex, education or employment status. No relationship was observed between age and interpersonal support in both groups.

Conclusions: Perceived interpersonal support received by people with tinnitus is on the level similar to a general population. Thus in spite of being afflicted with tinnitus these people can have better quality of life related to interpersonal relationships compared to people with postlingual deafness using CI. There is still a question whether this reported social support is not a result of e.g. denial of problems in social relationships by people with tinnitus, which needs to be investigated.

P.28 • Effect of Tinnitus Distress on Quality of Life in Patients with Vestibular Schwannoma: Multidimensional Analysis

Kojima T., Oishi N., Suzuki N., Ogawa K.

Department of Otolaryngology, Head and Neck Surgery, School of Medicine, Keio University, Japan

Tinnitus is one of the most common symptoms in patients with vestibular schwannoma. Although 70 to 80 percent of the patients experience this symptom, few studies showed an effect of tinnitus on quality of life (QOL). Several studies have indicated a change in tinnitus after

surgical treatment, however, reports on the impact that tinnitus influences QOL in patients with conservative observation is deficient. The aim of this study is to evaluate the effect of tinnitus distress on QOL of patients who receive conservative observation.

This prospective study included patients with vestibular schwannoma who receive wait-and-scan follow-up from October 2016. We used SF-36v2 health survey as a questionnaire assessing QOL in individuals. Regarding variables, we analyzed patient background, tumor size, auditory function and self-registering questionnaires, which included the Tinnitus Handicap Inventory, the Dizziness Handicap Inventory, the FaCE scale, and Visual Analog Scale of subjective hearing impairment.

We suppose that QOL in patients with vestibular schwannoma reflects severity of tinnitus, as well as the interrelationship of patient background, auditory function and subjective severity of hearing impairment, dizziness, and facial dyskinesia.

This multidimensional analysis studied effect of tinnitus distress on patients QOL with conservatively observed vestibular schwannoma from an otolaryngologist's perspective. We included only the individuals who received wait-and-scan follow-up; therefore, our results may facilitate to decide a treatment plan. Various patients' status that includes one's background and degree of dysfunction reflected QOL of patients with vestibular schwannoma. Physicians should consider a course of remedy from various respect of patients' situation.

P.29 • **Hidden hearing loss and tinnitus laterality**

Lee H.Y., Cha W.W., Seo Y.M.

Department of ORL-HNS, Eulji University, South Korea

We aimed to assess the auditory brainstem response (ABR) and distortion product oto-acoustic emissions(DPOAEs) findings in tinnitus with normal audiogram.

The audiologic testing was performed in twenty-eight patients with non-pulsatile chronic tinnitus between January 2015 and December 2016. Their results were compared to ninety-five normal control who underwent regular medical check-up during same period.

No significant difference in the ABR results between tinnitus group and control group ($p>0.05$). For unilateral tinnitus, the ABR and DPOAEs findings in patients were not different from normal control. In contrast, patients with bilateral tinnitus showed a shortening of latency in ABR wave III on the right side ($p=0.047$), wave V on the left side ($p=0.024$) as well as having more absent DPOAEs compared to normal control ($p<0.001$).

Different mechanism may be involved in the generation of tinnitus with normal hearing based on tinnitus laterality. We assumed that bilateral tinnitus is associated with abnormalities in auditory pathway from hair-cell dysfunction to brain. In contrast, unilateral tinnitus in normal hearing is caused by change in non-classical auditory pathway. Abnormal ABR and DPOAEs findings were more commonly found in normal hearing with bilateral tinnitus compared to unilateral tinnitus.

P.30 • **The alteration of auditory evoked potential after electroacupuncture in animals**

Lin C., Wang T.-C., Chung H.-K., Chen Y.-H.

Department of Otolaryngology Head and Neck Surgery, China Medical University and Hospital, China

Electroacupuncture (EA) has its neuromodulatory role in the management of several neuro-otological disorders such as tinnitus. In order to elucidate the effect of EA in these neuro-otological disorders, the physiological changes in the central auditory tract after EA need to be clarified.

Adult SD rats were used for this study. EA was performed in different acupoints or the tail after the animals were sedated. Early and late auditory evoked potential (AEP) were recorded before and after the EA procedure. Further recording of AEP was performed after resection of vagus nerve resection or local regional nerve.

Compared with the control groups, EA at different acupoints could induce variable AEP latency alterations. EA at the common ear acupoints (Zhongzhu, Ermen and Tinghui) would induce more consistent prolongation of AEP latencies. Such AEP alterations would recover three days after cessation of EA. Using Zhongzhu acupoint to study the effect of vagus nerve and local nerve, the AEP changes become less evident after vagus nerve or local nerve (median/ulnar nerve) resection. All the EA procedures do not influence auditory brainstem response (ABR) threshold in animals.

This study showed that EA at common ear acupoints would induce a consistent alteration in AEP latencies, which do not affect the ABR hearing level. Such alterations may recover in short days after EA. This demonstrates the neuroplastic change in central auditory tract after EA. Vagus nerve or local nerve may play some role in these plastic changes.

EA at common ear acupoints may cause some neuroplastic changes in central auditory tract.

P.31 • **Extractions of steady state auditory evoked fields in normal subjects and tinnitus patients using complementary ensemble empirical mode decomposition**

Lin P.-Y., Wang K.-W., Lee P.-L., Shiao A.-S., Li L. P.-H.

Department of Otolaryngology, Cheng-Hsin General Hospital, Taipei, Taiwan

Auditory steady-state response (ASSR) can be measured using electro-encephalography (EEG) and magnetoencephalography (MEG), referred to as steady-state auditory evoked potential (SSAEP) and steady-state auditory evoked field (SSAEF), respectively. However, the signal level of SSAEP and SSAEF are weak so that signal processing technique is required to increase its signal-to-noise ratio.

In this study, a complementary ensemble empirical mode decomposition (CEEMD)-based approach is proposed in MEG study and the extraction of SSAEF has been demonstrated in normal subjects and tinnitus patients.

Ten subjects (5 normal and 5 tinnitus patients) were studied. The auditory stimulus was designed as 1 k Hz carrier frequency with 37 Hz modulation frequency. Two channels in the vicinities of right and left temporal areas were chosen as channel-of-interests (COI) and decomposed into IMFs. The spatial distribution of each IMF was correlated with a pair of left- and right-hemisphere spatial templates. IMFs with spatial distributions highly correlated with spatial templates were identified using K-means and those SSAEF-related IMFs were used to reconstruct noise-suppressed SSAEFs.

The current strengths estimated from CEEMD processed SSAEF showed neural activities greater or comparable to those processed by conventional filtering method. Both the normal and tinnitus groups showed the phenomenon of right-hemisphere dominance. The mean current strengths of auditory-induced neural activities in tinnitus group were larger than the normal group.

ASSR induced by repetitive auditory stimulus is commonly used for audiometric testing. Human ASSR has been reported as an effective tool for the measurements of hearing loss in adults and children, Anesthesia level, and tinnitus. Since the SNR in ASSR signal is weak, it usually requires average over a large amount of epochs for noise suppression. A complementary ensemble empirical mode decomposition (CEEMD)-based approach may be up to the task.

The present study proposes an effective method for SSAEF extraction. The enhanced SSAEF in tinnitus group echoes the decreased inhibition in tinnitus's central auditory structures as reported in previous studies.

P.32 • Tinnitus and hearing profiles in patients with vestibular migraine

Liu T.-C.

Department of Otolaryngology, National Taiwan University Hospital, Taiwan

Aim: To investigated the hearing condition and occurrence of tinnitus in patients with vestibular migraine.

Material and methods: This study retrospectively analyzed the pure tone audiometry and tinnitus history in 40 cases of vestibular migraine (VM) diagnosed based on the IHS criteria. These cases were also evaluated by AAO's criteria for the diagnosis of Meniere's diseases (MD).

Results: Among our 40 patients, 7 cases also meet the criteria of MD. The overlap rate is 17.5%. In the remaining 33 cases with "pure" VM, 26 (79%) of them had completely normal hearing. 7 (21%) had mild high frequency hearing loss and none had low frequency hearing loss. Two patients (6%) experienced high frequency tinnitus and one (3%) complained of aural fullness. In the 7 overlapped cases, all of them had low frequency hearing loss, aural fullness with chronic tinnitus.

Discussion: The presenting auditory symptoms of VM are controversial in the literature. Some reports revealed over 38% of tinnitus, aural fullness and hearing loss during vertigo attack. Substantial overlapping of VM and MD was also demonstrated before. In our series, we found that in pure VM, few patients experienced tinnitus or aural fullness, and their hearing are mostly normal. This is may be helpful in differential diagnosis of VM and MD.

Results: In our series, excluding the overlapped Meniere's diseases, most patients with pure vestibular migraines have normal hearing or mild hearing loss. Tinnitus and aural fullness are also rare. Vestibular migraine is primarily a disease that affects balance rather than hearing system.

P.33 • Impact of tinnitus on the partner

Lurquin P., Real M., Thill M.P., Lechien J.R.

ENT Department, CHU St Pierre, Brussels, Belgium

To assess the impact of tinnitus on quality of life of the partner of the patient and, overall, on the couple's quality of life.

Forty outpatients and their partners were enrolled in this study. Patients received Tinnitus Retraining Therapy and were assessed along the trial with Tinnitus Handicap Inventory (THI), Jastreboff's Structured Interview (JSI) and a visual analog scale to measure intensity, awareness, annoyance and impact of the tinnitus on life. At the same time, the partners fulfilled separately the same questionnaires and were invited to respond to them as they were in place of the patient. Partners also fulfilled a third questionnaire measuring the couple's life degradation related to tinnitus.

The complaints of the partner were significantly higher than patient's own concerning intensity, annoyance and impact on quality of life ($p<.05$). Only the awareness item seemed to be in accordance with the patient's result. The partner also considered that friends and family of the patient systematically underestimated the problem of the patient.

Our study revealed a negative significant correlation between quality of life of the partner and tinnitus annoyance, intensity, and awareness ($p<.05$). Too few previous studies had been done on tinnitus partner advice, distress and suffering.

We suggest (if possible) to incorporate the partner in every counselling session. Tinnitus has a significant impact on quality of life of both the patient and the partner impacting on the couple's life. Couple psychological care must take a prominent place in the management of the disease.

P.34 • The value of Eye Movement Desensitization Reprocessing in the treatment of tinnitus

Luyten T., Gilles A., Jacquemin L., Van Looveren N.,Declau F., Fransen E., Van de Heyning P.

Department of ENT and Head and Neck Surgery, University Hospital Antwerp, Belgium

Current therapy forms most often provide psychotherapeutic treatment which are intended to train the patient how to deal with the tinnitus sound. Tinnitus Retraining Therapy (TRT) and Cognitive Behavioral Therapy (CBT) may significantly improve the quality of life for tinnitus patients but are not always sufficiently effective. Recent insights show that Eye Movement Desensitization Reprocessing (EMDR) may increase effectivity of psychotherapy. The aim of this randomized, controlled study with blind evaluator is to examine the effect of EMDR compared to CBT in chronic tinnitus patients.

Patients with subjective, chronic, non-pulsatile tinnitus will be randomized in two treatment groups: TRT and CBT versus TRT and EMDR. Evaluations will take place at baseline before therapy, at the end of the treatment and 3 months after therapy. The score on the Tinnitus Functional Index (TFI) will be used as the primary outcome measurement. Secondary outcome measurements will be the Visual Analogue Scale of Loudness (VAS), Tinnitus Questionnaire (TQ), Hospital Anxiety and Depression Scale (HADS), Hyperacusis Questionnaire (HQ) and psychoacoustic measurements.

