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Abstract Book

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Aage Møller Distinguished Lecture on Tinnitus

AM

The role of brain networks in tinnitus perception

Dirk DE RIDDER

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The brain is formed by 7 canonical functional networks and is considered a complex adaptive system (CAS), aka as complex neuroplastic system. All CAS are characterized by emergence. Tinnitus and tinnitus disorder can thus be regarded as emergent properties of multiple interacting, dynamically changing networks.

As tinnitus is an auditory conscious percept, it requires to fulfil the essential criteria of consciousness.

Consciousness requires high frequency oscillations, anticorrelated activity, small world topology and activation of the consciousness enabling networks such as the default mode network and central executive network. For auditory consciousness the extended salience network needs to be co-activated, which includes the ventral attention network. Since tinnitus is unrelated to an external sound source, it must be related to default mode activity rather than central executive activation. This may result in tinnitus becoming an integral part of the self-percept.

Tinnitus disorder requires extra changes to generate the negative cognitive and emotional aspects such as anxiety and depression. These are the consequence of clinically maladaptive but energetically adaptive reorganization of the triple network.

Understanding the brain networks involved in tinnitus may lead to better neuromodulation and pharmacological approaches to treat this enigmatic symptom and disorder

Plenary Lecture 01

PL 01

Current procedures and future directions in surgical treatments for tinnitus

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The current treatment of tinnitus is in most cases based on non-invasive methods. However, for certain forms of hearing loss, surgery also plays an important role in the treatment of tinnitus. Consequently, invasive strategies play a role in the treatment of tinnitus in combination with conductive hearing loss. In patients with otosclerosis, tinnitus perception can most likely be improved or in some cases even completely suppressed after stapes surgery. Other options include tympanoplasties for patients with tinnitus and chronic otitis media. In this condition, surgical intervention should only be planned to close the eardrum and improve hearing. The effect on tinnitus remains unpredictable. Cochlear implantation in individuals with single- or double-sided deafness, severe to profound hearing loss, or deafness is a success story, not only in terms of restoring hearing but also in terms of suppressing tinnitus. However, the exact mechanisms of tinnitus suppression in this situation are not fully understood. It is suspected that electrical stimulation in the fluid-filled spaces of the cochlea is the most important factor. Therefore, recent research activities have been devoted to extending this type of electrical stimulation to tinnitus patients who have only mild or moderate hearing loss. This lecture will cover both research with intracochlear and extracaochlear implants for tinnitus improvement.

Another field in which surgical therapy of tinnitus is used, in addition to cases associated with hearing loss, is that of pulsatile tinnitus. This involves neurosurgical, otosurgical and minimally invasive neuroradiological approaches to eliminate the body's own sound source, which causes the unpleasant hearing of blood flow in the ear. The causes to be mentioned here are mainly bony dehiscences, arteriovenous fistulas or vascular tumors. In recent years, new indications in this area have been added, in particular due to innovations in the field of catheter-based minimally invasive procedures (e.g. stenting of a high jugular bulb).

Last but not least, surgery can also play a role in an experimental sense in the direct or indirect electrical stimulation of the brain or cranial nerves (e.g. vagus nerve). Improvements in neuronavigation and robotics are playing an increasingly important role in deep brain stimulation. This makes it possible to place electrodes in the brain tissue with increasing precision and in a less invasive way. This could also open up new treatment approaches in the control of small brain areas that play a role in the tinnitus generation.

Plenary Lecture 02

PL 02

Tinnitus Through My Eyes: Sharing 20 Years of Scientific and Clinical Insights

Eui-Cheol NAM

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Over the past two decades, I have conducted a series of investigations aimed at advancing our understanding of tinnitus and improving its management. In this plenary session, I will provide an overview of this body of work, structured around three principal themes: the analysis of clinical characteristics, neuroimaging-based research on neuromodulation, and the evaluation of therapeutic strategies.

First, in order to better understand how tinnitus is perceived and experienced by patients, I examined both psychoacoustic features and subjective dimensions. Parameters such as pitch, loudness, and somatosensory modulation were evaluated alongside audiological findings, while emotional distress and perceived burden were also assessed. This line of research sought to elucidate the ways in which tinnitus is shaped not only by auditory input but also by cognitive and affective factors.

Second, I employed functional magnetic resonance imaging to explore the neural effects of transcutaneous vagus nerve stimulation, focusing on brain regions implicated in tinnitus. This included comparative studies of various stimulation sites and an assessment of their potential to modulate central neural networks associated with tinnitus perception and regulation.

Third, I investigated the clinical efficacy of a range of treatment modalities, including pharmacological therapies, sound-based interventions, and hearing aid use. Patient outcomes and treatment sustainability were monitored to help identify the most suitable approaches for specific subgroups of individuals with tinnitus.

Taken together, these studies highlight the heterogeneous nature of tinnitus, emphasizing that it is not a single disease entity but rather a complex symptom influenced by diverse mechanisms and individual variability. Looking ahead, the implementation of personalized assessment and targeted treatment strategies appears increasingly essential. In this presentation, I will reflect on the evolution of this integrative approach and share key milestones from the past 20 years of research and clinical practice.

Keynote Lecture 01

KL 01

Heterogenous dimensions of tinnitus: Neurophysiological insights

Sven VANNESTE

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Tinnitus, the perception of sound without an external source, is widely recognized as a heterogeneous condition. This heterogeneity stems from its multifaceted nature, with diverse underlying mechanisms, clinical presentations, and patient experiences. While tinnitus is often perceived as a single condition, it is more accurately described as a spectrum disorder, characterized by significant variability in onset, severity, and persistence among individuals.

Diverse Aetiologies and Mechanisms
The heterogeneity of tinnitus begins with its aetiologies. Tinnitus can arise from a range of causes, including noise-induced hearing loss, ototoxicity, age-related degeneration, or neurological disorders. It may also be associated with conditions such as temporomandibular joint dysfunction, head or neck trauma, or stress-related psychological factors. These diverse origins suggest that tinnitus is not a singular condition but rather a symptom that emerges from multiple underlying pathologies.

At the mechanistic level, tinnitus involves a complex interplay of auditory and non-auditory systems. Dysregulation within the auditory pathway, particularly at the level of the cochlea, auditory nerve, or central auditory structures, is often implicated. However, non-auditory factors, such as aberrant activity in the limbic and autonomic systems, further contribute to the condition, amplifying its emotional and physiological impact.

Variability in Clinical Presentations
Clinically, tinnitus manifests in a variety of forms, ranging from intermittent, mild sounds to constant, debilitating noise. Some individuals experience tonal tinnitus, described as a continuous ringing or buzzing, while others report more complex sounds, such as hissing, clicking, or roaring. The perceived loudness and pitch of the tinnitus can vary widely, even among patients with similar aetiologies.

Moreover, the condition can have vastly different impacts on quality of life. For some, tinnitus is a minor annoyance; for others, it leads to significant distress, anxiety, insomnia, or depression. This variability underscores the need for personalized assessment and management strategies tailored to each patient's unique experience.

Challenges in Classification and Treatment
Efforts to classify tinnitus into distinct subtypes have faced significant challenges. Traditional approaches have attempted to group tinnitus based on factors such as duration (acute vs. chronic), laterality (unilateral vs. bilateral), or associated hearing loss. However, these categorizations often fail to capture the complexity and overlap of symptoms experienced by patients.
The heterogeneity of tinnitus also complicates treatment. While some individuals benefit from hearing aids, sound therapy, or cognitive-behavioral interventions, others show minimal response to these approaches. This variability in treatment efficacy highlights the need for a deeper understanding of the underlying mechanisms and the development of novel, targeted therapies.

A Call for a Dimensional Framework
To address the challenges posed by the heterogeneity of tinnitus, researchers are increasingly advocating for a dimensional framework. Such an approach views tinnitus not as a categorical condition but as a dynamic spectrum of interacting behavioural, biological, and neurophysiological factors. By focusing on the interplay between these dimensions, this framework offers a more nuanced understanding of the disorder, paving the way for individualized diagnostic and therapeutic strategies.

In this presentation, I will focus on how neurophysiological insights can help further our understanding of the underlying mechanisms of this heterogenous condition. By delving into the neurophysiological underpinnings, I aim to uncover how various neural pathways and brain networks contribute to the onset and persistence of this condition. These insights are pivotal for identifying potential therapeutic targets and refining treatment strategies.

In conclusion, tinnitus exemplifies the complexity of heterogeneous diseases, where diverse mechanisms, clinical presentations, and patient experiences converge. Recognizing and embracing this heterogeneity is essential for advancing research, improving clinical outcomes, and ultimately alleviating the burden of tinnitus for those who live with it. By integrating neurophysiological knowledge into our approach, we can move closer to developing more effective, personalized interventions for managing this challenging condition.

Keynote Lecture 02

KL 02

Tinnitus does not exist: So why do so many people hear it?

William SEDLEY

Translational and Clinical Research Institute, Newcastle University, UK

When we refer to 'tinnitus', we usually mean 'subjective tinnitus', which by definition does not result from any source that exists in the physical world. Nonetheless, a large proportion of the population hears such a non-existent sound regularly or permanently, and once we consider transient tinnitus then we find that nearly everybody experiences tinnitus, either intermittently over background sound, or persistently in silent environments.

As such, there is a fundamental question of why we possess such an inherent propensity to experience 'phantom' sound. Is tinnitus merely a design flaw or inherent limitation in our auditory systems, or can it even confer benefits in some situations, as well as the resulting harm we know that so many people report?

Finding objective evidence of tinnitus in the brains of people who experience it is immensely challenging. It is tempting to liken the search to finding a 'needle in a haystack', but I would argue it is much more challenging than that. A 'needle' implies a qualitatively different, alien or pathological substance or process to the 'hay' of the healthy brain. Yet, tinnitus is more likely the result of alterations of the 'hay' itself, i.e. an emergent property of an otherwise healthy brain (though acknowledging that an 'unhealthy' ear is commonly, but not always, associated).

Whilst many alterations in brain structure, spontaneous, task-related and sound-driven activity have been reported in association with tinnitus, understanding the relevance and role of each change is much more challenging. We know well that tinnitus is strongly associated with hearing loss, hyperacusis, anxiety, stress, and in some cases alterations in attention and cognition, and that is before considering those cases that exist alongside comorbidities such as musculoskeletal problems, migraine, chronic pain and affective disorders. We know now that many changes initially attributed to tinnitus were, in fact, correlates of the underlying hearing loss. More recent studies are revealing how hyperacusis and tinnitus-related distress can act as similar confounds.

One might go so far as to ask the question of what is left of the presence of tinnitus in the brain once we control for hearing loss, compensation for hearing loss, hyperacusis, musculoskeletal factors, attention, vigilance, stress, and individual reactions to, and memories of, tinnitus. Might we simply be left with the trace of brain activity associated with hearing a sound (any sound) and nothing else? Or, is there something unique and 'special' about tinnitus? If there is, then it would instantly beg the question of why, given the absence of a clear benefit or need.

Conversely, if objective markers of tinnitus in the brain are simply the 'sum of parts' of predisposing mechanisms and reactions related to tinnitus, then is tinnitus, in mechanistic terms, simply a set of conditions of the hearing and perceptual systems, rather than a distinct tangible entity in itself?

These questions are far from esoteric, as these are what must be answered if we are truly to master tinnitus: why it occurs, how it develops, why it persists, how to measure it, and ways to change the conditions responsible for convincing the brain that it exists.

Keynote Lecture 03

KL 03

A lesson learned from neuroimaging studies of the tinnitus brain

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Tinnitus, the perception of sound in the absence of external auditory stimuli, is a prevalent condition affecting millions of individuals globally. It presents a significant clinical challenge due to its complex neurophysiological underpinnings. For those who suffer from it, the experience can be profoundly debilitating, often leading to anxiety, sleep disturbances, and cognitive changes. Despite its widespread occurrence, no definitive treatment exists yet, making the pursuit of precision therapies a critical area of research. One of the primary obstacles in developing effective treatments is the elusive understanding of the neurobiological mechanisms underlying tinnitus.

Recent advancements in neuroimaging techniques have provided unprecedented insights into how the brain processes and responds to this phantom sound, revealing structural and functional alterations that enhance our knowledge of this enigmatic topic. Tinnitus, however, is so deeply embedded in the brain's complex network that we cannot see the complete picture even by using the most fantastic equipment of brain imaging technologies nowadays in spite of these advances. Therefore, it is essential to continue refining our methods to "listen" to the brain more carefully, even if a full inspection may always remain just out of reach.

In this presentation, I will synthesize findings from researches by a variety of neuroimaging modalities—conducted by our team and others—trying to elucidate the neural mechanisms associated with tinnitus. Key lessons learned from neuroimaging studies of the tinnitus brain will be explored, shedding light on how these findings might influence clinical practice and improve outcomes of treatment strategies for individuals affected by this challenging entity. These studies, utilizing techniques such as magnetic resonance imaging (MRI), electroencephalography (EEG), magnetoencephalography (MEG), and positron emission tomography (PET), provided data in terms of both evoked responses and resting-state activity in auditory and non-auditory networks.

For example, our research has shown that the long-term effects of repetitive transcranial magnetic stimulation (rTMS) on tinnitus can be observed through steady-state auditory evoked fields (SSAEFs). Additionally, we found that tinnitus patients exhibit significantly stronger global connectivity in the alpha band within the left frontal pole (FP) and significantly stronger global connectivity in the temporal and parietal lobes for the delta band. These findings support the emerging consensus that neural correlates within these lobes may play a central role in the operational mechanisms of tinnitus. Other studies suggest that changes in brain connectivity could be linked to neuroinflammation, potentially contributing to the negative aspects of tinnitus, such as anxiety, cognitive impairment, and depression. These findings are supported by evidence showing real-time changes in SSAEF magnitude following rTMS treatment and molecular data from animal studies indicating that rTMS reduces microglial activation in the prefrontal cortex (PFC). Since rTMS leads to mitigation of discomfort from tinnitus for some patients, the phenomenon could have pinpointed the possible association between tinnitus and neuroinflammation.

While significant progress has been made, there is still much to learn. Neuroimaging studies have illuminated altered brain activity in individuals with tinnitus and highlighted the complex interplay between different brain regions. As we continue to unravel the neural mechanisms involved, it is clear that a multidisciplinary approach is essential for developing novel treatments. Advancements in neuroimaging technology will not only deepen our understanding of tinnitus but also pave the way for the innovative development of targeted therapeutic strategies. In particular, improvements in brain imaging techniques may one day allow us to visualize tinnitus-related neuroinflammatory changes at the molecular level. By integrating insights from diverse imaging modalities and accounting for individual differences in brain structure and function, we can move toward a more personalized approach to tinnitus management, ultimately improving patient care with a curative intent.

Keynote Lecture 04

KL 04

Musical Hallucinations and the Aging Brain

Akinori FUTAMURA

Department of Neurology, Showa Medical University Fujigaoka Hospital, Japan

Musical hallucination is a complex auditory condition. Subjects perceive complex sound in the form of music in the absence of acoustic stimulus. It has been reported in association with psychiatric disorders, organic brain disease, and epilepsy. However, the most common form is idiopathic musical hallucination with deafness in the elderly. The elderly hear emotional music, associated with nostalgia. There have been reports of hearing children's songs, folk songs, sacred songs, military songs and the national anthem. Recent reports reveal musical hallucinations due to mild cognitive impairment and dementia. Furthermore, musical hallucinations with hearing loss may reflect deterioration of cerebral function. Auditory Charles Bonnet syndrome is the established pathophysiological mechanism of musical hallucination. Decrease of auditory stimuli and activation of the auditory network activate the cerebral network related to music. It is also thought that musical hallucination appears via disintegration of the complementary relationship between sensation and memory. Treatment is still uncertain. Some authors report that hearing aids, antiepileptic drugs, anticholinergics, or antipsychotics may all improve musical hallucination. There is a possibility that it can lead to treatment for the underlying disease. The aging rate in Japan has exceeded 20%, ahead of any other country in the world, and may conceal many undiagnosed subjects.

Keynote Lecture 05

KL 05

Tinnitus: Ringing in the Brain

Josef P. RAUSCHECKER

Neuroscience, Georgetown University Medical Center, USA

My lecture will be divided into the following parts:

What is Tinnitus ?

Where is Tinnitus ?

Why Tinnitus ?
1. Peripheral Hearing Loss
2. Central Hyperactivity
3. Inability to Suppress Hyperactivity

Fronto-Striatal Gating Theory

Where do we go from here?

An early version of my lecture can be watched as a TED talk on YouTube or on ClassCentral.

Keynote Lecture 06

KL 06

Tinnitus disorder, hyperacusis and cognitive decline

Jose Antonio LOPEZ-ESCAMEZ

Meniere disease Neuroscience Laboratory, Faculty of Medicine & Health, School of Medical Sciences, The Kolling Institute, University of Sydney, Australia

Tinnitus disorder is a severe form of tinnitus reported in 1-2% of the population that is associated with emotional distress, cognitive dysfunction, and/or autonomic arousal, leading to behavioral changes and functional disability. These individuals also present sensorineural hearing loss and hyperacusis, and should be consider a distinct tinnitus endophenotype, requiring a multidisciplinary management. Several epidemiological studies have shown that tinnitus and tinnitus disorder have a significant heritability, with common and rare variation having a different effect size on the tinnitus phenotype. Hyperacusis is a common condition usually reported by many patients with tinnitus, showing an association with some mental conditions such anxiety. Cognitive decline is an age-related condition that also is associated with sensorineural hearing loss and tinnitus disorder.
Although the heritability of hyperacusis and cognitive decline has not been established in epidemiological studies, we hypothesize that the combination of common and rare variants, located in non-coding and coding region of the genome, respectively could be associated to tinnitus disorder and may exert small, pleiotropic effects by regulating multiple genes in different brain regions involving sensorial perception, attention and cognition. By using genomic datasets from the several European cohorts, were have identified rare variants associated with tinnitus disorder in several genes, including ANK2, an ankyrin protein essential in axonal branching and neuron connectivity. Moreover, a multicenter study including patients with chronic tinnitus from the UNITI cohort also showed an association with tinnitus handicap inventory scores, high-frequency hearing loss and mild cognitive impairment. This strong association between tinnitus, hearing loss and mild cognitive impairment could be mediated by the combined effect of common and rare genetic variation with pleiotropic effects.

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Keynote Lecture 07

KL 07

The Neurophysiological Model of Tinnitus: Insights and Implications for Research and Treatment

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[2]*JHDF, Inc., USA*

The Neurophysiological Model of Tinnitus (NMT) proposed in 1990 postulated that in the clinically significant tinnitus (i.e., tinnitus affecting peoples' lives to the extent that they seek help) the auditory system is secondary and other systems in the brain play dominant role. The model delineated the mechanisms of tinnitus and hyperacusis and separated mechanisms responsible for tinnitus perception from mechanisms responsible for reactions to tinnitus.

Tinnitus retraining Therapy (TRT) is a treatment based on the NMT, attempting to block spreading of tinnitus signal (i.e., neuronal activity perceived as tinnitus) to centers in the brain involved in negative reaction to tinnitus, and through this mechanism to remove these reactions, i.e., achieving habituation reactions evoked by tinnitus. Habituation of perception occurs automatically once a sufficient level of habituation of reactions is achieved. This approach is not trying to modify the tinnitus signal, or modify reactions evoked by tinnitus, or to improve coping. The etiology of tinnitus is irrelevant when using TRT, as the method is not attempting to modify or suppress the tinnitus signal. TRT is successful in treating somatosounds as well. It utilizes methods used to extinguish subconscious conditioned reflexes. For treatment, the plasticity of the neural connections is of paramount importance, therefore factors decreasing brain plasticity, e.g., benzodiazepines, should be avoided.

Over the years, data accumulated from patients, animal and clinical research refined the model. Furthermore, in 2001, once the phenomenon of misophonia was recognized and its definition and potential mechanisms proposed, misophonia was incorporated in the model as well as its treatment based on principles of the NMT has been proposed.

Currently, the model stresses importance of: 1) the functional connections of auditory system with other system in the brain; 2) dominant role of subconscious connection which are furthermore governed by pattern recognition and principles of conditioned reflexes; 3) importance of the principles of stimuli generalization and complex conditioned stimuli; 4) significance of limbic and sympathetic part of the autonomic nervous system in developing and sustaining negative reactions.

Importantly, all brain systems, except the auditory system, may function normally – the problem arises from their incorrect activation by tinnitus signal "proper reaction to wrong stimulus." In case of misophonia even the auditory system may function normally and problems arise from improper, subconscious connections between the auditory and other systems in the brain. Consequently, in research and clinical work attention should be at delineating functional connections between systems, rather than potential dysfunction of these systems. Dysfunctions may contribute to the extent of reactions, but they are not necessarily responsible for the development of tinnitus, hyperacusis or misophonia.

While the model was proposed for auditory system, its features encompass all other sensory systems, e.g., visual, somatosensory, pain. The model pointed out presence of phantom sensory perceptions – tinnitus (auditory), nonretinal vision (visual), phantom limb (somatosensory), phantom pain (pain) as well as mechanisms of synesthesia.

Keynote Lecture 08

KL 08

A new era of tinnitus treatment: Multimodal neuromodulation through a whole health approach

Hubert LIM

Biomedical Engineering & Otolaryngology, University Of Minnesota, USA

There is a rapidly growing field with remarkable developments in implantable or wearable neurotechnologies for treating a range of health conditions, catalyzed by considerable investments by multiple funders across countries. These neurotechnologies traditionally target a specific physiological system or a focused set of clinical outcomes with limited opportunities for incorporating a whole health approach. In my talk, I will share my lab's positive experiences and challenges in incorporating a human-centered design for translating new neurotechnologies to patients for treating various health conditions, including tinnitus. I will also present recent efforts through a large NIH-funded consortium for understanding how the vagus nerve affects multiple physiological systems and clinical outcomes across the body, which can potentially open up opportunities for novel technologies and interventions to leverage the vagus nerve pathways for improving clinical care within a whole health framework. Collectively, these efforts support the need for multimodal approaches that can interact with multiple body systems and neural pathways spanning sensory, immune, metabolic, autonomic and cognitive function for treating tinnitus as well as other chronic disorders.

Symposium 01

Treatment I: Implantable Hearing Devices
SP 01-FT

Towards a Cure of Tinnitus with Implantable Hearing Devices

Shi Nae PARK

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Tinnitus, defined as a symptom of conscious awareness of a tonal/or noise sound for which there is no identifiable corresponding external acoustic source, has been known to result from compensatory brain mechanism related with "filling-in" phenomenon. Based on the brain network model and neurophysiological model of tinnitus, various types of sound therapy which inhibit compensatory filling-in phenomenon of the brain may provide a hope for achieving a cure of tinnitus.

Implantable hearing device(IHD) as a tool for proper sound therapy along with structured directive counseling as part of tinnitus retraining therapy, have demonstrated promising outcomes, including complete resolution of tinnitus. Bone conduction implant(BCI), middle ear implant (MEI) or cochlear implant (CI) have played an important role in reducing or even curing tinnitus. Two critical factors for achieving a cure through IHDs are:(1) appropriate selection, fitting and use of IHD customized to each patient's auditory function and severity of tinnitus, (2) comprehensive and professional directive counseling before implantation, followed by regular postoperative follow-up with counseling until a cure of tinnitus is achieved.

My recent clinical study showed the 65% of cure rate of tinnitus with single sided deafness(SSD) or asymmetric hearing loss(AHL) treated with CI, and up to 24% with BCI. CI demonstrated a superiority to other IHDs as a sound therapeutic modality for a cure of tinnitus in SSD/AHL patients. Nonetheless, BCI and MEI still remained valuable alternatives for managing tinnitus in selected patients.

This presentation will highlight clinical outcomes and representative cases demonstrating a cure of tinnitus with IHD. While a journey toward a cure of tinnitus as a clinician scientist has been complex and demanding, advances in science of tinnitus offer a meaningful hope for a cure of tinnitus to the patients suffering from severe and debilitating tinnitus.

Symposium 01

Treatment I: Implantable Hearing Devices
SP 01-1

Impact of electrode positioning on tinnitus suppression in single-sided deafness patients

Kelly ASSOULY[1,2,3]

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[3]Advanced Innovation, Cochlear Technology Centre Belgium, Belgium

Objective
We aimed to assess the relationship between the cochlear implant (CI) electrode array positions and the outcomes of tinnitus characteristics and impact on daily life in single-sided deaf (SSD) patients at three months post-activation.

Methods
In this prospective cohort study, twenty-five SSD patients implanted with a CI completed tinnitus questionnaires (Tinnitus Handicap Inventory (THI), Tinnitus Questionnaire (TQ), Tinnitus Burden Questionnaire (TBQ)) pre-implantation and at three months post-activation. The electrode position was determined using the radius of the most apical electrode, the angular spacing position of the most apical electrode and the angular spacing position of the most basal electrode on high resolution computed tomography scans performed three months after activation.

Results
There were statistically significant reductions in median THI, TQ and TBQ VAS scores when the CI was active (except for the TBQ VAS sleep) scores between pre-implantation and post-activation in the overall group of patients reporting tinnitus (Wilcoxon singed-rank test, $p<0.05$). There were no statistically significant relations between electrode position parameters and tinnitus characteristics and impact outcomes.

Conclusion
Overall, tinnitus characteristics and impact significantly decreased three months post-activation in patients reporting tinnitus. No influence of electrode position was found on tinnitus outcomes in SSD patients implanted with a CI. Further research is needed to investigate the possible influence of electrode position on tinnitus impact and characteristics in order to optimize the effect of cochlear implantation on tinnitus.

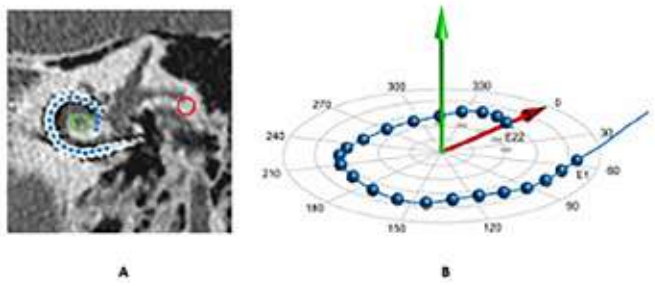

Figure
(A) Reformatted CT slice through the basal turn of the cochlear. (B) CT-based cylindrical coordinate system.

Symposium 01

Treatment I: Implantable Hearing Devices
SP 01-2

The impact of cochlear implantation on tinnitus: Insights from data-logging analysis

Tadao YOSHIDA

Otorhinolaryngology, Nagoya University, Japan

Background
Binaural hearing offers numerous advantages. In Japan, the 2017 revision of the adult cochlear implantation (CI) criteria states that bilateral CI should not be denied if deemed beneficial. At our department, the number of patients requesting simultaneous or sequential CI has increased.
Hearing loss is a significant risk factor for tinnitus, and the use of hearing aids is generally recommended. CI not only improves auditory performance in individuals with hearing loss but is also considered beneficial for tinnitus. This effect is attributed to external sound stimulation, which mimics acoustic therapy and helps prevent silence, potentially alleviating tinnitus symptoms. However, the evidence regarding CI's effectiveness in tinnitus management remains inconclusive, with reports of both symptom improvement and worsening postoperatively.
Methods
This study evaluates tinnitus symptoms before and after CI at our hospital. A total of 40 patients (64 ears) who underwent CI from 2018 onward were included. The study population comprised 24 bilateral CI recipients (BiCI group, 48 ears) and 16 unilateral CI recipients (UniCI group, 16 ears). The mean age was 48.5 years (range: 15–69) in the BiCI group and 57.4 years (range: 22–83) in the UniCI group. The male-to-female ratio was 4:20 in the BiCI group and 6:10 in the UniCI group.
In the BiCI group, 17 patients underwent simultaneous implantation, while 7 underwent sequential implantation with an average interval of 1.9 years (range: 0.7–2.9 years). The average duration of hearing loss was 7.2 years in the BiCI group and 7.1 years in the UniCI group. Preoperative hearing levels were 101.5 dB (BiCI) and 99.9 dB (UniCI), with speech discrimination scores of 70.0% and 50.4%, respectively.
Tinnitus severity was assessed preoperatively and at 6 to 55 months postoperatively using the Tinnitus Handicap Inventory (THI) and the Visual Analogue Scale (VAS) for loudness and distress. Improvement was defined as a reduction of ≥2 points in the THI score.
Results
Among the 35 patients assessed, 29 (82.9%) showed improvement in THI scores, 3 (8.6%) remained unchanged, 2 (5.7%) experienced worsening symptoms, and 1 (2.9%) reported newly developed tinnitus postoperatively. Bilateral CI recipients demonstrated significantly greater improvements in THI scores, loudness, and distress compared to unilateral CI recipients.
Tinnitus is thought to arise due to reduced inhibitory activity in the central auditory pathway following decreased acoustic input, leading to neural overexcitation. Our findings suggest that bilateral CI may be more effective than unilateral CI in suppressing tinnitus, likely due to the restoration of bilateral acoustic stimulation.
Discussion
CI for tinnitus can increase activity in the peripheral auditory system and help mask external sounds, thereby reducing tinnitus perception (Quaranta et al., 2004). Our study supports this, demonstrating that bilateral CIs for bilateral severe-to-profound sensorineural hearing loss were significantly more effective in suppressing tinnitus compared to unilateral CI.
Moreover, patients who exhibited significant improvement in VAS loudness scores had a higher percentage of CI use in noisy environments and a lower percentage in silent settings. These findings suggest that exposure to environmental sounds may play a role in tinnitus relief. Improved auditory input and communication ability may reduce the impact of tinnitus on psychological well-being and quality of life, as previously suggested by Baguley & Atlas (2007).
Conclusion
Increased peripheral stimulation of both ears through bilateral CI appears to provide greater tinnitus suppression in cases of bilateral sensorineural hearing loss. Furthermore, in patients who showed VAS improvement, data logging revealed a preference for noisy environments, suggesting that auditory enrichment may contribute to tinnitus relief. Further studies with larger sample sizes and extended follow-up periods are necessary to validate these findings.

Symposium 01

Treatment I: Implantable Hearing Devices
SP 01-3

Auditory Brainstem Implant for Tinnitus: First Results

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Abstract.
Tinnitus is an auditory perception in the absence of an external sound source. For some people this has a serious impact on their quality of life and ability to participate in social activities.
Tinnitus inhibition has been reported after cochlear implantation (CI) in functional deaf patients and after Auditory Brainstem Implantation (ABI) in neurofibromatosis type II (NFII) patients. The ABI is originally indicated for hearing restoration when cochlear implantation is not possible due to a non-functioning cochlear nerve, which is often the case in NFII patients.
In this study we are investigating whether stimulation of the cochlear nucleus with an ABI can reduce tinnitus without damaging the existing functionality of the auditory pathway.

Method
Adult tinnitus patients, where standard tinnitus rehabilitation was unsuccesful, will be included in the study. These participants suffer from severe unilateral tinnitus combined with asymmetric hearing loss, where the tinnitus lateralises to the poorer ear. A MED-EL Mi1200 Synchrony ABI will be implanted on the tinnitus side. Six weeks after implantation the ABI will be activated and stimulation strategies will be optimised during several fitting sessions. At present, 5 subjects are implanted.

The primary outcome measures are safety of the procedure (stability of auditory and vestibular function) and change in Tinnitus Function Index (TFI) one year after implantation. Secondary outcomes will be TFI, tinnitus handicap(Tinnitus Handicap Inventory), quality of life (Hospital Anxiety and Depression Scale) and tinnitus characteristics at a long-term follow-up of 5 years.

Results
Currently, two subjects are in follow-up and three subjects are in the first year after ativation (rehabilitation phase). The two subjects who finalized follow-up show a clear clinical reduction in TFI and tinnitus burden, while the subjects in the rehabilitation phase already show a reduction in TFI and tinnitus burden in the rehabilitation phase. No clinical changes were measured in audiometry and in vestibular tests. No persistent side effects due to stimulation are reported.

Conclusion
We are halfway through enrolment in this trial and the results and interim results show that ABI seems to be a safe intervention and has a positive effect on tinnitus. Final conclusions can be drawn when the enrolment is complete.

This study is approved by the Institutional Review Board of the University Medical Center of Groningen (ABR nr. NL55276.042.15). The study is registered at www.clinical trials.gov NCT02630589

Symposium 01

Treatment I: Implantable Hearing Devices
SP 01-4

Tinnitus suppression with cochlear implant

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Purpose: The suppression of tinnitus is a well-documented side effect of electrical stimulation to the cochlea. This suppression has been reported by some cochlear implant (CI) recipients who received CIs from Cochlear, Medel, and Advanced Bionics. Each brand of CI has a different length of electrode array. The purpose of this study was twofold: to determine the ideal length of electrode and ideal current to effectively suppress tinnitus.
Method: Our study collected data from 10 patients who had tinnitus both before and after surgery that was suppressed when the processor was activated. Participants completed the Tinnitus Handicap Inventory (THI) both before and after surgery. Additionally, they were asked to rate the volume of their tinnitus on a scale of 0 to 10 under the following conditions: processor on, processor off, and with electrical stimulation through a single electrode at the T Level, C Level, and 50% DR Level. The time required for tinnitus to disappear upon activation and reappear upon deactivation of the processor was recorded.
Results: For 80% of our participants, their tinnitus was resolved immediately after the processor was turned on. For the remaining 20%, suppression was achieved an average of 46 seconds after processor-on. For 80% of the participants, tinnitus reappeared immediately after the processor was off; while for the other 20%, it reappeared an average of 75 seconds after processor-off. Regardless of the current used for stimulation, tinnitus volume was perceived to be the lowest in the basal region and the highest in the apical region. Under M/C level stimulation, participants experienced the lowest tinnitus volume overall.
Conclusion: Our results support the use of cochlear implants to reduce tinnitus symptoms in recipients. An electrode that provides stimulation in the basal region is sufficient to effectively diminish tinnitus at any current.

Keywords: cochlear implant, activated, deactivated.

Symposium 01

Treatment I: Implantable Hearing Devices
SP 01-5

Active transcutaneous bone-conduction implant on tinnitus in patients with ipsilateral sensorineural hearing loss

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Cochlear Implant was the first successful implantable cranial nerve stimulator. The indications were expanded.

Table 2
Overview of CI Indications

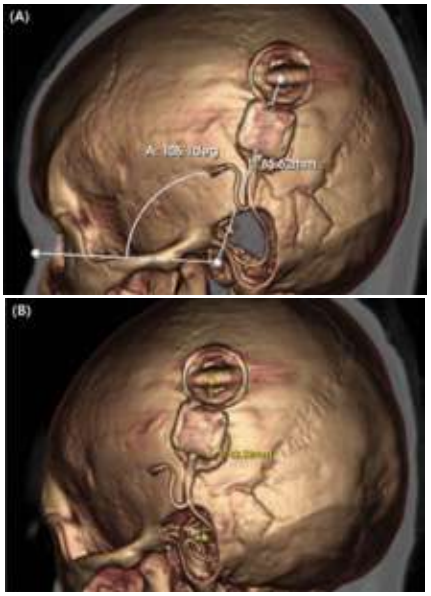
	US Food and Drug Administration*	Medicare
Adults		
Cochlear Corporation	Moderate to profound bilateral SNHL; ≤50% on sentence recognition testing on implanted ear, <60% on contralateral ear	Moderate to profound bilateral SNHL 40% on sentence recognition testing
Med-El	Severe to profound bilateral SNHL; ≤40% on open-set sentence recognition testing in best aided condition	
Advanced Bionics	Severe to profound bilateral SNHL; ≤50% on sentence recognition testing in best aided condition	
Hearing preservation/EAS		
Cochlear Corporation	EAS: Residual low-frequency hearing, and severe to profound SNHL; aided CNC word scores between 10%–60% in ear to be implanted, ≤80% CNC in contralateral ear but not better than implanted ear	Normal to moderate hearing loss in low frequencies and severe to profound SNHL in mid to high frequencies; moderately severe to profound mid to high frequency loss in contralateral ear; aided CNC word scores ≥10% and ≤60% in ear to be implanted; ≤80% CNC in contralateral ear
Med-El	EAS: Residual low-frequency hearing, and severe to profound SNHL; aided CNC word scores ≤60% in ear to be implanted; worse thresholds and CNC scores in contralateral ear	Normal to moderate SNHL in low frequencies and severe to profound loss in mid to high frequencies; Aided CNC word scores ≤60% in ear to be implanted and contralateral ear
Pediatrics	12–24 mo: profound SNHL and limited benefit from binaural hearing aid trial 24 months–17 years: Severe to profound SNHL and limited benefit from binaural hearing aid trial; MLNT, LNT scores ≤30%	–

Vestibular Schwannoma

Among these indications is the possibility of implanting patients with Vestibular Schwannoma (VS); that is, patients with SNHL of retrocochlear origin.