The objective is to evaluate whether the bimodal therapy TRT and EMDR can provide faster and/or more relief from the annoyance experienced in chronic tinnitus patients' daily lives compared to the bimodal therapy TRT and CBT. This is, to our knowledge, the first prospective, randomized, controlled, clinical trial with blind evaluator that uses TRT and EMDR as a treatment for tinnitus. To date, patient recruiting and treatment has started.

EMDR could be an important therapy for patients with tinnitus who experience a great decrease in their quality of life. EMDR has shown promising results for the treatment of phantom limb pain. Therefore, we hypothesize that EMDR also may be an effective treatment method for patients with subjective, chronic tinnitus. Tinnitus viewed from the perspective of a trauma, more specifically in the auditory and limbic regions, leads to the need for effective information processing. The development of new neural networks could be generated through EMDR.

Bilateral stimulation promotes the plasticity of the brain causing neural networks to be adjusted. The use of bilateral stimuli to treat tinnitus is an innovative treatment method. In the literature, only limited data can be found in a few case studies where EMDR treatment is performed on tinnitus patients. Preliminary results of the current study will be presented at ITS 2017.

P.35 • Selective attentional impairment in chronic tinnitus: Evidence from an event-related potentials study

Mannarelli D.[1], Pauletti C., Mancini P.[2], Fioretti A.[3], Eibenstein A.[3], Greco A.[2], Marco De Vincentiis M.[2], Fattapposta F.[1]

[1] *Department of Neurology and Psychiatry, Sapienza University of Rome, Italy*
[2] *Department of Sense Organs, Sapienza University of Rome, Italy*
[3] *Department of Tinnitus Center, European Hospital, Italy*

Tinnitus is an auditory phantom sensation experienced in the absence of a sound source. Cognitive dysfunctions, especially in working memory and attention, are frequently reported to be associated with tinnitus. The aim of this study was to investigate attentional functioning in a group of subjects with chronic tinnitus using ERPs, and in particular the P300 components.

We studied 20 patients with chronic tinnitus and 20 healthy subjects that performed a P300 Novelty task. P3a amplitude was significantly lower in tinnitus subjects (TS) than in controls. P3a latency was comparable in patients and controls. The P3b parameters were similar in the two groups. N1 latency for all the stimuli was significantly longer in tinnitus subjects than in controls.

Our P3a findings point to a selective dysfunction in the orienting phase of attentional processing of the auditory stimulus, especially in the shift toward salient stimuli. In particular, while the temporal start of this cognitive activity appears to be preserved (as indicated by comparable P3a latencies in TS and controls), the attentional resources available for an adequate switching process are reduced (lower P3a amplitude in TS versus controls).

These results point to a general slowing in early stimulus perception in tinnitus subjects. Moreover, a specific difficulty emerged in attentional switching to unexpected events during an orienting response, probably owing to a dysfunction in the ventral attention network.

P.36 • Case Study – A Prescriptive Sound Amplification Method for Tinnitus Relief Using Hearing Aids

Modan A.

Department of Audiology, Audiologos Hearing Care Center

Tinnitus represents the perception of the sounds in the absence of an external source. Depending on the definition of tinnitus and the criteria applied, prevalence rates in adult populations is 8.2–20.0%1, rising to 17.9–30.3% in those over 50 years of age, as described by 1. Fabijanska A., Rogowski M., Bartnik G., et al., 1999. Tinnitus sufferers are coping in various ways with their problem, some of them being profoundly affected in everyday tasks. Our aim is to find an algorithm of amplification of environmental sounds, easy to use via hearing aids, capable of offering tinnitus relief.

Group: 8 patients with tinnitus (6 with hearing loss, 2 without hearing loss). Materials: 6 frequency channels hearing aids, NAL-NL2 prescriptive method for amplification and TFI developed in 2014 by Henry et al. for collecting the patients responses at the first visit, at 2 weeks, 1 month, 3 months, 6 months. For the patients with hearing loss, we increased by 10% the prescribed gain at tinnitus frequency domain, fixed the CR at 2 and used a CK of 72 dB. For the patients without hearing loss, we used the tinnitus threshold and used linear amplification.

The 2 patients with tinnitus without hearing loss had the TFI score improved with a mean of 6 points after 2 weeks and 1 month, a mean of 10 points at 3 months and with a mean of more than 13 points at 6 months. From the 6 patients with hearing loss and tinnitus, the TFI score improved with a mean of 10 points after 2 weeks, 12 points at 1 month, and more than 13 points at 3 months and 6 months.

In case we'll obtain longterm good results with more patients we'll develop an algorithm of amplification as an easy to apply and non-invasive tinnitus relief method.

Based on the results obtained so far, we will further apply, observe and improve the efficiency of the described prescriptive amplification method in more patients.

P.37 • Validation of the Italian version of the TQ12-I for Assessment of Tinnitus-related distress

Moschen R.[1], Fioretti A.[2], Eibenstein A.[2], Natalini E.[2], Cuda D.[3], Chiarella G.[4], Rumpold G.[1], Riedl D.[1]

[1] *Department of Medical Psychology, Medical University of Innsbruck, Austria*
[2] *Tinnitus Center, European Hospital Rome, Italy*
[3] *Department of Otorhinolaryngology, "G. da Saliceto" Hospital Piacenza, Italy*
[4] *Department of Experimental and Clinical Medicine, University 'M. Graecia' of Catanzaro, Italy*

The use of reliable and valid psychometric tools to assess subjectively experienced distress due to tinnitus is broadly recommended. We evaluate the reliability, validity and factorial structure of the Italian version of Tinnitus Questionnaire 12 item short form (TQ 12-I) as a brief screening test for the assessment of patient reported tinnitus-related distress.

We conducted a cross-sectional multicenter study including 150 outpatients with tinnitus. The original TQ-12 was translated by means of a translation-back translation procedure. Sociodemographic and clinical data were assessed with the Tinnitus Sample Case History (TSCH), tinnitus-related distress with the Tinnitus Questionnaire Short Form (TQ 12-I) and the Tinnitus Handicap Inventory (THI). Psychological and psychosomatic distress was assessed with the Brief Symptom Inventory (BSI) and the patients' Health-Related Quality of Life (HRQOL) with the Short Form Health Survey (SF-36).

No floor or ceiling effect was found for the TQ 12-I total score. Exploratory factor analysis revealed a two-factor solution (emotional distress, cognitive distress), accounting for 54.3% of variance. Good internal consistency for the total score (α=0.86) and both factors (α=0.80–0.87) was found. High correlations with the THI (r=0.67, $p<0.001$) indicated good convergent validity. Comparison with the THI provided evidence which showed a good fit of the severity cut-off scores proposed in previous studies (F=35.78, $p<0.001$).

To our knowledge, this is the first study to evaluate the Italian Version of the TQ 12. Our results clearly showed that the TQ 12-I is a reliable and valid instrument to assess tinnitus-related distress. It permits a compact, quick and economical assessment of the most important aspects of subjective tinnitus distress. The provided cut-offs facilitate the interpretation of individual scores and provide indications for multidisciplinary therapeutic approaches.

The TQ 12-I can be used in everyday clinical practice as well as international studies.

P.38 • Tinnitus Acceptance in Patients with Chronic Tinnitus – Results of a Cross-Sectional Multi-Center Study

Moschen R.[1], Fioretti A.[2], Eibenstein A.[2], Natalini E.[2], Cuda D.[3], Chiarella G.[4], Rumpold G.[1], Riedl, D.[1]

[1] *Department of Medical Psychology, Medical University of Innsbruck, Austria*
[2] *Tinnitus Center, European Hospital Rome, Italy*
[3] *Department of Otorhinolaryngology, "G. da Saliceto" Hospital Piacenza, Italy*
[4] *Department of Experimental and Clinical Medicine, University 'M. Graecia' of Catanzaro, Italy*

Recent findings show the importance of acceptance in the treatment of chronic tinnitus. Only limited knowledge on influential factors of tinnitus acceptance exists so far. The aim of this multicenter study was to investigate tinnitus acceptance, tinnitus distress and Quality of Life (QoL) in an Italian sample of n=134 outpatients with chronic Tinnitus.

Tinnitus acceptance was assessed with the Italian 'Chronic Tinnitus Acceptance Questionnaire' (CTAQ-I), tinnitus distress with the TQ 12-I and the Tinnitus Handicap Inventory (THI). Also, we assessed the patient's general psychological distress (Brief Symptom Inventory – BSI) and the Health Related Quality of Life (SF-36). Sociodemographic and clinical data were assessed with the Tinnitus Sample Case History. To evaluate the correlation of sociodemographic and clinical factors on tinnitus acceptance we calculated correlation coefficients, analysis of variance and independent sample t-tests.

Elevated levels of tinnitus acceptance correlated with less tinnitus distress, decreased general psychological distress and higher levels of psychological quality of life. Tinnitus acceptance was neither influence by gender, age nor tinnitus duration. Patients with lower levels of tinnitus acceptance described their ear noise as louder, were annoyed by it more often and found that loud noise worsened the

tinnitus significantly. They felt that sounds caused them pain or physical discomfort more often, they had more headaches and suffered from more frequent temporomandibular disorders.

Increased levels of acceptance are related to less psychological distress and better quality of life. Although tinnitus acceptance was not influenced by the symptom duration our study showed some important correlations between tinnitus acceptance and clinical aspects such as hyperacusis.

Tinnitus acceptance plays an important role for patients with chronic tinnitus. Further research should focus on the understanding of acceptance-building factors in psychological treatment as well as in medical and audiological treatments.

P.39 • Mobile EEG in tinnitus: Usability, feasibility and first results

Neff P., Gueng S., Weidt S., Kleinjung S., Meyer M.

Department of Psychology, University and University Hospital of Zurich, Switzerland

Mobile assessment of tinnitus has become an emerging line of research in recent years. In an effort to broaden the scope of assessed data, we tested the feasibility of concurrent psychometric and electroencephalographic (EEG) ecological momentary assessment (EMA) in a pilot study (n=5). Primary outcomes of interest were 1) usability in a self-reliant manner by participants, 2) EEG data quality and 3) first results.

Psychometric EMA data was assessed using TrackYourTinnitus (TYT) with random notifications three times a day during two weeks. Upon completion of the TYT questionnaire, participants proceeded with the self-reliant EEG resting state recordings (alternating eyes open/closed for 5 minutes) and subsequent completion of a modified version of the Amsterdam Resting State Questionnaire (ARSQ). The EEG system comprised an OpenBCI 32-bit 8 channel board with a RFduino control unit, dry electrodes (Fp1+2, T3+4, P3+4, Pz, Oz) and a custom-made helmet for quick setup and recording initialization.

Usability: Comfort rating was 5.5 in average (10=very comfortable, SD=2.5, range=3–9) and handling of the apparatus 6.5 (10=very difficult, SD=1.7, range=4–8).

Feasibility of EEG data: Raw signal amplitude range was between –100 and 100 μV. Berger effect was highly significant ($p<0.001$). Visual steady state responses significantly differed from baseline activity ($p<0.05$).

EEG and TYT: tinnitus loudness was negatively correlated with temporal alpha activity (single subject, T3; r=–.512, p=.009, partial correlation controlling for tinnitus distress; r=–.408, p=.048).

First results point to a correlation between EMA psychometric and neurophysiological data in the daily life of tinnitus sufferers over 42 assessed time points, most prominently a negative correlation between perceived tinnitus loudness and temporal alpha activity. Moderate ratings of usability were observed even after minimizing user interaction with the apparatus. EEG data was susceptible to (changing) environments (e.g. train line noise in cities) and high frequencies (>30 Hz) were often detrimented. Random sampling strategy required the participants with flexible occupations.

Overall, given the novelty of the approach and applied technology, we conclude that there is room for optimization or reconsideration regarding equipment, workflows and study design. This comes as no surprise as the safe zone of a controllable research laboratory is discarded. Furthermore, the self-reliant aspect of the measurements even exacerbate this situation and introduce a manifold of error sources. Yet, we consider the approach as feasible for real life EMA and first results a fascinating glance into the longitudinal neurodynamics of tinnitus.

P.40 • Effect of 12 weeks of yoga training on quality of life of patient with chronic tinnitus

Niedzialek I.[1,2], Milner R.[1,2], Ganc M.[1,2], Lewandowska M.[1,2], Raj-Koziak D.[1,2], Skarzynski H.[1,2]

[1] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

Yoga is an ancient technique used for promoting physical and mental health. Studies have shown that the practice of yoga reduces perceived stress and negative feelings. We performed a study to examine the beneficial effect of 12 weeks of yoga training on quality of life of patient with chronic tinnitus.

We recruited patients with chronic tinnitus who had no experience with yoga. The data of 25 participants who were followed during 12 weeks of yoga training (twice a week by 90 minutes) were analyzed. We used TFI questionnaire (Tinnitus Functional Index) and assessed 8 important domains of negative tinnitus impact before and after 12 weeks of yoga training.

After 12 weeks of yoga training all negative subscale scores of tinnitus impact (intrusive, sense of control, cognitive, sleep, auditory, relaxation, quality of life, emotional) were significantly decreased compared with those before starting yoga training.

Yoga training has the potential to improve quality of life of patient with chronic tinnitus.

P.41 • Efficacy of treatment for tinnitus based on cognitive behavioral therapy in an inpatient setting: A 10-year retrospective outcome analysis

Nolan D.R., Schneeberger A.R., Huber C.G., Gupta R.

Department of Psychotherapy, Psychiatrische Dienste Graubunden, Switzerland

Tinnitus is a phenomenon with a high prevalence in the general population, leading to high levels of suffering. It is a symptom that can presents itself comorbidly with a variety of psychiatric and medical illnesses. We established a treatment of tinnitus, which is based on a multimodal approach including a specific cognitive-behavioral therapy (CBT) method in an inpatient setting. This approach includes education on tinnitus, applying coping strategies and techniques of relaxation, directed attention and music therapy. We aim to evaluate the efficacy of this treatment approach.

We included retrospective data of 268 patients that underwent tinnitus treatment throughout the ten-year existence of the treatment program. We assessed routine clinical data pre and post treatment with parameters concerning tinnitus-distress, hyperacusis and psychological well-being. To determine these variables we used validated instruments including the Tinnitus Questionnaire (TQ), Questionnaire on hypersensitivity to sound (QHS), Brief Symptom Inventory (BSI) and the Beck Depression Inventory (BDI). Questionnaires were implemented before and after the treatment program.

Patients showed highly significant reduction in all of the implemented questionnaires. Reduction of TQ, the primary outcome measure, was 15.39 points (SD 21.88) from 35.72 to 20.32 ($p<0.001$). The QHS showed a reduction from 18.98 down to 12.26, which equals 6.72 points (SD 8.23; $p<0.001$). Moreover, psychological strain was also reduced with high significance, as illustrated in reduction of BSI and BDI with all examined subsets; reduction in BSI from 49.63 to 25.21 points (24.41, SD 26.88; $p<0.001$) and BDI from 16.89 to 9.41 points (7.47, SD 8.76; $p<0.001$).

The multimodal treatment program for tinnitus, including a specific CBT method proves to be a highly effective means of significantly reducing not only tinnitus and hyperacusis, but also distress related to tinnitus. It also offers patients preservation of symptom reduction. Furthermore it also enables considerable reduction of concomitant psychiatric symptoms such as depression. Our results underline the necessity of intensive and multimodal approaches to the treatment of tinnitus.

P.42 • The effect of hearing aids on tinnitus in patients with unilateral sensorineural hearing loss

Oishi N., Shinden S., Ogawa K.

Department of Otolaryngology, Head and Neck Surgery, Nagoya City University Medical School, Keio University School of Medicine, Japan

Aim: To show the effects of sound therapy by hearing aids (HAs) in patients with tinnitus accompanying a unilateral sensorineural hearing loss.

The subjects are 43 patients with chronic tinnitus who had a unilateral sensorineural hearing loss (SNHL) and were treated by HAs from 2009–2015 (HA group). As a control group, 29 patients were also enrolled who had a unilateral SNHL and were treated by noise generators (NGs) from 2002–2008 (NG group). The mean pure tone averages were 58 dBHL in the HA group and 57 dBHL in the NG group, respectively. The effects of treatment were assessed with THI and VASs for tinnitus loudness and annoyance at six months after the start of treatment.

In the NG group, the mean THI score significantly improved from 61 to 50; the mean VAS for tinnitus loudness improved from 76 to 69, and the mean VAS for tinnitus annoyance improved from 79 to 68. All of these changes were significant despite not large changes. In contrast, in the HA group, the mean THI score improved from 53 to 12; the mean VAS for tinnitus loudness improved from 66 to 26, and the mean VAS for tinnitus annoyance improved from 73 to 23. These changes in the HA group were all significant. The improvement in the HA group was much more apparent compared to the improvement in the NG group.

The results of this study indicated that a sound therapy by HAs could be a very effective method to treat tinnitus in patients with a unilateral sensorineural hearing loss. As a TRT protocol by Jastreboff recommends, an actual compensation for hearing impairment can be more efficient in treating tinnitus than just enriching background sound in patients with hearing loss.

P.43 • Effect of sound generator on tinnitus and hyperacusis

Park J.M., Kim W.J., Ha J.-B., Han J.J., Yeo S.W., Park S.N.

Department of Otorhinolaryngology-HNS, The Catholic University of Korea, South Korea

Sound generator (SG) plays a role as effective sound therapy of tinnitus retraining therapy (TRT) in patients with severe tinnitus (Category 1) or hyperacusis (Category 3). White band noise of SG reduces the contrast between background and tinnitus signals and enhances the habituation of perception of tinnitus. This study was performed to evaluate the therapeutic effect of sound generator on tinnitus and hyperacusis during their course of TRT.

A total of 120 tinnitus patients who visited our tinnitus clinic from Jan 2008 to Dec 2016 and were treated with

bilateral SG along with directive counseling of TRT were included in this study. They were divided into two groups by tinnitus category; 78 patients of category 1 who did not respond to sound therapy of environmental sound, and 42 patients of category 3 who showed more annoying hyperacusis than tinnitus. Their medical records were retrospectively reviewed to evaluate the therapeutic effect of sound generator on tinnitus and hyperacusis.

The initial clinical characteristics were not significantly different between two groups except the age distribution and the period from initial visit to wearing of SG. Category 3 patients were younger than category 1 patients (P=0.001) and were prescribed SG earlier than category 1 patients due to their severe symptom of hyperacusis (P=0.002). Initial visual analog scale(VAS) scores of effect on life(EOL) and tinnitus handicap inventory (THI) were significantly higher in category 3 patients (P<0.01), which indicate their more severe symptom. Both in the category 1 and 3 groups, tinnitus VAS scores of loudness, annoyance, loudness and EOL were significantly improved six months after wearing SG(P<0.05). THI and tinnitus VAS scores showed the tendency of greater improvement in category 3 patients than in category 1 patients although there was no statistical significance.

Sound generator was effective on tinnitus management and even more effective on hyperacusis during their course of TRT. Significant reduction of their symptoms can be expected at least 6 months after wearing SG.

P.44 • Measurement of Tinnitus and Stress Hormonal Changes in Mice after Noise Stimuli

Park S.N.[1], Kim M.J.[1], Park I.[2], Park S.Y.[1]

[1] *Department of Otorhinolaryngology, The Catholic University of Korea, South Korea*
[2] *Department of Biomedical Engineering, Dankook University, South Korea*

Tinnitus animal models previously demonstrated the development of deficits in Gap-prepulse inhibition of the acoustic startle reflex (GPIAS). In this study, noise-induced tinnitus (NIT) in mice was serially evaluated by GPIAS after different types of noise exposure to determine the most appropriate method for tinnitus development and to measure its changes.

To investigate the relationship between NIT and stress, we firstly evaluated the stress hormones in the plasma. Male C57BL/6 mice aged 1 mo were exposed to three different noise stimuli: 110 dB SPL white noise for 1 hr once, 4 hrs once, and 4 hrs every day for 5 days. Auditory brainstem response (ABR) thresholds and distortion product optoacoustic emissions (DPOAE) were serially recorded up to 3 months. Tinnitus was also assessed serially by GPIAS to obtain GPIAS ratios. All the audiological and GPIAS data of three NIT groups were compared with those of the control group. Cochlear histopathologic study and plasma levels of norepinephrine (NE) and cortisol were also compared among the four groups.

During the 3 mo follow-up period, hearing levels of three different NIT groups showed significantly elevated ABR thresholds with a mild increasing trend with time compared to the control group. The NIT groups show significantly lower grading scores of OC. GPIAS ratios decreased in NIT groups up to 1 month, and subsequently, individual variations seemed to increase. NE level in the plasma of 1 hr NIT group and cortisol levels of 4hr5D NIT group were significantly higher than those of the controls. One-hour white noise at 110 dB SPL was sufficient to induce tinnitus in mice. Tinnitus behavior continued significantly in all NIT groups for 1 month.

We suggest that future tinnitus study can be reliably performed within one month after induction of tinnitus using single exposure to 110 dB SPL white noise for 1 or 4 hours. Elevated NE and cortisol levels in the plasma of NIT mice should be highlightened in this study, which needs to be validated in further studies.

NIT mouse models developed by different types of noise exposure and confirmed by GPIAS seem to be well established in this study. Elevated plasma level of stress hormone in NIT groups indicates its possible role as a biomarker in tinnitus-related stress condition, which still needs further investigation.

P.45 • Validation of the German version for Switzerland of Tinnitus Functional Index

Peter N., Kleinjung T., Jeker R., Meyer M., Klaghofer R., Weidt S.

Department of Otorhinolaryngology, Psychiatry, Psychology, University Hospital of Zurich, Germany

Different standardized questionnaires are used to access tinnitus severity, making comparisons across studies difficult. These questionnaires are also used to measure treatment-related changes in tinnitus although they were not designed for this purpose. To solve this problem, a new questionnaire has been established, the Tinnitus Functional Index (TFI), which is highly responsive to treatment-related change and promises to be the new gold standard in tinnitus evaluation. The aim of the current study was to validate the TFI for a German-speaking population in Switzerland.

A total of 264 subjects completed a survey including the German version for Switzerland of Tinnitus Functional Index (TFI), Tinnitus Handicap Inventory (THI), Beck Depression and Anxiety Inventory (BDI and BAI). Internal consistency of the TFI was calculated with Cronbach's alpha coefficient. Pearson correlation coefficients were used for the test-retest-reliability of the TFI and to investigate convergent and discriminant validity with THI respectively BDI and BAI. Factor analysis was assessed using a principal component analysis. The extracted factors were compared with the original TFI.

The German Version of the TFI for Switzerland showed an excellent internal consistency (Cronbach's alpha of 0.97) and an excellent test-retest reliability of 0.91. The convergent validity with THI was high (r=0.86). The discriminant validity with BAI and BDI showed moderate results (BAI: r=0.60 and BDI: r=0.65). In the factor analysis of the German version of the TFI, the scree plot indicated just one

dominant factor with a high eigenvalue of 15.26 and all following eigenvalues ≤ 2.1. Nevertheless, using the Jolliffe's criterion (eigenvalues >0.7) five factors could be extracted.