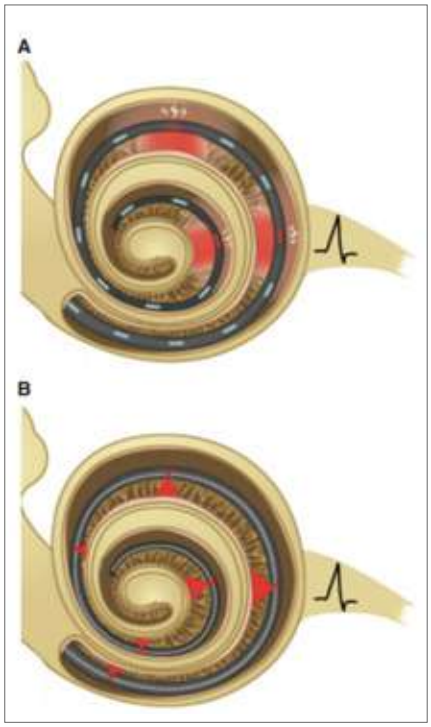
Initially, this was explored as an alternative to Auditory Brainstem Implants (ABIs) in patients with Neurofibromatosis type 2 (NF2). More recently, cochlear implantation has been considered even for patients with sporadic tumors with normal contralateral hearing.

1) Intralabyrinthine Schwannoma
2) Cochlear Schwannoma
3) Vestibular Schwannoma
4) Optimal Positioning of Cochlear Implant for Surveillance of tumor through MRI

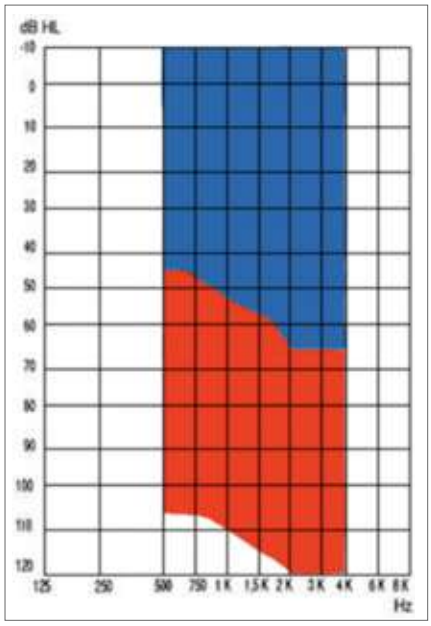


Optical Cochlear Implant

Comparing electrical and optical cochlear implants (oCIs). Electrical cochlear implant (eCI), broad activation of neurons from each stimulation channel, channel cross talk, few channels. oCIs, spatially confined activation, many channel



Middle Ear Implant



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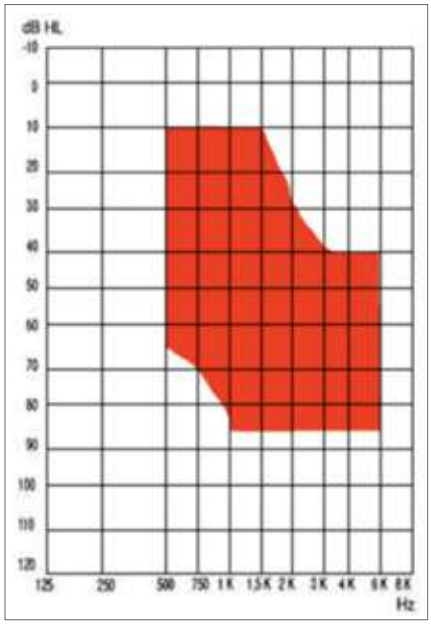

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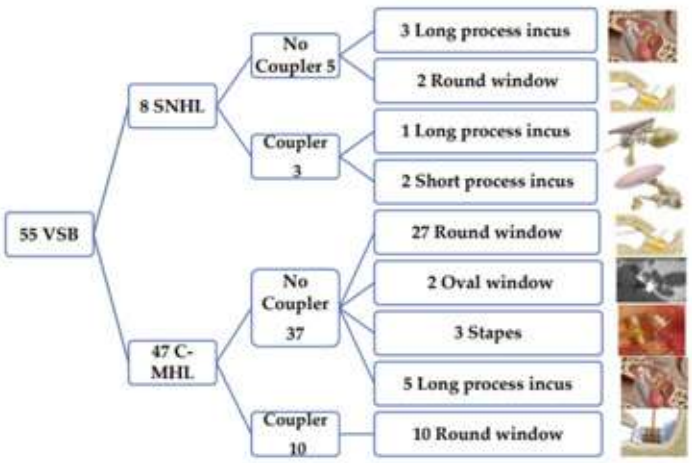
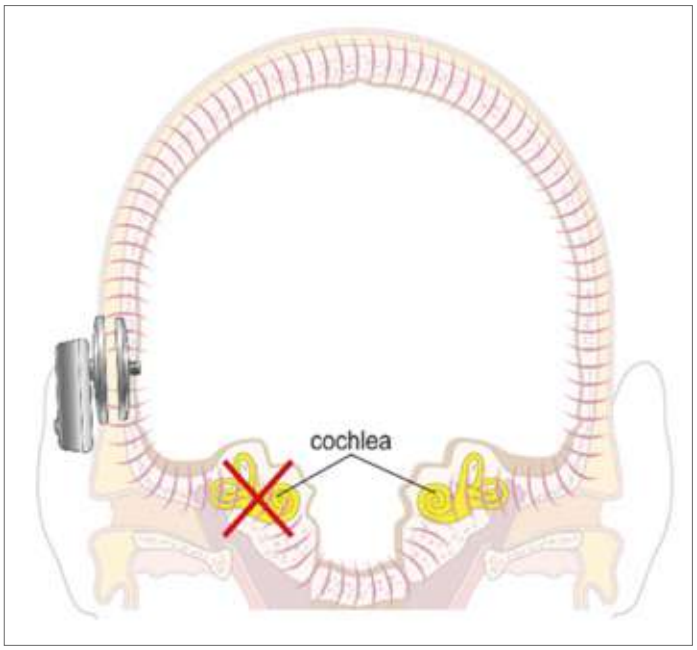
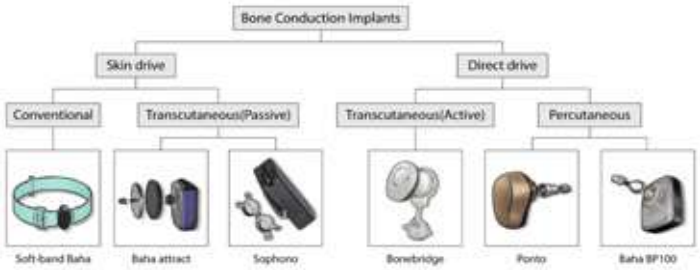


Bone Conduction Implant





Symposium 02

Combined Disease
SP 02-FT

Association of tinnitus and inner ear disorders

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Tinnitus is a prevalent symptom in various inner ear disorders, with recent studies suggesting a strong association between migraine and inner ear dysfunction. The concept of inner ear migraine (IEM) encompasses cochlear migraine (CM), vestibular migraine (VM), cochlear-vestibular migraine (CVM), and sudden sensorineural hearing loss (SSNHL), all of which exhibit a high prevalence of tinnitus and share a common migraine-related pathophysiology. These conditions are increasingly recognized as part of a top-down neuroinflammatory process, in which central nervous system dysfunction contributes to peripheral auditory and vestibular disturbances.

Vestibular migraine is well-documented, characterized by episodic vertigo often accompanied by tinnitus and hearing fluctuations. The emerging concept of cochlear migraine describes patients with fluctuating or sudden hearing loss and tinnitus, without significant vestibular symptoms. Cochlear-vestibular migraine represents a spectrum disorder involving both auditory and vestibular symptoms, further supporting the involvement of migraine mechanisms in inner ear pathology. Notably, studies suggest that migraine is a significant risk factor for sudden sensorineural hearing loss (SSNHL), possibly due to vascular dysregulation, neurogenic inflammation, and abnormal cortical-auditory processing.

The top-down hypothesis posits that migraine-related central sensitization and trigeminovascular activation influence the auditory and vestibular pathways, leading to dysfunction in the inner ear. Functional imaging studies reveal altered brainstem auditory processing, disrupted cochlear blood flow, and heightened central auditory hypersensitivity in migraineurs with tinnitus and hearing disturbances. Neuroinflammatory processes, mediated by calcitonin gene-related peptide (CGRP) and other vasoactive neuropeptides, may contribute to transient or permanent cochlear damage.

Recognizing the central-to-peripheral nature of these disorders may refine diagnostic approaches and guide targeted treatments for tinnitus associated with migraine-related inner ear dysfunction. Future research should explore the efficacy of CGRP antagonists, neuromodulation, and anti-inflammatory interventions in managing tinnitus and hearing loss in this population.

Symposium 02

Combined Disease
SP 02-1

Management of tinnitus in patients with vestibular schwannoma who underwent surgical resection

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Purpose: To evaluate tinnitus and its management in patients with vestibular schwannoma (VS) who underwent surgery, we investigate the effect of surgical approach or residual hearing on tinnitus severity and the effects of intervention for tinnitus including educational counseling, sound therapy using hearing aids (HAs), and medication (selective serotonin reuptake inhibitors, and SSRIs).

Methods: Seventy-one subjects of VS patients who underwent surgery were included. Their tinnitus severity was evaluated using the Japanese version of the Tinnitus Handicap Inventory (THI). The relationships between postoperative THI scores and surgery types or residual hearing levels were examined. We also examined longitudinal changes in THI scores and the efficacy of the intervention.

Results: Surgery approach, hearing preservation or hearing loss surgery, and residual hearing levels were not significantly related to the postoperative tinnitus severity. In 71 cases, 45 cases did not require any management for tinnitus. On the contrary, 26 patients had at least one episode of tinnitus distress (THI score was greater than or equal to 18). Educational counseling alone was found to be effective in 17 cases out of the 26 cases, and the remaining 9 cases required more intervention than educational counseling alone. We selected sound therapy with HA for 7 cases and administration of SSRI for 2 cases, which was found to be highly effective in 8 cases.

Conclusion: Based on the present study, we consider that appropriate management may be possible for tinnitus in the majority of VS patients who underwent surgery.

Symposium 02

Combined Disease
SP 02-2

Tinnitus as a presentation of vestibular schwannoma

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Tinnitus is a common and often underestimated symptom in patients with vestibular schwannoma (VS). In this study, we retrospectively reviewed 137 patients diagnosed with VS at our institution to evaluate the prevalence of tinnitus and its possible audiological correlates. Among them, 104 patients (75.9%) reported tinnitus, while 33 patients (24.1%) did not. We further analyzed auditory brainstem response (ABR) patterns in these patients, focusing on the presence or absence of wave abnormalities and interaural latency differences. Our findings suggest that certain ABR features may be more frequently observed in patients with VS, although variability remains. In this presentation, we aim to share intriguing cases that highlight diverse ABR findings in VS patients presenting with tinnitus. Our study reveals the variability of ABR findings in VS patients with tinnitus and highlight the clinical value of including tinnitus in the diagnostic consideration for vestibular schwannoma.

Symposium 02

Combined Disease
SP 02-3

Differential Vulnerability and Risk Factors on Noise-Induced Hearing Loss

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Noise-induced hearing loss is caused by exposure to hazardous levels of noise, representing a major global public health issue. Excessive noise exposure is the necessary risk factor for noise-induced hearing loss, regardless of whether it occurs at work, in the environment, or during leisure. In addition to hazardous noise exposure, a variety of risk factors are associated with noise-induced hearing loss, including a variety of extrinsic and intrinsic factors. On top of that, differential vulnerability to noise-induced hearing loss is well recognized. While noise reduction is always an important way to prevent noise-induced hearing loss, increased public awareness of the excessive noise exposure dangers, particularly in high-risk populations, should be also implemented to help prevent noise-induced hearing loss.

Symposium 02

Combined Disease
SP 02-4

Association between tinnitus and vertigo associated disorders

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Tinnitus and vertigo are two of the most frequent and often debilitating symptoms encountered in neurotology. While they can appear independently, these symptoms frequently coexist, suggesting overlapping pathophysiological mechanisms and shared clinical pathways. Understanding the association between tinnitus and vertigo-associated disorders is essential for improving diagnostic accuracy and tailoring patient-centered management approaches. This review explores the interrelationship between tinnitus and a range of vestibular disorders, including Meniere's disease, benign paroxysmal positional vertigo (BPPV), vestibular migraine (VM), vestibular schwannoma, and persistent postural-perceptual dizziness (PPPD).

In Meniere's disease, tinnitus is a cardinal symptom and is typically characterized by low-frequency, fluctuating sounds that accompany episodes of spontaneous vertigo, aural fullness, and sensorineural hearing loss. The underlying mechanism is believed to involve endolymphatic hydrops, which affects both cochlear and vestibular function. The temporal correlation between tinnitus and vertiginous attacks in Meniere's disease makes it one of the clearest examples of a direct pathophysiological link between the two symptoms.

BPPV, in contrast, is a mechanical disorder caused by dislodged otoconia affecting the semicircular canals, and while it is the most common cause of peripheral vertigo, tinnitus is generally not a characteristic symptom. When present, tinnitus in BPPV patients is usually incidental or related to coexisting inner ear pathology, rather than the positional vertigo itself. Thus, the association between tinnitus and BPPV is considered weak and often clinically irrelevant.

Vestibular migraine presents a more complex scenario. Patients often report tinnitus in addition to episodic vertigo, photophobia, phonophobia, and motion sensitivity. The nature of tinnitus in VM is variable and can resemble both peripheral and central patterns. Although the exact mechanisms remain unclear, altered central sensory processing and brainstem involvement are thought to play a role in the generation of both vertigo and tinnitus in these patients. The fluctuating and migrainous nature of VM may contribute to the subjective variability in tinnitus perception.

Vestibular schwannoma, a benign tumor of the eighth cranial nerve, frequently manifests with unilateral tinnitus and progressive sensorineural hearing loss. Vertigo may be absent or subtle, but imbalance and chronic disequilibrium are common. The tinnitus in vestibular schwannoma is typically constant and high-pitched, and often one of the earliest presenting symptoms. Its presence in the context of asymmetric hearing loss is a key clinical clue that warrants further imaging, particularly MRI.

Persistent postural-perceptual dizziness is a chronic functional vestibular disorder characterized by persistent non-spinning dizziness, unsteadiness, and hypersensitivity to motion or complex visual environments. Although traditionally considered a disorder of altered central processing and postural control, recent studies suggest that tinnitus may be a coexisting symptom in a subset of PPPD patients. This overlap may reflect shared neural circuitry involving multisensory integration, anxiety, and heightened bodily vigilance. In some cases, the presence of tinnitus can amplify the patient's distress, contributing to a self-perpetuating cycle of perceptual and emotional dysregulation.

Taken together, these observations highlight that tinnitus is not only a common co-symptom in several vestibular disorders, but also a potentially important diagnostic and prognostic marker. While the nature and pathophysiology of tinnitus differ across conditions, its presence may offer insights into the underlying disorder and guide more targeted evaluation and treatment strategies. Clinicians should remain attentive to the characteristics and temporal patterns of tinnitus when evaluating patients with vertigo or chronic dizziness, as this may aid in differentiating between peripheral, central, and functional vestibular pathologies.

Symposium 03

Genetics & Epidemiology
SP 03-FT

Genetics and molecular insight into tinnitus

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Background
Epidemiological studies in large cohorts of individuals with tinnitus, including twins, adoptees, and familial aggregation studies support significant tinnitus heritability, particularly for severe bilateral tinnitus. We hypothesize that the combination of common and rare variants, located in non-coding and coding region of the genome, respectively could be associated to tinnitus disorder and may exert small, pleiotropic effects by regulating multiple genes involving attention, cognition and perception in different brain areas. We have assessed the available evidence to support a genetic contribution to tinnitus and define the role of common and rare variants in tinnitus.
Methods
After a systematic search and quality assessment, 31 records were included (14 epidemiological studies and 17 genetic association studies). General information on the sample size, age, sex, tinnitus prevalence, severe tinnitus distribution and SNHL was retrieved. Studies that did not included data on hearing assessment were excluded. Genetic variants and genes were listed and clustered according to their potential role in tinnitus development.
Results
The average prevalence of tinnitus estimated from population-based studies was 26% and 20% of patients reported it as an annoying symptom, being the European population with higher prevalence. Genome-wide association studies has identified and replicated 2 common variants in Chinese population (rs2846071; rs4149577) in the intron of TNFRSF1A, associated with noise-induced tinnitus. Moreover, gene burden analyses in sequencing data from Spanish and Swede patients with severe tinnitus have identified and replicated ANK2, AKAP9, TSC2 genes.
Conclusions
The genetic contribution to tinnitus shows population-specific effects in European and East Asian populations. The common allelic variants associated with tinnitus that showed replication are associated with noise-induced tinnitus. Although severe tinnitus has been associated with rare variants in the ANK2 gene, their role on hearing or hyperacusis has not been established.

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Symposium 03

Genetics & Epidemiology
SP 03-1

Global prevalence and incidence of tinnitus

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In nearly every introduction to a scientific article on tinnitus, the prevalence rate of 10–15% is cited—a figure so familiar that it's practically ingrained in the minds of tinnitus researchers. Given this ubiquity, you might wonder: what new insights could a talk on the global prevalence and incidence of tinnitus possibly offer? Why should you attend this session?
This talk will explore the fascinating world of epidemiological studies, which goes far beyond the latest quantification of tinnitus prevalence and incidence. By examining cross-country comparisons, we uncover the potential roles of socioeconomic, cultural, and environmental factors in shaping tinnitus prevalence. A deeper analysis of the temporal evolution of tinnitus prevalence over the last centuries reveals insights into the association of tinnitus with societal changes and challenges. Exploring different tinnitus subtypes sheds light on their distinct characteristics and potential mechanisms, sparking fresh hypotheses for research.
Outlining the trajectory of tinnitus incidence over one's lifetime will help one better understand tinnitus risk factors and how to fight them. The talk will also illuminate disparities in tinnitus prevalence across societal groups, further advancing our understanding of influencing factors.
Furthermore, you will learn some methodological tips and tricks to perform a cost-efficient epidemiological study on tinnitus in your country and gain access to shared resources and tools for conducting robust prevalence research.

Symposium 03

Genetics & Epidemiology
SP 03-2

Sensorineural tinnitus and sleep-related issues

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Objectives: Growing evidence suggests a potential link between tinnitus and sleep-related disturbances. This study aimed to explore this association in a large-scale population based data.

Study Design: A cross-sectional study.

Setting: The 6,951 subjects with data on demographics, sleep patterns, sleep-related symptoms, and otologic assessments were selected from the 8th and 9th Korea National Health and Nutrition Examination Surveys (2019, 2020 and 2022), a database representing the general population.

Main Outcomes Measures: Subjects were classified into tinnitus and non-tinnitus groups, with the tinnitus group subdivided by chronicity (acute/chronic) and severity (mild/severe), and their association with sleep issues was analyzed.

Results: The chronic tinnitus group had shorter sleep durations (weekdays, $P < 0.001$; weekends, $P < 0.001$) and higher proportions of sleep deprivation (weekdays, $P = 0.001$; weekends, $P < 0.001$), fatigue ($P < 0.001$), and witnessed obstructive sleep apnea ($P = 0.026$) compared to the non-tinnitus group. They also exhibited shorter sleep duration ($P = 0.027$) and more sleep deprivation ($P = 0.025$) on weekends than the acute tinnitus group. The severe tinnitus group exhibited shorter sleep durations (weekdays, $P = 0.004$; weekends, $P < 0.001$), more sleep deprivation (weekdays, $P = 0.025$; weekends, $P = 0.001$), and higher levels of fatigue ($P = 0.001$) compared to the non-tinnitus group, as well as more fatigue than the mild tinnitus group ($P = 0.001$).

Conclusion: The chronicity and severity of tinnitus were significantly associated with sleep problems. Chronic and severe tinnitus are strongly associated with sleep disturbances, emphasizing the need for targeted management.

Symposium 03

Genetics & Epidemiology
SP 03-3

Tinnitus Quest: A new initiative to foster and fund patient-driven tinnitus research

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[2]Executive Board, Tinnitus Quest, Germany

Tinnitus sufferers have long been frustrated at the seeming lack of progress in tinnitus research and the perceived misallocation of funds to behavioral treatments like CBT. Researchers have struggled to get adequate funding to make meaningful progress in silencing tinnitus.

Rather than waiting for governments or commercial parties to step in, we believe it's time for a patient-driven initiative to fund cure-focused research. Tinnitus Quest was founded in 2024 with the sole mission of silencing tinnitus by funding 'high risk, high gain' exploratory research to tests experimental treatment approaches.

Tinnitus sufferers have become wary of solicitation of funds due to lack of communication about research and a plethora of scam products. But we have already demonstrated that they can and will support research if it's driven by patient needs and supported by frequent and transparent communication. Hence, bringing patients and researchers closer together is core to our research approach.

Tinnitus Quest is proud to announce that we will be opening up our grants program in 2025. We are looking for enthusiastic (young) researchers, with fresh out-of-the-box ideas to apply. More information will follow during the TRI conference. We look forward to seeing you there!

Symposium 03

Genetics & Epidemiology
SP 03-4

Changes in Circadian Clock Genes in Patients with Tinnitus and Treatment with the Taiwanese Edition of the Self-Help Book

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BACKGROUND: Tinnitus is defined as a disorder in which tones or noises are perceived in the absence of corresponding external acoustic stimuli.
The aim of this study was to investigate the expression of circadian genes in subjects with and without tinnitus and assess the response in tinnitus patients using a self-help book.
METHODS: We collected subjects from a clinical setting and grouped them into a normal control group (12 patients) and a tinnitus group (39 patients). We analyzed mRNA expressions of 9 circadian genes using quantitative polymerase chain reaction (Q-PCR) from peripheral blood mononuclear cells (PBMC). Additionally, we performed immuno-cytochemistry (ICC) staining on PBMC. Twenty-two participants who passed the pre-test evaluation were randomly assigned to either the experimental group (11 patients) or control group (11 patients). The experimental group underwent 6 weeks of self-help book training. All participants were asked to complete a post-intervention assessment of tinnitus (1st post-test).
RESULTS: We found that the expression of CRY2 mRNA was significantly lower in the tinnitus group compared to the normal control group. In contrast, the expression of CRY1 showed a higher trend opposite to that of other circadian genes. The expression patterns of CRY1 and CRY2 ICC were consistent with the Q-PCR results and showed a significant difference between the two groups. 11 patients who received the tinnitus self-help book showed significant improvement of their tinnitus-related score in the TRQ, the tinnitus visual analogue scale, question 3 (VAS3), and question 4 (VAS4).
CONCLUSIONS: The alteration of circadian gene expression, specifically CRY1 and CRY2, may play an important role in tinnitus. A self-help book, without therapist assistance, can serve as an inexpensive alternative treatment for tinnitus that is not bound by time or place. Future studies should directly compare gene expression and treatment effectiveness and explore the relationship more thoroughly.

Symposium 03

Genetics & Epidemiology
SP 03-5

Relationship between tinnitus and food consumption: Insights from big data analysis

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Tinnitus, a widespread auditory condition, has been linked to various lifestyle and dietary factors. While its underlying mechanisms remain complex, emerging evidence suggests that specific food consumption patterns may influence tinnitus and hearing health. This study examines the association between tinnitus and dietary intake, focusing on coffee, chocolate, and other potential tinnitus-modulating foods, using data from the 2009–2013 Korean National Health and Nutrition Examination Survey (KNHANES). A total of 13,448 adults (≥19 years) were analyzed based on their hearing status, tinnitus symptoms, and dietary habits.

The results indicate that frequent coffee consumption is inversely correlated with both bilateral hearing loss and tinnitus, particularly in individuals aged 40–64 years. Daily coffee drinkers exhibited 50–70% less hearing loss than rare consumers, suggesting a dose-dependent protective effect. Brewed coffee demonstrated a stronger association than instant or canned coffee. Similarly, chocolate intake was associated with a reduced risk of hearing loss in middle-aged adults, with significantly lower prevalence in consumers (26.78%) compared to non-consumers (35.97%, $p < 0.001$). However, chocolate was not linked to tinnitus symptoms or tinnitus-related distress.

Beyond coffee and chocolate, other dietary factors were found to impact tinnitus severity. Higher consumption of antioxidant-rich foods, such as fruits (especially citrus and berries), vegetables, and nuts, was associated with reduced tinnitus symptoms. Omega-3 fatty acids, commonly found in fish and flaxseeds, were linked to improved auditory health and lower tinnitus prevalence. Additionally, magnesium-rich foods, including spinach, almonds, and bananas, demonstrated potential protective effects against tinnitus, likely due to their role in neural and vascular function.

These findings suggest that a diet rich in antioxidants, omega-3 fatty acids, and magnesium, along with regular coffee and chocolate consumption, may contribute to better auditory health and reduced tinnitus risk. Further research is needed to establish causal relationships and explore dietary interventions for tinnitus management.

Symposium 04

Treatment II: Neuromodulation
SP 04-FT

Neuromodulation in tinnitus treatment: Clinical insights and emerging trends

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There is considerable evidence that tinnitus is associated with changes in brain function. Based on these findings, neuromodulatory treatments have been proposed for the treatment of tinnitus. Although disappointing from a clinical perspective, these findings have been key to a more detailed understanding of the complex involvement of different brain networks in the pathophysiology of tinnitus. More recent approaches, such as bimodal stimulation and network stimulation, have shown more promising results and warrant further investigation.

Symposium 04

Treatment II: Neuromodulation
SP 04-1

Recent successes in tinnitus treatment with bimodal neuromodulation

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About 10-15% of the population suffers from bothersome or debilitating tinnitus. The only clinically recommended treatment for tinnitus across clinical guidelines has been cognitive behavioral therapy, with increasing evidence for similar types of psychotherapy approaches that can lead to long term benefit of symptoms. Sound therapy approaches can provide benefit to some tinnitus sufferers. The main advantage of sound devices is that they are easy to implement and accessible, unlike psychotherapy approaches that can take many months to be effective. However, sound methods typically have transient therapeutic effects and are still not sufficiently effective for many individuals. An emerging approach that can provide long-term benefit of tinnitus symptoms in an accessible way is bimodal neuromodulation, which combines sound therapy with electrical stimulation of the body (e.g., tongue, ear, neck or face regions). One mechanism of action of how bimodal neuromodulation treats tinnitus is based on Pavlovian conditioning or the concept of paired plasticity. Sound therapy can mask or interfere with the tinnitus percept or enable temporary habituation to the tinnitus symptoms. Electrical body stimulation can amplify or enhance the benefits of sound therapy by reinforcing their therapeutic effects through paired plasticity that can drive long-term changes in the brain. There have been five separate groups across three countries that have consistently demonstrated the ability to reduce tinnitus symptoms with bimodal neuromodulation across multiple clinical trials that can have lasting benefit from several weeks to one year after treatment has stopped; these benefits have shown to be greater and longer lasting compared to what has been observed for sound only approaches in animal and human studies. More recently, especially with FDA De Novo approval of the Lenire bimodal treatment device, there have been over a thousand patients now treated with bimodal neuromodulation worldwide in a real-world setting. Consistent with clinical trial results, multiple clinics are demonstrating high satisfaction rates with more than two-thirds responder rates where some clinics achieve greater than 90%, demonstrating successful integration of bimodal neuromodulation for tinnitus treatment into a clinical setting.

Symposium 04

Treatment II: Neuromodulation
SP 04-2

Predictive coding and neuromodulation in tinnitus adaptive mechanisms

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Predictive coding has been a topic of discussion for a long time now. From being a theoretical concept to having empirical studies backing the predictive nature of the brain, predictive coding has been long debated on whether it could help us understand the mechanism of action of tinnitus. Per the predictive coding model, the brain has developed a model of the external world through years of learning to the point where the brain has an expectation of what the next input may be. The comparison of the actual sensory input (likelihood) the expected input (prediction) generates a prediction error (PE). The likelihood and prediction have a certain weight or precision which determines how the PE is handled. If the likelihood carries more weight than the prediction, the internal model of the brain may be changed according to the input to compensate for the PE. If the prediction carries more weight than the input, then the internal model may not be changed and the PE may need to be compensated another way.

In the tinnitus field, it is commonly agreed that tinnitus is generated as a compensatory mechanism of the brain to reduce a PE between the received and expected auditory input. However, how this PE is compensated has been debated. Sedley and colleagues propose a more bottom-up driven compensation involving an increase in precision of a "tinnitus precursor" signal due to too much attention, faulty noise-cancelling and other systems that may not successfully quieten this signal, thereby resulting in a change of the internal model of the brain from perceiving "silence" to perceiving "tinnitus" in the absence of an external sound.

De Ridder and colleagues resort to a more top-down compensations involving changes in activity and connectivity in different regions of the brain including memory-related regions to pull out the "missing" auditory information. This is also in line with the strong prior hypothesis put forth by Powers and Corlett in the hallucinations domain stating that even in the learning phase, the brains of those with phantom percepts may be more strongly wired to hold on their internal auditory models to the point where it is not able to adapt to changing auditory input. Therefore, the brain, in order to compensate for the strong internal prediction of auditory pattern, find other ways of compensating for the changing auditory input where there is a deafferentation.

Parallelly, there has been a steep increase in neuromodulation-based treatments for tinnitus which target both bottom-up and top-down predictive coding mechanisms. Direct current, alternating current, random noise, pink noise, brown noise stimulations to auditory and non-auditory regions in addition to sound-based stimulations have been tried independently and in combination with one another. Today bimodal electrical and sound stimulations have reached the market with varying levels of success in different parts of the world, with newer treatments coming out as we speak.

However, what might these different kinds of neuromodulation treatments be doing per different tinnitus generation models – particularly from a predictive coding perspective? Are they changing the input, precision of the input/prediction, PE or the internal model itself? In this talk, we will explore the mechanism of action of neuromodulation-based treatments for tinnitus from the lens of predictive coding theories of tinnitus generation.

Symposium 04

Treatment II: Neuromodulation
SP 04-3

Modulation of oscillatory brain activity with various brief protocols of repetitive transcranial magnetic stimulation in tinnitus.

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Pathological oscillatory brain activity patterns such as diminished power in the alpha range or enhanced power in the gamma frequency range have been linked to tinnitus. To counteract the given pathological neural conditions in relation to tinnitus, repetitive transcranial magnetic stimulation (rTMS) was introduced as a treatment option. By virtue of heterogeneity in tinnitus manifestations as well as inter-individual variability in treatment responses, the therapeutic effectiveness of rTMS remains uncertain. Besides daily rTMS applications, short rTMS sessions with only a modest quantity of administered pulses, revealed temporary suppressions of the tinnitus percept. Moreover, neurophysiological experiments have reported changes in tinnitus-related oscillatory brain activity following rTMS. The aim of the present experiment was to investigate changes in resting state brain activity, as measured via Electroencephalography (EEG) following various short rTMS protocols to evaluate whether potential EEG changes are correlated with changes in tinnitus loudness. Three short verum rTMS protocols (1 Hz, 10 Hz, 20 Hz; 200 pulses each) and one sham protocol (0.1 Hz; 20 pulses) were delivered to the left and right temporo-parietal junction of 22 tinnitus patients using an e-field-guided neuronavigation system. EEG data were collected before and after each protocol, along with subjective ratings of tinnitus loudness. Findings of the present study may provide further insights into TMS-induced neuroplasticity as well as its relevance for short-term tinnitus suppression.

Symposium 04

Treatment II: Neuromodulation
SP 04-4

Electric hearing and tinnitus suppression by noninvasive ear stimulation

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While noninvasive brain stimulation is convenient and cost effective, its utility is limited by the substantial distance between scalp electrodes and their intended neural targets in the head. The tympanic membrane, or eardrum, is a thin flap of skin deep in an orifice of the head that may serve as a port for improved efficiency of noninvasive stimulation. Here we chose the cochlea as a target because it resides in the densest bone of the skull and is adjacent to many deep-brain-stimulation structures. We also tested the hypothesis that noninvasive electric stimulation of the cochlea may restore neural activities that are missing in acoustic stimulation. We placed an electrode in the ear canal or on the tympanic membrane in 25 human adults (10 females) and compared their stimulation efficiency by characterizing the electrically-evoked auditory sensation. Relative to ear canal stimulation, tympanic membrane stimulation was four times more likely to produce an auditory percept, required eight times lower electric current to reach the threshold and produced two-to-four times more linear suprathreshold responses. We further measured tinnitus suppression in 14 of the 25 subjects who had chronic tinnitus. Compared with ear canal stimulation, tympanic membrane stimulation doubled both the probability (22% vs. 55%) and the amount (–15% vs. –34%) of tinnitus suppression. These findings extended previous work comparing evoked perception and tinnitus suppression between electrodes placed in the ear canal and on the scalp. Together, the previous and present results suggest that the efficiency of conventional scalpbased noninvasive electric stimulation can be improved by at least one order of magnitude via tympanic membrane stimulation. This increased efficiency is most likely due to the shortened distance between the electrode placed on the tympanic membrane and the targeted cochlea. The present findings have implications for the management of tinnitus by offering a potential alternative to interventions using invasive electrical stimulation such as cochlear implantation, or other non-invasive transcranial electrical stimulation methods.

Symposium 05

Musical Hallucination
SP 05-FT

Tinnitus and musical hallucinosis: The same but more

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While tinnitus can be interpreted as a simple or elementary form of auditory phantom perception, musical hallucinosis is a more complex auditory phantom phenomenon not only limited to sound perception, but also containing semantic and musical content. It most commonly occurs in association with hearing and has been explained by deficient Bayesian updating. Both simple and complex auditory phantoms are characterized by an increase in theta-gamma activity within the left auditory cortex compatible with thalamocortical dysrhythmia. This is associated with increased beta activity within the dorsal anterior cingulate cortex and anterior insula, essential for conscious perception. The difference between simple and complex auditory phantoms relies on differential alpha band activity within the auditory cortex and beta activity in the dorsal anterior cingulate cortex and (para)hippocampal area. This could be related to memory-based load dependency. Complex auditory phantoms further activate the right inferior frontal area (right sided Broca homologue) and right superior temporal pole that might be associated with the musical content. In summary, simple and complex auditory phantoms share a common neural substrate but complex auditory phantoms are associated with extra activation in brain areas related to music and language processing.

Symposium 05

Musical Hallucination
SP 05-1

Multi-dimensional changes in auditory verbal hallucination during antipsychotic treatment

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The prevalence of musical hallucinations (MH) in people with psychosis is more common than previously reported, and may vary depending on whether or not they are skillfully asked about MH. People with psychosis experience MH and auditory-verbal hallucinations (AVH) together, but not independently. MH in psychosis may change in quality, character, and meaning depending on the severity of the illness and antipsychotic treatment response. Changes in qualitative dimensions during antipsychotic treatment have been more favorably correlated than quantitative dimensions. A multidimensional approach may provide more information about the multifaceted structure of MH and AVH and the clinical status of patients than a unidimensional or categorical approach.

Symposium 05

Musical Hallucination
SP 05-2

Various Underlying Conditions of Musical Hallucinations

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Introduction: Musical hallucinations are auditory hallucinations where individuals perceive music, songs, or instrumental sounds without external sources. They are estimated to affect 1 in 10,000 people over 65. With an aging population, cases are increasing.

Cases: Six patients with musical hallucinations were seen at Showa University Hospital between 2010 and 2015. Their average age was 79.1 years (range: 65–95 years), with a male-to-female ratio of 2:4. None had a history of psychiatric disorders. Hearing loss was noted in 66.7%, and 33.3% had a musical background.