The German Version of the TFI showed an excellent internal consistency similar to the English version (both Cronbach's alpha of 0.97) and an excellent test-retest reliability of 0.91, which is better than in the original version (r=0.78). The convergent validity with THI was high (r=0.86) and comparable to the English version (r=0.75). In the factor analysis just five factors with one main factor could be extracted. Other studies also failed to reproduce the eight factor structure of the original questionnaire. Nevertheless, relations to the original eight subscales could be demonstrated.

The German version of the TFI for Switzerland is suitable for measuring the impact of tinnitus. The reliability and validity of this version are comparable with the original version of TFI. Although this study showed just five factors in the factor analysis, relations to the original eight subscales can be seen. Therefore, the German version of TFI for Switzerland can give relevant information about the different domains of tinnitus.

P.46 • **Pressurized Otoacoustics Emissions: Case report**

Sanfins M.D.[1], Diniz Hein T.A.[1], Skarzynski P.H.[2,3], Hatzopoulos S.[4], Colella-Santos M.F.[1]

[1] *Department of Child and Adolescent Health, State University of Campinas*
[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[3] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[4] *Hearing Science Laboratory, University Hospital of Ferrara, Italy*

The present study aimed to compare the OAEs response obtained with 0 da Pa of ambient pressure and with the compensation of the middle ear pressure in adolescents.

Two young male adolescents, aged 12 and 11.5 years old, were enrolled in this study. The subjects had a hearing threshold under 15 dB HL (250 to 8000 Hz) and no history of audiological disorders. Wideband Tympanometry (WBT) with 226 Hz probe tone, the peak pressure and the absorbance graph with 0 da PA were searched. Transient otoacoustic emissions (TEOAE) with 0 da Pa of ambient pressure and pressurized were investigated (present response=signal to noise ratio higher than 3 dB at least in three frequency bands).

Results showed that subject one had TEOAE presented in both conditions and subject two had TEOAE absented (in the ambient pressure condition) and TEOAE presented (in the pressurized). In comparison of the two types of TEOAE, the signal-to-noise ratio was 10 and 12 dB at 1 k Hz and 2 k Hz on the pressurized condition. Besides that, at 3 k Hz and 4 k Hz the difference was around 5 dB. At 5 k Hz the difference was 1 dB and the signal-to-noise ratio was higher in ambient pressure.

Middle ear compromises are common in the child population. Therefore, it is of great importance the existence of an objective method of evaluation that can aid in the diagnosis of these patients.

The pressurized TEOAE condition may be a promising condition for evaluating outer hair cells of the cochlea without influence of middle ear conditions in situations with tubal dysfunction.

P.47 • **Speech-evoked brainstem response in children and adolestents with musical learning**

Sanfins M.D.[1], Hatzopoulos S.[2], Diniz Hein T.A.[1], Bordin T.[1], Pastore A.[2], Aimoni C.[2], Skarzynski P.H.[3,4], Colella-Santos M.F.[1]

[1] *Department of Child and Adolescent Health, State University of Campinas, Brazil*
[2] *Hearing Science Laboratory, University Hospital of Ferrara, Italy*
[3] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[4] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*

The aim of the study was to assess the auditory processing for speech stimuli, in children and adolescents having already a musical learning.

Fifty children and young adolescents (28 female and 22 male; age: 8–14) participated in the study. All subjects were Italian native speakers with a background in musical learning. The musical learning of the participants took place in a public school in Ferrara, with activities lasting two hours a week for at least one year.

The Speech ABR was recorded at 80 SPL for speech stimuli, with the synthesized syllable /da/ provided by a computer software, using a Biologic Navigator Pro equipment. The data were analyzed by ANOVA (Analysis of Variance).

Results showed better values of latencies with significant statistically differences in the right ear (waves E and F) and the left ear (waves D e O). Regarding the amplitude values it was possible observe higher amplitude only wave F values in left ear in children and adolescents with musical learning. A period of auditory training may be able to provide important changes in brainstem responses to speech stimuli.

Distinguishing speech sounds is a task that demands an adequate and efficient processing of the acoustic signals and is fundamental for the success in the communicative process, for that, the peripheral and central auditory systems must work in harmony.

The results of the present study demonstrate that children and adolescents with musical learning show better responses in the assessment of speech ABR.

P.48 • Use of questionnaire as monitoring tool of auditory training in children with history of otitis media

Sanfins M.D.[1], Skarzynski P.H.[2,3], Donadon C.[1], Peixoto de Oliveira P.A.[1], Reis Borges L.[1], Colella-Santos M.F.[1]

[1] Department of Child and Adolescent Health, State University of Campinas, Brazil
[2] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[3] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland

Aim: To compare the scores of Scale of Auditory Behaviors questionnaire and responses of auditory processing tests in pre and post auditory and visual training.

Material and methods: 30 children aged from 8 to 14 years, underwent a bilateral myringotomy in the first five years of age, they were evaluated and divided into two groups: auditory training (Group 1) and visual training (Group 2).

Results: Both groups had air conduction threshold below 20 dBHL for octaves from 250 to 8000 Hz, 'A' type tympanogram with presence of ipsi and contralateral acoustic reflexes bilaterally. We observed a significant statistically difference in Group 1 results for Dichotic Digits [RE: 0.007 – LE: 0.004], Pitch Pattern Sequence – Humming [RE: 0.002 – LE: 0.001] and Verbal [RE: 0.000 – LE: 0.000], Gaps in Noise [RE: 0.001 – LE: 0.001], Synthetic Sentence Identification with Ipsilateral Competing [RE: 0.004 – LE: 0.001] and total questionnaire score (p=0.003). No significant statistically difference were found comparing pre and post visual training results considering the performance of the children in the behavioral tests and in the Scale of Auditory Behaviors questionnaire.

Discussion: The questionnaires are important tools in the process of monitoring the rehabilitation of auditory abilities. Behavioral assessment and the questionnaire are able to identify changes in the central auditory nervous system.

Conclusions: The analysis of the results showed that Scale of Auditory Behaviors questionnaire is an accurate tool for monitoring the rehabilitation of the central auditory system for and auditory and visual stimulation.

P.49 • The impact of psychological group therapy on perception of tinnitus based on results of the Tinnitus Functional Index

Sarnicka I.[1,2], Karendys- Luszcz K.[1,2], Kuklinska K.[1,2], Fludra M.[1,2], Raj-Koziak D.[1,2], Karpiesz L.[1,2], Niedzialek I.[1,2], Skarzynski H.[1,2]

1 Department of Tinnitus, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
2 World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland

Aim: Evaluation of the effectiveness of psychological group therapy to cope with tinnitus.

Material and methods: The study included 66 patients, average age of 56.33 years (32–79); including women (68.2%) and men (31.8%). Therapy effect was evaluated based on the results of questionnaires in the following diagram: Beck Depression Inventory filled at the start of the therapy and Tinnitus Questionnaire Functional Index (TFI) completed twice, before and immediately after completion of the course.

Results: In the study group, 54.5% of people received results indicating the presence of depressive symptoms. Patients with more symptoms of depression much worse cope with tinnitus, mainly in the field of emotional reactions to tinnitus, a sense of control over the problem and the quality of sleep. After treatment, there was significant improvement in all subscales tested in TFI except from subscale associated with hearing problems. The improvement was independent of age, depression level and duration of tinnitus. Women received significantly greater improvement after therapy than men.

Discussion: In The Institute of Physiology and Pathology of Hearing the team of psychologists conducts weekly group therapy, in which patients learn to cope with the emotional effects of tinnitus. Therapy is a unique project consisting of three thematic blocks: (1) psychoeducation, (2) relaxation therapy with the use of music therapy and body work, and (3) activating exercises improve concentration.

Conclusions: The results confirm the positive effect of psychological therapy on the patient's functioning, sleep, concentration, relaxation and emotional reaction to the perceived tinnitus.

P.50 • Combined amplification and sound generation for tinnitus: Scoping review

Sereda M.[1,2], Tutaj L.[3]

[1] NIHR Nottingham Biomedical Research Centre, Nottingham, UK
[2] Otology and Hearing group, Division of Clinical Neuroscience, School of Medicine, University of Nottingham, UK
[3] Division of Audiology, Faculty of Health and Life Sciences, De Montfort University, Leicester, UK

Sound therapy is the preferred mode of audiological tinnitus management and refers to a wearable sound generator or hearing aid. Recent innovations in hearing aid technology have seen the arrival of combination devices: hearing aids with built-in sound generators. These devices can amplify speech whilst simultaneously delivering masking sound. The aim of this scoping review was to establish current knowledge around combined amplification and sound generation for tinnitus.

The scoping review methodology was based on Arksey and O'Malley (2005) methodological framework and consisted four stages: 1) Identifying potentially relevant records; 2) Selecting relevant records; 3) Extracting data items; 4) Collating, summarising and reporting results. Thematic analysis was conducted to identify main themes. Data were gathered using a systematic search strategy through

multiple search engines to cover peer-reviewed as well as grey literature.

Searches returned 5959 records. After exclusion of duplicates and out of scope works, 81 records remained. Two main themes emerged from the thematic analysis of the records: 1) Efficacy (n=37) and 2) Management option (n=34). Twenty out of 37 efficacy studies noted reduction in tinnitus annoyance or distress when using combination devices, however those benefits were at best comparable to benefits provided by conventional hearing aids. There was a considerable variability in approaches including candidacy and fitting parameters which depended strongly on the management programme followed.

Despite large number of records identified, many had methodological drawbacks. Variability in clinical practice pointed to the need for development of guidelines for combined amplification and sound generation for tinnitus. Due to lack of sufficient evidence in the literature it might be difficult to develop evidence-based guidelines.

Systematic review of prospective studies looking at efficacy of combination aids should be conducted. Recommended procedures for candidacy and fitting of combination aids based on expert knowledge should be formulated.

P.51 • Outcome measures and associated problem domains used in efficacy studies of combination hearing aids for tinnitus

Sereda M.[1,2], Tutaj L.[3], Smith S.[1,2], Hall D.[1,2], Fackrell K.[1,2]

[1] *NIHR Nottingham Biomedical Research Centre, Nottingham, UK*
[2] *Otology and Hearing group, Division of Clinical Neuroscience, School of Medicine, University of Nottingham, UK*
[3] *Division of Audiology, Faculty of Health and Life Sciences, De Montfort University, Leicester, UK*

Hearing aids are recommended by current tinnitus management guidelines for patients who experience hearing difficulties. Recent innovations have seen the arrival of combination aids: hearing aids with built-in sound generators. The evidence for the efficacy of combination aids for tinnitus is limited due to a lack of well-designed definitive trials. One issue when designing a clinical trial is the choice of outcome measures. The aim was to collate a list of outcome measures used in the studies looking at the efficacy of combination aids for tinnitus and map them onto problem domains.

As a part of a scoping review to establish current knowledge around combined amplification and sound generation for tinnitus we populated the list of outcome measures used in published studies. We have identified the problem domains covered by items in the tinnitus-specific measures using an inductive thematic analysis approach.

Forty three different outcome measures were identified. Researchers mainly used tinnitus-specific questionnaires (n=29) followed by Visual/Numeric Analogue Scales (n=16, across 9 studies). The most common questionnaires were Tinnitus Handicap Inventory (n=13), Tinnitus Handicap Questionnaire (n=5) and Tinnitus Functional Index (n=4). Visual/Numeric Analogue scales most commonly measured loudness (n=4) and tinnitus annoyance (n=3). We have identified 18 problem domains including interference with activities/relationships, coping styles, emotional impact, sleep, cognition and speech.

There is a marked variability in the choice of outcome measures and domains measured when assessing clinical efficacy of combined amplification and sound generation for tinnitus. This points to the urgent need of developing a Core Outcome Set in Tinnitus. Standardisation of outcome measures would provide a framework for the design of clinical trials for tinnitus. It will also reduce variability in outcomes between studies therefore enhance future systematic reviews and meta-analyses.

P.52 • An unusual case of pulsatile tinnitus caused by an aberrant artery at tympanic membrane

Sirin A.A.[1], Sirin A.[2]

[1] *Department of HNS-ORL, Doctors Clinic, Istanbul, Turkey*
[2] *Acibadem Medical School, Istanbul, Turkey*

We describe a case of an unusual case of pulsatile tinnitus caused by an aberrant artery at tympanic membrane.

The patient was a 35-year-old male complaints from a severe tinnitus in his right ear, which worsens during exercise. The patient had a history of sensorineural hearing loss on his both ears for 5 years and had bilateral tinnitus for 3 years. His Tinnitus Handicap Inventory score was 94 and his Beck Depression Inventory score was 32 when he referred to our clinic.

The examination revealed that the cause of the pulsatile tinnitus is an aberrant artery at tympanic membrane of his left ear. The patient underwent surgery and this aberrant artery was coagulated under microscope.

The patient's post-operative course was uneventful. The patient had immediate relief of his pulsatile tinnitus after surgery. The patient reported that his tinnitus occurs very rare and not significant after surgery. His post-operative Tinnitus Handicap Inventory score is 10.

Pulsatile tinnitus can have many causes. It is often caused by an alteration in blood flow. Intracranial hypertension, arterial and venous anatomical variants and abnormalities, arteriovenous fistulas, arterial stenoses are reported causes of pulsatile tinnitus. Patient history and careful examination plays an important role for diagnosis. This case of aberrant artery at tympanic membrane is an unusual case of pulsatile tinnitus and should be paid attention.

The clinical findings and imaging studies must always be made properly and evaluated together. The treatment should be planned after careful examination.

P.53 • Electric-acoustic stimulation in treatment of tinnitus (PDT – EAS)

Skarzynski P.H.[2,3], Dziendziel B.[2], Raj-Koziak D.[2], Skarzynski H.[1,2], Wanatowska O.[2]

[1] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

[3] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*

Introduction: Partial deafness with preserved to a different degree functional or partially nonfunctional residual hearing is presently one of the most common hearing disorders in adults, although it can be founds also in other age groups. A very annoying accompanying problem is often constant tinnitus. This is why application of an appropriate cochlear implant system with a minimally invasive surgical procedure is a good base for achieving good and very good results of treatment. The aim of this study is to present the first and largest in the world group of more than 2 thousand patients with simultaneous acoustic stimulation in low frequencies and electric in mid and high frequencies. Always an additional indication for treatment besides a PDT-EAS type partial deafness was persistent tinnitus.

Material and methods: Material was a group of more than 2 thousand patients with PDT-EAS type partial deafness implanted with an appropriate length (24–28 mm) maximally flexible electrode type Med-EL or Cochlear. Surgery was conducted according to the H. Skarzynski's 6-step surgical procedure.

Results: Follow up duration was from 2 to 19 years. Complete preservation of preoperative hearing was observed in 94.7% patients. In some patients we observed deterioration of hearing in both ears after one-side cochlear implantation. It had no marked effect on the results of treatment but necessitated reprogramming of speech processors used by these patients. An important achievement of treatment was the reduction of tinnitus observed to a different degree in more than 80% of patients after implantation.

Conclusions: Persistent constant tinnitus should be considered as an additional argument when qualifying patients for cochlear implantation in partial deafness treatment, allowing achieving the effect of combining electric stimulation with cochlear ear with acoustic stimulation with a hearing aid in the other ear or with application of Duet or Hybrid systems.

P.54 • Treatment of tinnitus in partial deafness – PDT-EC

Skarzynski P.H.[2,3], Dziendziel B.[2], Raj-Koziak D.[2], Skarzynski H.[1,2], Wanatowska O.[2]

[1] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

[2] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

[3] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*

Introduction: Partial deafness with functional hearing up to the level of 0.5 k Hz and no reception of comprehendible acoustical sensation on other frequencies can be found in patients in any age. The goal of surgical intervention is to preserve preoperative hearing and to complement it with electrical hearing though a cochlear implant. The aim of this report is to present the first and largest in the world group of several hundreds of patients with preserved hearing up to 0.5 k Hz supplemented in a deaf part with electric stimulation. Additional indication for treatment besides partial deafness was tinnitus.

Material and methods: The material included 329 adult patients with partial deafness– PDT-EC, implanted with a maximally flexible electrode of appropriate length (20–25 mm) by Med-EL or Cochlear. Surgery had been conducted according to the 6-step procedure developed by H. Skarzynski.

Results: In follow up period ranging 3–15 years a complete preservation of preoperative hearing was observed in 97.2% patients after implantation. There was no case of total loss of preoperative hearing. Time needed to achieve good results did not exceed the first 6 months of rehabilitation. An important benefit obtained in treatment was reduction of tinnitus in about 85% of patients after implantation. Patients had good and very good results of speech understanding in noise.

Conclusions: Persistent constant tinnitus should be considered an additional argument in favor of qualifying patients for cochlear implantation in partial deafness allowing obtaining the effect of electric stimulation with cochlear implant as an electric complementation.

P.55 • Treatment of tinnitus in single-sided deafness with application of a cochlear implant

Skarzynski P.H.[1,2,3], Raj-Koziak D.[1,4], Dziendziel B.[1], Osinska K.[1,5], Ratuszniak A.[1], Lorens A.[1], Krol B.[1,5], Skarzynska M.B.[1,3]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*
[4] *Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[5] *Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[6] *Implants and Auditory perception Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*

Introduction: Patients with partial deafness significantly more often than other groups complain of the presence of usually faint tinnitus in deaf ear and sometimes also in head. Treatment of deafness with cochlear implants involves simultaneous treatment of tinnitus. In the program of treatment of single-sided deafness elaborated in the Institute of Physiology and Pathology of hearing presence of persistent tinnitus is an additional argument for the decision about performing cochlear implantation. The aim of the study is to present the course of treatment of deafness with unilateral assessment of the degree of tinnitus reduction in single-sided deafness.

Material and methods: Material comprises a group of 10 patients with single-sided deafness provided with cochlear implants.

Results: Results of treatment were evaluated with regard to the level advantage provided by cochlear implant in terms of bilateral hearing. Particularly noteworthy were the first observations of patients, who commented on decrease of tinnitus intensity. It was probably related to the fact that these patients already had a good level of communication using one ear. Their unequivocal emphasis of the importance of tinnitus reduction in a very short time after the speech processor activation suggests that reduction of perceived tinnitus is an additional, very important justification for the development of treatment of single-sided deafness with cochlear implants.

Conclusions: Tinnitus perceived in the deaf ear is a very important argument in favor of using the electric stimulation not only for the needs of deafness treatment.

P.56 • Connection between cognitive process and severity of tinnitus among patients with hearing impairment

Skarzynski P.H.[1,2,3] Swierniak W.[1], Bienkowska K.[1], Rajchel J.[1], Raj-Koziak D.[1], Skarzynska B.[3,4]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*
[4] *Department of Descriptive and Clinical Anatomy, Center of Biostructure, Medical University of Warsaw, Poland*

Tinnitus is defined as a disorder which results from experiencing phantom auditory sensations without any external audio source. While some people with tinnitus show habituation to internal sounds, many of them experience significant daily life impairments. Tinnitus can have many different effects on people, including interference with concentration, annoyance, insomnia and depression. This study designed to investigate the relationship that self-reported tinnitus severity has with cognitive processing, particularly in the domains of attention and memory as well as language functioning.

We have planned a study including around fifty adults. The sample will comprise 25 patients with normal hearing and 25 with mild to severe hearing loss. All patients will be hospitalized due to tinnitus at the Institute of Physiology and Pathology of Hearing in Kajetany. All patients will be asked to complete questionnaire concerning tinnitus perception: Tinnitus Handicap Inventory (THI). Cognitive process will be measured using the Mini–Mental State Examination (MMSE).

Review of literature shows that the presence of tinnitus may automatically direct attention towards the tinnitus ear, which in turn may compromise the function of the involuntary attention system.

If results of study confirm impair cognitive process due to tinnitus, the therapeutic perspectives could focus rehabilitation on control of attention and practicing memory.

P.57 • Tinnitus and health-related quality of life in patients with auditory brainstem implants

Skarzynski P.H.[1,2,3], Rajchel J.[1], Lorens A.[1], Pinkas W.[4], Dziendziel B.[1], Skarzynska B.[3,5]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*
[4] *Local Student's Scientific Society at the Institute of Physiology and Pathology of Hearing and Medical University of Warsaw, Kajetany/Warsaw*
[5] *Department of Descriptive and Clinical Anatomy, Center of Biostructure, Medical University of Warsaw, Poland*

The aim of the study was to retrospectively evaluate tinnitus and health-related quality of life in auditory brainstem implant (ABI) users.

The study included 4 patients who underwent the auditory brainstem implantation. The participants were asked to complete the Tinnitus and Hearing Survey (THS-POL), the Tinnitus Handicap Inventory (THI-POL), the Tinnitus Functional Index (TFI-Pl), the Abbreviated Profile of Hearing Aid Benefit (ABHAB) and the Nijmegen Cochlear Implant Questionnaire (NCIQ). Two different sets of questionnaires were administered. The first one referred to the preoperative period and the second to the present situation, i.e. minimum 3 years of ABI use. The study included 3 woman and 1 men whose age ranged from 29 to 42 years. The participants declared using their ABI minimum 12 hours a day. All patients were satisfied or very satisfied with the device.

Tinnitus distress was clearly reduced in 3 patients based on subjective opinion and tinnitus questionnaires. The remaining patients did not notice any change after operation. Additionally, a meaningful change in health-related quality of life was observed in all patients.

Auditory brainstem implants are a modern method of treating hearing impairment caused by the auditory nerve damage. The study presents unique data on additional benefits obtained by patients qualified to ABI, mainly tinnitus distress and health-related quality of life improvement. To the best authors' knowledge, it is one of the very few reports considering this important issue. Our results are compatible with other findings in larger group of ABI patients, in which tinnitus handicap was significantly suppressed after operation process.

Auditory brainstem implant users benefit from their devices also in terms of tinnitus and health-related quality of life.

P.58 • Handicapping impact of tinnitus in clinical population of children with hearing loss in Kyrgyzstan

Skarzynski P.H.[1,2,3], Raj-Koziak D.[1], Rajchel J.J.[1], Uzakbaev K.[4], Beisheeva Ch.[4], Kermalieva B.[5], Pierzynska I.[3,5], Ludwikowski M.[1], Pilka A.[1], Skarzynski H.[1], Wolujewicz K.[1]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*
[4] *National Maternity and Childhood Center, Bishkek, Kyrgyzstan*
[5] *Center of Hearing and Speech Medincus, Bishkek, Kyrgyzstan*

The aim of the study was to evaluate tinnitus in children with hearing loss in Kyrgyzstan, taking into consideration also gender, age and tinnitus duration influence.

Consecutive pediatric patients were included into analysis. Eligibility criteria were age between 7 and 18 years of age, complaint of persistent tinnitus (lasting≥1 year), concomitant hearing loss (based on the pure-tone audiogram assessment) and lack of serious mental and physical disorders. After obtaining oral consent for participating in the study from a parent and a child, patients were asked to fill in two questionnaires: Tinnitus and Hearing Survey (THS) and Tinnitus and Handicap Inventory (THI). For statistical analysis, SPSS v. 24 was used.