Symptoms: The primary symptom was hearing music (4 cases). All patients recognized the hallucinatory nature of the music, but 83.3% could not identify the source. Hallucinations improved with external noise or conversation in 50% of cases but worsened in quiet environments in 33.3%. Background Diseases: Conditions included aging (1 case), mild cognitive impairment (1 case), suspected Lewy body dementia (2 cases), suspected Alzheimer's disease (1 case), and cerebral amyloid angiopathy (1 case). Treatment: Among four cases treated with antiepileptic drugs, three improved or remitted. One of two cases treated with dementia-related medications showed improvement.

Discussion: In elderly patients with hearing loss and no localized brain lesions, musical hallucinations may be related to cognitive decline. Effective management requires collaboration between neurology and psychiatry.

Symposium 05

Musical Hallucination
SP 05-3

The spatial location of auditory verbal hallucinations

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Auditory verbal hallucinations (AVHs) are the perceptual experience of hearing voices in the absence of corresponding external auditory stimuli. Musical hallucinations (MH), a subtype of auditory hallucination, differ from internally generated musical experiences such as musical imagery or earworms, as they are more often perceived as originating externally. The phenomenology of AVHs is diverse and multidimensional, with spatial location being one of the identified dimensions. AVHs may be perceived as arising from inside the head, outside the head, or both, though their reported distribution varies depending on assessment tools, definitions, and study populations. Additionally, self-reports from patients and clinician-rated assessments reveal both similarities and discrepancies. A deeper understanding of the clinical characteristics of AVHs, including MH, could provide valuable insights into the relationship between mental disorders and physical diseases.

Symposium 06

Basic Research
SP 06-FT

An Animal Model of Tinnitus Treatment Using Near-Infrared (NIR) Light Therapy

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Tinnitus results from noise trauma that triggers oxidative stress and inflammation in the cochlea. The peripheral auditory de-afferentation results in central maladaptive neuroplasticity, leading to tinnitus percept. Thus, reducing oxidative stress and inflammation should help down-regulate maladaptive neuroplasticity and relieve tinnitus. Our team has demonstrated that near-infrared (NIR) light serves as a cytochrome c oxidase inhibitor to "inhibit" mitochondrial respiration and production of reactive oxygen species, thus reducing oxidative stress and inflammation. We set out to test for the therapeutic effects of NIR light on noise-induced hearing loss and tinnitus. Experiments were conducted using adult Sprague-Dawley rats. The rats were first exposed to a loud noise to induce hearing loss and tinnitus, and then treated with NIR light to rescue hearing and relieve tinnitus. Tinnitus behavioral assay was conducted using our optimized conditioned licking suppression (CLS) behavioral paradigm (Pace, Zhang et al., 2016). The ABR and DPOAE results showed significant improvement in those ears that received NIR treatment compared to the ears without treatment. The ears with NIR light treatment had a significant lower hair cell loss rate than the ears without treatment. NIR light treatment also significantly reduced the number of Mitosox (+) hair cells compared to without treatment. The noise trauma increased cytochrome c oxidase (COX), which was reduced following NIR light treatment. The results of CLS behavioral assays showed that NIR light treatment significantly reduced the number of water licks during silence trials in noise-exposed rats, compared to rats without NIR light treatment, indicating suppression of behavioral evidence of tinnitus. This study demonstrated that NIR light has significant therapeutic effects on noise-induced hearing loss and tinnitus by inhibiting cytochrome c oxidase to reduce oxidative stress and inflammation.

Symposium 06

Basic Research
SP 06-1

Central Gain and Neural Adaptation Model of Hyperacusis

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Hyperacusis is a devastating disorder that affects people's lives. The symptom is commonly reported in people after noise exposure or in children with neurological disorders, including Williams syndrome, FoxG1 syndrome and autism spectrum disorders (ASD). Increased neural activities in the central auditory system (CAS) to compensate for the hearing loss, named "central gain", are thought to underlie the cause of hyperacusis. However, as most people who experience hearing loss do not develop hyperacusis, it is unclear whether the "central gain" represents a plasticity change of the CAS to the hearing loss or the cause of hyperacusis.

In this study, we used two different animal models of hyperacusis, i.e., the noise exposure model and the FoxG1 gene mutation model, to study the neurological model of hyperacusis. CBA mice, wild-type mice, and FoxG1 gene mutation mice (G216S) were used in the experiment. Low-level noise exposure (83 dB SPL, 2 weeks, 12 hrs/per day) was used to induce hyperacusis in the WT mice. FoxG1 mutant mice were used as genetic model of hyperacusis. Acoustical startle responses (ASR) were used to evaluate sound sensitivity, and gap-induced prepulse inhibition (gap-PPI) was used to evaluate sensory gating. The auditory cortex (AC) response was measured in the control, noise-exposed, and FoxG1 mutant mice. Auditory brainstem response (ABR) was used to evaluate peripheral hearing loss.

ABR results showed no significant hearing loss was induced in the noise group or FoxG1 gene mutant group. Enhanced ASR and increased gap-PPI were recorded in the noise model. A significant enhancement of AC onset response was recorded in noise-induced mice, an indication of "central gain". FoxG1 mice showed no significant enhancement of the ASR. However, the ASR showed a lack of habituation for repetitive acoustic stimuli. These mice also showed a lack of gap-PPI suggesting impaired sensory gating caused by FoxG1 gene mutation. The AC recording shows no signs of enhanced response, but longer post-stimuli responses.

Our findings highlight two distinct models of hyperacusis: noise exposure-induced central gain and a neural adaptation model in FoxG1 mutants, consistent with reports in ASD patients. Our study suggests that (1) central gain is not a result of a cortical compensatory response to peripheral lesions, but rather an enhanced synaptic processing; and (2) a lack of sound habituation due to cortical immaturity may contribute to altered sound tolerance and loudness perception, potentially explaining hyperacusis in children with ASD.

Symposium 06

Basic Research
SP 06-2

The mitochondrial membrane permeability as a promising target for protecting auditory function in cisplatin-induced hearing loss

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mPTP is a multi-protein complex that opens in mitochondria during cell death. Cisplatin-induced hearing loss is also known to be caused by mPTP opening. Thus, our study evaluated the protective effect of a novel mPTP inhibitor named DBP-iPT against cisplatin-induced hearing loss. The cell viability result showed that DBP-iPT provided a 40 % protective effect compared to the group treated with cisplatin. In addition, the DBP-iPT treated group exhibited a reduction in intracellular ROS levels, counteracting the excessive ROS accumulation induced by cisplatin at the whole cell level. Intriguingly, mitochondrial ROS levels in the DBP-iPT group were elevated three-fold compared to the cisplatin-treated group. Despite this increase in mitochondrial ROS, the mitochondrial membrane potential in the DBP-iPT group was three times higher than that of the control. These findings present intriguing contradictions to prior studies. Therefore, we investigated whether the mitochondria were damaged or not and found that DBP-iPT treatment maintained an increased portion of elongated mitochondria, suggesting autophagy-mediated removal of damaged mitochondria. This process leads to improved mitochondrial dynamics. Finally, in vivo studies confirmed that the ABR test using a mouse model showed the same pattern of protection against cisplatin-induced hearing loss in the DBP-iPT treatment group. We have identified a new target that has a protective effect against cisplatin-induced hearing loss. Therefore, this study is expected to provide valuable insights as it focuses on targeting mPTP opening to protect against ototoxicity caused by cisplatin. This discovery will serve as a significant foundation for future research.

Keywords: Autophagy; Cisplatin; Hearing loss; Mitochondrial permeability transition pore; Reactive oxygen species.

Symposium 06

Basic Research
SP 06-3

GABAergic inhibition in tinnitus: a PET study in humans

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Gamma-aminobutyric acid (GABA) is the main inhibitory neurotransmitter in the brain. Experiments in animals suggest that deficient GABA neurotransmission may lead to tinnitus. In addition, MR spectroscopy studies in humans showed a reduced concentration of GABA in the auditory cortex of patients with tinnitus. Together, these observations suggest a role of in GABAergic neurotransmission in tinnitus. In order to further investigate this, we performed position emission tomography (PET) scan using a [11C] flumazenil tracer. Flumazenil is a molecule that binds to GABA(A) receptors in the brain. The PET scans provide an estimate of the binding potential of flumazenil, which is a function of the available GABA receptors in the brain. PET scans were analyzed using the simplified reference tissues model (SRTM). This analysis showed a significant increase of the binding potential in the auditory cortex of participants with tinnitus, as compared to participants without tinnitus. Consequently, GABAergic inhibition must differ between participants with and without tinnitus. These results provide strong clinical evidence for a key role of GABA in human tinnitus. They strongly motivate further investigation into pharmaceutical interventions for tinnitus.

Symposium 06

Basic Research
SP 06-4

Objective Assessment of Tinnitus Using Brain Imaging

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Background: Currently there is no objective measure of tinnitus that can be used clinically. Clinical assessment of the condition uses subjective feedback from individuals, which is not always reliable and is prone to placebo effects. We have shown sensitivity of a non-invasive brain imaging technique called functional near-infrared spectroscopy (fNIRS) to detecting tinnitus presence and severity.

Using machine learning data analytics, we have identified fNIRS features associated with subjective ratings of tinnitus severity – both when comparing tinnitus and control participants, and within tinnitus participants at different severity levels. In addition, by recording heart rate we investigated objective assessment of tinnitus using multimodal techniques.

Objective: our overall aim is to develop objective measures of tinnitus to identify the presence and severity of the condition and identify subtypes of tinnitus based on underlying neural activity.

Methods: fNIRS is a non-invasive brain imaging technique which uses near-infrared light to monitor changes in blood oxygen levels allowing imaging and analysis of the oxygen demands of active brain regions. fNIRS measures changes in oxygenated and de-oxygenated haemoglobin concentrations using a montage of light sources and detectors placed on a cap. We recorded fNIRS signals in the resting state and in response to auditory or visual stimuli from 155 individuals with chronic tinnitus and 82 controls. Severity of tinnitus was rated using the Tinnitus Handicap Inventory and subjective ratings of tinnitus loudness and annoyance were measured on a visual rating scale. Differences in features derived from both evoked responses and resting state data were compared between groups. These signal features are now being used with machine learning data analytics to classify tinnitus patients from controls and tinnitus patients at different severity levels. In a subset of participants, we recorded heart rate in addition to fNIRS as an indicator of stress experienced in individuals with tinnitus.

Using the same protocol, we also performed fNIRS recordings in a group of cochlear implant users who experienced tinnitus and whose perception of tinnitus changed with use of their implant. A cochlear implant is used to provide a sense of sound to a person who is deaf and, in many cases also suppresses tinnitus. We performed resting state and evoked recordings with the cochlear implant turned on and off. To assess neural synchrony, we compared functional connectivity networks with the implant turned on and off using a network feature called diversity coefficient.

Results: Using machine learning applied to fNIRS signals, we differentiated individuals with tinnitus from controls with 78% accuracy and individuals with mild versus severe tinnitus, with 87% accuracy using cross-validation testing. By adding measures of heart rate as an indicator of stress, a common symptom in tinnitus, we further improved classification of individuals at low versus high severity levels to 90% accuracy.

In cochlear implant users we found a significant correlation ($r = 0.79$) between changes in diversity coefficient and changes in loudness ratings with the implant turned on and off.
To validate our measures, we have now begun clinical trials with the University of Melbourne Audiology Clinic and Monash Health in Australia, to record our objective measures in patients prior to and after receiving clinical treatment. We will assess how our objective measures compare with subjective ratings of tinnitus before and after treatment and enable identification of subtypes of tinnitus with specific pre-treatment fNIRS brain activity, who respond to the treatments used in the trials.

Conclusion: An objective measure of tinnitus presence and severity would greatly benefit clinicians, researchers and patients by providing a tool to assess new treatments and monitor patients' treatment progress, aiding personalised treatment interventions.

Symposium 06

Basic Research
SP 06-5

The association between chronic metabolic disorder and hearing loss

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Various metabolic diseases such as diabetes have already been found to be associated with hearing loss, and it is thought that inflammatory responses throughout the body increase, and these inflammatory responses also affect the auditory organs. In this lecture, we will discuss the association between hearing loss in major metabolic diseases such as diabetes, obesity, chronic kidney disease, and chronic liver disease through animal experiments, and in particular, we will deal with the aspect of the blood labyrinth barrier of the cochlear wall.

Symposium 07

Treatment II: Sound Therapy and CBT
SP 07-FT

Tinnitus: A dysfunctional condition

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Tinnitus, the phenomenon of perceiving phantom sounds without an external acoustic stimulus, is often caused by cochlear damage and peripheral deafferentation. This sensory deprivation leads to plastic changes in the central nervous system that manifest as structural and functional abnormalities. Elgoyhen and colleagues [1] summarize that tinnitus is associated with abnormal neuronal activity in widely distributed networks of the brain. Hyperactivity in the auditory cortex and impaired connectivity within limbic and somatosensory systems are particularly emphasized. An international research group [2] proposes clear theoretical and operational definitions to standardize the understanding and diagnosis of tinnitus. Tinnitus is defined as the perception of a sound without an external source, while tinnitus disorder is characterized as tinnitus with accompanying negative biopsychosocial effects.

Updated national and international guidelines emphasize the multidisciplinary diagnostic of tinnitus [3]. This includes a detailed recording of the patient's medical history including accompanying symptoms (e.g. hearing loss, dizziness). In the psychometric measurement, standardized questionnaires such as the Tinnitus Questionnaire (TF) are used to record the tinnitus burden and psychological stress (stress, depression, anxiety). Further findings are currently available, particularly in the psychoacoustic area (influences on hearing ability), but also in the psychometric area (questionnaire standards).
Tinnitus is associated with numerous comorbidities. These are primarily affective disorders, anxiety disorders, reactions to severe stress and adjustment disorders as well as somatoform disorders [4].

In addition, functional impairments can occur as a result of the tinnitus or the accompanying symptoms. These include impairment of the cognitive-emotional response (e.g. concentration and attention disorders, subjective loss of control), impairment of the behavioral response systems (e.g. sleep disorders, social withdrawal) and communication disorders (due to hyperacusis, dysacusis and recruitment phenomena). Physical response systems can also be negatively affected, e.g. by otalgia, myofacial cervical spine imbalances and bruxism [5].

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Symposium 07

Treatment II: Sound Therapy and CBT
SP 07-1

Psychological aspects, their biomarker and Cognitive Behavioral Therapy for Tinnitus Patients in Japan

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In 20% of cases, the patient often experiences severe enough distress, impairing their daily activities. In addition to hearing impairment, tinnitus is associated with different types of clinical symptoms due to the involvement of various pathologies resulting from environmental, psychological (depression or anxiety disorder), or other factors.
In Tinnitus Sample Case History Questionnaire (TSCHQ), mental stress is the most common onset-related event in Japan. Although there is likely to be a commonly accepted relationship between stress and tinnitus, clinical evidence is still insufficient.
There may also be some overlap between stress and a change in hearing. The severity of tinnitus patients is classified by tinnitus handicap inventory (THI), and severe cases with high THI have been reported to be associated with lower quality of life and more patients with high anxiety and depression. We also found that BDNF and SNP related depression are also biomarkers of severity of tinnitus.
BDNF
BCR rs131702 the single nucleotide polymorphisms (SNP) is involved in severe cases with high THI. This SNP is a bipolar depression, suggesting that these patients would be depression if left untreated. In fact, tinnitus is associated with an increased hazard of subsequent major depressive disorder in Taiwan (Lin HC 2022).

Cognitive Behavioral Therapy for tinnitus
If the THI is 56 or higher, the patient is more likely to be anxious or depressed, and psychiatric treatment is recommended in addition to tinnitus retraining therapy (TRT) in Japanese clinical practice guideline.
Psychotherapy including cognitive behavioral therapy (CBT) is not reimbursed in Japan, however, doctors and psychotherapists have tried CBT for tinnitus patients with depression and anxiety. We will show you Protocol and data of several cases in Japan.

Symposium 07

Treatment II: Sound Therapy and CBT
SP 07-2

Long-term effects of a single psycho-educational session in chronic tinnitus patients

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AIMS: The purpose of the current retrospective analysis is to evaluate the effects of a single psycho-educational session on tinnitus burden in chronic tinnitus patients. The session is organised at a tertiary referral centre for otologic disorders at the University Hospital Antwerp as a group session (with 15-20 patients attending at a time) lasting for approximately 3-4 hours. The session focusses on different aspects of tinnitus generation, burden and provides support in building strategies for better coping mechanisms.

METHODS: The study reports on 96 patients who completed the Tinnitus Functional Index (TFI), Visual Analogue Scale for mean loudness (VAS), Hyperacusis Questionnaire (HQ) and the Hospital Anxiety and Depression Scale (HADS) prior to treatment and at six-month follow-up. The TFI was chosen as the primary outcome. Paired samples-T tests were performed to evaluate therapy effect at 6-month follow-up. In addition, a logistic regression model revealed baseline TFI/VAS scores and duration of tinnitus as contributing factors to a significant decrease of the TFI.

RESULTS: The TFI total score showed a significant decrease ($p < 0.001$) at the 6-month follow-up time point. At follow-up 75% of patients reported their tinnitus to be under control not requiring any additional treatment. The logistic regression model showed that patients with higher baseline TFI scores, lower baseline mean VAS loudness ratings and shorter tinnitus duration were more likely to show clinically significant improvement on the TFI scale.

CONCLUSIONS: Regular Tinnitus Retraining Therapy or Cognitive Behavioural Therapy are effective though very time consuming and expensive treatments. A single psycho-educational group session was shown to be highly effective in decreasing the tinnitus burden, which increases feasibility and cost-effectiveness. More extensive therapeutic guidance should be provided if required in certain patients.

Symposium 07

Treatment II: Sound Therapy and CBT
SP 07-3

Low intensity noise tinnitus suppression (LINTS): A new therapeutic approach based on the Erlangen model of tinnitus development

Holger SCHULZE

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Recently, we proposed a model of tinnitus development that proposes a permanent optimization of information transfer in the auditory system by means of stochastic resonance (SR). There, internally generated neuronal noise has to be constantly adapted and added to the cochlear input to the dorsal cochlear nucleus to maximize information transmission, thereby improving hearing thresholds. According to this view, tinnitus is a by-product of this hearing optimization process, as the noise can be perceived when it is propagated to the auditory cortex. Interestingly, in healthy subjects auditory thresholds can also be improved by adding external, near-threshold acoustic noise. We therefore have tested the hypothesis that tinnitus can be cancelled if the internally generated neuronal noise is substituted by externally provided acoustic noise that is spectrally matched to the patients' audiometric data. In a series of pilot studies, we were able to demonstrate that this is indeed the case.

Here we have implemented this new therapeutic approach, "Low Intensity Noise Tinnitus Suppression (LINTS)", in hearing aids and treated patients for four weeks. A placebo group was treated with spectrally non-matched, i.e. white noise, for two weeks before the LINTS treatment. The success of the therapy was assessed using the Tinnitus Questionnaire (TQ).

We found that TQ score improved significantly in patients treated with LINTS, while there was no effect in the placebo group. Furthermore, the positive effect of LINTS treatment appeared to be delayed in the placebo group, while it tended to persist beyond the end of therapy in the LINTS group. Finally, patients in the placebo group showed a clearly higher dropout rate than those in the LINTS group.

We conclude from these encouraging observations that LINTS represents a genuine new therapeutic option which, when optimally adapted, enables tinnitus patients to experience real silence again.

Symposium 07

Treatment II: Sound Therapy and CBT
SP 07-4

Embracing the Complexity of Tinnitus Patients: Advancing Person-Centered Psychotherapeutic Care

Benjamin BOECKING

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Chronic Tinnitus presents a unique challenge in clinical care, not only due to its variability in symptom presentation but also due to its profound psychological impact. From a psychotherapeutic perspective, tinnitus patients can be considered complex due to the interaction of cognitive, emotional, attentional, motivational, and behavioral factors, as well as their subjective experiences of self and context. This complexity necessitates a move beyond conventional symptom-focused approaches toward a person-centered model, leveraging principles from "third-wave" therapies and an idiographic, process-based functional analysis approach.

To address the psychological complexity of patients with chronic tinnitus, five key features are particularly relevant (adapted from Hayes and Hofmann, World Psychiatry, 2021).

1. A focus on context and function allows clinicians to explore how (and why) tinnitus-related distress manifests in the individual's unique life circumstances. For instance, a patient's catastrophic thoughts about tinnitus may be driven by contextual factors such as social isolation or complex intrapersonal or interpersonal experiences. Understanding the functional role of these thoughts—whether they serve as avoidance mechanisms, expressions of unmet emotional needs, or attempts to regain control—provides a nuanced foundation for psychotherapeutic intervention.
2. The integration of new models and methods with earlier strands of CBT emphasizes that progress in treating tinnitus patients does not discard foundational principles of cognitive restructuring or behavioral activation. Instead, newer approaches build on these methods by emphasizing acceptance, self-compassion, the impact of biographical experiences, and the therapeutic relationship.
3. The shift from a symptom- or diagnosis focused approach to one emphasizing experiential repertoires. Tinnitus-related distress often arises not from the sound itself but from a rigid, maladaptive response repertoire—such as hyperfixation on the sound or avoidance of quiet environments—that exacerbates emotional suffering and is maintained by multilayered psychological functions. This focus on functional adaptability resonates with a growing recognition that treating tinnitus involves addressing broader aspects of psychological equilibrium rather than solely targeting the auditory symptom.
4. The importance of applying processes of change not only to the client but also to the clinician. In the context of tinnitus care, this means that clinicians ought to cultivate empathy, flexibility, and resilience – particularly given frequently challenging therapeutic interactions with patients struggling with anger, shame, despair or hopelessness. This alignment between clinicians and clients creates a therapeutic alliance rooted in shared understanding and genuineness.
5. Finally, expanding one's therapeutic stance towards the rich therapeutic frameworks historically characteristic of humanistic, existential, analytic, or systemic psychotherapy. Tinnitus often intersects with existential concerns such as loss of identity, fear of an uncertain future, or feelings of isolation. Incorporating elements from existential psychotherapy, such as exploring the patient's sense of meaning and purpose, can enrich the therapeutic process. Additionally, systemic factors—such as familial responses to the patient's distress—can significantly influence the trajectory of tinnitus-related suffering.

The implications for person-centered care in tinnitus are profound. Tailoring interventions to target nuanced psychological processes in each individual represents a significant advance in mental health care. For tinnitus care, this means moving away from one-size-fits-all protocols and instead embracing an idiographic, psychological process-oriented framework. Clinicians must adopt an open stance, integrating insights from third-wave therapies, traditional CBT, and humanistic-existential approaches to co-create interventions that resonate with the patient's actual lived experience.

In conclusion, tinnitus patients are complex due to the intricate interplay of cognitive, emotional, attentional, and motivational processes that shape their experience. Third-wave therapies provide a robust framework for understanding and addressing this complexity, emphasizing context, flexibility, clinician-client alignment, and the integration of broader psychotherapeutic traditions. By tailoring interventions to target the specific processes underlying each patient's distress, the field can be advanced towards more effective, person-centered mental health care.

Symposium 07

Treatment II: Sound Therapy and CBT
SP 07-5

Sound therapy with a smartphone app for tinnitus management

Il Joon MOON

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In the era of the Fourth Industrial Revolution and digital therapeutics, there has been growing research interest in smartphone- and internet-based tinnitus management. Numerous tinnitus applications have been developed, ranging from those that utilize notched music or band-pass noise to those that provide relaxation exercises, attentional focus training, and diary-writing features. Some studies have demonstrated positive effects of these applications on tinnitus symptoms. However, others have reported negative findings, and research on the long-term effects of these applications—particularly regarding sustained tinnitus relief and user sound preferences—remains limited.

We investigated the potential benefits of a tinnitus application over a six-month period in participants with subjective tinnitus. A statistically significant reduction in both subjective tinnitus annoyance and perceived stress levels was observed. In addition, Tinnitus Handicap Inventory (THI) scores showed a statistically significant decrease after six months. Participants also reported high levels of satisfaction with the application.

These findings suggest that smartphone-based tinnitus applications hold promise as effective tools for tinnitus management.

Symposium 08

Comorbidities
SP 08-1

Tinnitus and migraine

William SEDLEY

Translational and Clinical Research Institute, Newcastle University, UK

Tinnitus and migraine have much in common; they are both extremely prevalent, coexist above statistical chance level, often feature excessive stimulus sensitivity, and may be triggered or exacerbated by physical or psychological stress. Furthermore, the presence of migraine is associated with greater severity of tinnitus. Tinnitus can even occur as part of migraine aura, and in rarer cases be the sole or predominant symptom of 'cochlear migraine'. Tinnitus and migraine are also symptoms usually present in Visual Snow Syndrome.

However, in some respects they are polar opposites; tinnitus is usually a persistent disorder whilst migraine is usually episodic (though the converse can occur in each case), tinnitus is usually suppressed by external sensory stimulation whilst migraine is exacerbated, tinnitus increases during stress whilst migraine often flares up after a period of stress, and tinnitus neuroscience is hampered by the struggle to find even a single associated reproducible brain abnormality whilst migraine is associated with so many dramatic and reproducible alterations in nervous system function that it is hard to account for them all in any overarching model.

Migraine has many effective pharmacological treatments, often highly effective, whilst in tinnitus there is not a single pharmacotherapy supported by top-level evidence. However, some treatments used for migraine are still prescribed for tinnitus in certain centres, with some studies indicating success. Whilst many of its treatments are broad-acting across many physiological systems, migraine medicine has seen a sea change with the discovery of the key role of the peripheral neuromodulator calcitonin gene related peptide (CGRP), and the highly successful treatments that block its action.

The past few years have also seen the intriguing proposal that tinnitus and migraine may share some fundamental mechanisms, and even claims that they are different parts of the spectrum of the same condition.

In this talk, I discuss the commonalities and differences in the clinical features and underlying neurobiology of tinnitus and migraine, and consider implications for future mechanisic and therapeutic work that might provide answers to questions such as to what extent are tinnitus and migraine part of the same condition, and what can we learn from each condition that might help us in maging the other.

Symposium 08

Comorbidities
SP 08-2

Emotional stimulus processing as a key for understanding comorbidity in tinnitus patients

Christian DOBEL

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During the course of human development, processing of emotional stimuli was a crucial necessity for survival. From a biological viewpoint emotional stimuli are survival relevant stimuli. As a consequence, the human brain is devoted and possibly even predetermined to process such stimuli in an extremely fast and efficient manner within 100 msec or less. This is the case for positive stimuli, but much more so for negative, aversive stimuli. As a cognitive correlate of this effeicient processing, such stimuli attract attention in an automatic way and enhance memory processes for longterm storage. These results are well established both for visual as well as auditory stimuli. They make it quite plausible why the permantent presence of an aversive, visual stimulus leads to emotional and cognitive impairments. I will review the mentioned findings and relate them to our neurophysiolgocial work using magnetoencephalography in which we demonstrated the involvement of limbic structures in response to the tinnitus frequency, but not a control tone. A change of dorso-medial prefrontal activity induced by transcrancial stimuliation evoked changed the neural network related to distress, but not the network responsible for auditory processing.

Symposium 08

Comorbidities
SP 08-3

Tinnitus and sleep

Jeon Mi LEE

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Tinnitus and sleep are intricately linked. Tinnitus can disrupt sleep, and conversely, inadequate sleep can exacerbate tinnitus. Adequate sleep is essential; insufficient rest diminishes the brain's capacity to manage stress, hence increasing sensitivity to tinnitus. Moreover, the stress or anxiety induced by tinnitus might disrupt sleep. This may readily evolve into a detrimental loop.
This presentation aims to structure studies on the correlation between tinnitus and sleep.

Symposium 08

Comorbidities
SP 08-4

Infradian 3–4 days rhythmicity in the intensity of tinnitus modulated by sleep

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Objective
A subset of tinnitus patients experiences drastic variations in tinnitus intensity related to sleep. On certain days, they report perceiving intense tinnitus immediately upon waking and throughout the day, while on others, they wake without tinnitus and remain symptom-free until their next sleep episode, unless they take a nap. To date, no studies have investigated whether these alternations between tinnitus presence and absence are purely random or exhibit regular, potentially predictable patterns.

Materials and Methods
17 tinnitus patients exhibiting this symptomatology were prospectively recruited and reported daily tinnitus intensity and sleep diary for two months. Lomb-Scargle periodogram was used to determine whether periodic oscillations in their tinnitus were present. A confirmatory analysis was conducted on a retrospective database comprising a test group (N=11) and two control groups (N=16 and N=21). Additionally, the relations between tinnitus intensity and sleep parameters such as sleep duration sleep pressure and nocturnal awakenings was investigated.

Results
A periodicity specifically between 2.5 and 4.5 days was significantly present in the prospective cohort and only in the test group of the retrospective database ($p < 0.001$). No periodicity was either identified in other frequency bands nor in the control groups of the retrospective data-base. Tinnitus intensity absolute variations were more important during the night than the day without naps ($p < 0.001$). Additionally, tinnitus intensity during nocturnal and morning awakenings correlated with sleep pressure at the same times ($p < 0.001$).

Conclusion
The alternation between tinnitus presence and absence in this subpopulation does not appear random. While sleep plays a key role in the transitions of tinnitus intensity, the observed infradian rhythms likely reflect an underlying physiological phenomenon (e.g., related to sleep pressure, inflammatory or endocrine mechanisms). Future research should explore the physiological basis of this rhythmicity.

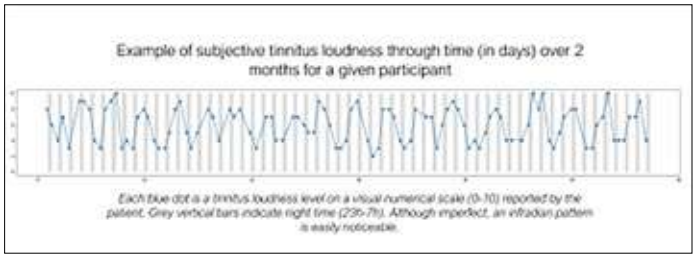

Figure Example of subjective tinnitus loudness through time (in days) over 2 months for a given participant

Symposium 08

Comorbidities
SP 08-5

Somatic Symptom Disorder and Autonomic Dysregulation in Tinnitus Patients: A Prospective Study

Chen-Chi WU

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Background:
Tinnitus is a persistent auditory symptom often associated with increased psychological distress. Somatic symptom disorder (SSD), characterized by a disproportionate preoccupation with physical symptoms, is increasingly associated with autonomic dysregulation. However, there is limited data on this relationship in tinnitus patients. This study examines the psychological and physiological profiles of chronic tinnitus patients, focusing on SSD and autonomic function.
Methods:
We prospectively recruited chronic tinnitus patients (>3 months) from otorhinolaryngology outpatient clinics. Psychological assessments included the Patient Health Questionnaire-15 (PHQ-15), the Health Anxiety Questionnaire (HAQ), the PHQ-4 (a brief screener for depression and anxiety), and the World Health Organization Quality of Life (WHOQOL-BREF). Physiological indicators-heart rate variability (HRV), skin conductance, finger temperature, respiratory rate and amplitude, and frontalis electromyogram (EMG)-were recorded using ProComp5 Infiniti during a standardized 5-minute resting state. SSD was identified based on PHQ-15 scores ≥4 and HAQ scores ≥17.
Results:
A total of 84 adult patients were enrolled (mean age = 56.9 years, range = 27-81). Of these, 34 participants (40.5%) met the criteria for probable SSD. These individuals had significantly higher somatic symptom, health anxiety, and emotional distress scores and lower WHOQOL-BREF scores, particularly in the physical and psychological domains. Physiologically, SSD patients showed reduced heart rate variability as reflected by lower SDNN (Standard Deviation of Normal-to-Normal Intervals), decreased finger temperature, increased skin conductance, and increased EMG activity - patterns suggestive of sympathetic overactivation and parasympathetic suppression.
Conclusion:
Approximately 40% of tinnitus patients exhibited signs of SSD and showed concurrent autonomic dysregulation. The integration of psychological assessment and peripheral physiological biomarkers may improve early identification and inform more holistic interventions for tinnitus patients at psychosomatic risk.

Symposium 08

Comorbidities
SP 08-6

Exploring the link between diabetes and tinnitus: Clinical and animal study findings

Da Jung JUNG

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Background
Diabetes is known to contribute to neural and microvascular complications, which may affect the auditory system. This study investigated the link between diabetes and tinnitus by evaluating the therapeutic effect of alpha-lipoic acid (ALA) – a treatment for diabetic neuropathy – on hearing and tinnitus. Both clinical patient data and an animal model of diabetes were used to explore auditory changes and tinnitus outcomes associated with diabetes.
Methods
Clinical Study: Changes in hearing and tinnitus were investigated in patients with chronic tinnitus (treated with oral ALA) and age-matched patients with tinnitus (controls).Auditory function was assessed with pure-tone audiogram, and tinnitus severity was evaluated using the Tinnitus Handicap Inventory (THI) and a visual analog scale (VAS) at baseline, 6mo, and one-year follow-up.
Animal Study: A diabetic mouse model (db/db mice) was used to mirror clinical findings. Diabetic mice received either ALA or saline. Auditory Brain stem Response (ABR) testing was performed to measure hearing thresholds tinnitus-like behavior was assessed using the gap prepulse inhibition of acoustic startle reflex(GPIAS).
Results
Clinical: Diabetic tinnitus patients treated with ALA showed significant tinnitus relief and modest hearing preservation over one year. THI scores improved by roughly 50% (indicating a substantial reduction in perceived tinnitus handicap), and tinnitus VAS ratings also decreased markedly in the diabetic ALA group. Animal: ALA-treated diabetic mice exhibited markedly less age-related auditory deterioration than saline-treated controls. Furthermore, ALA greatly reduced tinnitus-like behavior in diabetic mice.
Conclusion
Diabetes was associated with worsened hearing and increased tinnitus severity, ALA treatment provided significant tinnitus relief and some hearing prevention in diabetic patients, and it preserved hearing function and prevented most tinnitus-related behavior in the diabetic mouse model. These clinical and preclinical findings suggest that diabetic neuropathy contributes to tinnitus and hearing loss, and that managing this neuropathy with ALA may be a promising strategy to mitigate tinnitus and auditory decline in diabetic individuals.

Symposium 09

Diagnosis
SP 09-FT

Psychoacoustical measurement and perceptual consequences of tinnitus

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Tinnitus a perception of sound without an external source. The origin of sound is still unclear but likely reflects the brain's compensatory response to changes including hearing loss. Tinnitus has been traditionally assumed to be "bad" – worsening hearing, speech perception and cognitive perception. After reviewing existing literature, I found that evidence supporting this assumption is weak. Instead, our experimental work showed that tinnitus does not interfere with auditory and speech perception, per se, and may even compensate for the cognitive decline induced by hearing loss. I will discuss this new insight and relate it to tinnitus mechanisms and management.

Symposium 09

Diagnosis
SP 09-1

Harnessing predictive coding to unlock the mysteries of tinnitus

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There is compelling and growing evidence supporting Bayesian frameworks of brain function, such as predictive coding. These models suggest that perception relies on internally generated representations of the environment, which are continuously updated and refined by incoming sensory information. Bayesian perception encompasses both automatic, stimulus-driven perceptual inference and active, time-dependent processes that facilitate the strategic sampling of predicted sensory inputs.

In this framework, specific neural oscillatory activities are linked to different aspects of perceptual inference. Beta-band activity is associated with predictions, while alpha-band activity reflects the precision of these predictions. Gamma-band oscillations correspond to prediction errors, particularly within sensory cortices, where these errors are propagated to other brain regions. In active inference, neural correlates show some distinctions: theta activity represents predictions, delta activity encodes precision, and gamma activity relates to prediction errors, especially in the hippocampus and associated cortical areas.

These frequency bands, especially in auditory and other cortical regions, have been implicated in tinnitus, though the specific relationship between Bayesian processes and tinnitus remains underexplored. Two Bayesian-based models have been proposed to explain the pathophysiology of tinnitus. The first model suggests that tinnitus arises from memory-based prior beliefs about sounds, which are activated to compensate for a lack of sensory input, aligning with principles of active inference. The second model proposes that spontaneous activity in the ascending auditory pathway (a "tinnitus precursor") is typically disregarded as noise. Chronic tinnitus occurs when this activity gains sufficient precision to override the default prediction of "no sound," leading to a persistent perceptual inference of tinnitus.