The investigated group consisted of 32 girls and 33 boys. The age of the children was 10 years (SD 2) on average. Tinnitus was perceived mainly in the head (46%) or in both ears (37%). Unilateral tinnitus was rare (12% in right and 5% in the left ear). The majority of children (77%) experienced at least moderate tinnitus handicap. There were no differences in terms of tinnitus distress measured by THI and THS (for both total and subscale scores) according to gender. Statistical analyses revealed moderate negative correlations between the THI score and children's age and tinnitus duration.

Nowadays there is no validated questionnaire enabling to assess tinnitus distress in children. One of the most popular tools used in adults is Tinnitus Handicap Inventory. This questionnaire was successfully incorporated also in pediatric population. As our group of children had a concomitant hearing loss, we decided to additionally use in our assessment Tinnitus and Hearing Survey, which aims to differentiate bothersome tinnitus from hearing difficulties. A relatively frequent prevalence of tinnitus in both normal hearing and hearing impaired children was noted in the literature previously.

Tinnitus is a significantly distressing factor in children with hearing loss. Our data suggest, in contrast to adult population, that tinnitus handicap is less severe in younger children, and, additionally, its handicapping impact is reduced with longer tinnitus duration.

P.59 • Questionnaires used to assess tinnitus before and after cochlear implant – a literature review

Skarzynski P.H.[1,2,3], Swierniak W.[1], Bienkowska K.[1], Skarzynski H.[1]

[1] *World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland*
[2] *Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland*
[3] *Institute of Sensory Organs, Warsaw/Kajetany, Poland*

In most cases tinnitus occurs simultaneously with hearing impairment. In both clinical and experimental practices we can observe a significant growth of using questionnaires in evaluation of tinnitus distress. The purpose is to determine precisely the severity and negative impact of tinnitus on daily functioning. The aim of the study is to give an overview of questionnaires used to evaluate tinnitus in adults before and after cochlear implant.

The results are based on review of English-language literature: PubMed, Web of Science, Cochrane and Medline. A research was performed with using the keywords such as: "tinnitus", "Cochlear Implant", "adults". Time-frame was limited to years 2008–2016. After reviewing the literature, questionnaires for tinnitus sufferers, cochlear implant users were classified into four categories.

To sum up, there is no single, standardized tool that allows comparison of research results among patients suffering

from tinnitus distress and using cochlear implants. Despite the availability of many various questionnaires in English, there have not been created a universal tool that allows assessing tinnitus severity in group of patients mentioned above.

P.60 • Connection between tinnitus and job satisfaction among hospitalized patients – preliminary study

Skarzynski P.H.[1,4,5], Bienkowska K.[1], Swierniak W.[1]., Rajchel J.[1], Raj-Koziak D.[1,2], Gos E.[1], Niedzialek I.[1,2], Karpiesz L.[1,2], Ludwikowski M.[1], Dziendziel B.[1], Skarzynski H.[1,4,5]

[1] World Hearing Center, Warsaw/Kajetany, Poland
[2] Tinnitus Department, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[3] Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland
[4] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland
[5] Institute of Sensory Organs, Warsaw/Kajetany, Poland

Frame of mind is considered to be one of the most important factors that impact on job satisfaction. Research shows that chronic tinnitus can influence patient's mental health which contributes to depressed mood, higher level of anxiety and worse results in cognitive processes such as attention and memory. In turn these aspects can significantly affect job and effectiveness. In consequence it leads to resignation from professional activity among adult tinnitus sufferers. The aim of this study is to assess how tinnitus impact on job satisfaction among hospitalized patients.

The study includes fifty adult tinnitus sufferers (normal and hearing impaired) who will be hospitalized in World Hearing Center in Kajetany. During the test patients will be asked to fill out three questionnaires: Tinnitus Handicap Inventory, Courtauld Emotional Control Scale (CECS), The Satisfaction With Job Scale. The statistical analyses will be conducted using SPSS v.24.

It is supposed that connection between the level of tinnitus nuisance and job satisfaction will occur. Adult tinnitus sufferers will demonstrate lower job satisfaction as well as obtaining worse results on Courtauld Emotional Control Scale.

P.61 • Management of tinnitus in partial deafness with electric-natural hearing – PDT-ENS

Skarzynski P.H.[2,3], Dziendziel B.[2], Raj-Koziak D.[2], Skarzynski H.[1,2], Wolujewicz K.[2]

[1] Oto-Rhino-Laryngology Surgery Clinic, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland

[2] World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland

[3] Heart Failure and Cardiac Rehabilitation Department, Medical University of Warsaw, Warsaw, Poland

Patients with good, fully functional hearing up to 1.5 k Hz and deafness in all other frequencies pose the greatest challenge for a surgeon. Treatment procedure is aimed at preserving a natural preoperative hearing and complementing it with electric hearing after cochlear implantation.

The aim of this paper is to present the first in the world group of patients with well-preserved hearing up to 1.5 k Hz complemented in a deaf range with electric stimulation. Additional indication for treatment besides partial deafness was persistent tinnitus in one or both ears. Material was a group of adult patients with partial deafness – PDT-ENS (partial deafness treatment – electro-natural stimulation), who have been implanted in a worse-hearing ear with an electrode of appropriate length (16–19 mm) maximally flexible electrode Med-EL. Surgery was performed according to the 6-step procedure developed by H. Skarzynski.

In follow-up period ranging from 1 to 7 years, the preoperative hearing thresholds were completely preserved in more than 80% of patients. Partial hearing preservation, measured according to the hearing preservation classification scale by Skarzynski et al., was observed in more than 10% of patients. In almost 5% was observed minimal hearing preservation. There were no cases of complete loss of hearing. Patients needed no more than 6 months of rehabilitation to achieve good hearing results. An important element of the achieved results was the reduction of tinnitus in nearly 80% of patients after surgery in the first year of follow-up and in nearly 90% in follow-up longer than 2 years.

It should be underlined that patients obtained very good results of speech understanding in noise. Improvement of speech understanding in silence was significant, but less spectacular. Even in cases were preoperative hearing partially deteriorated, which was observed after some time in both implanted and not implanted ear, electric stimulation was capable of providing full compensation of a deficit.

Persistent constant tinnitus should be considered as an additional argument in favor of qualifying patients for partial deafness treatment with cochlear implant that enables achieving the effect of electro-natural stimulation.

P.62 • Promotion and views on tinnitus self-help interventions within UK national health service audiology departments

Smith S., Broomhead E., Watts E., Greenwell K., Stockdale D., Hoare D.J.

National Institute for Health Research (NIHR) Nottingham Biomedical Research Centre, Otology and Hearing Group, Division of Clinical Neuroscience, University of Nottingham British Tinnitus Association, Sheffield, UK

When developing and evaluating new health interventions it is important to consider issues that may influence successful uptake and implementation. Self-help interventions have the potential to provide low-cost and effective ways of improving access to psychological services for people with tinnitus. As part of a British Tinnitus Association audiology service evaluation we asked clinicians to describe

their use and views on self-help interventions, and to describe any potential barriers to uptake and implementation.

An online questionnaire was distributed to all (~220) NHS audiology departments in the UK, and was completed by audiologists, hearing therapists, and one clinical psychologist, totalling responses from 124 NHS departments. About two-thirds of respondents reported providing or recommending self-help materials such as books, information leaflets, or websites.

Potential benefits were identified as patient empowerment, providing a means of engaging the patient in their care, and the prospect of improvement in symptoms from engaging in self-help activities. However, almost half of respondents felt that there is insufficient training or guidance for clinicians on supporting self-help interventions.

Respondents recognised the potential for self-help interventions to play a useful role in tinnitus management. For patients with low level tinnitus severity they may reduce the number of audiology appointments that are needed. For patients with more complex needs self-help interventions may be useful to engage with between clinical appointments.

Before clinicians can confidently recommend or implement them as part of their practice, self-help interventions need to be thoroughly evaluated to provide evidence of effectiveness and to determine who benefits and how. Clinicians will also benefit from formal guidance on promoting and supporting self-help interventions for tinnitus.

P.63 • An economic evaluation of the healthcare cost of tinnitus management in the UK

Stockdale D., McFerran D, Brazier P., Pritchard C., Kay T., Dowrick C., Hoare D.J.

British Tinnitus Association, UK

There is no standard treatment pathway for tinnitus patients in the UK. Possible therapies include education and reassurance, cognitive behavioural therapies, modified tinnitus retraining therapy (education and sound enrichment), or amplification of external sound using hearing aids. However, the effectiveness of most therapies is somewhat controversial. As health services come under economic pressure to deploy resources more effectively there is an increasing need to demonstrate the value of tinnitus therapies, and how value may be continuously enhanced.

Current treatment pathways, costs and health outcomes were determined from the tinnitus literature, national statistics, a patient survey, and expert opinion. These were used to create an Excel-based economic model of therapy options for tinnitus patients. The probabilities associated with the likelihood of an individual patient receiving a particular combination of therapies was used to calculate the average cost of treatment per patient, average health outcome per patient measured in QALYs gained, and cost-effectiveness, measured by the average cost per QALY gained.

The average cost of tinnitus treatment per patient per year is GB£717, equating to an NHS healthcare bill of GB£750 million per year. Across all pathways, tinnitus therapy costs £10,600 per QALY gained. Results were relatively insensitive to restrictions on access to cognitive behaviour therapy, and a subsequent reliance on other therapies.

NHS provisions for tinnitus are cost-effective against the National Institute for Health and Care Excellence cost-effective threshold. Most interventions help, but education alone offers very small QALY gains. The most cost-effective therapies in the model were delivered within audiology.

P.64 • Validation and translation of the Japanese version of the tinnitus functional index

Suzuki N.

Department of Otolaryngology, Head and Neck Surgery, School of Medicine, Keio University, Japan

The tinnitus functional index (TFI), a new self-report questionnaire, was developed for measurement of tinnitus severity and treatment-related change. The original version has been translated into several languages other than English, such as Dutch, Polish, and Swedish. Various studies suggest that the TFI is valid and reliable with great psychometric properties. The purpose of this study was to evaluate the reliability and validity of the Japanese version of the TFI.

The English version of the TFI was translated into Japanese using a translation-back translation method, and 143 patients in the Otorhinolaryngology Department of Keio University Hospital with subjective tinnitus were involved. Participants completed a series of questionnaires including the TFI, Tinnitus Handicap Inventory (THI), Self-rating Depression Scale, State-Trait Anxiety Inventory, visual analogue scales for tinnitus loudness and annoyance, and the questionnaire of subjective improvements in symptoms. We examined the reproducibility, the internal consistency, and the effect size.

The reproducibility (intra-correlation coefficients: 0.860) and the internal consistency (Cronbach's coefficient alpha: 0.954) showed good results. At six months after the start of treatment, the effect sizes for the TFI (–1.31 to 0.60) were larger than those for THI (–0.65 to 0.31).The TFI consists of eight subscales, and cover various symptom domains. This questionnaire is expected to be a new gold standard for measurement of tinnitus. This study showed that the Japanese version of the TFI is valid and reliable because of the high reproducibility and the high internal consistency. In the evaluation of the treatment-related change, the Japanese version of the TFI is considered more useful than the THI because of its responsiveness estimated with effect sizes.

The reliability and validity of the Japanese version of the TFI are comparable with the original version of the TFI. This study demonstrates that the Japanese version of the TFI is appropriate for measuring of tinnitus severity and treatment-related change.

P.65 • Identification of tinnitus-specific microRNAS reveals dysfunctions in cellular integrity

Sylvius N.[1], Ladas V.[1], Hamann M.[1], Stockdale D.[2]

[1] University of Leicester, UK
[2] British Tinnitus Association, UK

The purpose of this project is to determine the role of microRNAs (miRNAs), a class of small non-coding RNA molecules silencing messenger RNAs in the development of tinnitus.