Stress is a significant factor that may influence perceptual inference. It can contribute to the initial onset of tinnitus or perpetuate the condition by altering the precision of predictions and errors. In both models, the incorporation of the tinnitus percept into the brain's default predictive framework plays a central role in the chronic nature of the condition.

While anatomical and electrophysiological findings in tinnitus research are compatible with Bayesian brain models, these findings remain largely circumstantial and are also consistent with alternative interpretations. Further research is needed to solidify these connections and refine our understanding of tinnitus within a Bayesian framework. These concepts and their implications for understanding tinnitus will be explored in greater detail during the presentation, offering insights into how Bayesian processes shape perception and potentially inform therapeutic approaches.

Symposium 09

Diagnosis
SP 09-2

The value of electrophysiology for tinnitus patients

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Introduction
Tinnitus is a common disorder that negatively impacts quality of life. While many patients have hearing loss, some have normal pure-tone thresholds, suggesting the involvement of the central nervous system in its generation and maintenance. Cortical auditory evoked potential (CAEP) measures the bioelectrical activity of thalamocortical neurons in response to short auditory stimuli. The aim of our study is to identify potential deficit of central auditory process in tinnitus patients with normal audiogram (TNA).

Method
We conducted a prospective study recruiting idiopathic TNA patients. All participants underwent a comprehensive hearing test battery and CAEP assessment and completed questionnaires quantifying symptom severity. The control group included age- and sex- matched participants with normal audiogram but no tinnitus (NA).

Result
We enrolled 29 TNA and 24 NA participants, with an average age of 41.5 ± 10 y and 40.9 ± 15.7 y, respectively. Hearing test battery results showed no significant difference between the two groups. For CAEP, the interpeak latency (IPL) of P2-N1 and P2-P1 at 2k Hz was significantly shorter, while P1 latency at 4k Hz was significantly longer in the TNA group (p=0.011, 0.014, 0.015, respectively). A trend toward longer P1 latency and shorter P2 latency at 2k Hz was also observed (p=0.068 and 0.066, respectively). Within-subject analysis of 11 participants with unilateral tinnitus showed no difference, except for longer N1 latency at 500Hz (p=0.037).

Conclusion
Our results demonstrated altered neural activity in the primary auditory cortex, particularly in Heschl's gyrus, along with compensatory mechanisms in other primary auditory regions around the temporal lobe in tinnitus patients. The similarity between tinnitus and non-tinnitus ear within the same subject suggests that non-auditory cortices contribute to the generation of tinnitus. In conclusion, our findings support the "top-down" theory of tinnitus generation in patients without peripheral hearing deficits.

Symposium 09

Diagnosis
SP 09-3

Developing an Objective Evaluation of Tinnitus and Hyperacusis Using a Wearable AI-powered Pupil Dilation System

Wei SUN

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Pupil dilation is an important physiological marker regulated by the autonomic nervous system and has shown sensitivity to sound stimuli, making it a reliable index of arousal. Studies indicate that changes in pupil dilation are strongly correlated with the presence and severity of conditions such as tinnitus and hyperacusis. Given its sensitivity to autonomic arousal, pupil dilation has emerged as a promising objective measure for these disorders.
As the current system for pupil dilation is expensive and not suitable for clinical use, we developed AudioSight, a wearable pupil dilation recording system that employs an AI-based algorithm to detect changes in pupil size and derive key parameters related to sound-induced emotional responses. Using the custom system, we have tested people with tinnitus and hyperacusis and compared their results with control subjects. Our preliminary results have demonstrated that individuals with hyperacusis and tinnitus exhibit pronounced pupil dilation, particularly in the form of peak amplitude and heightened excitatory phases in response to sound stimuli.
This system represents an advancement in objectively quantifying sound tolerance and arousal responses to tinnitus, offering potential improvements in clinical diagnosis and research. A mobile version of AudioSight is also under development, further enhancing its accessibility and ease of use while maintaining its cost-effectiveness. By enabling more objective, AudioSight could provide an accessible and cost-effective assessments for tinnitus and hyperacusis.

Keywords: Pupil dilation, tinnitus, hyperacusis, AI

Symposium 09

Diagnosis
SP 09-4

Advancing Tinnitus Diagnosis through Objective Biomarker Discovery: Insights from the Tinnitus Detection (TIDE) Consortium

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Tinnitus diagnosis remains fundamentally reliant on subjective self-reports, as an unequivocal objective biomarker has yet to be identified. While numerous studies have revealed measurable neural activity differences between individuals with and without tinnitus, translating these group-level findings into a reliable single-subject diagnostic tool has proven elusive. Among key paradigms, resting-state EEG, the auditory oddball paradigm, and the Gap Prepulse Inhibition of the Acoustic Startle paradigm have consistently shown promise in detecting group-level discrepancies associated with tinnitus.

The TIDE consortium has embarked to identify and validate robust biomarkers for tinnitus perception. We aim to develop an objective diagnostic biomarker capable of reliably detecting tinnitus at the individual level, marking a transformative step in the field.
The consortium currently records EEG activity from 560 participants (280 tinnitus, 280 controls) to reach this goal. Neural activity is recorded using electroencephalography across three conditions: resting state, auditory oddball paradigm, and GPIAS paradigm. Complementing these recordings are comprehensive behavioural and clinical assessments, including:
• Questionnaires: European School for Interdisciplinary Tinnitus Research Screening Questionnaire, Tinnitus Handicap Inventory, Tinnitus Functional Index, Hospital Anxiety and Depression Scale, Perceived Stress Questionnaire, Hyperacusis Questionnaire.
• Auditory Evaluations: Pure-tone audiometry, tinnitus pitch matching, tinnitus loudness matching.

Data analysis employs a rigorous, blinded protocol involving inferential statistics, logistic regression, and cutting-edge machine learning techniques. To develop and validate classifiers capable of identifying tinnitus perception, an 80%-20% training-to-test dataset split is used. The study's commitment to scientific integrity and transparency is underscored by its pledge to openly publish anonymized data, analysis scripts, and stimulation paradigm protocols.

This multicenter study is being conducted across sites in Austin-US, Dublin-Ireland, Ghent -Belgium, Illinois-US, Regensburg-Germany, Tübingen-Germany, and Zürich/St. Gallen -Switzerland.

The TIDE consortium aims to develop objective, reliable, and clinically applicable biomarkers for tinnitus by combining large-scale data collection with sophisticated analytical techniques.

Keywords: Objective marker, EEG, Machine learning

Symposium 09

Diagnosis
SP 09-5

Role of Audiometric Testing in Tinnitus Classification and Personalized Treatment: Evidence from Cluster Analysis

Ho Yun LEE

ORL-HNS, Ewha Womans University, Korea

We aimed to identify distinct tinnitus subtypes and determine optimal treatment approaches based on audiometric testing and detailed patient assessment. Comprehensive cluster analysis was performed on audiometric, psychological, and subjective tinnitus measures from 311 patients. A systematic optimization process identified k=4 as the optimal cluster solution through silhouette coefficient and stability testing. Due to similarities between clusters 3 and 4, they were consolidated, resulting in a final three-cluster solution. Each cluster demonstrated unique profiles: Cluster 1 (severe tinnitus with normal hearing), Cluster 2 (hearing loss-dominant tinnitus), and Cluster 3 (mild psychosomatic tinnitus). Treatment efficacy varied significantly by cluster, with Diuretics showing greatest improvement for Cluster 1 (36.2%), Baclofen for Cluster 2 (41.4%), and Indenol for Cluster 3 (39.5%). Notably, hearing aids benefited Cluster 2 (26.0% improvement) but were detrimental in Clusters 1 and 3. These findings may back up the essential role of audiometric testing in developing personalized treatment strategies.

Symposium 10

Digital Therapeutics
SP 10-FT

Digital Therapeutics Approval Process and Market Overview in the US

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Alston & Bird, USA

Digital therapeutics (DTx) are evidence-based, software-driven interventions designed to manage or treat medical conditions. Recent FDA authorizations of DTx products highlight chronic conditions and mental health management. Challenges for start-up manufacturers include regulatory complexity, data privacy concerns, and clinical trials. While the U.S. market shows a strong growth potential, addressing reimbursement and coverage is critical to ensuring patient access.

This presentation will examine the US regulatory pathways for DTx, focusing on the US FDA framework for software products, 510(k) clearance, and de novo classification. Products recently authorized by the US FDA for the tinnitus management will be reviewed, highlighting their regulatory strategies and data requirements. This presentation will also discuss practical considerations for a successful market strategy to accelerate the pathway from innovation to patient impact for tinnitus-focused medical devices.

Symposium 10

Digital Therapeutics
SP 10-1

Digital therapeutics for tinnitus management

Matthieu RECUGNAT

Mindear, Australia

Introduction
Research has shown that cognitive behavioural therapy (CBT) is an effective treatment option for patients experiencing distressing tinnitus. While the traditional delivery of CBT involves time with a psychologist, recent research into the efficacy of internet-based CBT (iCBT) has shown that it is cost-effective and accessible. Moreover, The advent of conversational agents or a "chatbot" that can deliver CBT exercises in a conversational manner and allow users to work through complex situations with guidance from a virtual coach has been promising. As the primary endpoint, this study evaluated the effectiveness of the Tinnibot iCBT chatbot program, in reducing tinnitus distress, when combined with or without human-delivered telepsychology.

Methods
Twenty-eight adult participants were randomly assigned to one of two parallel groups. One group received only the Tinnibot program (T), while the other received Tinnibot with four sessions of 30-minute teleconsultation with a psychologist within 8 weeks (T+P). The primary outcome measure was the Tinnitus Function Index while secondary measures included

Results
9 out of 14 participants (~61%) showed a clinically significant decrease in tinnitus distress (>13 Tinnitus Functional Index point decrease) 16 weeks post-intervention in both groups. The results after 8 weeks of therapy differ between the two groups. 6 out of 14 (42%) had a clinically significant decrease in TFI when provided with Tinnibot only while 9 out of 14 had a significant decrease when Tinnibot was combined with telepsychology. Even though the mean TFI decrease was larger for the T+P group compared to the T group, a mixed analysis of variance (ANOVA) revealed no significant between-group interaction effects (time by group interaction: $F_{2,52}$ $P=0.71$)

Conclusion
Overall, the study suggests that the Tinnibot iCBT chatbot program in isolation or in combination with telepsychology counselling can be effective in helping patients who experience distressful tinnitus. More research is needed to determine the optimal mode of delivery for different patient groups.

Symposium 10

Digital Therapeutics
SP 10-2

Effectiveness of computerized cognitive behavioral therapy for chronic tinnitus

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Chronic tinnitus is a prevalent and often debilitating condition that can lead to significant emotional distress and reduced quality of life. While cognitive behavioral therapy (CBT) is known to be effective in managing tinnitus, its accessibility remains limited due to the shortage of trained therapists and the time-intensive nature of conventional therapy. In this study, we evaluated the effectiveness of a 6-week computerized cognitive behavioral therapy (cCBT) program specifically designed for patients with chronic tinnitus.
The cCBT program consisted of structured video-based education modules, guided sound therapy exercises, and interactive components such as thought diaries to promote cognitive restructuring and emotional processing. The intervention was delivered entirely online, allowing patients to engage with the content at their own pace and convenience.
Preliminary results demonstrated significant improvements in tinnitus-related distress, as measured by validated questionnaires. Participants also reported reductions in anxiety and depressive symptoms following the program. Importantly, the intervention showed high levels of user satisfaction and adherence, indicating that cCBT may serve as a practical and effective therapeutic option for chronic tinnitus, especially in settings with limited access to in-person CBT. Our findings suggest that computerized CBT, incorporating psychoeducation, self-reflective tools, and sound-based strategies, holds promise as a scalable and accessible approach to tinnitus management.

Symposium 10

Digital Therapeutics
SP 10-3

Digital therapy for improved tinnitus care study

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Background
Tinnitus is a prevalent and burdensome condition, affecting millions worldwide and imposing significant economic costs on healthcare systems. Traditional treatments, such as one-to-one therapist-delivered approaches, often struggle with accessibility, cost, and the availability of trained professionals. The Digital thErapy For Improved tiNnitus carE (DEFINE) trial (trial registration ISRCTN99577932) was designed to evaluate an innovative, smartphone-delivered tinnitus therapeutic, the Oto app, as an effective, scalable and cost-effective alternative to standard therapy.

Methods
This prospective open-label, non-inferiority, parallel-design randomized controlled trial enrolled 210 UK adults with tinnitus symptoms for ≥3 months that impacted quality of life. Participants were randomized 1:1 to receive either the Oto app or up to 6 sessions of one-to-one therapist-delivered tinnitus therapy. Randomization was performed centrally by computer, matching groups for age, sex, and hearing level. The primary outcome was change in Tinnitus Functional Index (TFI) total score at 26 weeks. Secondary outcomes included adverse events and health-related quality of life measured using the EuroQol EQ-5D-5L and Health Utilities Index Mark 3 (HUI3).

Results
Both treatment groups demonstrated clinically meaningful improvements in TFI scores at 26 weeks with mean total TFI score change of -15.4 in the control group (therapist-delivered therapy) and -15.0 in the intervention group (Oto app), demonstrating Oto to be non-inferior to therapist delivered therapy. Improvement was evident in both groups from baseline through the 1 and 3 month timepoints and sustained from three months through six and twelve months. The app achieved a high mean System Usability Score of 75 (SD 17). Adverse events were reported by 11% of the Oto group and 5% of the control group (mostly temporary worsening of tinnitus symptoms), with no serious events related to either intervention. Health related quality of life measures improvements were consistently non-inferior across all timepoints.

Conclusions
The DEFINE trial demonstrates that smartphone-delivered tinnitus therapy (the Oto app) can offer efficacy comparable to traditional therapist-delivered treatment. Digital therapeutics for tinnitus can significantly enhance accessibility and quality of tinnitus care.

Symposium 10

Digital Therapeutics
SP 10-4

Latent trajectories of tinnitus symptoms during treatment

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Digital phenotyping refers to the use of real-time data collection methods to monitor and track individuals' behaviors and symptoms, offering rich insights into their health status over time. This approach holds great promise for advancing personalized treatment in various medical fields, including tinnitus. Tinnitus, a condition marked by persistent ringing or buzzing in the ears, remains poorly understood, with clinical studies on treatment effectiveness often yielding mixed results. While factors like treatment duration and measurement tools might explain some of this variability, individual differences in treatment response have been insufficiently explored. Conventional clinical trials typically assume uniform treatment responses and linear symptom progression across patient groups, an approach that fails to account for the heterogeneous nature of tinnitus and its fluctuating course.

To address this gap, we examined the longitudinal trajectories of tinnitus symptoms using growth curve mixture modeling, applied to daily self-reports collected over 12 weeks of treatment. Data from both a clinical trial and an online study (N > 400) were used to identify distinct subgroups of patients based on their symptom patterns. Our findings revealed significant heterogeneity in treatment responses, highlighting the need for personalized treatment strategies. Additional analyses identified demographic and clinical predictors that could help classify patients into subgroups, offering valuable insights for refining treatment approaches.

By uncovering clinically meaningful subgroups, this study provides a new perspective on tinnitus treatment, emphasizing the importance of dynamic symptom patterns and individual variability. Tailoring interventions to these findings may offer more effective and personalized management of tinnitus.

Symposium 10

Digital Therapeutics
SP 10-5

Electroceuticals and Digital Therapeutics for Tinnitus

Jae-Jun Song

Department of Otorhinolaryngology, Korea University Guro Hospital

Tinnitus, a prevalent and often debilitating auditory disorder, lacks universally effective treatments. Recent advances in neuromodulation and digital therapeutics offer promising avenues for intervention. This presentation reviews state-of-the-art developments in electroceutical approaches, particularly transcutaneous auricular vagus nerve stimulation (taVNS), and digital cognitive behavioral therapy (CBT) applications for tinnitus management.

Vagus nerve stimulation (VNS) has been extensively studied for neurological disorders such as epilepsy and depression. Its application to tinnitus involves modulating auditory cortex plasticity through paired VNS and sound therapy, aiming to reverse maladaptive neural activity underlying tinnitus perception. Both invasive and non-invasive (transcutaneous) VNS targeting the auricular branch of the vagus nerve (ABVN) have demonstrated efficacy in improving tinnitus symptoms and associated stress responses. Clinical pilot studies report approximately 50% of patients experiencing tinnitus improvement after taVNS combined with sound therapy, with minimal side effects1.

Anatomical studies confirm the ABVN innervates specific regions of the external ear (cymba conchae, tragus), enabling targeted stimulation. Functional neuroimaging and electrophysiological studies reveal taVNS induces bottom-up modulation, enhancing frontal alpha asymmetry and improving executive control during emotional and cognitive tasks, suggesting broader neuromodulatory effects beyond auditory pathways. Additionally, taVNS has been shown to improve heart rate variability (HRV), indicating enhanced parasympathetic tone and stress reduction, which are critical in tinnitus pathophysiology.

CBT remains the gold standard psychological intervention for persistent, bothersome tinnitus, supported by multiple randomized controlled trials and systematic reviews demonstrating its efficacy in reducing tinnitus distress, improving quality of life, and alleviating comorbid anxiety and depression. Recent developments include internet-based and app-delivered self-help CBT programs, which have shown effectiveness in decreasing tinnitus-related distress and offer accessible alternatives for patients unable or unwilling to attend face-to-face therapy.

The Soriclear digital therapeutic application integrates personalized sound therapy with CBT principles, utilizing notch-filtered music tailored to individual hearing profiles to maximize therapeutic effects. Real-world data from nearly 6,000 users indicate significant reductions in Tinnitus Handicap Inventory (THI) scores, with up to 50% improvement at treatment completion. A multicenter randomized controlled trial is underway in Korea to validate Soriclear's efficacy and secure regulatory approval.

Integrating electroceutical neuromodulation via taVNS with evidence-based digital CBT platforms represents a promising multimodal approach for tinnitus treatment. Ongoing clinical trials and mechanistic studies will further elucidate optimal stimulation parameters and therapeutic protocols, potentially transforming tinnitus management by addressing both neural and psychological dimensions of the disorder.

Symposium 11

Somatic Tinnitus
SP 11-FT

Somatic Tinnitus: Past, Present, and Future

Robert Aaron LEVINE

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In 1987 when I started seeing patients for tinnitus, there was no concept of tinnitus arising from outside the auditory system. Over the next few years I encountered a number of patients whose tinnitus was inexplicable on an auditory basis. At the same time evidence from animal models was (1) implicating the dorsal cochlear nucleus (DCN) as the site of tinnitus generation and (2) identifying direct connections between the somatosensory system and the DCN. This confluence led to my proposing the hypothesis that "somatic (craniocervical) tinnitus, like otic tinnitus, is caused by disinhibition of the ipsilateral dorsal cochlear nucleus."

At about the same time, again taking our cues from what some patients were reporting, namely, that they could modify the perception of their tinnitus by making a strong contraction of their jaw or neck muscles, the effect of head and neck strong muscle contractions upon auditory perception was explored systematically in tinnitus and non-tinnitus subjects alike.

Because testing for somatic modulation appeared to be a simple bedside way of probing the connection between the somatosensory and auditory systems, all tinnitus patients seen by me were tested for somatic modulation (aka "somatic testing"). This yielded dividends; it led to the identification of a previously unknown type of subjective pulsatile tinnitus, that is now referred to as somatosensory pulsatile tinnitus (SSPT). Such patients had undergone an exhaustive fruitless search for an objective (acoustic) source for their pulsatile tinnitus. However, if their tinnitus was pulsatile at the time of testing, then somatic testing suppressed their pulsations. On the other hand, if pulsatile tinnitus was not present at the time of testing, then somatic testing elicited their pulsations.

Once the connection between the somatosensory system and the auditory system was identified as the underlying etiology of "somatic tinnitus," then we anticipated that correction of the underlying somatic disorder with standard modalities such as physical therapy might resolve the tinnitus. In fact it rarely did. Even now 25 years later Intense physical therapy programs targeting the involved muscles and dental programs designed to reduce the overuse of the muscles of mastication have generally shown some degree of improvement in patients' tinnitus but total remission remains elusive. It is rarely achieved.

Wyant in 1979 found it surprising that, when treating neck pain with trigger point injections, tinnitus serendipitously disappeared for up to four months, particularly because he could not find any prior such reports. Twenty years later Estola-Partanen reported 60 more such patients. Teachey has found that of 135 cases treated with trigger point injections in about 25% tinnitus was abolished, and in another 25% tinnitus was much improved. Using dry needling or ischemic compression of trigger points, Lerner has found that 80% of his patients were improved, but none were abolished.

Two somatic tinnitus subtypes were serendipitously found to respond dramatically to botulinum toxin by Ranoux, a pain neurologist. The first was tinnitus associated with chronic migraine. While studying the treatment of chronic migraine with botulinum toxin, 40% had their tinnitus abolished and the other 60% were more than seventy percent improved. Even more impressive was the response to botulinum toxin of the tinnitus subtype known as intermittent unilateral pulsatile tinnitus, a type of SSPT. For 13 of 14 such patients, their tinnitus was abolished for 4 to 6 months by a single injection of botulinum toxin into the ipsilateral suboccipital splenius capitis muscle.

Using the PREEMPT botulinum toxin protocol for migraine, supplemented by periauricular subcutaneous injections, Lainez has found that about half of his more than a hundred somatic tinnitus patients have had a very good response and another 20% a partial response.

Somatic tinnitus patients have also been treated with acoustic / somatosensory bimodal stimulation. Again with favorable results. This included 2 of 120 who reported complete elimination of their tinnitus. In other similar studies not limited to somatic tinnitus subjects, results were comparable, which suggests that the benefit is not because the study group had somatic tinnitus but a more generalized effect.

Looking back over my nearly 40 year career in the field, after first establishing that (1) "not all that rings is coming from the ear" but rather tinnitus can arise from outside the auditory system (almost exclusively the somatosensory system) and (2) its varied manifestations (e.g. SSPT), and (3) understanding the limits of its response to traditional methods of treating disorders of muscle, tendon, and joint disorders, now in 2025 I feel we may be on the brink of therapies which are non-traditional and have the potential of even more effective treatments for somatic tinnitus, namely botulinum toxin injections and bimodal stimulation.

It is our challenge now to investigate more fully the potential of these two modalities so as to maximize their benefit.

Symposium 11

Somatic Tinnitus
SP 11-1

Somatic Tinnitus-Unresolved Issues and Future Research Directions

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Somatic tinnitus (ST) is commonly characterized as tinnitus modulated by somatosensory stimulation, such as muscle contractions and movements of the neck and jaw. However, given that similar somatosensory stimulation can elicit new tinnitus in healthy, non-tinnitus individuals, a fundamental question remains: does this somatosensory-auditory interaction represent a pathological phenomenon or a normal physiological response? Furthermore, the utility of somatic modulation maneuvers in distinguishing ST from other tinnitus subtypes has yet to be conclusively established.

Attempts to define the clinical significance of ST have been limited, and efforts to establish diagnostic criteria remain inconclusive. A significant risk of overdiagnosis persists, largely due to the absence of rigorous exclusion criteria and the lack of well-defined inclusion criteria—particularly regarding tinnitus persistence, which is essential for distinguishing ST from transient stimulus-evoked responses. While determining the proportion of ST among tinnitus patients is an important research focus, its estimated prevalence remains highly dependent on the diagnostic framework employed. Thus, refining diagnostic criteria and accurately assessing ST prevalence represent critical future research directions.

The underlying mechanisms of somatic modulation in tinnitus suggest that somatosensory inputs influence auditory processing at the level of the dorsal cochlear nucleus (DCN). However, a fundamental paradox remains—how can a single somatic maneuver, such as identical muscle contractions, both amplify and attenuate tinnitus perception? While somatosensory-based tinnitus is often described as being more strongly and readily modulated than other tinnitus subtypes, current evidence is inconclusive. Notably, animal studies and human functional imaging research suggest that individuals with hearing impairment exhibit heightened DCN activity in response to somatosensory stimulation.

Despite emerging therapeutic strategies—including physical therapy, myofascial release, botulinum toxin injections, and multimodal stimulation—the clinical landscape of ST management remains largely exploratory. A standardized treatment protocol is notably absent, underscoring the urgent need for empirical validation and the development of evidence-based clinical guidelines.

Future research should aim to refine diagnostic indicators, develop assessment methodologies that integrate musculoskeletal dysfunction as a contributing factor, and advance targeted, multimodal interventions—ultimately leading to a more precise classification and effective management of ST.

Symposium 11

Somatic Tinnitus
SP 11-2

Somatosensory tinnitus: Recent developments in diagnosis and treatment

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Somatosensory (or somatic) tinnitus (ST) arises when altered somatosensory input from the head and neck region influences a patient's tinnitus perception. Because tinnitus is often multifactorial, pinpointing a somatosensory component can be challenging. To address this, a diagnostic decision tree based on four clinical criteria has been proposed, achieving 82.2% accuracy, 82.5% sensitivity, and 79% specificity.

Once ST is accurately identified, targeted musculoskeletal physical therapy can be highly effective. This treatment focuses on managing cervical spine dysfunctions, temporomandibular disorders, or both, using a combination of counseling, exercises, and manual techniques to restore normal function in the cervical spine and temporomandibular region. While other treatment approaches have been suggested, additional large-scale randomized controlled trials are needed to establish their efficacy.

This presentation will provide an up-to-date overview of the diagnosis and management of ST, including the clinical decision-making process, evidence-based physical therapy interventions, and emerging therapeutic strategies.

Symposium 11

Somatic Tinnitus
SP 11-3

Lidocaine injections to the otic ganglion for the treatment of tinnitus

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Berthold Langguth, Department of Psychiatry and Psychotherapy, University of Regensburg, Germany
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Introduction
Tinnitus as the perception of noise without an external auditorial stimulus is difficult to treat. Previous studies showed a potential trigeminal input in certain tinnitus patients, this subtype of tinnitus is called somatosensory tinnitus. Therefore, we explored the therapeutic effects of injections of lidocaine to the otic ganglion and trigeminal anatomical structures in patients with chronic tinnitus.

Methods
In a pilot study with 20 participants, we explored tolerability and effects of this therapeutical approach. We performed three injections of lidocaine in the area of the otic ganglion via an oral approach at the side of the percepted tinnitus.
In a second prospective study 50 patients with chronic tinnitus were treated during a placebo-controlled study. Both groups received local oral injections with lidocaine or with placebo.
The assessment consisted of different audiological tests, TSCHQ, THI, TQ, CGI and numeric rating scales over a follow-up period of four weeks.

Results
We observed in both experiments only small side effects like dizziness and headache.
The pilot data suggest that lidocaine injections targeting trigeminal structures may be able to reduce tinnitus complaints. In the second study with a shorter follow-up we could not recognize significant differences in our endpoints between both groups. The groups showed improvements in tinnitus loudness, tinnitus complaints and CGI after 30 minutes. One week later, the improvements could be recognized again, but in the follow-up after four weeks we could not see significant differences between the two groups.

Discussion
Former studies showed a potential association between the perception of tinnitus and manoeuvers of the temporomandibular joint and/or of the cervical spine. This association in patients with somatosensory tinnitus is the basis for our described studies.
Our results address a possible improvement of tinnitus perception after the injection of lidocaine in the region of the otic ganglion and trigeminal structures of patients who show clinical symptoms of a somatosensory tinnitus. But the positive effects of the injections were only short termed. Limitations of the study were the small cohort and the differences in baseline scores.

Symposium 11

Somatic Tinnitus
SP 11-4

How patient experiences have improved diagnostic tools for somatic tinnitus

Hazel GOEDHART

Director, Tinnitus Hub, UK

Lack of diagnostic tools and consensus on tinnitus sub-types have long been major impediments to progress in tinnitus research. Crowdfunded data could be a key part of the solution, especially if large sample sizes can be achieved.

Tinnitus Hub has run online surveys with close to 10k responses, and we believe much larger sample sizes are achievable. The statistical power that this provides could solve critical puzzles related to diagnostics and sub-typing, as well as progression of tinnitus over time, individualized treatment, and more.

A case in point is the "Tinnitus and the Body" survey, which Tinnitus Hub conducted in 2020, and which achieved over 9k responses. Topics covered were tinnitus characteristics, physical/somatic links with tinnitus, and other/related conditions. The survey led to a new diagnostic tool for somatic tinnitus, developed by Dr. Sarah Michiels.

We call on all interested researchers to: a) conduct further statistical analysis on our existing survey results; b) collaborate on future surveys that could contribute to improvements in tinnitus treatments.

Symposium 11

Somatic Tinnitus
SP 11-5

Methods, Applications, and Limitations of Somatic Maneuvers for the Modulation of Tinnitus

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The modulation of tinnitus through somatic maneuvers is a well-documented phenomenon in tinnitus patients with somatic disorders. The purpose of this talk is to introduce the methods, applications, and limitations of somatic maneuvers. First, 35 somatic maneuvers proposed by various research groups will be summarized according to four body areas (jaw, head and neck, eye, and limbs), following which their applications and limitations will be assessed. Although some studies have shown that somatic maneuvers can aid in screening for somatic tinnitus and may help alleviate symptoms with repeated practice, the limited number of studies and inconsistent results among studies make it difficult to draw definitive conclusions. Therefore, follow-up studies are required to overcome these limitations and determine whether the treatment of somatic disorders can also aid in alleviating somatic tinnitus.

Symposium 12

Hyperacusis/Misophonia
SP 12-FT

Tinnitus with hyperacousis: A pathophysiologically distinct subtype of tinnitus?

Berthold LANGGUTH

Psychiatry And Psychotherapy, University Of Regensburg, Germany

Tinnitus is a very heterogeneous disorder and there is a consensus among researchers and clinicians that a better understanding of the heterogeneity of tinnitus is of great importance for understanding the pathophysiological mechanisms of tinnitus, for developing more effective therapeutic interventions and for improving the clinical management of tinnitus patients. Therefore, it is crucial to identify criteria to delineate different forms of tinnitus.

Comorbid hyperacusis may be a promising criterion for a specific tinnitus subtype, as it is related to a specific pathophysiological mechanism (increased central gain) and is associated with several other clinical features, such as higher tinnitus-related psychological and general distress; higher rates of comorbid pain disorders; more difficulty understanding speech in noise; and higher rates of tinnitus modulation by sound and somatic manoeuvres.

Symposium 12

Hyperacusis/Misophonia
SP 12-1

An overview on the neurosciences of (loudness) hyperacusis

Arnaud NOREÑA

Crpn, Cnrs - Aix Marseille University, France

It has been proposed that hyperacusis, or at least one of its subtypes, results from an increase in central gain after a reduction in sensory input. This hypothesis also applies to normal audiograms. Indeed, it has recently been shown that even normal audiograms can in fact "hide" cochlear lesions (synaptopathy and degeneration of high-threshold cochlear nerve fibers). I will present recent data on the neuroscience of hyperacusis, including its putative molecular mechanisms.

Symposium 12

Hyperacusis/Misophonia
SP 12-2

Characteristics of Misophonia in the Korean Population

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Purpose: Misophonia is a sound tolerance disorder that causes strong negative reactions to specific sounds. This study aims to investigate the types of sounds that trigger misophonia, the emotional responses to these sounds, and the audiological correlates of misophonia in individuals exhibiting misophonia symptoms. This research is part of the An Interdisciplinary Cross-National Study of Misophonia project and reports preliminary data from South Korea.

Methods: Eighty-six participants with misophonia (M:F = 18:68) and 24 controls were recruited. They completed a battery of questionnaires, including the Duke Misophonia Questionnaire, the Hyperacusis Questionnaire (HQ), the Tinnitus Handicap Inventory, and the Hearing Handicap Inventory. Participants also underwent Discomfort Index (DI) measurements for 27 trigger sounds and 23 neutral sounds, as well as audiological assessments, including Loudness Discomfort Levels (LDLs).

Results: There was no significant difference in pure-tone hearing thresholds between the misophonic group and the controls. However, LDLs were significantly lower in the misophonia group compared to the control group (right ear: 89.60 ± 11.78 dB HL vs. 98.05 ± 7.78 dB HL; left ear: 91.35 ± 12.04 dB HL vs. 100.62 ± 7.95 dB HL). The misophonic group exhibited a significantly higher DI in response to both trigger sounds (0.98 ± 0.46 vs. 0.40 ± 0.27; $p < 0.001$) and neutral sounds (0.52 ± 0.28 vs. 0.15 ± 0.21; $p < 0.001$) compared to the control group. Among the misophonic participants, the sound of a blackboard elicited the highest DI, followed by the sounds of a door slamming and eating food.
Using the diagnostic criteria for hyperacusis (HQ score > 22 and LDL < 77 dB), 8 participants-all from the misophonic group-were diagnosed with hyperacusis. This subgroup exhibited a significantly higher overall DI compared to the non-hyperacusis subgroup (0.94 ± 0.18 vs. 0.66 ± 0.30; $p = 0.005$). A significant correlation was also found between the HQ score and overall DI ($r = 0.688$, $p < 0.001$).
Tinnitus was present in 27 participants in the misophonic group and in one participant in the control group. However, no significant differences in DI were observed based on the presence of hearing loss, tinnitus, psychiatric treatment history, or age.

Conclusion: Misophonic individuals report greater discomfort than controls not only in response to trigger sounds but also to neutral sounds. The prevalence of hyperacusis and tinnitus was higher in the misophonic group compared to the control group. Those with hyperacusis exhibited greater discomfort in response to trigger sounds, independent of other auditory abilities or symptoms.

Symposium 12

Hyperacusis/Misophonia
SP 12-3

Evidence of Successful Treatment and Potential Cure in Misophonia Using Tinnitus Retraining Therapy Protocols

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Misophonia, defined as present when abnormally strong reactions occur to a sound with a specific pattern and/or meaning to an individual. The reactions may depend on the environment where the offensive sound is presented. The physical characteristics of the sound are secondary. Frequently, a person with misophonia will respond strongly to soft sounds with specific patterns but not react to other, louder sounds. Furthermore, reactions depend on the environment where misophonic triggers are presented and, on the origin, or person producing them.

The treatment of misophonia is a topic of ongoing discussion and research, with no established consensus on the most effective intervention. Since 2000, we have used Tinnitus Retraining Therapy (TRT) protocols, based on the Neuropsychological Model of Tinnitus and Decreased Sound Tolerance, to treat over 1,000 patients diagnosed with misophonia. A systematic study of 184 consecutive patients with misophonia revealed that 83% demonstrated clinically significant improvement in their symptoms following treatment. Importantly, a substantial portion of these patients achieved what we define as "cure": the complete elimination of reactions to previously bothersome misophonic triggers. These individuals were able to resume their daily lives without the debilitating effects of misophonia as if they had never experienced misophonia previously.

The prevailing opinion within the field suggests that a cure for misophonia is not possible. Therefore, to illustrate complete removal of misophonic reactions – a cure – a number of specific patient's cases will be presented. These cases show the possibility of achieving a state where sounds previously triggering misophonic reactions no longer elicit any adverse reactions, effectively representing a cure for these patients.

Symposium 12

Hyperacusis/Misophonia
SP 12-4

A Preliminary Study of Remote Counseling and Sound Therapy for Hyperacusis

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Background and Aim:
Receiving treatment for hyperacusis is often limited by issues of accessibility and affordability. To provide helpful solutions to hyperacusis patients, we developed and evaluated feasibility of a remote counseling program that included a sound therapy trial.

Methods:
We created a four-week remote counseling program, Hyperacusis Activities Treatment-Online (HAT-Online), that included asynchronous videos, hands-on activities and quizzes, resources for teaching coping skills, and synchronous discussions for coaching. Weekly content focused on five topics: 1) overview of hyperacusis, tinnitus, hearing and hearing loss; 2) reactions to hyperacusis; 3) thought analysis and restructuring; 4) relaxation techniques and mindfulness; and 5) gradual sound exposure and hearing protection. Following counseling, we compared two sound therapy approaches. Participants were randomly assigned into one of two groups: 1) listen to everyday sounds from a speaker or headphones, and 2) listen to low-level, continuous broadband noise from wearable sound generators. Participants used successive approximations to increase the level and duration of the sound over four weeks. Hyperacusis symptoms were measured before, during, and after intervention using the Inventory of Hyperacusis Symptoms and a psychoacoustic sound test. In this preliminary study, we enrolled 24 participants.