Wistar rats were anesthetised and exposed to a loud single tone which triggered temporary hearing threshold shifts after 24 hours. Tinnitus was assessed using the gap-induced prepulse inhibition of acoustic startle response by mixing a pseudo-random sequence of 12 startle only trials (no gaps) with 12 silent trials (gap condition), both embedded in similar background noise. Blood and brainstem samples were collected following behavioural screening. Total RNA including the small RNA fraction was extracted. MicroRNAs were quantified by small RNA sequencing. Differential expression was determined.

12 mature miRNAs were differentially expressed in the brainstem of rats with gap detection deficits (tinnitus) compared to controls. 4 circulating miRNAs were differentially expressed in the blood of rats with tinnitus compared to controls. 3 microRNAs were common to both brainstem and blood, and were differentially expressed in rats with tinnitus compared to rats with hearing loss. A pathway enrichment analysis using human equivalent of the miRNAs highlights signaling pathways affected in tinnitus including gap junctions and extracellular matrix signaling pathways, and the biosynthesis of glycans.

The identification of dysregulated miRNA provides insight to the molecular mechanisms involved in tinnitus, in particular a dysfunctional cellular structural integrity. Furthermore, the identification of circulating miRNAs offers a research avenue to explore novel and easy to access biomarkers of tinnitus.

P.66 • Prevalence and characteristic of tinnitus in patients with vestibular migraine

Tacikowska G., Rzeski M., Pietrasik K., Sosna M.

World Hearing Center, Institute of Physiology and Pathology of Hearing, Warsaw/Kajetany, Poland

Aim: To examine the prevalence and characteristics of tinnitus in patients with vestibular migraine (VM).

Material and methods: Retrospective review of 153 patients (ages 18–75 years) with consensus diagnose of VM, collected from ambulatory tertiary dizziness clinic (2014–2016). The prevalence of tinnitus, its association to migraine attacks as well as intensity and type (pulsatile or constant) was analysed.

Results: After ruling out patients with hearing loss and tinnitus due to alternate diagnosis the prevalence of tinnitus among all patients with VM was 15.6% (n=24). Twenty patients (13%) had tinnitus associated with attack (appearance or increase in intensity), in 5 patients concurrent with hearing loss. Among those, 6 patients had tinnitus as aura of migraine attack. Pulsatile type of tinnitus was found in 35% of patients (7/20). The intensity of tinnitus was estimated subjectively using visual analog scale and the points range from 0 to 5.

Discussion: The prevalence of tinnitus in patients with VM is comparable with that in general population (10–15%, ages 20–69, Moller, 2011). The overlap of tinnitus and hearing loss associated with vestibular symptoms make the differential diagnosis with Meniere's disease difficult. However, this is only 3.2% of all patients with VM in our study. Pulsatile tinnitus occurring in more than 1/3 of patients require, particularly in the context of dizziness, detailed diagnostic procedures to exclude serious pathology.

Conclusions: The perception of the intensity of tinnitus by patients with VM as a light to moderate can be explained by a greater focus on dizziness and sensory hypersensitivity annoyance.

P.67 • New Grading System of Tinnitus and Medical Management

Takahashi M., Kabaya K., Sekiya K., Murakami S.

Department of Otolaryngology, Head and Neck Surgery, Nagoya City University Medical School, Japan

Depressive illness affects tinnitus perception and such psychological problems may complicate tinnitus treatment to some extent. Therefore, psychological assessment as well as severity of tinnitus sensation should be considered for tinnitus management. Here, we propose new grading system and practical protocol of systematic treatment for tinnitus considering of tinnitus severity, psychological problems and catastrophic condition, and used it for the evaluation of tinnitus treatment outcomes.

Practical treatment protocol was used for 82 patients. We treated grade 1 patients using TRT with enrichment of background sound. Grade 2 patients were treated using TRT with sound generator. Grade 3 and grade 4 patients were treated using TRT with sound generator in addition of psychotropic agents and/or counseling. Grade 5 patients were treated using TRT with sound generator in addition of psychotropic agents and psychiatric treatment. Patients were followed at least 6 months and treatment effects were evaluated using pre and post treatment scores of THI, HADS and DSM-IV.

We observed improvement in THI scores 50.3 ± 22.5 points before treatment and 40.5 ± 20.0 after treatment, average of HADS score is 12.9 ± 6.9 points before treatment and 11.3 ± 6.9 after treatment. Improvement of tinnitus bothersome and psychological problems in daily living were achieved more effectively in patients with severe cases of grade III, IV and V.

These results suggests psychotropic agents and psychiatric treatment is effective for moderate and severe cases who have psychological problems and catastrophic condition. We classified tinnitus patients into 5 grades depending

on the tinnitus severity, psychological problems and catastrophic condition.

Our practical treatment protocol brought excellent outcomes in patients with moderate and severe cases of grade III, IV and grade V. Scoring the severity of tinnitus and psychological conditions using THI, HADS and DSM-IV, enable us to classify tinnitus grades as well as simplify tinnitus treatment.

P.68 • What we talk about when we talk about a psychological intervention for tinnitus

Thompson D.M.[1,2], Taylor J.[1,2], Hall D.A.[1,2], Walker D.M.[1,2], McMurran M.[1,2], Casey A.[1,2], Stockdale D.[1,2], Featherstone D.[1,2], Hoare D.J.[1,2]

[1] NIHR Nottingham Biomedical Research Centre, UK
[2] Otology and Hearing group, University of Nottingham, UK

Psychotherapies are effective in improving tinnitus-related distress, and though some audiologists deliver psychological interventions, these are not standardised across the UK. Our aim was to determine which components of psychological therapy are most important to include in an audiologist-delivered psychological intervention for tinnitus.

A 3-round Delphi survey was conducted to identify consensus across patients and clinicians. The panel included 18 patients and 21 clinicians (audiologists, hearing therapists, and psychologists). In round 1, panelists were asked an open-ended question, 'what are essential components of an audiologist-delivered psychological intervention for tinnitus'. Responses were coded using thematic analysis to produce a list of components presented in subsequent rounds as closed questions asking how important these are to include in an audiologist-delivered psychologically informed intervention tinnitus.

Consensus (>80% agreement) was reached that 76 components were important to include. These components were predominantly common therapeutic skills such as Socratic questioning and active listening, rather than specific CBT techniques like exposure and cognitive restructuring.

Efforts to develop a treatment manual should consider including important common skills, and the inclusion of any specific techniques should be justified.

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P.69 • An outcome selection process for a psychological tinnitus intervention

Thompson D.M.[1,2], Taylor J.[1,2], Hall D.A.[1,2], Walker D.M., Hoare D.J.[1,2]

[1] NIHR Nottingham Biomedical Research Centre, UK
[2] Otology and Hearing group, University of Nottingham, UK

There is a lack of consensus concerning the selection of outcome domains and instruments for use in tinnitus clinical trials. This has led to variation in outcome selection, impeding synthesis of research and decision-making in clinical care. This study presents an example of the outcome selection process for an audiologist-delivered psychologically informed tinnitus intervention.

Template analysis was used to identify outcome domains referred to in the intervention manual. Potential domains were selected from a list that was constructed by grounded theory using existing tinnitus questionnaires. A primary outcome instrument was identified if it was designed to be responsive to therapeutic change and possessed good content validity and internal consistency. Secondary instruments were included if they possessed good content validity and internal consistency in relation to domains identified in template analysis that were not measured by the primary outcome instrument.

Template analysis identified emotional impact and negative cognitions as domains of interest. The TFI was identified as the only instrument designed to be responsive to therapeutic change. The TFI possesses good content validity and internal consistency to measure the emotional impact of tinnitus. However, it does appear to measure negative cognitions. The TCQ represents the only an additional instrument specifically designed to measure negative cognitions with good content validity and internal consistency.

Our audiologist-delivered psychologically informed tinnitus manual is predicted to affect change in emotional impact and negative cognitions. This would appear to be best measured by the TFI and TCQ in the context of a clinical trial. It may not be feasible to use both in routine clinical care.

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P.70 • Transcranial Direct Current Stimulation (tDCS) in patients with tinnitus

Wang T.-C., Lin C-D.

Department of Otolaryngology – Head and Neck Surgery, China Medical University Hospital, South Korea

Subjective tinnitus is a phantom sensation experienced without any external source of sound that greatly impacts quality of life. Some investigations have claimed that transcranial direct current stimulation (tDCS) reduces tinnitus,

but studies on tDCS have demonstrated variable results. This meta-analysis aimed to examine the effect of tDCS on patients with tinnitus.

For this meta-analysis, we searched for articles published through January 5, 2016 in the following databases: Medline, Cochrane, EMBASE, and Google Scholar. The study outcomes were change in magnitude estimates of loudness (loudness), tinnitus-related distress (distress), and tinnitus handicap inventory (THI).

A total of 47 studies were identified, and after assessing the selection criteria, 5 studies were included in this meta-analysis. Our pooled results demonstrated that tDCS might have a beneficial effect on loudness (pooled standardized difference in means=0.674, 95% CI=–0.089 to 1.437, P=0.083). Further, the pooled results demonstrated a greater reduction in distress for the tDCS group (pooled standardized difference in means=0.634, 95% CI=0.021–1.247, P=0.043).

This study analyzed the effect of tDCS on patients with tinnitus and demonstrated that tDCS provided a benefit on loudness; however, this effect did not reach significance. Our pooled results demonstrated a larger reduction in distress in groups treated with tDCS, as compared with those administered a sham treatment.

tDCS demonstrated a greater reduction in distress for patients with tinnitus.

P.71 • Why is Tinnitus a Problem? A Qualitative Analysis of Problems Reported by Tinnitus Patients

Watts E.J., Fackrell K., Smith S., Sheldrake J., Haider H., Hoare D.J.

[1] *NIHR Nottingham Biomedical Research Centre, Otology and hearing group, Division of Clinical Neuroscience, School of Medicine, University of Nottingham, UK*
[2] *The Tinnitus and Hyperacusis Centre, London, UK*
[3] *ENT Department, Hospital Cuf Infante Santo – Nova Medical School, Lisbon, Portugal*

To date only two studies have qualitatively evaluated why tinnitus is a problem, in different populations, and with relatively modest sample sizes. The aim of this study was to determine the domains of tinnitus problem according to a large clinical data set.

This was a retrospective analysis of anonymised clinical data from 988 patients who attended a tinnitus treatment centre in the UK between 1989 and 2014. Content analysis was used to code and collate the responses of 671 patients to the clinical interview question 'Why is tinnitus a problem?' into categories of problems (domains).

We identified 18 distinct domains of tinnitus-associated problems. Tinnitus-related fear, constant awareness, and annoyance were notably common problems.

Clinicians need to be mindful of the numerous problem domains that might affect their tinnitus patients. Current questionnaires, as well as being measures of severity, are useful clinical tools for identifying problem domains that need further discussion, and possibly measurement with additional questionnaires.

The domains identified in this work will inform a core outcome set for tinnitus research currently under development in Europe, and the development of future clinical tinnitus questionnaires.

P.72 • General Practitioner support for tinnitus – a survey of patient experience

Wray N., Broomhead E., Stockdale D.

British Tinnitus Association, UK

Approximately 10% of adults in the UK experience tinnitus. In around 1% of adults, tinnitus may affect quality of life. There are approximately 750,000 General Practitioner (GP) consultations for tinnitus each year. Access to reliable information, on-going support and reassurance are key elements in the management and treatment of tinnitus. The British Tinnitus Association (BTA) aims to play a key role in the delivery of these functions and we wish to support GPs in their vital role.