Results:
A repeated-measures ANOVA showed that IHS questionnaire ratings of hyperacusis symptoms declined over the course of the four time points, ($F(3) = 4.05$, $p = .01$). Comparing sound therapy groups, the rate of decline in hyperacusis symptoms did not differ, ($F(3) = 0.73$, $p = .54$). On the psychoacoustic sound test, we did not find a significant improvement over time, ($F(3) = 2.55$, $p = .07$). Overall, 57% of participants have reported a moderate to large decrease in their hyperacusis symptoms.

Conclusion:
The preliminary data indicated a significant improvement in hyperacusis after receiving remote counseling and using sound therapy. We continue to gather additional evidence to assess the effectiveness of HAT-Online.

Keywords: Hyperacusis, Sound therapy, Counseling

Symposium 12

Hyperacusis/Misophonia
SP 12-5

The role of sound therapy in the treatment of hyperacusis

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Hyperacusis is recognized as a condition marked by abnormal auditory gain regulation, often coexisting with tinnitus and other decreased sound tolerance disorders. While its precise neural mechanisms remain under investigation, current models implicate dysfunctional central auditory gain processing, limbic system hyperactivity, and deficient top-down inhibitory control. Sound therapy, particularly within the framework of tinnitus retraining therapy (TRT), has emerged as a cornerstone of management. Clinical evidence indicates that structured and progressive sound therapy can elevate loudness discomfort levels (LDLs), reduce auditory hyperresponsiveness, and mitigate sound-induced distress. These effects may be further enhanced when integrated with patient-tailored counseling and cognitive-behavioral strategies. Recent neuroimaging studies also suggest that sound therapy may attenuate aberrant activity within the auditory cortex and modulate functional connectivity between auditory and limbic circuits. Although randomized controlled trials for sound therapy on hyperacusis patients remain limited, accumulating longitudinal data support the long-term benefits of sound therapy in improving sound tolerance and quality of life. Various sound stimuli have been proposed for sound therapy, including broadband or narrowband noise, filtered noise, music, and natural sounds, to promote auditory habituation and recalibrate central gain mechanisms. With technological advances, mobile sound therapy applications, customizable sound generators, and hearing aids with real-time sound therapy integration have become available and are increasingly incorporated into clinical practice. However, variability in treatment options underscores the need for individualized protocols informed by baseline audiometric profiles, neuropsychiatric comorbidities, and patient-reported outcome measures. This presentation will explore clinical strategies and future directions in the use of sound therapy for hyperacusis, emphasizing its role as a neuromodulatory intervention in the broader context of auditory rehabilitation.

Roundtable 01

Objective Tinnitus Ⅰ
RT 01-FT

Novel surgical interventions for pulsatile tinnitus

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Pulsatile tinnitus (PT) is often associated with anomalies such as sigmoid sinus dehiscence (SS-Deh). Although sigmoid sinus resurfacing (SSR) surgery has been proven to be effective in subjects with SS-Deh, there are still cases of insufficient improvement after surgery. Based on the fact that SS-Deh frequently accompanies adjacent diverticulum (Div), we modified the surgical principle in subjects with combined SS-Deh/Div and report the preliminary surgical outcomes. From August 2014 to July 2024, A total of 168 patients underwent SS surgery for PT and 65 of them presented with SS-Deh. Of these 65, 33 were treated with previously reported SSR with bone chip insertion and the other 32 were treated with SSR and smoothing of adjacent Div. Pre- and postoperative visual analog scale (VAS) loudness and VAS distress were compared. In the bone chip insertion group, the mean VAS loudness and VAS distress improved from 6.8 to 2.0 and from 6.9 to 2.1, respectively (all P<0.001). Meanwhile, in the SSR with adjacent Div smoothing group, the mean VAS- loudness and distress decreased from 7.6 to 116 and from 7.3 to 0.9, respectively (all P<0.001). The RM-ANOVA analysis revealed that both VAS-loudness and distress improvements were significantly higher in the SSR with adjacent Div smoothing group than in the bone chip insertion group. The current study underscores the importance of adjacent diverticulum smoothing as well as the resurfacing of the dehiscent area in subjects with SS-Deh.

Roundtable 01

Objective Tinnitus Ⅰ
RT 01-1

New diagnostic and therapeutic approaches for the pulsatile tinnitus caused by vascular dehiscence

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Introduction: The exact pathophysiology of pulsating tinnitus is still unclear. We wanted to describe the results of a novel test which can be done easily in a clinic, water occlusion test, in patients with pulsatile tinnitus related to identifiable radiologic abnormality and to pursue its clinical implications.
Material &Method: Retrospective analysis of 25 patients with pulsatile tinnitus with identifiable radiologic abnormality. Water occlusion test was performed by filling the external auditory canal with water and the patients were asked whether the pulsatile tinnitus disappeared, decreased or increased. The results of water occlusion test were characterized by the identified radiologic abnormalities and posttreatment results.
Results: For 20 patients with venous sinus dehiscence (VSD), dehiscence of sigmoid sinus was identified in 16 (80%) and jugular bulb in 5 (25%). Water occlusion test made the pulsatile tinnitus to disappear in 15 (75%), decrease in 3 (15%), and persist in 2 (10%). Ipsilateral neck was compressed in 12 patients and the pulsatile tinnitus disappeared in 10, decreased in 1 and persisted in 1. The sigmoid sinus dehiscence was resurfaced in 4 patients and the pulsatile tinnitus disappeared postoperatively. For 4 patients with arteriovenous fistula (AVF), the pulsatile tinnitus could be heard through a stethoscope and ipsilateral neck compression did not make any change of the tinnitus. The water occlusion test increased the pulsatile tinnitus. They were treated with transarterial embolization. In one patient with superior canal dehiscence, water occlusion test increased the pulsatile tinnitus.
Conclusion: Our findings showed that sigmoid sinus was the most common site of venous sinus dehiscence which could be identifiable by imaging study and suggested that the pulsation of the venous membrane at the dehiscence site could be transmitted through aeration to the tympanic membrane, causing pulsatile tinnitus, which is different from AVF where the turbulent blood flow caused tinnitus. Our novel diagnostic test might provide a logical insight helping with the choice of an effective diagnostic and treatment option.

Roundtable 01

Objective Tinnitus Ⅰ
RT 01-2

Objective evaluation of pulsatile tinnitus through radiologic modalities: Implications to clinical practice

Yue-Lin HSIEH

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Pulsatile tinnitus (PT) is a rhythmic, often heartbeat-synchronous noise that can significantly impair a patient's quality of life. Identifying the underlying cause of PT is crucial for effective management, as it may stem from a variety of vascular, middle ear, or intracranial pathologies. Traditional diagnostic methods are often limited by their subjectivity and inability to provide detailed anatomical and functional information. Recent advancements in radiologic imaging, including 4D flow MRI, ultra-high-resolution CT, transcranial ultrasonography, and other specialized techniques, offer new avenues for the objective evaluation of PT and its potential causes. This presentation aims to introduce and discuss the latest radiologic techniques used in the objective evaluation of pulsatile tinnitus, focusing on their clinical relevance and implications for diagnosis and management.

Roundtable 01

Objective Tinnitus Ⅰ
RT 01-3

Navigation guided surgery for treatment of pulsatile tinnitus

Jen-Tsung LAI

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Sigmoid sinus diverticulum (SSD) and sigmoid sinus wall dehiscence (SSWD) are recognized as significant causes of pulsatile tinnitus (PT). Surgical repair via a trans-mastoid approach is an effective treatment, but traditional methods require extensive bone removal, increasing surgical time and intraoperative bleeding risks. Navigation image-guided surgery (IGS) has been widely adopted in otolaryngology, particularly for sinus and skull base surgeries, yet its application in otologic procedures remains limited. In this study, we describe the use of IGS to improve surgical precision, reduce operative time, and minimize bleeding risks during SSD/SSWD repair.

From February 2018 to May 2021, 16 patients (3 men, 13 women; mean age: 40 years) with SSD or SSWD-related PT underwent navigation-assisted trans-mastoid surgery. Preoperative high-resolution computed tomography (HRCT) with 0.5 mm slicing was used for image acquisition, and a Karl Storz navigation system was employed to facilitate localization. Surgery involved precise diverticulum skeletonization and multi-layer resurfacing reconstruction using surgical glue, bone powder, cartilage, and temporalis fascia. Intraoperative nerve monitoring (IONM) and real-time CT/MRI fusion allowed for accurate identification of the sigmoid sinus, facial nerve, and adjacent structures, particularly in cases of multiple dehiscence sites.

Postoperatively, 62.5% of patients (10/16) achieved complete resolution of PT, while 37.5% (6/16) had partial relief, with no cases of worsening symptoms or complications. Compared to traditional approaches, navigation-assisted surgery significantly reduced operative time (105±32 min vs. 146±43 min, $p<0.05$) and decreased intraoperative blood loss, with only three cases of significant bleeding.

This study demonstrates that IGS is a valuable tool for SSD/SSWD repair, enhancing surgical precision, reducing invasiveness, and improving patient outcomes. While initial setup and learning curve are factors to consider, further research with larger patient cohorts is warranted to confirm its long-term efficacy and broader applications in otologic surgery.

Roundtable 01

Objective Tinnitus Ⅰ
RT 01-4

Surgical management of sigmoid sinus associated pulsatile tinnitus-Taiwan experience

Chang-Wei HUANG

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Sigmoid sinus associated pulsatile tinnitus can be divided into upstream and downstream components. Upstream involves the mastoid and is further classified into sigmoid sinus wall dehiscence (SSWD) and sigmoid sinus diverticulum (SSD). Downstream involves the hypotympanum within the middle ear, focusing on the jugular bulb. It can include arterial aberrant carotid artery and high jugular bulb/dehiscence.

Common treatment approaches include soundproof wall reconstruction, turbulence elimination, and endovascular coiling. We adopt the multilayer resurfacing method, which we believe to be the most efficient and safest option.

Our treatment highlights include preoperative tinnitus recordings to confirm objective tinnitus, intraoperative monitoring of lesion resolution, and postoperative recordings to verify tinnitus elimination. Navigation systems are particularly useful for single lesions, allowing smaller incisions and reduced operative time. Exoscopic monitoring is also employed, as most sigmoid sinus dehiscence lesions face the mastoid antrum, making them challenging to observe under a microscope. Using exoscopy from the contralateral side minimizes the risk of bleeding by avoiding unintended injuries.

Over the past 8 years, we have treated 64 cases with an 80% surgical success rate and a 66% complete cure rate. We emphasize including sigmoid sinus dehiscence/diverticulum in the differential diagnosis of pulsatile tinnitus and look forward to sharing Taiwan's treatment experience with all of you.

Roundtable 02

Objective Tinnitus II
RT 02-FT

The contribution of the middle ear and trigeminal nerve to specific sub-types of tinnitus and hyperacusis: An update

Arnaud NOREÑA

Crpn, Cnrs - Aix Marseille University, France

Some patients report a cluster of symptoms such as tinnitus, hyperacusis, ear fullness and pain (in the ear, face and neck). It has been proposed that these symptoms may result, at least in part, from a dysfunction of the middle ear (including middle ear muscles) and involvement of the trigeminal nerve. We have tested a new group of patients (n=14) using different approaches such as psychoacoustics, tympanometry and ear canal pressure measurement (reflecting tympanic movements). Overall, our data confirm the role played by the trigeminal nerve and suggest dysfunction of the tensor tympani muscle.

Roundtable 02

Objective Tinnitus II
RT 02-1

Experience on the treatment of typewriter tinnitus

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Objective
To analyze the clinical characteristics and the possible mechanism of the typewriter tinnitus.
Methods
From April 2020 to July 2023, twenty-six cases of typewriter tinnitus were enrolled in Shandong Provincial ENT Hospital, Shandong University, including 21 cases treated with oral drugs and 5 treated with surgery. The sound characteristics of the tinnitus, tympanic membrane conditions during tinnitus, audiological related tests, including long-term acoustic tympanogram, pure tone auditory threshold and auditory brainstem response (ABR) test were recorded. Three of them were operated under local anesthesia, and the intraoperative conditions were also recorded in detail. The patients were followed up for 24 months and the tinnitus changes were observed.
Results
The age ranged from 33 to 64 years, with a median age of 51 years. ALL cases were unilateral tinnitus. The sounds of tinnitus are intermittent and diverse. Twenty-five cases were treated with carbamazepine, of which 18 cases were completely controlled and 5 cases were relieved (later changed to oxcarbazepine); 2 cases were invalid. The effective rate of carbamazepine in our cases was 72%. The results of ABR were normal, including the threshold and latency. Internal auditory canal Magnetic Resonance Imaging (MRI) was performed in 18 cases. Obvious neuro-vascular compression of the cochlear nerve (NVCC) was showed in 11 cases of the affected side and 10 cases of unaffected side. Sawtooth waves were detected in 11 cases of long-term acoustic immittance. 10 cases had tinnitus accompanied by transient vertigo, most of them showed a sense of instability, two of them can be relieved in certain position. Five surgically treated cases were initially diagnosed with middle ear myoclonus, because of similar tinnitus, long term recorded sawtooth waves, the poor reaction to carbamazepine treatment, the poor awareness of the disease at initial. One patient had tinnitus with epilepsy, because she had been taking antiepileptic drugs without attempting carbamazepine treatment. All of these 5 cases treated with surgery were ineffective. Three of them were operated under local anesthesia, and the stapedius contraction was observed during the onset of tinnitus. 2 cases complained the tinnitus recurred after returning to the ward. One patient complained of tinnitus continued several minutes after the tensor tympanostomy and stapedius transection, and a contraction of the stapedius stump were observed. 4 of these patients were subsequently treated with oxcarbazepine and their tinnitus was controlled. The one with epilepsy refused the subsequent treatment due to personal reasons.
Discussion
None has proposed a relationship between typewriter tinnitus and middle ear muscle contraction, but we observed stapedius muscle contraction in 3 patients under local anesthesia during surgery, indicating that typewriter tinnitus can also have stapedius muscle contraction, which also explained why some patients with typewriter tinnitus can record waveforms in long-term acoustic immittance. However, its pathogenesis is different from that of middle ear muscle spasm and the severing of the muscle did not relieve the tinnitus. We could also observe the contraction of the severed end of the stapedius muscle after transection in one of the patients, and it was once thought that typewriter tinnitus might be related to the contraction of the stapedius muscle in the canal. But later we disproved this assumption because it was later found that the contraction of the stumps of the stapedius muscle was also observed in the cases of middle ear myoclonus, but the tinnitus no longer appeared.
The currently accepted treatment for typewriter tinnitus is carbamazepine, but the pathogenesis remains unclear. Some scholars have suggested that typewriter tinnitus is related to the vascular compression of the cochlear nerve shown in MRI. However, it is not recommended as a basis for diagnosis for the low specificity. Our results also argue that the NVCC detected by MRI are not specific for typewriter tinnitus. Some people reported that ABR is a useful tool for the diagnosis of typewriter tinnitus and The IPL I-III of most ears with typewriter tinnitus was longer than 2.3ms. However, none of the patients we saw with typewriter tinnitus had abnormal ABR results (exclusion of other diseases).
Conclusions
The efficacy of carbamazepine in the treatment of typewriter tinnitus is not 100%. Typewriter tinnitus is more common be accompanied by transient dizziness and can be related to postural changes. Neither ABR nor MRI can be used as a basis for diagnosis. Patients with typewriter tinnitus have constriction of the stapedius muscle during the onset of tinnitus, but cutting the stapedius muscle is ineffective for the treatment, and the reason is unknown.

Roundtable 02

Objective Tinnitus II
RT 02-2

Neurovascular compression syndrome of the 8th cranial nerve

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Neurovascular compression syndrome of the eighth cranial nerve is characterized by recurrent audiologic and vestibular symptoms, such as paroxysmal episodes of tinnitus. This condition is a rare cause of objective tinnitus and is likely underdiagnosed. A physician's clinical impression, based on thorough history-taking along with an anticonvulsant trial, is essential for diagnosis. While imaging studies, regardless of resolution, have limited diagnostic value, they are necessary to rule out neural compression caused by other pathologies, such as CPA tumors. Low-dose anticonvulsants are an effective treatment, and surgical decompression may be considered as a therapeutic option. In this talk, I will discuss the pathophysiology, diagnostic strategies, and therapeutic approaches for this rare condition.

Roundtable 02

Objective Tinnitus II
RT 02-3

Stepwise Management of Patulous Eustachian Tube Dysfunction

Cheng Yu HSIEH

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Patulous Eustachian Tube Dysfunction (PETD) is a challenging condition to manage clinically, primarily due to its significant impact on patients' quality of life. Symptoms such as autophony and aural fullness often cause considerable distress, affecting daily living. Diagnosing PETD is crucial for distinguishing it from obstructive Eustachian tube dysfunction (OETD), ensuring accurate treatment decisions. A comprehensive diagnostic and therapeutic pathway is proposed, integrating subjective tools, such as the ETDQ-7 and PHI-10 questionnaires, with objective assessments including tympanometry, sonotubometry, TTAG, and nasopharyngeal endoscopy.

The treatment strategy follows a structured, stepwise approach. The initial focus is on categorizing patients based on symptoms and prior interventions, such as exposure to radiation therapy or other treatments. Conservative management, including hydration, weight gain, and nasal irrigation with saline solutions, is the first-line option. If symptoms persist, more advanced interventions are employed, such as Eustachian tube augmentation or transcanal cartilage insertion.

This pathway highlights the importance of multimodal diagnostic tools and individualized treatment planning to effectively manage PETD. By prioritizing symptom-specific approaches and tailored treatment, this framework could improve both symptom resolution and overall quality of life for patients with PETD.

Roundtable 02

Objective Tinnitus II
RT 02-4

Transcanal Endoscopic Stapedial and Tensor Tympani Tenotomy for Middle Ear Myoclonus: A Retrospective Case Series of Surgical Outcomes

Jin Woong CHOI

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Objective: To describe and analyze the surgical outcomes of transcanal endoscopic resection of the stapedial tendon (ST) and tensor tympani tendon (TT) in the management of middle ear myoclonus (MEM).

Study Design: A retrospective case series.

Setting: Tertiary academic center.

Patients: Seven consecutive patients (seven ears) with tinnitus were diagnosed with MEM.

Intervention: Transcanal endoscopic resection of both the ST and TT using either microinstruments or a laser.

Main Outcome Measures: The symptom of tinnitus, based on visual analog scale and Tinnitus Handicap Inventory scores, was analyzed preoperatively and postoperatively for each patient. The intraoperative findings and postoperative complications were also evaluated.

Results: Amelioration of objective tinnitus with significant improvement in visual analog scale and Tinnitus Handicap Inventory scores was noted in all seven patients. The ST and TT were easily identified in the same endoscopic field, with minimal or no removal of the scutum. There was no need to perform an anterior tympanotomy to expose the TT. Resection of both the ST and TT and creating a gap between the cut edges were achieved by using either microinstruments or a laser under an endoscopic field. Conversion to or conjunction with the microscopic approach was unnecessary for any of the seven patients. No hearing loss or hyperacusis occurred postoperatively.

Conclusions: Transcanal endoscopic resection of the ST and TT successfully ameliorated the symptom of tinnitus in patients with MEM. A transcanal endoscopic approach provides an alternative method to manage MEM, providing excellent visualization and minimal invasiveness.

Roundtable 03

Treatment I: Clinical Practice Guideline
RT 03-1

UK clinical practice guidelines for tinnitus

Derek James HOARE

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Tinnitus disorder represents a major health burden in the UK. Over one million people present to primary care each year with a main complaint of tinnitus, with UK healthcare costs of tinnitus in the region of £750Million, and societal costs estimated to exceed £2Billion per year. Historically, part of the challenge has been a lack of standardisation of care and the absence of clinical practice guidelines; patients followed different healthcare pathways, and were treated by clinicians with differences in experience, training, and expertise. Access to devices and psychological therapies also varied by department and region. Ultimately, this leads to inequity of care.

In the last decade various UK groups have sought to address this inequity with the production of national tinnitus guidelines. The first, published in 2015, provided guidance for the assessment and management of tinnitus in children. These include guidance of creating a bespoke tinnitus service for children, taking a family-oriented approach, and addressing tinnitus-related issues in the classroom. The second guideline was produced by the UKs National Institute for health and Care Excellence and published in 2020. This guideline was based on a series of systematic reviews evaluating the clinical and cost effectiveness of a priority subset of clinical management strategies. These guidelines make clear recommendations for what assessments and treatments should be offered by tinnitus services in the UK National Health Service (e.g., management of hearing loss, cognitive behavioural therapy), and which should not (e.g., betahistine). This guideline also specifies a series of research priorities (e.g., evaluating audiologist delivered psychological therapies, paediatric questionnaires, and accessible services for adults who are deaf). The most recent UK guideline was published by the British Society of Audiology in 2021. This guideline provides a practical and comprehensive overview of tinnitus therapies, again making recommendations for treatments with a strong evidence base (e.g., cognitive behavioural therapy), and cautions again certain self-management or alternative therapy options.

The three UK guidelines for tinnitus are complimentary and provide an important source of information and training for all clinicians involved in tinnitus care, and importantly, identifies where there are gaps in knowledge and opportunities for research.

Roundtable 03

Treatment I: Clinical Practice Guideline
RT 03-2

Clinical practice guideline of Japan for tinnitus

Sho KANZAKI

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Clinical practice guidelines in Japan for tinnitus were published in May 2019. Effective treatment of tinnitus contributes to quality of life and may improve depression, anxiety, and cognitive function. The highest priority of treatment recommended by this guideline involves educational counseling, including an explanation of the mechanisms of tinnitus. Understanding tinnitus pathology has also been reported to be a therapeutically effective educational counseling strategy. Further, explaining how sound therapy such as tinnitus retraining therapy (TRT) works is effective. TRT consists of educational counseling and sound therapy. Rehabilitation of tinnitus is important because anxiety and depression are often observed in patients with severe tinnitus.

Psychological and cognitive behavioral therapies may be an option. Here, the hearing aid is coupled with a sound generator in order to administer sound therapy for patients with more-severe symptoms. In Japan, it can be difficult to perform psychotherapy alongside otorhinolaryngology, and exemplary sound therapy is more likely to be carried out. Similarly, Cochlear implant (CI) is not indicated for single side deafness, and CI has not been performed in Japanese patients with single side deafness and tinnitus, although it has been found to be effective in a small number of studies.

In any case, the purpose of treatment is not to eliminate tinnitus, but rather reduce distress that manifests in response to tinnitus by promoting sensory adaptation. Clinically, the most important subject is not the loudness of tinnitus, but the severity of tinnitus distress.

The tinnitus handicap inventory (THI) is used to measure the distress level for tinnitus and to determine treatment priorities.

As for guidelines from other countries, the content is considered to be similar to that of the German guidelines, which were published close to the time of publication.

Roundtable 03

Treatment I: Clinical Practice Guideline
RT 03-3

Exploring Consensus on Tinnitus Management in Taiwan Based on the TRI Tinnitus Flowchart Using the Delphi Method

Chia-Der LIN

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Background: Tinnitus is characterized by the perception of sound without an external source. There still remains a lack of standardized protocols among healthcare providers, including ENT specialists. The Tinnitus Research Initiative (TRI) Tinnitus Flowchart provides a structured framework for tinnitus management, but its implementation in Taiwan may require consensus among practitioners. The Delphi technique, a widely recognized method for collecting expert opinions within their domain of expertise, was employed it in this study. This research aims to establish a consensus among ENT specialists in Taiwan regarding tinnitus management, using the TRI Tinnitus Flowchart as the basis for discussion.
Method: Seventeen experts specializing in tinnitus management in Taiwan were recruited to participate in a three-round modified Delphi study conducted during a consensus meeting. The experts assessed the importance and local applicability of each item in the TRI Tinnitus Flowchart using a 4-point scale. Agreement levels from the Delphi process were analyzed, with consensus defined as over 70% of participants scoring 3 or 4, and a median score of 3.25 or higher.
Results: A total of 64 statements were derived from the TRI Flowchart and categorized into four groups: subtyping of tinnitus (11 statements), specialized neuro-/otological evaluations (12 statements), customized examinations based on tinnitus subtypes (36 statements), and symptomatic treatments (5 statements). Overall, consensus was achieved for 38 statements (59.4%) regarding their importance and 27 statements (42.2%) regarding their local applicability. In the tinnitus subtyping group, all 11 statements reached consensus for both importance and local applicability. For the specialized neuro-/otological evaluations group, 11/12 statements (91.7%) achieved consensus for importance, while 7/12 (58.3%) did so for local applicability. Within the customized examinations based on tinnitus subtypes group, consensus was reached for 14/36 statements (38.9%) regarding importance and 8/36 (22.2%) for local applicability. Lastly, for the symptomatic treatments group, consensus was achieved for 2/5 statements (40%) regarding importance and 1/5 (20%) regarding local applicability.
Conclusion: We employed a modified Delphi method to explore a TRI flowchart-based consensus for tinnitus management in Taiwan. The expert panel reached full consensus on tinnitus subtyping, substantial agreement on specialized neuro-/otological evaluations, and lower levels of agreement on customized examinations tailored to tinnitus subtypes and symptomatic treatments.

Roundtable 03

Treatment I: Clinical Practice Guideline
RT 03-4

The multidisciplinary European clinical guideline for chronic tinnitus (diagnostics, assessment and treatment): New developments

Rilana CIMA

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Abstract:
Chronic tinnitus disability, affects millions globally and remains a complex condition requiring nuanced, evidence-based clinical approaches. Since the publication of a 2017 systematic review evaluating existing clinical practice guidelines (CPGs) for tinnitus, assessing their scope, comparability, and purpose, and the subsequent landmark publication of a 2019 EU multidisciplinary guidelines, significant advancements have emerged in clinical consensus, research, and policy. This presentation highlights the critical need for updating the Multidisciplinary European Guideline for Tinnitus to reflect contemporary innovations in diagnostics, assessment, and treatment, while outlining the structured process for its imminent revision.

Background and Rationale
Clinical practice guidelines (CPGs) are systematically developed statements designed to assist clinicians and patients in making informed healthcare decisions for specific clinical scenarios. The 2019 EU guideline represented a pivotal step toward standardizing tinnitus care by synthesizing evidence across disciplines, including audiology, psychology, otolaryngology, and neurology. However, the dynamic nature of tinnitus research, coupled with evolving diagnostic technologies and therapeutic modalities, necessitates periodic reassessment. The original guideline steering group committed to re-evaluating and updating the document within five years of its publication, ensuring alignment with emerging evidence and clinical realities.

New Developments Since 2019
Expanded Evidence Base: Advances in neuroimaging, biomarker research, and digital therapeutics (e.g., app-based cognitive behavioral therapy, neuromodulation devices) have reshaped understanding of tinnitus mechanisms and management.
Global Clinical Consensus Initiatives: Collaborative efforts, such as the Tinnitus Research Initiative and pan-European working groups, have proposed refined diagnostic criteria (e.g., subclassification of tinnitus phenotypes) and standardized assessment protocols to improve inter-clinic comparability.
Patient-Centered Innovations: Growing emphasis on personalized care has driven demand for guidelines integrating patient-reported outcome measures (PROMs) and shared decision-making frameworks.
Policy Shifts: Regulatory bodies, including the European Medicines Agency (EMA), have updated recommendations for clinical trials, emphasizing real-world data and long-term outcomes, a gap identified in earlier guidelines.

Methodology for Guideline Revision
The update process, slated to commence in late 2025, will follow the AGREE II (Appraisal of Guidelines for Research & Evaluation) framework to ensure methodological rigor:
Systematic Literature Review: A comprehensive analysis of peer-reviewed studies (2020–present) will identify new evidence on diagnostics (e.g., brain imaging, genetic markers), assessment tools (e.g., Tinnitus Functional Index, Mini-TQ), and treatments (e.g., bimodal stimulation, mindfulness-based therapies).
Stakeholder Engagement: Multidisciplinary panels, comprising clinicians, researchers, patients, and policymakers, will prioritize recommendations through Delphi consensus rounds.
Gap Analysis: The 2019 guideline's limitations, such as sparse guidance on comorbidities (e.g., insomnia, hyperacusis) and pediatric tinnitus, will be addressed.
Integration of Real-World Data: Collaborations with EU-wide tinnitus registries will enrich recommendations with longitudinal outcome data.

Key Areas of Focus in the Updated Guideline
Diagnostics: Refinement of protocols
Assessment: Standardization of PROMs and clinician-administered tools to track severity, comorbidities, and quality-of-life impacts.
Treatment: First-line interventions: Strengthened evidence for CBT, and hearing aids. Emerging therapies: Graded recommendations for neuromodulation, pharmacotherapy and digital health solutions.
De-implementation: Deprecation of outdated practices (e.g., sole reliance on masking devices) lacking robust evidence.

Implications for Clinicians and Patients
The revised guideline aims to reduce variability in care by simplifying decision making pathways for clinicians while empowering patients through transparent, evidence-based options. For example:
Streamlined Referral Pathways: Clear criteria for referral to tertiary centers
Enhanced Multidisciplinary Collaboration: Protocols for integrating mental health support, audiological rehabilitation, and primary care.
Health Equity: Recommendations tailored to underserved populations (e.g., elderly, low-income groups) to address access disparities.

Challenges and Future Directions
Updating CPGs in a rapidly evolving field poses challenges, including reconciling conflicting evidence (e.g., efficacy of transcranial magnetic stimulation) and balancing innovation with practicality.

The steering group will establish a "living guideline" framework, enabling incremental updates via continuous evidence surveillance. Future priorities include:
• Development of AI-driven decision-support tools for clinicians.
• Growth in freely available self-help app driven treatment modalities
• Expansion of patient advocacy roles in guideline co-creation.
• Harmonization with non-EU guidelines (e.g., American Academy of Otolaryngology) to foster global best practices.

Conclusion
The 2025 revision of the Multidisciplinary European Guideline for Tinnitus represents a critical opportunity to align clinical practice with cutting-edge research, technological advancements, and patient-centered care paradigms. By addressing gaps in the 2019 document and incorporating contemporary evidence, this initiative seeks to improve outcomes for individuals with chronic tinnitus while reducing the societal and economic burden of this pervasive condition. The collaborative, iterative approach outlined here underscores the steering group's commitment to advancing tinnitus care as a model for multidisciplinary, evidence-based medicine.

Roundtable 03

Treatment I: Clinical Practice Guideline
RT 03-5

Development from Delphi consensus into clinical practice guideline for management of tinnitus in Korea

Yong-Hwi AN

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Three Delphi surveys by the Korean tinnitus study group were performed in 2021-2022 to establish consensus statements on 1) the definition, classification, and diagnostic tests for tinnitus, 2) tinnitus assessment and treatment outcome evaluation, and 3) the treatment of tinnitus. And then, comprehensive clinical practice guidelines for tinnitus management in Korea was under development based on the Delphi consensus

The guidelines will address key clinical questions based on systematic reviews of the current literature, focusing on the most effective interventions and diagnostic strategies. Key Questions (KQs) to be addressed in the guidelines include: KQ1: How accurately does a patient's subjective perception or severity of tinnitus predict results from tinnitus questionnaire assessments? KQ2: Considering the high prevalence of hearing loss among tinnitus patients and its impact on treatment strategies, does conducting hearing tests benefit the management of tinnitus? KQ3: In cases of asymmetric hearing loss, and in patients with persistent tinnitus for more than six months or pulsatile tinnitus, does imaging help in diagnosis? KQ4: Is tinnitus retraining therapy more effective in alleviating tinnitus symptoms compared to no treatment? KQ5: Does cognitive-behavioral therapy show greater effectiveness in symptom reduction compared to no intervention in tinnitus patients? KQ6: Does the use of hearing aids in tinnitus patients with hearing loss lead to greater symptom relief compared to no hearing aid use? KQ7: Is sound therapy more effective in alleviating tinnitus symptoms compared to no sound therapy? KQ8: Does administering anxiolytics in tinnitus patients improve symptoms more effectively than no medication? KQ9: Does neurostimulation therapy provide greater symptom relief for tinnitus patients compared to no therapy? KQ10: Does the supplementation of nutrients such as zinc or magnesium reduce tinnitus symptoms compared to no supplementation?

This guideline development process follows a rigorous methodology, incorporating the best available evidence and expert consensus to ensure that the final recommendations are both scientifically valid and clinically applicable. So Korean guidelines aim to standardize the management of tinnitus in Korea and optimize patient outcomes by providing evidence-based approaches for both diagnostic and therapeutic interventions.

Instructional Course 01

IC 01

Inhibition of cortical evoked responses to sound pulses by preceding silent gaps

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Inhibitory mechanisms in sensory gating has been traditionally measured in humans by means of startling blinking responses, being partially suppressed by preceding and weaker lead stimuli. Paradigms such as pre-pulse inhibition (PPI) have been used for near half a century as a means to diagnose psychiatric disorders in which disrupted PPI is a surrogate for altered sensory gating in schizophrenia. However, the electrooculographic (EOG) response is very variable and some individuals do not blink, making it a poor outcome measure at the individual level. Unlike PPI, which is regulated in the lateral globus pallidus from the basal ganglia, inhibition of the startle reflex by preceding silent gaps embedded in a continuous background noise is processed in the auditory cortex, making it particularly suitable for measuring cortical responses. Here, based on the behavioral Gap-Pre-pulse Inhibition of Acoustic Startle (GPIAS) stemming from animal research, we present a new paradigm using source localized magnetoencephalography (MEG) in 22 normal hearing healthy participants. We evidence a near 72.5% (SD ±15.9) suppression of N1 evoked response to a pulse as high as 90 dB(A) sound pressure level (SPL) when preceded by a 50 ms long silent gap in a 60 dB(A) SPL broadband carrier noise. Cortical inhibition was greatest with 240 ms time intervals between gap and pulses, and about 1.5 times larger in the right transverse temporal gyrus when compared to the left hemisphere. While merely 23% of the individuals blinked at the highest pulse levels, cortical evoked responses were found in all participants. Overall, we provide evidence that the N1 cortical response to sound pulses is reliably inhibited by preceding gaps. We propose this paradigm as an effective method to assess auditory sensory gating through development and aging, and potentially as a method for the diagnosis of hearing disorders like tinnitus or hyperacusis.

Keywords: Tinnitus, GPIAS, Objective diagnosis

Instructional Course 02

IC 02

Assessment and Management of Somatosensory Tinnitus: Clinical Strategies for Success

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Somatosensory tinnitus, a subtype of tinnitus influenced by somatic structures and pathways, presents unique diagnostic and therapeutic challenges. It is often characterized by the modulation of tinnitus perception through head, neck, or jaw movements and may coexist with temporomandibular joint (TMJ) dysfunction, cervical spine disorders, or other musculoskeletal conditions. This instructional course provides an in-depth overview of the mechanisms, assessment strategies, and evidence-based management approaches for somatosensory tinnitus, equipping clinicians with the skills necessary to address this complex condition.

The course begins by elucidating the neurophysiological mechanisms underlying somatosensory tinnitus, emphasizing the role of somatosensory-auditory interactions in the dorsal cochlear nucleus. Participants will gain insights into the distinguishing features of somatosensory tinnitus, its overlap with other tinnitus subtypes, and the importance of accurate diagnosis. Key assessment tools, including detailed case history, physical examinations of the TMJ and cervical spine, and tinnitus questionnaires, will be explored alongside audiological evaluations to identify somatic modulators and contributory factors.

Management strategies focus on an interdisciplinary approach, integrating audiology, physical therapy, and dentistry. Evidence-based interventions such as sound therapy, tinnitus retraining therapy (TRT), and manual therapy techniques for musculoskeletal conditions will be discussed. Special emphasis will be placed on patient education and self-management strategies, enabling individuals to actively participate in their care.

Case studies and practical demonstrations will illustrate the application of these concepts in clinical practice, offering participants hands-on experience and actionable takeaways. This course is ideal for audiologists, otolaryngologists, physical therapists, and other healthcare professionals seeking to enhance their understanding and management of somatosensory tinnitus.