A nine question survey was devised which asked basic questions about the respondent's experience of asking for help for tinnitus from their GP, and the services that the GP offered them.

The BTA distributed a link to the survey, which was hosted on SurveyMonkey, to all BTA members for whom we had an email address via Mailchimp. This was sent to 1539 people. We received 928 completed questionnaires.

- 53 per cent of respondents were unsatisfied with their GP's response,
- 92 per cent of unsatisfied patients stated they felt their GP was 'dismissive or unsympathetic', or 'didn't have enough knowledge',
- 706 of 928 respondents were referred to ENT or audiology. Of those, 88 per cent had to wait up to four months for an appointment.
- In addition, 85 per cent were not offered any further support from their GP while they waited and just under half (48 per cent) said their tinnitus had a 'moderate' or 'severe impact' on their quality of life during this time.

It is clear from our recent patient survey that people with tinnitus feel they are not getting the best possible help when first diagnosed with the condition. There is a knowledge gap within the medical community about the impact tinnitus can have and many patients don't feel listened to or supported enough. This is having an unnecessary impact on their quality of life and on the NHS as they make repeat visits to their GP.

GP's would greatly benefit from increased training and knowledge about tinnitus and local services.

P.73 • The influence of amplitude modulation on residual inhibition

Wrzosek M.[1], Bulla I.[2], Szymiec E.[3], Obrebowska Z.[3], Paolino M.[4], Paolino F.[4], Quemar A.[4], Norena A.[5]

[1] *Department of Logic and Cognitive Science, Institute of Psychology, Adam Mickiewicz University in Poznan, Poznan, Poland*
[2] *Institut fur Mathematik und Informatik, Universität Greifswald, Greifswald, Germany*
[3] *ENT Department, University of Medical Sciences, Poznan, Poland*
[4] *IMERTA Clinic, Marseille, France*
[5] *University Aix-Marseille, Laboratory of Integrative and Adaptive Neuroscience, Marseille, France*

Residual inhibition is a well-known phenomenon defined as a temporary reduction of tinnitus loudness after a prolonged exposure to an acoustic stimulus Recently it has been suggested that modulated (in amplitude – AM and frequency – FM) sounds are also effective in reducing the tinnitus loudness. The aim of our study was to test weather amplitude modulated white noise may be more effective in masking tinnitus and producing residual inhibition (RI) than standard, non-modulated stimuli (white noise).

We tested 57 patients from two ENT centers, namely the IMERTA Clinic in Marseille (22 patients) and the ENT Clinic in Poznan (35 patients). The mean age of patients in tested population was 51.04 years (SD=16.0), and the mean duration of tinnitus 5.53 years (SD=7.71). We studied the effects of three frequencies of modulation (100% Departmenth), namely 4, 32 and 64 Hz. The minimum masking level (MML) and the minimum residual inhibition level (MRIL) have been assessed from these stimuli.

The results indicate that that there is a dependency of the modulation frequency on the MRIL (the higher the frequency of AM, the lower MRIL is), which cannot be inferred from the data for the MML. On average, relatively high frequency modulated signals (64 Hz) are more efficient than unmodulated or low-frequency related signal to mask and produce residual inhibition of tinnitus.

We confirm that amplitude modulation of acoustic stimuli can modulate MML and MRIL.

P.74 • Continuous Zwicker tone illusion imitates tonal tinnitus – could Zwicker tone generators imitate different types of hearing loss?

Wrzosek M.[1], Szymiec E.[2], Obrebowska Z.[2], Norena A.[3]

[1] *Department of Logic and Cognitive Science, Institute of Psychology, Adam Mickiewicz University in Poznan, Poznan, Poland*
[2] *ENT Department, University of Medical Sciences, Poznan, Poland*
[3] *University Aix-Marseille, Laboratory of Integrative and Adaptive Neuroscience, Marseille, France*

The Zwicker tone (ZT) is an illusory percept (often described as a 'bing') that can arise as a result of turning off (for instance) a broa dBand noise with a spectral gap. Appropriate experimental set up can provoke the emergence of continuous ZT illusion.

The main aim of our study was to verify the hypothesis that continuous ZT resembles tonal tinnitus. Secondly, we planned to test the influence of the ZT illusion on the tinnitus perception. Finally, we wanted to check whether type of audiogram may influence the occurrence of illusion.

We tested 27 participants – 13 controls and 14 patients from the ENT Clinic in Poznan. Audiograms were assessed and two Zwicker tones generated for each patient – one matched to tinnitus frequency and control tone of 4 k Hz. Control group was presented with the illusion of 4 k Hz. Single tone and continuous illusion were evoked for both groups.

It was possible to evoke the single ZT illusion in 9 of 14 tinnitus patients and 11 of 13 controls. Continuous ZT illusion was perceived by 7 patients and for ZT of tinnitus frequency for the majority of patients described as very similar to their tinnitus. ZT perception influenced tinnitus in all cases, in 5 making it either inaudible or indistinguishable. All controls that perceived the single ZT were able to hear the continuous illusion.

ZT perception was strongly influenced by the degree of hearing loss and the shape of audiogram.

It has been suggested that mechanisms underlying perception of the ZT and its generation can contribute to better understanding of tinnitus. The analysis of the relation between psychoacoustic parameters of the Zwicker tone generator and tinnitus pitch potentially may shed a light on the type of hearing loss.

The described continuous Zwicker tone may be considered as a model of tonal tinnitus originated from the profound hearing loss of particular frequency range.

P.75 • Effects of Gene-Environmental Interaction on Sleep Quality among Chronic Subjective Tinnitus Patients

Wu J.-L., Lin C.-Y.

Department of Otolaryngology, National Cheng Kung University Hospital, China

For adult subjects with chronic subjective tinnitus, we aimed to investigate (1) the association of tinnitus severity with objective sleep quality and autonomic nerve system (ANS) function; (2) based on the different functional polymorphisms (5-HTTLPR and rs25531), the influences of sleep quality and ANS function by different tinnitus severity.

The patients with tinnitus and control subjects were assessed. They were matched for health and relevant socioeconomic factors. Objective assessments included hearing test, polysomnography and ANS function evaluation. Subjective assessments were Tinnitus Handicap Inventory (THI), Hospital Anxiety and Depression Scale (HADS), Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS). From blood sampling, 5-HTTLPR and

rs25531 polymorphisms of the SLC6A4 gene were determined by polymerase chain reaction (PCR)-restriction fragment length polymorphism analysis.

Total score of THI among tinnitus group was significantly higher ($p<0.05$). Lower sleep efficiency and higher score of PSQI were also found among tinnitus patients ($p<0.05$). In response to the cold pressor test, a significantly increase in heart rate occurred in tinnitus patients. The increase in systolic and diastolic blood pressure in the cold pressor test was similar in tinnitus patients ($p<0.001$). For the group with 5-HTTLPR S+ genotype, the association of tinnitus severity with sleep quality presentations and autonomic functional outcomes was significant individually ($p<0.05$). ANS function evaluation revealed tinnitus patients had a higher sympathetic drive to the myocardium. Using the univariate regression model, the possible predictors of subjective tinnitus severity included sleep latency, sleep efficiency, increase in heart rate and systolic and diastolic blood pressure occurred in the cold pressor test.

This study revealed that:
1. a significantly correlation between higher tinnitus severity with worse sleep quality (longer sleep latency, less sleep efficiency) and ANS dysfunction (sympathetic hyperactivity);
2. for subjects with low functional genotype of 5-HTTLPR polymorphism, this correlation still existed significantly; oppositely, the sleep quality and ANS function were not influenced by different tinnitus severity among high functional genotype group.

P.76 • Advanced Tinnitus Imaging Protocol: Is there any possible "one stop shop" algorithm?

Yildirim D.[1], Kilavuz A.E.[2], Sirin A.[3], Sirin A.A.[4]

[1] *Radiology Department, Acibadem Taksim Hospital, Istanbul, Turkey*
[2] *Emergency Department, Acibadem Taksim Hospital, Istanbul, Turkey*
[3] *Radiology Department, Acibadem Taksim Hospital, Istanbul, Turkey*
[4] *HNS- ORL Department, Doctors Clinic, Istanbul, Turkey*

Tinnitus, with its pulsatile and non-pulsatile subtypes, still remains as a dilemma. Especially in subjective forms, it is a big challenge to detect a radiological pathology. We aimed to establish a gold standard algorithm, that could overcome this challenge and that could be applied to all patients with tinnitus.

First of all, in order to comprehend the source of tinnitus, one must have a full command of normal anatomy and neural pathways. This system contains a complex anatomo-functional pathway, which starts form external ear canal and ends mostly at contralateral Heschel Gyrus. With the help of demonstrative images, we put together a protocol with imaging tips that contains the pathologies regarding all these pathways. The algorithm was based on the output obtained by using 128x2 dual source CT and 3 Tesla MRI (32 channel head coil). Starting from external ear canal, we detected that even irrelevant extra-auditory elements, such as dural arteriovenous fistulas also could generate tinnitus. Other than this, starting with vestibular-semicircular, cochlear labyrinthine anomalies, neurovascular compression syndromes, tinnitus etiology could be visualized. And, last but not least, the microstructural cochleo-thalamo-cortical auditory pathways could be scanned successfully.

We understood that the ossicular chain pathologies could only be detected with a proper quality CT scan. We realized that sparing even one minute to dynamic MR angiography before conducting a conventional contrast enhanced imaging could help solving many problems. Even though it is slowly losing its importance, neurovascular impingement alongside with Functional Magnetic Resonance Imaging (FMRI) and Diffusion Tensor Imaging (DTI) could help with cases in which the conventional methods fail to address the pathology.

Advanced radiological imaging protocols, when obtained from high technology units, and with sequences outside the conventional algorithms, provide objective findings in tinnitus with its both subjective and pulsatile forms.

P.77 • An unknown type of tinnitus induced by valsalva: Practical diagnosis with 4D- MR-Angiography

Yildirim D.[1], Turkmen S.[2], Alis D.[3], Sirin A.[4], Sirin A.A.[5]

[1] *Radiology Department, Acibadem Taksim Hospital, Istanbul, Turkey*
[2] *Emergency Department, Acibadem Taksim Hospital, Istanbul, Turkey*
[3] *Radiology Department, Acibadem Taksim Hospital, Istanbul, Turkey*
[4] *HNS- ORL Department, Doctors Clinic, Istanbul, Turkey*

Post-processing software enjoys a wide sphere of use thanks to advances in technology, and the fact that central venous insufficiency may be associated with tinnitus has been revealed using MRI. Our aim in this study was to use a relatively easier and shorter MRI method (4D- MR-Angiography) to reveal whether or not there is an association between tinnitus and jugular venous reflux by adding the valsalva maneuver to technique.

Thirty patients with unilateral tinnitus and undergoing contrast enhanced MRI with a special protocol were included in the study. Thick slab dynamic maximum intensity projection (MIP) images were obtained following short imaging with TWIST-MRA lasting a total of 90–110 sec. Reflux degree was graded (as grade 0, 1, 2) on MIP images obtained during valsalva maneuver.

In all cases no dural arteriovenous fistula was defined. Jugular venous reflux was not identified (grade 0) in 20 cases. Grade 1 reflux was determined on the right in five of the remaining cases and on the left in two. Reflux past the base of the skull and reaching the cortical veins and cavernous sinuses was determined during TWIST-MRA in three cases exhibiting a significant increase in tinnitus severity with valsava in their clinical histories.

This study reveals a relation between jugular venous reflux and tinnitus using an objective, non-operator dependent

modality. In our opinion, determination of this etiology will have a positive impact on the entire diagnosis-treatment-follow-up algorithm in cases of refractory tinnitus resistant to other treatments and induced with valsava.