By the end of the course, participants will be equipped with the knowledge and tools to deliver comprehensive, patient-centered care for individuals with somatosensory tinnitus, improving outcomes and quality of life.

Keywords: Somatosensory tinnitus, Assessment methods, Management techniques

Instructional Course 03

IC 03

GPIAS Measurement and Analysis for Tinnitus Animal Models: A Practical Guide from Fundamentals to Application

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This course introduces researchers to the gap prepulse inhibition of acoustic startle (GPIAS) method for objectively assessing tinnitus in animal models, providing a comprehensive guide from foundational concepts to practical application. Designed for researchers with limited experience in GPIAS, the course covers essential topics to ensure successful experimental implementation.
Participants will first see the basic principles of GPIAS and the standard configuration of measurement systems used in tinnitus research. Detailed protocols for animal preparation, experiment execution, and data analysis will be discussed, drawing from published studies and the lecturer's GPIAS system development experience. Special emphasis is placed on the practical use of a domestically developed GPIAS system, utilized in tinnitus research across eight Korean medical schools over the past 14 years. Key advantages of GPIAS, such as eliminating the need for extensive animal training and enabling quantifiable data visualization through signal processing and statistical analysis, will be highlighted. However, the variability in startle stimulus conditions and tinnitus assessment criteria across laboratories can complicate result interpretation.This course addresses these challenges by providing practical insights into standardized methodologies, system configurations, and analysis techniques, enabling researchers to adapt the GPIAS method effectively to their studies. Participants will gain the knowledge required to design experiments that yield reliable and reproducible results, enhancing their understanding of tinnitus mechanisms and advancing the field of tinnitus research.

Keywords: GPIAS (Gap Prepulse Inhibition of Acoustic Startle), Measurement and Analysis Methodology, Tinnitus Animal Models

Instructional Course 04

IC 04

Mastering the Art of the Academic PowerPoint: A Crash Course for PhD Starters

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Embarking on a PhD journey requires mastering numerous skills, and one of the most critical (and often overlooked) is creating effective and engaging PowerPoint presentations. This entertaining and practical workshop is designed specifically for new PhD students to navigate the dos and don'ts of academic presentations with confidence and creativity.

Through humor, real-world examples, and hands-on activities, participants will learn how to craft visually appealing slides, communicate complex ideas clearly, and avoid common pitfalls (overusing animations and transitions, unreadable fonts and data overload). Topics include choosing the right visuals, managing slide transitions, designing for accessibility, and the subtle art of timing and delivery.

Join this instructional course for an interactive session that transforms PowerPoint from a necessary evil into a powerful storytelling tool for sharing your research. Whether you're presenting at a lab meeting, conference, or defense, this course ensures your slides support your story, not sabotage it.

Keywords: PhD Starters, Course on Powerpoint presentations, Dos and Don'ts

Best Oral Presentation 01

Basic Research in Tinnitus
BOP 01-1

Stress-Induced Tinnitus in a Rat Model: Transcriptomics of the Prefrontal Cortex and Hippocampus

Jae Sang HAN[1], Junseong PARK[2,3], Ye Lin KIM[4], So Young PARK[1], Dokyeong KIM[3,4], Songzi ZHANG[3,5], Yeun-Jun CHUNG[3,5], **Shi Nae PARK**[1]

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The molecular mechanisms by which stress affects the brain and leads to the development of tinnitus are not yet well understood. This study aimed to identify brain changes in a chronic stress-induced tinnitus animal model through transcriptome analysis of the prefrontal lobe and hippocampus using RNA-seq. Twenty Sprague-Dawley rats were subjected to 10 consecutive days of chronic restraint stress for two hours. Following the gap prepulse inhibition of acoustic startle reflex (GPIAS) test to assess tinnitus development, the prefrontal lobes and hippocampi of the brains were harvested from 15 rats: five with evident tinnitus (stress-induced tinnitus; ST), five with noticeable non-tinnitus (stress-induced non-tinnitus; SNT), and five without stress (control group). Comparative RNA-seq analysis was conducted to examine gene expression profiles across these groups. In comparison to the control group, the ST group exhibited 971 and 463 differentially expressed genes (DEGs) in the prefrontal lobe and hippocampus, respectively (FDR < 0.05). The SNT group showed a largely similar gene expression to the control group. Enrichment analysis of the prefrontal lobe revealed the downregulation of gene sets associated with neurotransmitter and synapse-related functions and the upregulation of cell cycle-related gene sets in the ST group.
In the hippocampus, there were significantly downregulated gene sets associated with steroid production and upregulated gene sets related to the extracellular matrix in the ST group. Immune-related gene sets were upregulated in both the prefrontal lobe and hippocampus.
Our research presents evidence that differences in genetic expression in the prefrontal lobe and hippocampus after exposure to stress play a significant role in the development of tinnitus. We believe that an imbalance in neurotransmitters and maladaptive plasticity in the brain following stress exposure are important causes of tinnitus development.

Keywords : Tinnitus, Transcriptome, RNA

Best Oral Presentation 01

Basic Research in Tinnitus
BOP 01-2

Measurement of Strial Blood Flow in Mouse Cochlea utilizing an Open Vessel-Window and Intravital Fluorescence Microscopy

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[1]Department of Tinnitus Disease, Shandong Provincial Ent Hospital, Shandong University, China

Purpose: To establish open vessel window method for visualizing blood flow in vivo in the mouse cochlea. And compare vascular function in the control group and noise expose group.
Methods: Details of the methods include: 1) preparation of the fluorescent-labeled blood cell suspension from mice; 2) construction of an open vessel-window for intravital microscopy, and 3) measurement of blood flow velocity and volume using an offline recording of the imaging. Expose the mouse to broadband noise at 120 dB for 3 h and for an additional 3 h the next day. Vascular function in the noise-exposed mouse model was compared with vascular function in the control group. CoBF measurement was taken after 2 weeks.
Results: After surgical exposure of the cochlear capillaries in the lateral wall, intravital high-resolution fluorescence microscopic observation of Dil-labeled blood cells in FITC dextran-labeled vessels was feasible through an open vesselwindow. The lumina of these vessels is made visible by the fluorescence of FITC-dextran mixed with plasma. Individually labeled blood cells distributed in the vascular network are also clearly visible in this image. Anomalies included reduced vessel diameter and increased variation in vessel diameter. The blood flow velocities in the control and noise-exposed groups were calculated by tracking the routes of the DiO-labeled blood cells. These data indicate that loud sound notably affects blood circulation and causes reduced and disturbed blood flow.
Conclusion: Although surgery in a mouse model is challenging, this method provides for successful investigation of CoBF and associated biological processes in the mouse cochlear lateral wall in vivo and in real time. Recently developed transgenic mouse models add further to the armamentarium available for using an open vesselwindow and FIVM approach in a mouse model for better understanding CoBF associated cochlear homeostasis.

Keywords: Cochlea, Inner ear microcirculation, Noise-induced hearing loss

Best Oral Presentation 01

Combined Disease/Comorbidities Associated with Tinnitus
BOP 01-3

Magnetoencephalographic Correlates of Aversive Generalization Learning in Tinnitus

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Classical conditioning has been proposed as a key neurophysiological model to understand the psychological distress associated with tinnitus, where the tinnitus sound becomes linked to an aversive emotional state through repeated pairing. This model assumes implicit learning mechanisms as more relevant than conscious ones and stands as the theoretical framework for the "Tinnitus Retraining Therapy", focusing on passive extinction of the conditioned response. Building on conditioning models, we hypothesized that tinnitus patients would exhibit deviant aversive and safety learning, as well as an overgeneralization of the aversive response. Additionally, we expected reduced threat inhibition in prefrontal cortex regions, identified as a hub of dysfunctional connectivity in tinnitus by our previous work.Tinnitus patients and healthy controls underwent an auditory conditioning paradigm in which a low frequency (700 Hz) or a high frequency (1000 Hz) tone (CS+) was paired with an aversive sound (US) while the other tone remained unpaired acting as safety signal (CS-). Before and after the conditioning phase, CS+, CS- as well as seven generalization stimuli (GS) with frequencies logarithmically distributed between CS- and CS+ were presented while neural responses were recorded by magnetoencephalography. In addition, explicit subjective ratings of all stimuli were assessed.
Patients and controls showed generalization effects in their ratings of the GS stimuli: the more similar GS were to the aversively conditioned stimulus, the higher the ratings were in terms of threat response and the likelihood of the aversive stimulus occurring. Preliminary MEG data showed that consistent with our hypotheses, neural activity reflecting threat inhibition was found in prefrontal areas (vmPFC, dlPFC) with tinnitus patients showing inverted gradients compared to controls, suggesting dysfunctional prefrontal activation in tinnitus.
These findings suggest that tinnitus patients experience maladaptive aversive generalization learning associated with deviant prefrontal activation, which may contribute to the heightened affective distress observed in tinnitus.

Keywords: Tinnitus, Aversive Conditioning, VmPFC

Best Oral Presentation 01

Combined Disease/Comorbidities Associated with Tinnitus
BOP 01-4

Exploring a Possible Link between Tinnitus and Obstructive Sleep Apnea – A National Population-Based Cohort Study Using Propensity Score Matching Analysis

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Objective: The association between tinnitus and obstructive sleep apnea (OSA) has been receiving attention, but mechanisms linking the two conditions have not been established, with diverse outcomes. This study aimed to evaluate the association between OSA and tinnitus and which OSA characteristics affect tinnitus.

Methods: The study included participants aged 40-65 who completed both auditory examinations and the STOP-BANG questionnaire between 2019 and 2021 from the Korean National Health and Nutrition Examination Survey data. The possible causative factors for tinnitus were identified using logistic regressions. Based on the results, the participants in the low- and high-risk groups for OSA were 1:1 matched using a propensity score matching the possible causative factors and compared.

Results: 861 participants with low risk and 309 participants with high risk were included in the study. High-risk group exhibited higher experience ($p = 0.061$), persistence ($p = 0.043$), and severity ($p = 0.036$) of tinnitus. However, when the causative factors for tinnitus were matched, there were no significant differences in results. Most possible contributing factors were high frequency hearing level in the worse ear for experience and persistence of tinnitus, and smoking for severity of tinnitus.

Conclusion: The high-risk group experienced tinnitus more often and found it more bothersome than the low-risk group. However, when the tinnitus-affective factors were controlled, there were no differences between the groups. These findings draw the conclusion that tinnitus is not affected by OSA on its own but rather by hearing loss that accompanies OSA.

Keywords: Obstructive sleep apnea, STOP-BANG questionnaire, Hearing loss

Best Oral Presentation 01

Combined Disease/Comorbidities Associated with Tinnitus
BOP 01-5

Tinnitus in Obstructive Sleep Apnea patients : does Positive Airway Pressure also alleviate tinnitus?

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[3]Sleep pathologies Department, Pitié-Salpêtrière - Assistance Publique Hôpitaux de Paris (ap-hp), France

Introduction : Obstructive Sleep Apnea syndrome (OSAS) and tinnitus are two major issues regarding public health, and affect respectively as much as 20% and 14% of the population in European countries. The link between the two remains unclear although some models of interaction have been suggested. We investigated the efficacy of long-term Positive Airway Pressure (PAP) treatment of OSAS to alleviate concomitant bothersome tinnitus.
Material & Methods : 35 adult patients were screened by ENTs with OSAS and tinnitus and then referred for initiating PAP treatment. Recruitment and data collection were assured by a healthcare provider of PAP device, from November 2022 to January 2025. Tinnitus Handicap Inventory (THI) was assessed through an online questionnaire at baseline, 3 and 6-month of follow-up. Data regarding medical history and general characteristics were recorded at baseline, and PAP observance and parameters were collected through follow-up. Statistical analyses regarding the evolution of the THI index were conducted using non-parametric paired Wilcoxon test, each individual being its own control. All patients gave full informed consent.
Results : The investigation is currently ongoing. 35 patients were included to that date, whom 15 reached the 6-month follow-up. Their mean THI score decreased from 40.6 at baseline to 33.86 after 6 months of treatment ($p=0.018$). Patients classified in light to moderate severity scores (THI < 57) showed a greater reduction of THI (mean reduction 28%) comparing to severe and catastrophic ones (THI > 57 ; mean reduction 5%). Patients reporting initially ear fullness associated to tinnitus appeared marginally to benefit more from PAP treatment (Mann-Whitney, $p=0.14$). Conclusion : Long-term PAP use for OSAS tended to improve pre-existing bothering tinnitus in apneic patients.

Keywords: Tinnitus, Sleep apnea, Positive Air Pressure

Best Oral Presentation 01

Objective Tinnitus
BOP 01-6

Hemodynamic changes in transverse-sigmoid sinus junction following effective surgical reconstruction for unilateral pulsatile tinnitus with sigmoid sinus wall anomalies: a 4D flow MRI analysis

Xiaoyu QIU[1], Rong ZENG[1], Pengfei ZHAO[1], **Zhenchang WANG**[1]

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Background : Pulsatile tinnitus (PT) with sigmoid sinus wall anomalies (SSWAs) is often treated with surgical reconstruction. However, the effect of this surgical procedure on PT-related blood flow is unclear. This study compared the changes of blood flow velocity and pattern related to PT in the transverse-sigmoid sinus junction (TSSJ) before and after surgical reconstruction using 4D flow MRI.Methods: The data of patients who complained of unilateral pulse-synchronous PT, were confirmed to have ipsilateral SSWAs by preoperative CT, and underwent sigmoid sinus wall reconstruction were retrospectively analyzed. Patients who underwent pre- and postoperative 4D flow MRI, had PT eliminated or significantly alleviated after at least 6 months of follow-up were recruited. Quantitative and qualitative data of the blood flow properties, including bilateral velocity and net flow upstream and downstream of the TSSJ as well as vortexes in the TSSJ, were obtained and compared before and after surgery.
Results: Nineteen patients were recruited, including 6 patients with sigmoid sinus wall dehiscence and 13 with diverticulum. Significant differences were observed only in the ipsilateral upstream average velocity (Vavg) and contralateral downstream maximum velocity (Vmax) before and after treatment (p=0.01, p'=0.01). No significant changes were noted in other quantitative indicators. Among the 19 cases, 17 exhibited vortexes on the surgical side before surgery, of which 9 cases displayed vortex disappearance and 8 cases showed a reduction in vortex intensity post-surgery. Vortexes were observed in all 13 cases with diverticulum before surgery but disappeared after surgical intervention. The high-speed jet remained unchanged in 16 cases of TSS before and after treatment.Conclusions: Surgical reconstruction seems to lack a significant effect on PT-related blood flow properties, which suggests the safety of this surgery while the risk of ongoing recurrence.

Keywords: Pulsatile tinnitus, Sigmoid sinus wall anomalies reconstruction, Hemodynamics

Best Oral Presentation 01

Neuromodulation in Tinnitus Treatment
BOP 01-7

Advancing Tinnitus Research: The Crucial Role of Placebo Controls in Clinical Trials

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Placebo control is a cornerstone of rigorous medical research, providing a benchmark for distinguishing the true efficacy of an intervention from psychological or physiological effects unrelated to the active treatment. This is particularly critical in tinnitus research, where subjective perception, individual variability, and psychological influences can significantly impact outcomes. Current tinnitus trials increasingly incorporate innovative placebo control methodologies to address these challenges. For example, in pharmacological studies, placebo pills are matched in appearance, taste, and regimen to the active drug, ensuring blinding integrity. In neuromodulation trials, sham devices that mimic the active treatment but lack therapeutic functionality are used to control for patient expectations. Additionally, adaptive trial designs are emerging, using placebo run-in phases to better understand and mitigate placebo responses. Despite ethical and practical challenges, including ensuring participant adherence and addressing patient expectations, these approaches are critical for reliable efficacy evaluation. The current presentation will pinpoint the need for more rigorous placebo controlled trials and provides insights in how to tackle certain problems when designing such trials. By leveraging these advanced placebo control strategies, tinnitus research will deliver more robust and actionable findings, accelerating the development of truly effective treatments.

Keywords: Placebo, Advancing tinnitus research, Clinical trials

Best Oral Presentation 01

Others
BOP 01-8

Insula subregions contribution in transition from recent-onset to chronic in patients with idiopathic tinnitus

Qian CHEN

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Although the process of tinnitus development is a dynamic one, few studies have investigated neural plasticity during the transition of recent-onset tinnitus to chronic tinnitus. We determined the structural and functional alterations in the insula and its subregions in patients with idiopathic tinnitus in order to identify the neural changes involved in the progression from recent-onset to chronic tinnitus. We recruited 24 recent-onset tinnitus patients, 32 chronic tinnitus patients, and 36 healthy controls. We measured the gray-matter (GM) volume and fractional amplitude of low-frequency fluctuation (fALFF) of the insula and its subregions, and the functional connectivity (FC) within the insula and between the insula and the rest of the brain. Relationships between MRI and clinical characteristics were estimated using partial correlation analysis. Both recent-onset and chronic tinnitus patients showed significantly decreased fALFF across the insula and its subregions, but only chronic tinnitus patients showed bilateral GM atrophy in the ventral anterior insula (vAI). Abnormal FC was detected in recent-onset and chronic tinnitus patients relative to the healthy controls, but FC differences between recent-onset and chronic tinnitus patients were found in only the auditory-related cortex, frontal cortex, and limbic system. Functional alterations (fALFF and FC of the left vAI), but not structural changes, were correlated with clinical severity. Bilateral GM atrophy in the vAI, decreased regional activities in the left vAI and left posterior insula, and abnormal FC of the insula subregions with auditory and non-auditory areas were implicated in the progression from recent-onset to chronic tinnitus. This suggests that tinnitus generation and development occur in a dynamic manner, and involve aberrant multi-structural and functional (regional activity and abnormal FC) reorganization of the insula.

Keywords: Tinnitus, Insula subregions, Transition

Best Oral Presentation 01

Others
BOP 01-9

A service evaluation of UK audiologists' and hearing therapists' practice in the management of self-harm, suicidal ideation and behaviours in adult tinnitus patients

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Aims

Several studies and reports suggest an association between tinnitus and suicide. Our study aimed to understand 1) how self-harm, suicidal ideation and suicidal behaviours in adults who have tinnitus are assessed and managed in UK clinical practice 2) audiologists' and hearing therapists' views on care practice- what are the barriers and facilitators to assessing and managing suicidal ideation and suicidal behaviours and how may services be optimised? 3) clinicians' experiences, self-ratings of competence, and needs relating to suicide prevention, training and clinical supervision.

Methods

Fifty-seven respondents completed an online questionnaire between April-June 2021. Data were analysed using quantitative and thematic analysis.

Results

The key finding was a lack of standardisation in audiology services' suicide prevention policy, assessment, and referral procedures. Less than 2/3 of respondents used recommended measures. Variously, clinicians expressed 1) uncertainty about the scale of self-harm, suicidal ideation and suicidal behaviours and how to gauge and meet patients' needs, 2) polarised attitudes and orientation to discussing suicidal thoughts within treatment for tinnitus, 3) concerns about working beyond competence and responsibility, and 4) a belief that talking about self-harm, suicidal ideation and suicidal behaviours would make occurrence more likely.More than 2/3 of respondents felt that they lack the core knowledge and skills to support people experiencing self-harm, suicidal ideation and suicidal behaviours. Many (36%) had not had any suicide prevention training. Nearly all wanted training or re-training. Of those who had training, 2/3 continued to implement these skills. Most reported significant difficulties in supporting and referring patients. Clinicians lacked support: 79% had no clinical supervision.

Discussion

A pattern of consistent themes and differences separated standard from nonstandard practice across the data. This wide variation in professional training for suicide prevention, skills, practice, confidence and attitudes represents a missed tinnitus care/suicide prevention opportunity and warrants further research.

Keywords: Tinnitus, Suicide prevention, Audiology

Best Oral Presentation 02

Diagnosis of Tinnitus
BOP 02-1

The value of 4D Flow MRI in the clinical diagnosis of sigmoid sinus-derived pulsatile tinnitus

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Objective: To clarify the role and value of 4D Flow MRI in the clinical diagnosis and pathogenesis research of venous pulsatile tinnitus, in order to better understand the causes and pathogenesis of vascular pulsatile tinnitus.
Methods: Twelve patients with venous pulsatile tinnitus hospitalized in our hospital from May 2022 to October 2023 were selected, and 12 normal individuals without pulsatile tinnitus were selected as the control group. Both groups underwent 4D Flow MRI examinations to determine the blood flow velocity, blood flow volume around the ear, and the presence of abnormal blood flow conditions such as vortex flow. Preoperative and postoperative temporal bone CT, CTA+CTV, and 4D Flow MRI examinations were conducted, with comparative analysis of blood flow changes.
Results: Patients with pulsatile tinnitus exhibited disordered blood flow in the sigmoid and transverse sinuses, characterized by vortex or jet-like blood flow, with faster blood flow rates. Among the 12 patients, 10 had disordered blood flow, accounting for 83.33%. In contrast, the blood flow in the control group subjects was regular, mainly laminar, with slower blood flow speeds. Among the 12 subjects, 2 had disordered blood flow, representing 16.67%. Compared between the two groups, there were significant statistical differences ($P<0.05$). Surgical treatments for these patients involved the closure of sigmoid sinus diverticula or reconstruction of the sigmoid sinus bone wall. Postoperatively, all five patients with sigmoid sinus diverticula experienced the disappearance of tinnitus, and 4D Flow MRI examination showed marked improvement in abnormal blood flow around the sigmoid sinus, with a reduction in abnormal blood flow compared to preoperative levels.
Conclusion: This study suggests that the onset of venous pulsatile tinnitus is likely associated with abnormal changes in blood flow velocity and state. 4D Flow MRI potentially offering good diagnostic value for vascular pulsatile tinnitus.

Keywords: Pulsatile tinnitus, 4D Flow MRI, Sigmoid sinus

Best Oral Presentation 02

Objective Tinnitus
BOP 02-2

Identifying an EEG biomarker for Tinnitus in Resting State

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Purpose:
Diagnosis of tinnitus includes behavioral evaluations and questionnaires such as the Tinnitus Functionality Index (TFI) for assessing the severity of chronic tinnitus and its impact on the subject's quality of life. Since behavioral evaluations only provide a snapshot in time of tinnitus severity, adapting sound therapy to longitudinal changes in perceived tinnitus severity, as auditory neurofeedback, could benefit from an objective estimator of TFI suitable for continuous monitoring. In this pilot study, we evaluate using wireless dry-EEG recorded during eyes-closed resting for regressing TFI scores across subjects.

Method:
N=7 tinnitus subjects (6 chronic, ages 20 to 36, F=1) and an equal number of age-matched control subjects were recruited from a university community through flyers. A CGX Quick-32r headset was used to obtain scalp-EEG recordings using a standard 10-20 montage (28 scalp channels, 2 ear lobes, 2 horizontal EOG) for two five-minute recordings with a short break in between. Subjects were seated in a well-lit room and asked to keep their eyes closed, relax, and try not to fall asleep. EEG recordings were followed by an audiometric assessment and filling of the TFI. EEG for each session was visually inspected to remove and interpolate bad channels. Data was then epoched and trained using a small convolutional deep network (EEGNet) modified for regression.

Result and Conclusion:
The convolutional model was able to identify tinnitus vs control patients with a 95% accuracy. The regression model was also able to identify the level of severity indicated by the subject on the TFI with an R-squared score over 0.8. Such a wearable monitor of perceived tinnitus severity could advance closed-loop therapeutic interventions for tinnitus to continuously monitor for the presence of the percept, and tune intervention parameters appropriately to minimize the experienced percept.

Keywords: EEG, Neurofeedback, TFI

Best Oral Presentation 02

Objective Tinnitus
BOP 02-3

The causal associations between tinnitus at varying stages and levels of severity and the structural characteristics of distinct brain regions

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This study investigates the causal relationships between idiopathic tinnitus at different stages and severities and the morphological characteristics of specific brain regions. We employed two-sample bidirectional Mendelian randomization (MR) analysis to assess the causal effects of brain structure on tinnitus progression. Genetic variables from large-scale genome-wide association studies, focusing on tinnitus-related single-nucleotide polymorphisms, served as instrumental variables. We integrated these data with brain structural imaging to facilitate MR analysis and applied reverse MR to identify brain regions implicated in tinnitus onset. The results demonstrated causal links between tinnitus and structural changes in the brain, particularly within the auditory cortex, limbic system, and frontal-temporal-occipital circuits. Individuals with cortical thickness changes in the bilateral peri-calcarine and right superior occipital gyrus likely had prior tinnitus, while alterations in areas like the right rectus and left inferior frontal gyrus were unrelated. Notably, moderate tinnitus patients showed more pronounced brain alterations. The findings suggest that tinnitus induces structural changes mainly in the auditory-limbic-frontal-visual system, but no evidence supported reciprocal causality. Moderate tinnitus, rather than severe, appears to trigger the most significant morphological changes.

Keywords: Tinnitus, Brain, Severity

Best Oral Presentation 02

Objective Tinnitus
BOP 02-4

Radiologic Evidence of Sigmoid Sinus Wall Dehiscence and Diverticulum Progression: Sigmoid Sinus Wall Anomalies May Not Be Congenital

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Objective: Sigmoid sinus wall anomalies (SSWA) have a strong association with venous pulsatile tinnitus (PT). This study seeks to demonstrate that SSWA progresses over time rather than being a congenital condition.

Methods: A retrospective analysis was conducted on 42 PT patients with SSWA, each of whom had undergone at least two non-surgical CT scans at our clinic. The CT images were evaluated longitudinally to monitor the progression of SSWA.

Results: Of the 42 patients with SSWA, 12 (28.6%) showed progression. The rate of anastomosis between the diploic vein and diverticulum was significantly higher than in the dehiscence group ($p < 0.01$). In the diverticulum group, 7 patients (30.4%) exhibited diverticular enlargement, with an average wall expansion of 5.9%. Progressive erosion was detected in 2 patients (12.5%) within the dehiscence group, with an average erosion of 3.8% in the sigmoid plate. Three patients transitioned from dehiscence to diverticulum, with an average expansion in sigmoid sinus wall length of 43.8%.

Conclusion: SSWA can exhibit morphological changes over time, supporting the notion that it is a progressive condition rather than a congenital one.

Keywords: Pulsatile tinnitus, Congenital, Sigmoid sinus wall anomalies

Best Oral Presentation 02

Sound Therapy and Behavioral Therapy for Tinnitus
BOP 02-5

Bold exposure or safe masking: A fear conditioning approach to chronic Tinnitus Disability

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Background:
Tinnitus, a subjective perceptual phenomenon, is not measurable or objectively quantifiable, nor is it traceable to a clear pathology. While many individuals adapt to tinnitus without significant distress, a subset develops chronic, debilitating symptoms. Two theoretical frameworks—fear-avoidance and habituation—have been proposed to explain this disparity, with fear-avoidance theories supporting exposure-based treatments. However, evidence for these approaches largely stems from self-report data, leaving uncertainties about causal mechanisms and the relative effectiveness of exposure versus masking therapies.
Objective:
This study investigated the effectivenes of Tinnitus-Specific Behavioural Exposure Treatment as compared to tinnitus masking therapy in reducing tinnitus-related fear and severity while promoting recovery, in Tinnitus patients with complaints ranging from mild to severe. Secondary aims include identifying subgroups of patients likely to benefit from specific treatments, examining behavioural and emotional markers via daily assessments, and exploring risk and resilience factors in patients with varying degrees of tinnitus-related disability.
Methods:
A single-blind, sequential randomized controlled trial with 208 tinnitus patients stratified by severity and hearing level. Participants were allocated to a 12-week treatment of either Tinnitus-Specific Behavioural Exposure Treatment or masking therapy. Primary outcomes include tinnitus severity (Tinnitus Questionnaire scores) and Health related quality of life (HUI). Secondary outcomes include threat appraisal, fear-avoidance behaviours, and psychoacoustic loudness measures assessed at baseline, pre-/post-treatment, and 3- and 6-month follow-ups. Daily self-report diaries included capture of tinnitus-related fear responsing , accoustic intensity, and interference pre, during, and post intervention periods.
Results:
Tinnitus-Specific Behavioural Exposure Treatment leads to greater reductions in tinnitus-related fear, accoustic intensity, and severity compared to masking therapy. Moreover, distinct patient subgroups emerged, indicating possible differential benefits of each approach. Daily behavioural markers predict treatment outcomes, providing actionable insights into individualized therapy.

Keywords: Behavioural exposure treatment, Masking therapy, Daily behavioural markers

Best Oral Presentation 02

Sound Therapy and Behavioral Therapy for Tinnitus
BOP 02-6

Digital therapeutics for chronic subjective tinnitus : Korean Multicenter RCT

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Cognitive Behavioral Therapy (CBT) is an effective treatment for chronic tinnitus, but its traditional delivery is time-intensive, limiting its clinical use. To overcome this challenge, digital CBT programs customized for tinnitus patients are being developed. This study evaluated the effectiveness and safety of a new digital therapeutic program called Soundclear, a 6-week intervention combining personalized CBT with sound therapy, designed to reduce the mental and physical burden of subjective tinnitus.
The study was a prospective, multicenter, randomized, single-blind trial conducted from November 2023 to June 2024 across five major medical centers. Adults aged 19 and older with tinnitus lasting more than three months and Tinnitus Handicap Inventory (THI) scores between 18 and 77 were included. Participants were divided into two groups: The experimental group used Soundclear, which included video lessons to challenge unhelpful thoughts about tinnitus, notch-filtered sound therapy, and a thought diary. The program involved 30 sessions (five sessions per week for six weeks). The control group received conventional CBT materials.
A total of 112 participants were enrolled, and 105 completed the clinical trial At the end of six weeks, the Soundclear group showed significant improvement in THI scores compared to the control group, indicating better tinnitus-related mental and physical well-being.
Improvements were also observed in emotional, functional, and catastrophic subscale scores, as well as secondary measures like the Tinnitus Functional Index (TFI) and Visual Analog Scale (VAS) for negative emotions and discomfort. Anxiety (Beck Anxiety Inventory, BAI) and depression (Beck Depression Inventory, BDI) scores also improved significantly.
No serious adverse events were reported, confirming the safety of the program.
This study shows that a digital CBT program like Soundclear is a safe and effective treatment for chronic tinnitus. It holds great potential for integration into real-world clinical practice as a convenient therapeutic option.

Keywords: Digital therapeutics, Cognitive Behavioral Therapy, Sound therapy

Best Oral Presentation 02

Sound Therapy and Behavioral Therapy for Tinnitus
BOP 02-7

Quantitative EEG Alterations Following simultaneous CBT and TRT for Tinnitus Treatment: Short-Term Effects

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Introduction: Tinnitus retraining therapy(TRT) was presented based on the neurophysiological model of tinnitus, while cognitive behavioral therapy(CBT), aimed at addressing unrealistic, distorted, and negative thoughts. This study aimed to evaluate the combined effects of CBT and TRT in managing tinnitus. Alongside subjective surveys, we also sought to objectively assess brain activity using qEEG.
Methods: A randomized controlled study was conducted on adults aged 18 and older. Participants with chronic tinnitus (> 3 months) were included. TRT involved directive counseling and self-sound therapy using a smartphone-based application, while CBT was delivered through Neurive's Sori-CLEAR program. Patients attended weekly clinic visits for six weeks. The control group(n=22) received only TRT, while the experimental group(n=22) underwent both TRT and CBT simultaneously. Tinnitogram, negative - thinking VAS, tinnitus handicap inventory(THI), and qEEG(Neuron-Spectrum4/P) were conducted. qEEG was analyzed with Neurostat(Neuroguide).
Results: In the control group, THI improved from 40.6 to 33.0 immediately after treatment(P=0.04). In the experimental group, THI was more significantly decreased from 41.3 before treatment to 31.7 after treatment(P=0.002). At 3-months post-treatment, the THI were 35.6 in the control group and 30.9 in the experimental group, confirming that the treatment effects were sustained for 3 months(P=0.002).
Regarding qEEG, the control group exhibited an increase in Theta wave activity at Pz and P4 immediately after treatment compared to baseline. In the experimental group, a significant reduction in beta wave activity was observed in the right auditory cortex, both somatosensory cortices, and the right visual cortex(C4,T4,T6,Fz,Cz,Pz,F7,T5,P3,O2) at 3-months post-treatment. Additionally, slow alpha wave activity increased in the left somatosensory cortex and both visual cortices (C3,F7,T5,O1,O2).
Conclusion: Combined CBT and TRT treatment is more effective in reducing tinnitus compared to TRT alone, with the therapeutic effects lasting for at least three months. Additionally, this approach decreases brain activity in both the somatosensory cortex and the right auditory cortex.

Keywords: Cognitive behavioral therapy, Tinnitus retraining therapy, QEEG

Best Oral Presentation 02

Sound Therapy and Behavioral Therapy for Tinnitus
BOP 02-8

Characteristics of Tinnitus Patients in an Audiology Clinic and the Effectiveness of Cognitive-Behavioral Therapy (CBT) and Mindfulness Techniques: Reflections from a 3.5-Year Clinical Practice

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Purpose:
This presentation summarizes the observations and reflections of a clinical audiologist based on managing 227 patients with bothersome tinnitus from mid-2021 to the end of 2024. Among them, 95 patients engaged in CBT and mindfulness sessions. The goal is to share clinical insights, highlight patterns observed in patients, and discuss the practical application of psychological approaches in an audiology setting.

Method:
Patients were assessed using conventional audiograms, with 83 patients (37%) showing no hearing loss. Of the total patients, 215 (95%) reported experiencing anxiety, depression, or chronic stress based on validated measures (GAD-7, PHQ-9, PSS). CBT sessions focused on tinnitus distress, aiming to reduce THI scores and improve quality of life. Success was defined as achieving a THI score below 16, while dropout and failure cases were documented to understand barriers.

Results:
Of the 95 patients who participated in CBT sessions, 75 (79%) achieved successful outcomes, with significant reductions in tinnitus-related distress. However, 16 patients discontinued treatment prematurely, often after reporting partial improvement. Four cases were deemed failures due to severe psychiatric conditions (e.g., medication refusal or catastrophic mood issues) or ambiguous tinnitus diagnoses (e.g., perceived internal sounds not aligned with typical tinnitus).

Conclusion:
This review highlights that bothersome tinnitus is not necessarily linked to hearing loss but often coexists with psychological concerns. CBT and mindfulness techniques were effective in improving tinnitus-related distress, even in complex cases. Key challenges include patient reluctance due to stigma, financial concerns, and misunderstanding of treatment goals. These findings emphasize the importance of public education, the integration of mental health support in audiology, and proactive screening for mood disorders and sleep disturbances.

Keywords: Tinnitus, Cognitive Behavioral Therapy, Mindfulness

Best Oral Presentation 02

Sound Therapy and Behavioral Therapy for Tinnitus
BOP 02-9

INTENSIVE TREATMENT BASED ON SOUND THERAPY AND STRUCTURED COUNSELING IN PATIENTS WITH EXTREME TINNITUS PHENOTYPE: A PILOT STUDY

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Purpose of the Study
Tinnitus, a phantom sound perceived without an external stimulus, affects approximately 15% of the global population. However, only 1-2% present an extreme phenotype (EP). This condition can result in significant disability in these patients, leading to tinnitus disorder. While the causes of this EP are unknown, several studies suggest a genetic predisposition. In addition, and although no treatment has fully controlled tinnitus, interventions like structured counseling (SC), sound therapy (ST), cognitive behavioral therapy, and hearing aids for patients with hearing loss have shown positive effects.The aim of this study is to evaluate the effects of supervised SC and ST on tinnitus.
Methods
A randomized crossover study was designed, including five daily and consecutive sessions of ST and a group SC session, all conducted in person. Participants met the "Unification of Treatments and Interventions for Tinnitus Patients" (UNITI) project criteria, but focusing on individuals with EP (THI > 56). All these patients underwent an audiological assessment and whole genome sequencing before treatment, to identify gene variants that could help understand the development of this EP or explain the success or failure of these interventions. Descriptive statistics and paired t-tests were performed to compare baseline data and outcomes three months after treatment, using R-studio (Version 4.2.2).
Results
In a preliminary sample of nine patients (six males), with mean age of 51.4 years (±13.2), the analysis showed significant improvements in both THI score (Baseline= 74.7 ±11.9; after first intervention= 54 ±17.8, three months post-interventions= 43.4 ±27.7 ($p<0.05$)) and in GÜF score, for hyperacusis (Baseline= 21.3 ±5.66; after treatment= 12.1 ±6 ($p<0.05$)).
Conclusion
Our preliminary results suggest a significant reduction in tinnitus distress and hyperacusis. The intervention improved patients' quality of life, showing a change from severe discomfort to moderate or low-moderate distress levels.

Keywords: Sound Therapy, Structured Counseling, Randomized crossover study

Oral Presentation 01

Hyperacusis/Misophonia
OP 01-1

EXPLORING BRAINSTEM AND CORTICAL AUDITORY PROCESSING DEFICITS IN INDIVIDUALS WITH MISOPHONIA

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Purpose of the Study

Individuals with misophonia often exhibit hyper-focus on trigger sounds like chewing or sniffling, struggling to filter them out, unlike those with central auditory processing disorder (CAPD), who don't experience autonomic nervous system arousal (Pellicori, 2020). Research on misophonia shows conflicting results regarding auditory processing differences, with some studies finding no significant differences, while others suggest poor speech perception in noisy environments (Ila et al., 2023; Kim et al., 2023; Madappally, 2024; Schorder et al., 2014). Hence, the current study aims to assess the brainstem and cortical auditory processing abilities in individuals with and without misophonia.

Methods

Forty participants (aged 18–30 years) were recruited and divided into two groups: 20 with misophonia and 20 controls. Misophonia was diagnosed using criteria from Schröder et al. (2013) and the MisoQuest Questionnaire (Siepsiak et al., 2020). Tests included the Masking Level Difference (MLD) for binaural interaction, the Dichotic Consonant-Vowel (DCV) test for binaural integration, and the Pitch Pattern Test (PPT) for temporal ordering. Test scores were compared between the two groups.

Results

Results revealed that scores of dichotic consonant-vowel and pitch pattern tests were significantly poorer ($p < .05$) in individuals with misophonia compared to those without misophonia included in the study. No significant difference ($p > .05$) was observed in the masking level difference values. The current study findings align with the literature, suggesting abnormal auditory processing at the cortical level, and brainstem auditory processing remains unaltered (Kim et al., 2023; Schorder et al., 2014; Brout et al., 2018).

Conclusion

The study assessed auditory processing abilities in individuals with misophonia, revealing altered auditory processing in binaural integration and temporal ordering. While behavioral measures indicate brainstem and cortical alterations, further research with larger sample sizes and electrophysiological tests is needed for a comprehensive understanding.

Keywords: Misophonia, Binaural integration, Binaural interaction

Oral Presentation 01

Hyperacusis/Misophonia
OP 01-2

NEUROPHYSIOLOGICAL CORRELATES OF AUDITORY FUNCTION IN MISOPHONIA AND MISOKINESIA AND THEIR CO-EXISTENCE

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Purpose of the Study

Misophonia and misokinesia are emerging audiological conditions increasingly affecting individuals seeking professional help. Research on the coexistence and interaction between misophonia and misokinesia is limited, despite their significant impact on daily functioning and mental health. Thus, this study aims to assess auditory cortical functioning through late latency responses in normal-hearing individuals with misophonia, misokinesia, and their co-occurrence, to identify affected audiological measures.

Methods

Sixty participants (aged 18–30 years) were recruited and divided into four groups: 15 with misophonia, 10 with misokinesia, 10 with co-morbid misophonia with misokinesia and 10 controls. Misophonia was diagnosed using criteria from Schröder et al. (2013) and the MisoQuest Questionnaire (Siepsiak et al., 2020). Misokinesia was diagnosed using criteria from Jaswal et al. (2024) assessed through Misokinesia Assessment Questionnaire (MkAQ) (Dozier, 2015). Auditory late latency responses (ALLR) were recorded and latency and amplitude patterns were analyzed and compared between groups.

Results

The results of the study showed significant differences in P1 and N1 amplitude and latency across groups, but not in P2 or N2. Misophonia and combined groups showed earlier latencies and higher amplitudes for P1 and N1 compared to controls, with no differences between them. These results suggest enhanced early auditory processing in misophonia, characterized by auditory hyper-reactivity and heightened perceptual sensitivity, independent of visual sensitivities in misokinesia (Kumar et al., 2017; Jastreboff & Jastreboff, 2014). Misokinesia-only showed no significant auditory changes, supporting distinct neural mechanisms for the two conditions (Rouw & Erfanian, 2018).

Conclusions

The findings highlight enhanced early auditory processing in misophonia, absent in misokinesia, supporting their distinction as separate sensory profiles. Misophonia-specific hyper-reactivity may stem from altered sensory gating or cortical excitability. Future studies should explore sensory-limbic connectivity to understand their independent and combined effects.

Keywords: Misophonia, Misokinesia, Cortical functioning

Oral Presentation 01

Hyperacusis/Misophonia
OP 01-3

Exploring the Relationship Between Misophonia and Spatial Auditory Processing

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Purpose of the Study
This study aimed to evaluate spatial auditory processing in individuals with misophonia by comparing Interaural Time Difference (ITD) and Interaural Level Difference (ILD) thresholds, as well as Virtual Acoustic Spatial Identification (VASI) scores, to those of individuals without misophonia. Additionally, it explored potential correlations between these behavioral thresholds and A-MISO questionnaire scores in individuals with misophonia.

Methods
Forty normal-hearing participants were recruited, divided into two groups: 30 with misophonia and 30 controls. Behavioral tests included ITD and ILD threshold assessments using a three-interval forced-choice method, and a VASI test with white-band noise stimuli presented at eight azimuths. VASI scores, reaction times, and errors were analyzed for angle-specific and hemispheric differences. Correlations with A-MISO scores were also investigated.

Results
No significant differences were found between the misophonia and control groups for ITD and ILD thresholds, average reaction times, or angle-specific reaction times. However, individuals with misophonia exhibited significantly lower VASI accuracy scores at R45 and L45 azimuths and higher angle-specific errors, particularly in the left hemisphere. Within-group comparisons showed more errors in hemispheric (right and left) than midline (front-to-back) areas. A significant correlation was identified between VASI thresholds and A-MISO scores, but no significant correlation was found for ITD, ILD, or VASI reaction times.

Conclusions
Individuals with misophonia demonstrate deficits in spatial auditory processing, particularly in hemispheric localization accuracy, despite normal ITD and ILD thresholds. These findings suggest altered spatial processing mechanisms in misophonia and highlight a potential relationship between auditory spatial performance and misophonic severity. Further research is needed to understand how these deficits relate to other auditory or cognitive processes in misophonia, which may inform targeted interventions.

Keywords: Misophonia, Spatial perception, Localization

Oral Presentation 01

Hyperacusis/Misophonia
OP 01-4

AUDIDIAG: A new psychoacoustic tool to diagnose hyperacusis and misophonia

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We have recently developed a psychoacoustic tool (Enzler et al., 2021) designed to diagnose hyperacusis and misophonia. The development of the tool for hyperacusis was motivated by the limitations of the sound discomfort level test (biased, uncomfortable, etc.). Firstly, we chose to use natural sounds with complex acoustic characteristics likely to better reflect the patients' condition in daily life and the relevant processing of the auditory system. Secondly, we asked subjects to rate the sound on a pleasant/unpleasant scale, rather than on a loudness scale, in order to capture the subject's composite experience combining loudness and other aspects of sounds (affective, etc.). Thirdly, the method relies on the comparison of each subject's results with a normative database of normal-hearing subjects without hyperacusis. I will present new data, including updated normative values, obtained with this method and collected using an application (Audidiag) running on an android tablet and a limited number of sounds (Enzler's first study involved 69 sounds). In addition, the loudness dimension has been added in the latest version of the task, to enable the loudness dimension to be dissociated from the other dimensions. In the end, the addition of the sound dimension enables better discrimination between controls and subjects with hyperacusis. We hope that this method will be widely used in the auditory field, which will also enable us to refine it.

Keywords: Psychoacoustic, Natural sounds, Application

Oral Presentation 01

Others
OP 01-6

Clonazepam usage improves chronic tinnitus and sleep quality: questionnaire prospective cohort study

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Tinnitus is a chronic disease associated with hearing loss, and can causes depression and insomnia. This study aims to analyze the results of Tinnitus Handicap Inventory(THI), Beck Depression Inventory(BDI), and Pittsburgh Sleep Quality Index(PSQI) questionnaire survey before and after clonazepam usage. This study analyzed the association of three questionnaires of pre-treatment, and evaluate whether the post-treatment THI index can be predicted by pre-treatment factors.

Chronic tinnitus for more than 3 months, over 20 years of age were selected. Patients who needed hearing aids or diagnosed with acute sudden hearing loss, Meniere's disease, brain or IAC tumors, and muscular/vascular tinnitus were excluded. THI, BDI, PSQI questionnaire survey was conducted before and after 3 months therapy of clonazepam(Rivotril 0.25mg or 0.5mg).

A total of 76 patients were finally analyzed from 150 enrolled patients, there were 38 males and females each, and the mean age was 57.2 ± 9.01yrs. The pre-treatment THI score was 44.3 ± 23.4, BDI 7.96 ± 2.36, and PSQI 6.85 ± 4.68. The relationship between THI score and BDI and PSQI was significantly correlated with P=0.0027*** and P<0.0001***, respectively. The pre-THI score showed no significant association with age, sex, and hearing threshold (P=0.91, 0.85, and 0.23, respectively). The post-treatment THI score was 33.6 ± 17.1, which was significantly decreased compared with the pre-THI scores (P<0.0001***). Post-BDI was 7.38 ± 2.25 and Post-PSQI was 4.04 ± 3.20. Post-PSQI was also significantly decreased compared with pre-PSQI(P=0.0002***), But, Post-BDI was not significantly decreased (P=0.12). Among THI, question number 7(sleep disturbance) & 25(unstable mood) showed the greatest decrease.

Appropriate/optional usage of clonazepam at low doses of 0.25-0.5mg can significantly improve chronic tinnitus and sleep quality. Tinnitus was significantly associated with scores of THI, BDI, PSQI. Clonazepam significantly reduced THI and PSQI before and after clonazepam usage. However, clonazepam did not affect BDI score.

Keywords: Tinnitus, Clonazepam, Questionnaire

Oral Presentation 01

Others
OP 01-7

Bibliometric Analysis of Machine Learning Applications in Tinnitus: Trends, Publications, and Key Research Clusters

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Tinnitus, a condition characterized by the perception of ringing in the ears, has become a significant focus of research in recent years, especially with the application of machine learning (ML) techniques to enhance diagnosis and treatment. This bibliometric analysis aims to explore research trends, major contributors, and key areas in the field of tinnitus and machine learning. Data was collected from Scopus and PubMed databases using keywords related to tinnitus treatment between 2014 and 2024. Selected articles were sourced from medical and health journals. Analysis was conducted using VOSviewer and Bib software to map publication trends, author collaborations, and frequently occurring keywords. The analysis results show a significant increase in publications since 2015, with notable contributions from countries such as the United States, the UK, China, Germany, and South Korea. The most cited journals include IEEE Journal of Biomedical and Health Informatics, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Audiology, and Neurotology. Leading institutions contributing to this research include the University of Regensburg in Germany. Keyword co-occurrence analysis identified key clusters, including the application of machine learning and deep learning, as well as learning algorithms such as support vector machine for tinnitus diagnosis. The research also involves assessing the quality of life of tinnitus patients through questionnaires. Studies often include human subjects, employ diagnostic imaging techniques, and focus on middle-aged populations. Additionally, biomarkers are highlighted as potential indicators for tinnitus. These findings reflect the growing trend of utilizing ML techniques to personalize tinnitus treatment and improve clinical outcomes. This study provides valuable insights into the state of tinnitus research and the integration of advanced computational methods, while offering directions for future research to bridge existing research gaps.

Keywords: Bibliometric Analysis, Machine Learning, Tinnitus

Oral Presentation 01

Others
OP 01-8

Acupuncture as a Salvage Treatment for Tinnitus in Idiopathic Sudden Sensorineural Hearing Loss

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Background
Tinnitus is a distressing symptom frequently experienced by patients with idiopathic sudden sensorineural hearing loss (SSNHL), often persisting even after standard systemic and intratympanic steroid therapy. This study aimed to evaluate the effectiveness of acupuncture as a salvage treatment for tinnitus in SSNHL patients.
Methods
We enrolled SSNHL patients with residual tinnitus following systemic and intratympanic steroid therapy. Treatment outcomes were assessed using changes in Tinnitus Handicap Inventory (THI) scores. Subgroup analyses were conducted to identify factors influencing the effectiveness of acupuncture on tinnitus.
Results
Among 26 SSNHL patients with THI grade >2 tinnitus after steroid therapy, THI scores significantly improved from 45.33 ± 27.02 to 30.33 ± 23.98 after acupuncture ($P < 0.01$). Subgroup analysis revealed significant improvements in THI scores among females and younger (age < 60 y/o) patients. Patients receiving early acupuncture (<2 months after SSNHL onset) had a significantly higher likelihood of achieving good treatment outcomes, defined as a THI score reduction >17, compared to those receiving delayed acupuncture.
Conclusion
Acupuncture is an effective salvage treatment for reducing tinnitus severity in SSNHL patients after steroid therapy, particularly in females and younger patients. Early initiation of acupuncture may enhance treatment outcomes, achieving greater reductions in THI scores.

Keywords: Acupuncture, Tinnitus, Sudden hearing loss

Oral Presentation 01

Others
OP 01-9

An Experience and theory informed model of the Relationship between Tinnitus and Suicidal thoughts and behaviours (EXPERTS): a qualitative study

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Several studies suggest an association between tinnitus and suicidal thoughts and behaviours. Exploring individuals' experiences in depth and with reference to theories of suicide can further understanding of this co-occurrence. This study asked (1) what are the suicide-related care experiences of patients with tinnitus attending audiology clinics, and (2) how do people experience suicidal ideation and behaviours in the context of tinnitus, and can transdiagnostic features of both be identified?

Methods

This study had two components. In the first,164 participants completed a survey using open and closed questions about tinnitus care in UK audiology services with specific reference to suicide prevention. The second component involved in-depth interviews in which 15 participants were asked about their experiences of co-occurring tinnitus and suicidal ideation and behaviours, using a card sort task to identify key variables and transdiagnostic features.
Closed questions and card sort data were summarised quantitatively. Open text survey responses and interviews were analysed using narrative analysis.

Results

In the survey, 111 respondents reported experiencing suicidal ideation or behaviours. However, only 31 participants had disclosed this in an audiology appointment. Eighty-eight percent were not asked about suicide although most participants would have felt positive about being asked. Key factors affecting patient disclosure of suicidal ideation and behaviours were: being asked, clinicians' empathy and understanding of tinnitus, time in appointments, provision of ongoing supportive tinnitus-related management.

In the interview study, common factors (e.g. entrapment, fear, reduced positive future thinking) were identified to build a transdiagnostic model of tinnitus and suicide yielding a qualitative, directional understanding of the relationship and interactions between tinnitus and suicidal processes.

Discussion

Understanding shared transdiagnostic features and the function of suicidal ideation and behaviours within tinnitus distress will inform future clinical approaches and service provision to facilitate supportive tinnitus management and suicide prevention conversations between audiologists and patients.

Keywords: Tinnitus, Suicide, Transdiagnostic

Oral Presentation 02

Implantable Hearing Devices for Tinnitus Management
OP 02-1

Comparison of Tinnitus Suppression Using Cochlear Implants and Bone Conduction Implants in Patients with Asymmetric Hearing Loss and Single-Sided Deafness

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Implantable hearing devices, including cochlear implants (CI) and bone conduction implants (BCI), are used for hearing rehabilitation in patients with asymmetric hearing loss (AHL) and single-sided deafness (SSD). This retrospective study compared the effects of CI and BCI on tinnitus in AHL/SSD patients who underwent implantation between 2017 and 2023. Clinical data, including pre- and postoperative audiologic tests and tinnitus questionnaires (THI and VAS), were analyzed from 33 patients with significant tinnitus (THI ≥ 18). Of these, 16 received CI and 17 received BCI. In the CI group, all four VAS scores (loudness, awareness, annoyance, and effect on life) and THI scores significantly improved, whereas in the BCI group, only annoyance and effect on life improved, with VAS loudness and awareness remaining stable. A linear mixed model analysis revealed a significantly greater reduction in VAS scores in the CI group. Additionally, the CI group demonstrated a higher tinnitus cure rate (62.5%) compared to the BCI group (11.8%) at six months postoperative. Both CI and BCI were effective in reducing tinnitus, but CI showed a stronger effect on tinnitus suppression and a higher cure rate, making it the preferred option for tinnitus treatment in AHL/SSD patients.

Keywords: Asymmetric hearing loss, Single-sided deafness, Cochlear implant

Oral Presentation 02

Implantable Hearing Devices for Tinnitus Management
OP 02-2

Restoration of Deafferentation Reduces Tinnitus, Anxiety, and Depression: A Retrospective Study on Cochlear Implant Patients

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Introduction: Patients with profound bilateral deafness (BD) are prone to suffering from tinnitus, which further leads to psychological comorbidities and makes it more difficult for patients to communicate with people. This study was aimed at investigating the effect of cochlear implants (CIs) on tinnitus distress and psychological comorbidities in patients with profound BD.
Methods: This multicenter retrospective study reviewed 51 patients with severe postlingual BD who underwent cochlear implantation; 49 patients underwent unilateral cochlear implantation, and 2 patients underwent bilateral cochlear implantation. The patients were asked to complete all the questionnaires, including the tinnitus handicap inventory (THI), the visual analog scale (VAS) score, the Hospital Anxiety and Depression Scale Questionnaire (HADS), the Categories of Auditory Performance (CAP), and the Speech Intelligibility Rating (SIR), at least 4 months after implantation when the CI was on or off, in approximately May-June 2019.
Results: In our study, 94% (48/51) of BD patients suffered from tinnitus before CI, and 77% (37/48) of them suffered from bilateral tinnitus. In addition, 50.9% (26/51) of the CI patients were suffering from anxiety, 52.9% (27/51) of them were suffering from depression (score ≥ 8), and 66.7% (34/51) (27/51) of them were suffering from anxiety or depression. Cochlear implantation could reduce tinnitus more obviously when the CI was on than when the CI was off. Cochlear implantation also reduced anxiety/depression severity. There were significantly positive correlations between tinnitus severity and anxiety/depression severity before and after surgery. Moreover, hearing improvement is positively correlated with reduction level of tinnitus, the better hearing, and the lesser severity of tinnitus.
Conclusion: Thus, along with effective restoration of deafferentation, cochlear implantation shows positive therapeutic effects on tinnitus and psychological comorbidities, providing a reference for future clinical and research work.

Keywords: Tinnitus, Cochlear implant, Psychological comorbidities

Oral Presentation 02

Implantable Hearing Devices for Tinnitus Management
OP 02-3

Tinnitus Changes Among Cochlear Implant Recipients Pre and Post-operatively

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Purpose
An increasing number of candidates express concerns about potential changes in tinnitus during preoperative counseling for cochlear implantation (CI). This study aims to review and analyze the changes in tinnitus reported by cochlear implant recipients at our center.

Method
Data from 134 cochlear implant recipients (mean age: 43 years, range: 18–80 years) were analyzed to evaluate tinnitus presence, tinnitus distress (assessed using the Tinnitus Handicap Inventory, THI), and hearing-related quality of life. Quality of life was measured using patient-reported outcome measures (PROMs), such as the Hearing Aid/Cochlear Implant Benefit Inventory and the Hearing Implant Sound Quality Index (HISQUI19).

Results
Approximately 61% of patients experienced tinnitus pre-operatively. Of these, 54% no longer reported tinnitus post-operatively. Conversely, recipients who did not report tinnitus before implantation, 12% developed tinnitus after surgery. For patients who experienced tinnitus both before and after surgery, majority of them (63%) had progressive hearing loss, followed by sudden SNHL, with a small number of cases were LVAS. In contrast, among those who had tinnitus preoperatively but no longer experienced it postoperatively, 60% were LVAS cases. Additionally, for individuals who still experienced tinnitus after CI, the severity of tinnitus distress significantly decreased after implantation (THI = 9.7). This reduction was notably greater compared to the improvement achieved with hearing aids, where the THI score was reduced to 19.7.

Conclusion
CI recipients had significantly improvement in tinnitus severity after surgery and half of them don't have tinnitus anymore. CI is suitable to resolve both severe hearing loss and tinnitus problem for most patients.

Keywords: Cochlear implant, THI, Tinnitus

Oral Presentation 02

Implantable Hearing Devices for Tinnitus Management
OP 02-4

The effectiveness of CI for hearing and suppression of tinnitus of adult cochlear implantation at Chang-Gung Memorial hospital in Taiwan

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Background
Adult cochlear implant (CI) surgery is increasing, but data in Taiwan remain limited due to the small number of patients. Barriers include high costs and lack of awareness of CI effectiveness for hearing and tinnitus suppression. This study presents outcomes from a single tertiary hospital.

Methods
A retrospective study of **116 adult CI recipients** (≥18 years) from **1999 to 2020** who completed 12 months of speech perception tests. Quality of life (QoL) questionnaires were completed by 30 patients, and 71 participated in tinnitus suppression assessments.

Results
Speech perception scores for **easy sentences (ES), difficult sentences (DS),** and **phonetically balanced (PB) words** plateaued at **3 months post-CI** ($p < 0.01$). Post-CI QoL scores for **bodily pain, mental health,** and **social role functioning** significantly improved ($p < 0.05$). Tinnitus improved in **65.1%** of patients, with those in **THI grade 3–5** decreasing from **66.7% pre-CI to 34.4% post-CI**.

Conclusion
Cochlear implants improve **speech perception, QoL,** and **tinnitus** in adults with profound hearing loss. Outcomes at 3 months post-CI can serve as reliable indicators for recovery and prognosis.

Keywords: Tinnitus, Adult, Cochlear implant

Oral Presentation 02

Implantable Hearing Devices for Tinnitus Management
OP 02-5

Predicting Variability in Pediatric Cochlear Implant Outcomes through Synchronous Brain Activation Patterns: Insights from fNIRS

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Objectives: This study investigated the relationship between brain activation patterns and auditory performance in children with cochlear implants (CI) and normal hearing (NH) controls using functional near-infrared spectroscopy (fNIRS). The aim was to identify neural predictors of CI outcomes and to understand the underlying mechanisms of auditory processing in both groups.
Design: Eighteen pediatric CI users and 17 NH controls underwent auditory testing (non-speech sound and sentence recognition) while fNIRS data were collected. Estimated response amplitudes (ERAs) were analyzed to identify brain activation patterns associated with task performance and group differences.
Results: CI users showed similar accuracy (92.6 ± 4.2%) for non-speech sound discrimination compared to NH controls (91.7 ± 5.1%), but significantly lower accuracy (76.9 ± 6.8% vs. 96.1 ± 3.4%) for sentence recognition. fNIRS revealed distinct activation patterns between groups. CI users showed focal activation in the right temporal lobe during non-speech sound processing, whereas NH controls showed broader activation over the bilateral middle frontal gyrus. During sentence recognition, CI users relied on left parietal and frontal regions, whereas NH controls showed distributed activation over bilateral temporal and frontal regions. Importantly, right temporal lobe activation predicted non-speech sound accuracy in CI users, whereas no significant predictors were found in NH controls.
Conclusions: This study provides novel insights into the neural mechanisms underlying auditory processing in CI users and highlights the importance of specific neural circuits in explaining variability in CI performance. The distinct neural activation patterns observed in CI users suggest a reliance on compensatory mechanisms for speech processing. These findings have important clinical implications for developing targeted rehabilitation strategies and improving CI outcomes.

Keywords: Cochlear Implant, Spectroscopy Near-Infrared, Neural Plasticity

Oral Presentation 02

Implantable Hearing Devices for Tinnitus Management
OP 02-6

Cochlear implantation reduces tinnitus in single-sided deafness patients

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Introduction
Tinnitus suppression is hypothesized to occur through the partial restoration of afferent inhibition following cochlear implantation. Numerous studies have demonstrated that tinnitus is significantly reduced in 66-92% of patients undergoing cochlear implantation, attributed to the stimulation of the auditory nervous system where afferent inhibition has been restored. This study aimed to evaluate the efficacy of cochlear implantation as a tinnitus treatment and investigate potential correlations between mapping outcomes and tinnitus suppression in patients with single-sided deafness.

Methods
This study was conducted from November 2018 to July 2020 across three tertiary hospitals. Participants were patients diagnosed with single-sided deafness who experienced tinnitus and voluntarily consented to undergo cochlear implantation as a tinnitus treatment. Assessments included validated questionnaires such as the Korean version of the Hearing Handicap Inventory for the Elderly (K-HHIE), the Tinnitus Handicap Inventory (THI), and the Visual Analogue Scale (VAS). Additionally, tinnitogram evaluations were performed for loudness and pitch matching. The study analyzed the relationship between cochlear implantation mapping outcomes and tinnitogram pitch-matching results.

Results
K-HHIE scores decreased from 63.4 to 36 ($p=0.034$) after 12 months.
THI scores showed a statistically significant reduction after 3 months, both with the device on (32.4, $p=0.006$) and off (34.8, $p=0.061$) compared to preoperative scores (76).
VAS scores improved significantly one-month post-implantation and thereafter (preop: 8.25; device on: 2.42, $p<0.001$; device off: 4.33, $p<0.001$).
Tinnitogram frequency changes were observed in 4 patients post-implantation, with 2 shifting to lower frequencies and 2 to higher frequencies.

Conclusion
Cochlear implantation demonstrated significant efficacy in tinnitus reduction, with more pronounced improvements observed three months or later post-surgery. Changes in tinnitus pitch were noted in tinnitogram frequency assessments following implantation. While cochlear implantation shows promise as a tinnitus treatment, further research is warranted to identify factors associated with non-responders and to optimize outcomes for all patients.

Keywords: Tinnitus, Cochlear implantation, Amplification

Oral Presentation 02

Implantable Hearing Devices for Tinnitus Management
OP 02-7

Effect of electrical stimulation with a cochlear implant on tinnitus impact: protocol of an individual patient data meta-analysis

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While several studies have shown a reduction in tinnitus distress following cochlear implantation, others showed an increase or no change after implantation. At this stage, clinicians have little certainty when counselling their patients prior to implantation regarding tinnitus post-implantation. To help clinicians to counsel cochlear implant (CI) candidates on the risk of developing or improving tinnitus after implantation, we aim to assess the effect of electrical stimulation with a CI on tinnitus impact for individual adult patients with tinnitus. We will also apply prediction models to individual patient data (IPD) of clinical trials to find predictive factors of the effect of electrical stimulation on tinnitus impact.

Method and analysis
The IPD meta-analysis is a follow-up project of the systematic review on cochlear implantation in patients with tinnitus as a primary complaint. First, the systematic searches will be updated to date. Methodological quality of eligible studies will be assessed using the Risk of Bias In Non-randomised Studies of Intervention tool (ROBINS-I). Based on a data-sharing agreement, authors of the eligible studies will be invited to share their deidentified and complete IPD. The primary outcome is the effect of electrical stimulation with a CI on tinnitus impact 1 month or more post-implantation. IPD meta-analysis will be used to assess the primary outcome, while differentiating the tinnitus impact questionnaires. Second, linear regression analyses will be used to model the effect of electrical stimulation on tinnitus impact based on relevant predictors. In this presentation we will explain the methods used as well as the approach for data sharing used for the IPD meta analsyes.

Keywords: Individual Patient Data Meta analysis, Data sharing, Prediction

Oral Presentation 02

Implantable Hearing Devices for Tinnitus Management
OP 02-8

Tinnitus Reduction After Cochlear Implantation in Asymmetric Hearing Loss: A Prospective Multicenter Study

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Introduction
Tinnitus is a common symptom among patients with asymmetrical hearing loss(AHL). Cochlear implantation(CI) is an effective treatment for both auditory rehabilitation and tinnitus management in individuals with severe to profound hearing loss. This prospective multicenter study aims to evaluate the efficacy of CI in reducing tinnitus in patients with AHL.

Methods
This study included twenty patients with AHL. The worse ear had a pure-tone average (PTA) of ≥ 70 dB and an aided speech discrimination score(SDS) of ≤ 50% at 60 dB, while the better ear had a PTA of 40–70 dB. Hearing thresholds, speech discrimination scores(SDS), speech intelligibility, and tinnitogram were evaluated before and after CI surgery. To assess subjective changes in tinnitus symptoms, the tinnitus handicap inventory (THI) questionnaire was administered.

Results
A total of 15 patients were included in the study, with an average age of 57.8 ± 16.5 years. The etiologies of hearing loss were idiopathic (75%) and sudden sensorineural hearing loss(SSNHL) (25%). Before CI, the mean hearing threshold in the implanted ear was 90.6 ± 13.0 dB, with an SDS of 7.6 ± 11.7%. In the better ear, the mean hearing threshold was 60.1 ± 7.4 dB, with an SDS of 56.2 ± 24.2%. At three months after CI, the aided threshold improved to 28.3 ± 7.8 dB, with an aided SDS of 62 ± 22.9%. Additionally, the categories of auditory performance(CAP) score significantly improved to 6.4 ± 0.8. The THI score significantly decreased from a preoperative mean of 26.8 ± 13.0 to 26.8 ± 10.3 after cochlear implantation, indicating a notable reduction in tinnitus severity.

Conclusion
CI significantly improved auditory performance and reduced tinnitus severity in patients with AHL. These findings suggest that CI is an effective intervention for both auditory rehabilitation and tinnitus management in patients with AHL.

Keywords: Cochlear implantation, Asymmetric hearing loss, Tinnitus

Oral Presentation 03

Neuromodulation in Tinnitus Treatment
OP 03-1

Magnetoencephalography reveals changes in oscillatory activity and functional connectivity in people with tinnitus undergoing transcranial Direct Current Stimulation

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Background and aims Transcranial Direct Current stimulation (tDCS) is a technique involving a low-intensity electric current delivered via electrodes on the head. It is postulated to suppress or enhance neural activity in the region between electrodes. It represents a potential treatment option for tinnitus.
Magnetoencephalography (MEG) is a neuroimaging technique that allows for the mapping of brain activity by recording magnetic fields produced by electrical currents occurring naturally in the brain. In this study, MEG was used to investigate changes in the brain activity of people with tinnitus while undergoing tDCS. Methods 35 participants with tinnitus were randomly assigned to received either real or sham tDCS.
Resting state MEG recordings were collected for 10 minutes before, 20 minutes during, and 10 minutes after stimulation. Oscillatory brain activity was assessed at the level of the whole brain and two regions of interest: the frontal cortices -immediately below the electrodes – and the temporal cortices -containing the auditory cortices.
Results There was no statistically significant change in tinnitus loudness scores after verum tDCS compared to the sham condition. Localised changes in spectral power were observed in the beta and delta bands, and in the gamma band at the level of the whole brain. No changes in functional connectivity were observed.
Conclusion This study was the first to combine tDCS with MEG in a tinnitus population. Oscillatory changes in some frequency bands could be localised to the frontal or temporal regions. Some observed changes, most notably in the gamma band could only be detected at the whole-brain level. This suggests tDCS can induce changes in oscillatory brain activity in regions not directly affected by tDCS. These changes in activity do not translate to changes in functional connectivity. The design of future studies of tDCS for tinnitus should be informed by these findings.

Keywords: Tinnitus, TDCS, MEG

Oral Presentation 03

Neuromodulation in Tinnitus Treatment
OP 03-2

The Therapeutic Effect and Mechanism of Ultrasonography-Guided Stellate Ganglion Block in Acute Subjective Tinnitus

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Objective: To determine whether stellate ganglion block has a therapeutic effect on subjective tinnitus and to analyze the efficacy in acute subjective tinnitus without hearing loss.
Methods: The study involved 136 patients with acute subjective tinnitus from January 2021 to October 2023. A prospective design was conducted, with patients divided into experimental group of 70 and control group of 66. The control group received sound therapy, while the trial group additionally underwent stellate ganglion block. Scores on the THI, VAS scales were recorded before treatment, at one month post-discharge, and at three months post-discharge.
Results: A total of 150 patients were enrolled in the study, but some patients withdrew due to adverse reactions or other reasons, 136 completed the treatment.The experimental group consisted of 70 patients undergoing stellate ganglion block, including 29 females and 41 males, with an average age of 39.6 ± 16.5 years. The control group, comprising 66 patients who received sound therapy but did not undergo stellate ganglion block, included 29 females and 37 males, with an average age of 41.4 ± 17.5 years. There were no significant statistical differences in basic clinical characteristics between the two groups (P>0.05).
Results showed that the total effective rate in the experimental group(84.29%) were higher than those in the control group(60.61%). One month after treatment, and three months after treatment was also significantly higher in the experimental group compared to the control group. Conclusion: Stellate ganglion block demonstrated clear efficacy for acute idiopathic subjective tinnitus, with sustained effectiveness at the 3-month follow-up. Ultrasound-guided stellate ganglion block for tinnitus treatment exhibits good clinical safety and efficacy, warranting clinical promotion and application.

Keywords: Subjective tinnitus, Stellate Ganglion Block, Efficacy

Oral Presentation 03

Neuromodulation in Tinnitus Treatment
OP 03-3

Long-Term Real-World Clinical Outcomes of Bimodal Stimulation for Tinnitus

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Background:
Bimodal treatment combining sound with electrical tongue stimulation using the Lenire® device is a non-invasive, scalable and accessible neuromodulation treatment approach for tinnitus. The effectiveness of the bimodal device has been established in several large-scale clinical trials and real-world clinical chart reviews. Clinical trials have demonstrated that after 12-weeks of treatment with Lenire, the therapeutic effects of the treatment are sustained up to 12-months after treatment ended. To date, no results of long-term effectiveness for Lenire in a clinical practice setting have existed. The current study includes follow-up data collected 12-months after device fitting which provides invaluable insights into the long-term efficacy of the Lenire device. This will be the first time evidence of the sustained effect is shown outside of the controlled environment of a clinical investigation.

Methods:
At the Alaska Hearing and Tinnitus Center, patients with bothersome tinnitus were fitted with the Lenire bimodal stimulation device after completing an initial assessment. Patients were asked to return for follow-up assessments approximately 6-weeks (FU1), 12-weeks (FU2) and 12-months (FU3) post device fitting.

Results:
Improvements in tinnitus severity, measured using percentage responders and mean changes to treatment on the Tinnitus Handicap Inventory (THI) at FU1 and FU2 assessments were consistent with published clinical trial and real-world evidence results evaluating the Lenire device. Specifically, in more than 250 patients, over 90% of patients experienced clinically meaningful reduction in tinnitus after 12-weeks (FU2) of treatment. Among those who returned 12-months after their initial assessment (FU3), the clinically meaningful tinnitus improvement was sustained in 89% of patients.

Conclusions:
Tinnitus management remains challenging owing to the transient effects, lack of scalability and resource intensive characteristics of currently available treatments. Real-world evidence from this clinic strongly demonstrates that bimodal sound therapy and tongue stimulation is feasible in clinic, scalable and provides long-term relief.

Keywords: Bimodal stimulation, Real-world evidence, Neuroplasticity

Oral Presentation 03

Objective Tinnitus
OP 03-4

The effects of transverse sinus stenosis and trans-stenotic pressure gradient on the hemodynamics at the transverse - sigmoid sinus junction

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Objective To explore the effects of transverse sinus stenosis (TSS) and trans-stenotic pressure gradient (TPG) on the hemodynamics at the transverse - sigmoid sinus junction (TSSJ).

Methods Computed tomography venography of one patient with pulsatile tinnitus (PT) was used to construct a personalized venous sinus model. Different levels of TSS (0/25/ 50/ 75%) and TPG (2/ 5/ 8/ 11/ 14/ 17/ 20 mmHg) were used to constructed for steady-state computational fluid dynamics (CFD) simulation in a group of finite element models. The distributions of the wall pressure, maximum wall pressure (Pmax) and blood flow pattern (velocity vector or velocity streamline) were calculated to evaluate the hemodynamic changes.

Results The Pmax was located in the upper and lateral part of the TSSJ, regardless of different levels of TSS or/and TPG. As TSS level increased, the wall pressure at TSSJ decreased linearly as $y = 896.808 - 540.395xTSS$ ($R2 = 0.994$, $p = 0.003$); the blood flow velocity increased; the medial blood flow pattern tended to be disordered. As TPG level increased, the wall pressure at TSSJ increased linearly as $y = -35.704 + 100.603xTPG$ ($R2 = 0.998$, $p = 0.000$); the high pressure range expanded; the blood flow velocity increased; when the TPG exceeded 11 mmHg, the medial blood flow pattern was smooth.

Conclusion The Pmax location of TSSJ may not change with the levels of TSS and/or TPG, which may increase linearly with decreased TSS and/or increased TPG. The blood flow velocity may increase with increased TSS and/or TPG.

Keywords: Pulsatile tinnitus, Transverse sinus stenosis, Trans-stenotic pressure gradient

Oral Presentation 03

Objective Tinnitus
OP 03-5

Analysis of tinnitus characteristics and postoperative efficacy in Superior semicircular canal dehiscence syndrome (SSCDS)

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Objective: To explore the surgical approaches for superior semicircular canal dehiscence syndrome and the efficacy of tinnitus treatment.
Methods: A retrospective study was conducted to collect data on 17 patients diagnosed with superior semicircular canal dehiscence syndrome between January 2020 and November 2023 in our hospital (diagnosed using VEMP, PTA, and CT scans). Ten patients with symptoms of tinnitus and vertigo underwent surgical treatment. There were 7 females and 3 males and the median age was 42 years. Three patients developed tinnitus after exposure to loud sounds, and 7 patients had vascular tinnitus with a distinct rhythm. 10 cases underwent surgery via the mastoid approach: 5 cases applied for superior semicircular canal occlusion, 3 cases combined endoscopic superior semicircular canal repair, and 2 cases applied for microscopic repair. Postoperative follow-ups at 3 and 12 months assessed the improvement in vertigo, used the THI (Tinnitus Handicap Inventory) questionnaire to evaluate the improvement in tinnitus, and monitored the patients' hearing.
Results: Out of the 5 patients who underwent superior semicircular canal occlusion surgery, both tinnitus and vertigo were cured. In the repair group, 4 patients experienced a cure for both tinnitus and vertigo, while 1 patient showed no significant improvement in vertigo and tinnitus. None of the 10 patients experienced hearing loss. The THI (Tinnitus Handicap Inventory) scores of the 9 patients showed a statistically significant difference between preoperative and postoperative scores.
Conclusion: For patients with SSCDS, the transmastoid approach is a safe and effective surgical method. Superior semicircular canal occlusion surgery shows a higher rate of control for vertigo and tinnitus compared to semicircular canal repair surgery. The use of a microscope combined with an endoscope allows for a clear visualization of the dehiscence site and reducing the risk of membranous labyrinth injury.

Keywords: Superior semicircular canal dehiscence syndrome, Analysis of tinnitus characteristics, Postoperative efficacy

Oral Presentation 03

Objective Tinnitus
OP 03-6

Clinical evaluation of Eustachian tube injection for the treatment of patulous Eustachian tube

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Objectives: To analyze clinical characteristics of 19 cases of Eustachian tube injection for the treatment of patulous Eustachian tube.
Methods: Nineteen cases of patulous Eustachian tube were enrolled from July 2020 to April 2023, including 10 males and 9 females. The age ranged from 23 to 63 years. Eustachian tube injection were performed for these patients.Surgical treatment method, clinical symptoms before and after treatment, otoscopic tympanic membrane conditions, Eustachian tube function, long-term acoustic tympanogram, Eustachian tube magnetic resonance examination were recorded. The patients were followed up for 12-24 months.
Results: Among the 19 patients, 6 had aural fullness after chewing or swallowing and symptom was relieved after sniff, accompanied a habitual sniff. 13 cases had autophony of voice or breathing sounds, which showed espiratory-induced TM movement by endoscopy. Long-term acoustic tympanogram examination showed consistent changes in acoustic impedance with respiratory rhythm. All 19 patients underwent Eustachian tube injection using a pressurized syringe. Based on preoperative valuation, the amount of mixed fascia and fat tissue injected varied from 1ml to 4.5ml. All patient's symptoms have significantly improved. Magnetic resonance imaging of the Eustachian tube was performed after surgery, and fat as evenly distributed under the Eustachian tube mucosa. However, after 12 months post surgery, 3 patients experienced autophony of voice or breathing sounds again. Magnetic resonance imaging revealed a significant reduction in the distribution of submucosal fat in the Eustachian tube compared to before. All 3 patients also underwent Eustachian tube injection again. Follow up for 12 months after surgery showed no recurrence.
Conclusions: Subcutaneous fascia and fat injection of the Eustachian tube is one of the effective methods for treating patulous Eustachian tube. The dosage of injection varies greatly among individuals, and precise preoperative evaluation of injection dosage is required. Patients with postoperative recurrence can undergo Eustachian tube injection again.

Keywords: Patulous Eustachian tube, Submucosal fascia and fat injection, reoperation

Oral Presentation 03

Sound Therapy and Behavioral Therapy for Tinnitus
OP 03-7

Combining Unequal Variance Signal Detection Theory with the Health Belief Model to Optimize Shared Decision Making in Tinnitus Patients: Part 1 - Model Development

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Background
Shared Decision Making (SDM) may help patients to choose the intervention that best fits their needs. To improve SDM we developed a method to assess the accuracy and utility of decisions made by tinnitus patients when freely choosing between audiological care and psychosocial counseling.

Method
We developed a model by combining Signal Detection Theory (SDT) with the Health Belief Model (HBM). HMB states that perceived severity of an illness is strongly related to sick-role behavior. As proxies for perceived severity, we selected hearing loss and Tinnitus Handicap Inventory (THI) score at baseline. Data was gathered in a prospective cohort of 145 adults referred for tinnitus care to an outpatient audiology clinic in the Netherlands. The participants were asked to decide freely on uptake of audiological care (provision of hearing aids with or without a sound generator) and uptake of psychosocial counseling. Logistic regression with Bayesian inference was used to determine the cumulative distribution functions and the probability density functions of true positive decisions and false positive decisions as function of hearing loss and baseline THI-score for both treatment options, respectively.

Results
Baseline THI-score drives decisions about psychosocial counseling and hearing loss drives decisions about audiological care. For decisions about audiological care the unbiased decision criterion is 37 dB(HL), meaning that a lenient decision criterion (likelihood ratio < 1) is adopted by patients with a hearing loss below 37 dB and a strict criterion (likelihood ratio > 1) by patients with a hearing loss exceeding 37 dB. For psychosocial counseling uptake the decision criterion is always strict, regardless of baseline THI-score.

Conclusions
Combining SDT and HBM can help assess accuracy and utility of patient decisions, providing valuable information that can help to improve SDM by combining patient related outcome measures, decision drivers, and perceived benefits and costs of a treatment.

Keywords: Shared Decision Making, Sound Therapy, Cognitive Behavioral therapy

Oral Presentation 03

Sound Therapy and Behavioral Therapy for Tinnitus
OP 03-8

Combining Unequal Variance Signal Detection Theory with the Health Belief Model to Optimize Shared Decision Making in Tinnitus Patients: Part 2 – Patient Profiling

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Background
Shared Decision Making promotes patients and health care professionals making treatment choices together based on the best available evidence. In the case of professional equipoise (no clear treatment benefit), knowledge of the preferences and priorities for the patient impacting their decision making can be of utmost importance in the goal of achieving shared decisions made.

Methods
A statistical model was developed in previous work to analyze tinnitus patient decisions, synthesizing the Health Belief Model, Signal Detection Theory, and logistic regression to model patient decision patterns. We extended this statistical model to analyze how patient characteristics on sex, age, and laterality of tinnitus affect decision strategies concerning audiological care and cognitive behavioral therapy based psychosocial counseling.

Results
Sex - The results indicated that males used a strict decision criterion when deciding about psychosocial counseling, while females used a strict decision criterion for decisions about audiological care. The success rate of psychosocial counseling is only about 50% for females, corresponding to chance performance.

Age - Older participants adopted a more lenient decision criterion for audiological care, while younger participants adopt a stricter decision criterion. For psychosocial counseling, both younger and older participants adopt a strict criterion. For the younger group, psychological counseling is more likely to be successful compared with the older group.

Laterality - The probability of success for audiological care is at chance performance level for unilateral tinnitus patients, while bilateral tinnitus patients apply a strict decision criterion for hearing losses above 60 dB(HL). For decisions about psychosocial counseling, unilateral tinnitus patients adopt a strict decision criterion, while bilateral tinnitus patients adopt a lenient decision criterion for the entire baseline THI-score range.

Conclusions
Our findings underscore the importance of personalized treatment approaches based on specific patient characteristics and the need for further research to test and improve these findings.

Keywords: Shared Decision Making, Sound Therapy, Behavioral Therapy

Oral Presentation 03

Sound Therapy and Behavioral Therapy for Tinnitus
OP 03-9

Reorganizations of auditory cortex subregions and its prediction of sound therapy outcomes in tinnitus patients

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Purposes: To investigate structural and functional alterations in auditory cortex (AC) subregions of tinnitus patients, and identify potential predictive indicators for sound therapy.
Methods: Sixty-three tinnitus patients (29 in effective group (EG), 34 in ineffective group (IG)) and 38 healthy controls (HCs) were recruited. 3D high-resolution T1-weighted images, diffusion tensor imaging (DTI), and resting-state functional MRI (RS-fMRI) of all subjects were obtained using a 3.0T MRI system before the sound therapy. Gray matter volume, fractional anisotropy (FA), amplitude of low-frequency fluctuations (ALFF), fractional ALFF (fALFF), regional homogeneity (ReHo) within eight AC subregions, and functional connectivity (FC) between each subregion and the whole brain were compared among the three groups and between each pair of groups. Spearman correlations were used to estimate the relationships between imaging and clinical data. Receiver operating characteristic (ROC) analyses were used to search for sensitive imaging indicators to predict the prognosis of sound therapy.
Results: Patients in both EG and IG exhibited extensive structural and functional abnormalities in AC subregions, particularly in bilateral TE3.0. Compared with IG, EG exhibited significant higher FC between bilateral TE3.0 and left inferior temporal gyrus (ITG). Moreover, the FC values between bilateral TE3.0 and left ITG were positively correlated with the improvement in THI scores after treatment. When the FC values between bilateral TE3.0 and left ITG combined as an indicator, the area under the curve (AUC) values reaches the highest of 0.811.
Conclusion: Our findings demonstrated extensive AC reorganizations in TE3.0, providing new insights into the mechanism of tinnitus. The efficacy of sound therapy might be closely related to the individual differences in reorganizations of AC subregions, and the FC values between bilateral TE3.0 and left ITG in combination might be an effective predictor for sound therapy.

Keywords: Tinnitus, Auditory cortex, Subregion

Oral Presentation 04

Neuromodulation in Tinnitus Treatment
OP 04-1

Personalized neuromodulation: a novel strategy for improving tinnitus treatment

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Background: This study aimed to evaluate the potential efficacy improvement of personalized neuromodulation, where the choice of neuromodulation modality is determined based on responses from a pilot trial.
Methods: A total number of 71 patients were assigned to either the personalized or randomized neuromodulation groups. In the personalized group (n=35), both repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) were assessed during a pilot trial, and the responsive modality was subsequently administered to 16 participants. Non-responders in the pilot phase (n=19) were randomly assigned to receive rTMS, tDCS, or a combined treatment. In the randomized group (n=36), participants were allocated to a random order of rTMS, tDCS, or combined treatment. Tinnitus questionnaires were conducted before and after ten sessions of each neuromodulation.
Results: Among the 71 tinnitus patients, 11 dropped out due to reasons including increased tinnitus loudness (3), dizziness (1), skin burn (1), and loss to follow-up (6). The final analysis included 30 participants in each group. The personalized group exhibited significantly greater improvement in Tinnitus Handicap Inventory (THI) scores following neuromodulation compared to the randomized group. However, no significant difference was found between the two groups in terms of changes in tinnitus loudness, distress, and awareness. Within the personalized group, those who responded positively to the pilot test displayed greater THI score enhancement compared to non- responders. Across the rTMS, tDCS, and combined treatment subgroups, no significant differences were observed in THI scores, Numeric Rating Scale for loudness, distress, or awareness.
Conclusion: Personalized neuromodulation shows promising potential for optimizing neuromodulation modalities to enhance treatment outcomes.

Keywords: Neuromodulation, Tinnitus, Personalized

Oral Presentation 04

Neuromodulation in Tinnitus Treatment
OP 04-2

Alleviating Tinnitus with Electroacupuncture- A Prospective Randomized Controlled Trial

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Objective: Tinnitus is an endogenous sound without audiology stimulation and is bothersome that may lead to psychological reactions in some patients. Several treatment modalities treat tinnitus, but no single treatment can completely alleviate the symptom. There is well-established evidence of electroacupuncture application in treating neurological disease, but the effects on treating tinnitus need further elucidation. The primary endpoint of this study is to evaluate the effect of electroacupuncture on tinnitus. The secondary endpoint is the safety profile and adverse effect of treating tinnitus with electroacupuncture.
Materials and methods: This prospective clinical trial study underwent at China Medical University Hospital. We recruited patients with tinnitus and then divided them into two groups of actual acupuncture group and the control group with sham acupuncture. A total of 24 acupuncture sessions took place at a frequency of twice a week and lasted 12 weeks. The hospital anxiety and depression scale (HADS), tinnitus handicap inventory (THI) questionnaire and tinnitus VAS loudness and annoyance scale were completed by the patients before the intervention(W0), at the end of sessions(W12), and one month after the sessions(W16). The repeated measures ANOVA test compares the results in either group.
Results: Compared with the score before the sessions, the VAS loudness and VAS annoyance scores reduced significantly in the electroacupuncture group ($p = 0.05$, and $p = 0.005$, respectively). The HADS and THI scores did not decrease significantly between the electroacupuncture and control groups.
Conclusions: With electroacupuncture, the loudness and annoyance of tinnitus decreased without negatively impacting the psychological aspect. Further trial with large sample sizes is warranted, considering the minor intergroup differences and limited sampling size.

Keywords: Tinnitus, Electroacupuncture, Electrophysiology

Oral Presentation 04

Neuromodulation in Tinnitus Treatment
OP 04-3

Innovative Neuromodulation Protocol Design and Preliminary Results when Applied for Tinnitus Patients

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Tinnitus is a widespread auditory condition characterized by the perception of sound without an external source. It can severely impact the quality of life, leading to sleep disturbances, anxiety, depression, and reduced productivity. While traditional treatments like sound therapy and medications exist, neuromodulation with lingual stimulation has emerged as a promising therapy due to its innovative and multidimensional approach.

Neuromodulation Protocol
The patients followed a structured neuromodulation protocol combining lingual stimulation with sensory and auditory training. The protocol included:

Relaxation Phase: Initial relaxation to prepare the nervous system for neuromodulation.
White Noise Reading: Reading while exposed to white noise to engage cognitive and auditory pathways.
Postural Sensory Training:
Standing barefoot on the ground.
Standing on a cushion to challenge balance and proprioception.
Auditory Stimulation: Listening to a sweeping sound between 20 Hz and 20 kHz, designed to stimulate the auditory system across a broad frequency range.
Each stage lasted 20 minutes, totaling 1 hour and 20 minutes of stimulation per session. The protocol was administered twice daily with a 2-hour interval between sessions.

Results from Patient Data
Analysis of patient outcomes revealed significant improvements across tinnitus-related metrics:

Patient 1:
Tinnitus Impact (THI Total): 27% improvement.
Tinnitus Discomfort: 71% improvement.
Patient 2:
Tinnitus Impact (THI Total): 57% improvement.
Tinnitus Discomfort: 30% improvement.
Patient 3:
Tinnitus Impact (THI Total): 13% improvement.
Tinnitus Discomfort: No improvement.
Patient 4
Tinnitus Impact (THI Total): 60% improvement.
Tinnitus Discomfort: 80% improvement.
Patient 5
Tinnitus Impact (THI Total): 56% improvement.
Tinnitus Discomfort: 60% improvement.
Conclusion
This protocol, which combines lingual stimulation with auditory and sensory elements, demonstrates significant potential in reducing tinnitus severity and discomfort, with improvements of up to 80% in some cases. The multidimensional approach engages multiple neural pathways, likely contributing to its efficacy. Individual responses varied, emphasizing the importance of personalized treatment.

Keywords: Tinnitus, Neuromodulation, Tongue

Oral Presentation 04

Objective Tinnitus
OP 04-4

Feasibility of Using Distortion Product Otoacoustic Emission (DPOAE) for Objective Measurement of Vascular Pulsatile Tinnitus

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Objectives: An objective method for assessing vascular pulsatile tinnitus (VPT) could greatly enhance its diagnosis and evaluation. During distortion product otoacoustic emission (DPOAE) testing, some noise in the ear canal is inevitably recorded. This study aimed to determine whether VPT can be objectively measured using this recorded noise.
Methods: We retrospectively reviewed medical records of patients with unilateral VPT who visited our hospital between March 2019 and May 2023 with radiologically confirmed vascular abnormalities. A standard audiologic workup, including DPOAE, was conducted. DPOAE noise data were collected at six frequencies for both ears.
Results: A total of 29 patients participated, with a mean age of 41.3 years and an average symptom duration of three months. Lesion laterality was 24 on the right ear and 5 on the left. DPOAE noise on the VPT side was louder than the non-tinnitus side: 1.27 ± 2.04 dB at 1 kHz, 0.84 ± 2.87 dB at 1.4 kHz, 0.73 ± 2.54 dB at 2 kHz, 0.33 ± 2.19 dB at 2.8 kHz, 0.11 ± 2.64 dB at 4 kHz, and 0.97 ± 2.09 dB at 6 kHz. Pseudo-low frequency hearing loss (pseudo-LFHL) occurred in 7 patients (24%), with higher OAE noise values in pseudo-LFHL cases, though not statistically significant. After the water occlusion test (WOT), 17 patients (59%) were positive, 8 (28%) were partial, and 4 (14%) were negative. Noise levels were higher in positive or partial WOT cases, but no significant correlation was found between noise and WOT results.
Conclusion: Although DPOAE noise on the VPT side was generally higher than on the non-tinnitus side, the difference was not statistically significant. Greater noise was observed at frequencies below 2 kHz than at higher frequencies. More clinical data are needed to validate the feasibility of using DPOAE noise for VPT measurement.

Keywords: Vascular pulsatile tinnitus, DPOAE, Objective measurement

Oral Presentation 04

Objective Tinnitus
OP 04-5

Diagnosis and treatment strategies of 182 cases of middle ear

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Objective To analyze the clinical characteristics and treatment of middle ear myoclonus.
Methods 182 cases of middle ear myoclonus were enrolled in Shandong Provincial ENT Hospital, from September 2019 to August 2023, including 75 males and 107 females. The age ranged from 6 to 75 years, with a median age of 38 years. The relevant audiological and imaging findings were recorded. Oral carbamazepine and/or surgical treatment were used. The patients were followed up for 12-24 months and the tinnitus changes were observed.
Results Tinnitus was diverse. The inducing factors included external sound, speaking, chewing and blinking, etc. Tympanic membrane flutter with the same frequency as tinnitus was found in 36 cases by otoscopy, and 97cases of the waveform with the same frequency as tinnitus was found by longterm tympanogram examination. All patients with tinnitus had no change in hearing. 1 case of tinnitus complicated with epilepsy was treated with antiepileptic drug (topiramate) and tinnitus subsided. 1 case suffered from tinnitus after facial nerve decompression for traumatic facial paralysis was not given special treatment. 180 cases were treated with oral drug (carbamazepine), of which 42 cases were completely controlled and 67 cases were relieved; 71 cases were invalid. Among the 71 patients with no effect of carbamazepine treatment, 44 patients were treated by surgery, 39 patients had no tinnitus after surgery, 1 patient received three times of operation, and the third operation was followed up for 6 months, no tinnitus occurred again. The other 27 cases refused the surgical treatment due to personal reasons.
Conclusions Middle ear myoclonus tinnitus and the inducing factors manifestate diversity. Oral carbamazepine and other sedative drugs are effective for some patients, and surgical treatment is feasible for those who are ineffective for medication.

Keywords: Middle ear myoclonus, Tinnitus, Carbamazepine

Oral Presentation 04

Sound Therapy and Behavioral Therapy for Tinnitus
OP 04-6

Long-term efficacy of digital frequency customized relieving sound in treating chronic subjective tinnitus: a randomized controlled trialclicnial trial

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Background
Personalized sound therapy has emerged as a promising approach for treating chronic tinnitus. This study aimed to evaluate the effectiveness, particularly the long-term efficacy, of personalized sound therapy compared to unmodified music (UM) for managing chronic tinnitus.

Methods
This double-blinded, randomized parallel-group study assessed the long-term efficacy of personalized acoustic therapy over a 12-month period. Participants diagnosed with chronic tinnitus were randomly assigned to receive either Modified Tinnitus Relieving Sound (MTRS) or UM. The Tinnitus Handicap Inventory (THI) served as the primary outcome measure, evaluated at 3-month intervals. Secondary outcomes included the Athens Insomnia Scale (AIS), Hospital Anxiety and Depression Scale (HADS), and Visual Analogue Scale (VAS) scores.

Results
A total of 400 participants were enrolled and randomly assigned to therapy groups. All participants demonstrated reductions in THI scores compared to baseline during follow-up, but the improvement was more pronounced and sustained in the MTRS group. Significant improvements were also observed in AIS, HADS, and VAS scores in the MTRS group.

Conclusions
This study highlights the efficacy of personalized sound therapy, particularly the MTRS approach, in alleviating chronic tinnitus symptoms and associated conditions such as insomnia, anxiety, and depression. These findings support the integration of personalized sound therapy into clinical practice, given its potential for substantial and sustained benefits for tinnitus patients.

Keywords: Sound therapy, Tinnitus, FTRS

Oral Presentation 04

Sound Therapy and Behavioral Therapy for Tinnitus
OP 04-7

Efficacy and factors influencing outcomes of customized music therapy combined with a follow-up system in chronic tinnitus patients

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Backgrounds: The aim of this study was to explore the efficacy of customized therapy with a well-designed follow-up system in the treatment of tinnitus through a large sample one arm study and to identify the relevant factors affecting the treatment outcome.
Methods: The study investigated a total of 615 patients with unilateral or bilateral chronic tinnitus who received personalized and customized music therapy for 3 months. A complete follow-up system was designed by the professionals. Questionnaires of Tinnitus Handicap Inventory (THI), Hospital Anxiety and Depression Scale (HADS) and Visual Analogue Scale (VAS) were used to evaluate the therapeutic effects and relevant factors affecting the efficacy of therapy.
Results: The results showed a decreasing trend in THI and VAS scores after 3 months of therapy, with statistically significant differences between pre- and post-therapy time points($P<0.001$). All patients were divided into 5 groups according to THI scores, and the mean reduction score in catastrophic, severe, moderate, mild and slight group was 28, 19, 11, 5, 0 respectively. The proportion of tinnitus patients with anxiety was higher than that with depression (70.57% and 40.65%, respectively), and there were statistically significant differences between HADS-A/D scores pre- and post-therapy. Binary logistic regression showed that the baseline of THI, VAS scores, the duration of tinnitus and the state of anxiety prior to therapy were significant influencing factors of therapeutic efficacy.
Conclusions: The magnitude of reduction in THI scores after music therapy depended on the severity of the patients' tinnitus, the higher the initial THI scores, the greater the potential for improvement in tinnitus disorders. Music therapy also reduced the anxiety and depression levels of tinnitus patients. Therefore, personalized and customized music therapy with a comprehensive follow-up system may be an effective treatment option for chronic tinnitus patients.

Keywords: Tinnitus, Customized music therapy, Efficacy

Oral Presentation 04

Sound Therapy and Behavioral Therapy for Tinnitus
OP 04-8

A Cure of Tinnitus after Tinnitus Retraining Therapy - Insights from a Large Case Series

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ABSTRACT

Objectives: To identify the clinical features of sensorineural tinnitus patients who achieved complete symptom resolution or "cure" after tinnitus retraining therapy (TRT) and to determine significant factors that influence tinnitus resolution duration after TRT.

Methods: A retrospective analysis of sensorineural tinnitus patients who underwent TRT and achieved a cure between January 2017 to January 2022 was performed. Cure of tinnitus was defined as patients experiencing symptoms for less than 5 minutes of awareness per day. Clinical information, including demographics, tinnitus duration, audiometric results, and therapeutic response, were examined.

Results: A total of 1027 patients who achieved a cure of tinnitus were included, with more females (65.4%, n=672) than males (35.6%, n=355). The median age was 57 years (range:12-92) with most having unilateral tinnitus (73.3%, n=753). More than half had tinnitus with hearing loss (53.3%, n=549) and the majority were under Jastreboff's tinnitus category 2 (38.7%, n=397). The median duration of tinnitus before consult was 12 months range (range:1-480) while the median duration before tinnitus resolution after TRT was 17 months (range:1-96). In Jastreboff's tinnitus categories, category 4 had the longest resolution time (median 18 months) and category 1 the shortest (median 15 months), but the difference was not statistically significant. A moderate correlation was observed between age and tinnitus resolution duration (Spearman correlation coefficient=0.391, p-value<0.05) and between tinnitus duration before consult and tinnitus resolution duration (Spearman correlation coefficient=0.355, p-value<0.05)

Conclusion: TRT seems to be a promising treatment option for patients with sensorineural tinnitus. The time to achieve this cure may range from a few months to years after TRT, indicating the heterogeneity of the mechanism and therapeutic response. The younger patients and the earlier management after the onset of tinnitus seem to be good prognostic factors for a shorter tinnitus cure time after TRT.

Keywords: Directive counseling, Sensorineural tinnitus, Tinnitus retraining therapy

Oral Presentation 04

Sound Therapy and Behavioral Therapy for Tinnitus
OP 04-9

Neurophysiological correlates of tinnitus suppression investigated with EEG using amplitude-modulated sound stimuli

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Residual inhibition (RI) refers to the temporary reduction or suppression of the tinnitus percept following acoustic stimulation. Various acoustic stimuli have been evaluated for their effectiveness, with neurophysiological correlates measured via EEG and behavioral metrics such as tinnitus loudness. This presentation reports initial results from an EEG study investigating acoustic stimulation with amplitude-modulated (AM) sounds. The study aims to compare the effectiveness of different AM stimuli in inducing RI and examine associated changes in oscillatory brain activity. Additionally, it explores whether these changes correlate with tinnitus loudness ratings and includes comparisons between responders and non-responders to sound stimulation.

Patients were recruited at the Tinnitus Center in Regensburg. Baseline measures included tinnitus questionnaires (e.g., Tinnitus Handicap Inventory, THI), audiometry, and tinnitus frequency and loudness matching. During the experiment, EEG was recorded for 3 minutes before stimulation, during 3 minutes of stimulation, and for 3 minutes after stimulation. The stimuli included amplitude-modulated (AM) sounds at 10 Hz and 23 Hz at the tinnitus frequency, 10 Hz and 23 Hz as a low tone three octaves below the tinnitus frequency, and an unmodulated control stimulus at the tinnitus frequency. After stimulation, participants rated their tinnitus loudness seven times at 30-second intervals using a percentage scale relative to pre-stimulation (100%).

Data analysis included 42 participants with a mean THI score of 35 (SD = 21). All stimuli induced residual inhibition within the first 90 seconds (3 ratings average). The reference control stimulus was the least effective, with a mean tinnitus loudness of 90% ($\beta = 89.9$, $p < .001$), while the 10 Hz amplitude-modulated stimulus at the tinnitus frequency was the most effective ($\beta = -10$, $p < .001$). Oscillatory power changes and responder analyses will be presented.

Keywords: Residual inhibition, EEG, Amplitude modulation

Oral Presentation 05

Combined Disease/Comorbidities Associated with Tinnitus
OP 05-1

Lower DTI-ALPS index in patients with tinnitus: DTI-ALPS Mediates the effect of sleep on tinnitus

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Background:
Sleep disturbance is a common comorbidity in tinnitus patients, which may be attributed to changes in brain structure and function. The aim of this study was to explore the potential role of the glymphatic system (GS), a recently discovered pathway for brain waste clearance, in tinnitus and the associated sleep disturbance.
Methods:
The DTI_ALPS index of 22 tinnitus patients and 22 healthy controls (18–60 years old) were compared after controlling for age, sex, and handedness. Partial correlation and mediation analyses were performed to explore the association between the above parameters and clinical data.
Results:
Significant differences were found between the right-side DTI-ALPS index and the DTI-ALPS index of the healthy group. Furthermore, the DTI-ALPS index in tinnitus patients was significantly lower than that of the healthy group (1.288 vs. 1.422, p =0.009). After adjusting for age and sex, the DTI-ALPS index correlated significantly with the Tinnitus Handicap Inventory (THI) scores (r= -0.587, p<0.001). The DTI-ALPS index was negatively correlated with Pittsburgh Sleep Quality Index (PSQI) scores (r= -0.457, p = 0.032). The mediation analysis of the ALPS index, PSQI, and THI revealed a significant indirect effect of PSQI on the association between ALPS index and THI (p<0.0001)
Conclusion: The glymphatic system may influence sleep disturbance in tinnitus patients due to its role in brain waste clearance.We observed a decrease in DTI-ALPS in tinnitus patients, and our analyses suggest that sleep disturbances influence tinnitus through the mediation of DTI-ALPS.Thus, greater emphasis should be placed on averting sleep issues at the Tinnitus.

Keywords: Diffusion tensor imaging, Glymphatic system, Perivascular space

Oral Presentation 05

Combined Disease/Comorbidities Associated with Tinnitus
OP 05-2

Effects of Personality Traits on the Severity of Chronic Subjective Tinnitus: A Cross-sectional Analysis

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We hypothesized that an individual's personality traits would have an impact on the distress of subjective tinnitus. To investigate this, 32 participants were recruited; we followed up with this cohort. This study is a cross-sectional analysis of a part of this cohort, identifying how their personality traits make a difference in the severity of tinnitus distress. Thirty-two participants completed a personality test based on the Big Five theory, consisting of 160 items. Additionally, the severity of tinnitus was assessed using the Tinnitus Handicap Inventory (THI), and the accompanying level of depression was measured using the Beck Depression Inventory (BDI). Audiometry tests, including pure-tone audiometry, were also conducted. Participants were categorized into the 'mild group' if their total THI score was 36 or below, and into the 'severe group' if their score was 38 or above. In the traditional five domains of the Big Five Inventory (Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism), only the 'Neuroticism' domain showed a difference between the two groups (25.1 ± 21.0 in the mild group and 43.1 ± 18.2 in the severe group, p = 0.014). Among ego-related factors, the 'Helplessness' domain (26.3 ± 22.9 in the mild group and 62.3 ± 27.9 in the severe group, p < 0.001) and the communication-related factor of 'Listening' (58.7 ± 18.8 in the mild group and 37.8 ± 27.9 in the severe group, p = 0.020) showed differences between the two groups. In the multivariate analysis, 'Helplessness' (estimate 0.419, 95% confidence interval 0.249–0.589, p < 0.001), 'Emotional Trauma' (0.213, 0.020–0.406, p = 0.032), and 'Pure-tone threshold at 2000 Hz' (0.944, 0.477–1.411, p < 0.001) were identified as factors influencing the severity of tinnitus distress. Ego-related factors, particularly Helplessness and Emotional Trauma, can influence tinnitus distress and should be considered in the management of tinnitus.

Keywords: Tinnitus, Personality, Big Five

Oral Presentation 05

Combined Disease/Comorbidities Associated with Tinnitus
OP 05-4

Global, regional, and national burden and trends of otitis media from 1990 to 2021: insights from the Global Burden of Disease Study 2021

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Background
Otitis media(OM) is a common cause of hearing loss and tinnitus both in children and adults. Thus, we carried out this study to discuss the global, regional, and national trends of otitis media from 1990 to 2021.
Methods
This research extracted two main indicators, including prevalence and incidence, related to OM across all ages from the Global Burden of Disease (GBD) database from 1990 to 2021. This study presented point estimates with 95% uncertainty intervals (UIs). It evaluated the changing trends of otitis media using the estimated annual percentage change (EAPC) and percentage change.
Results
(1) In 2021, the global prevalence and incidence of OM were 121.2 (95% UI:104.3
-140) per million and 391.3 (95% UI: 292.4 - 525.5) per million, respectively. More detailly, the age-standardized rate (ASR) of prevalence and incidence of OM were 1593.7 (95% UI: 1374.4 - 1833) and 5529.1 (95% UI: 4104.7 - 7511.9), respectively, with the estimated annual percentage change (EAPC) of -0.42(95% UI:-0.43,-0.40) and 0.12(95% UI: 0.10,0.14).
(2) Among the 5 Socio-Demographic Index (SDI) regions, in 2021, the Low SDI region recorded the highest ASR of prevalence and incidence, estimate at 2046.2 (95% UI:1733.1 - 2366.8) and 6133.8 (4494.8 - 8374.2), respectively. Approximately, the High SDI region recorded the lowest age-standardized prevalence rate of 1015 (95% UI :885.5 - 1158.1).
(3) In terms of WHO region, in 2021, the South-East Asia Region recorded both the highest prevalence and incidence with rates 38.9 (95% UI:33.1 - 45.2) and 112.2 (95% UI:83.2 - 151.5) per million, respectively.
Conclusions
This study conducted a comprehensive analysis of the prevalence, incidence, and trends of OM worldwide. The trend of OM on different regions is heterogeneous. The Low SDI and Low-middle SDI region have a heavier disease burden and need to pay attention on the management of OM.

Keywords: Otitis media, Disease burden, GBD 2021

Oral Presentation 05

Combined Disease/Comorbidities Associated with Tinnitus
OP 05-5

The association between smoking and tinnitus based on population data in Korea

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Background: There have been insufficient studies about the association between smoking and tinnitus. The association of smoking to tinnitus was investigated using population-based data in Korea.
Methods: This cross-sectional study used the 8th Korea National Health and Nutrition Examination Survey data from 2019 to 2021. People aged 40 years or older with hearing threshold of 25 dB or lower at both ears in pure tone audiometry were included and the association between smoking and tinnitus was evaluated. In total, 5219 people were included in this study.

Results: The numbers of current, ex-, and non-smoker groups were 768, 1163, and 3288, respectively. Among them, 50, 71, and 191 people had experienced tinnitus for 5 minutes or more in current, ex-, and non-smoker groups, respectively. There was no significant difference in the distribution of people who had experienced tinnitus for 5 minutes or more between the groups (p=0.745). Among people who had experienced tinnitus for 5 minutes or more, there was significant difference in the distribution of people who had experienced tinnitus lasting for 6 months or more between the groups, with the highest proportion in ex-smoker group (p=0.031). However, smoking was not a significantly associated factor of tinnitus in the multivariate regression analysis with other factors.

Conclusion: The association between smoking and tinnitus was uncertain in this population-based study.

Keywords: Tinnitus, Smoking, Population-based study

Oral Presentation 05

Combined Disease/Comorbidities Associated with Tinnitus
OP 05-6

Analysis of Postoperative Efficacy in Patients with Otosclerosis and Tinnitus

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Objective: To explore the efficacy of tinnitus treatment following stapedectomy surgery
Methods: A retrospective study analyzed 86 cases of patients with unilateral or bilateral otosclerosis accompanied by tinnitus, surgically diagnosed in our department from March 2022 to March 2024. There were 36 males and 56 females, with the youngest patient being 12 years old and the oldest being 71 years old. Exclusion criteria included tinnitus caused by other otological or psychological diseases. The Tinnitus Handicap Inventory (THI) was used to grade the severity of tinnitus preoperatively and postoperatively for the operated ear, with higher scores indicating more severe tinnitus. The grading is as follows: Grade I (mild, 0–16 points), Grade II (mild, 18–36 points), Grade III (moderate, 38–56 points), Grade IV (severe, 58–76 points), and Grade V (catastrophic, 78–100 points). A reduction of ≥20 points in the postoperative THI score compared to the pre-treatment score indicates alleviation of tinnitus; patients with disappearance or alleviation of tinnitus postoperatively were considered effective, while those with no significant change or worsening of tinnitus were considered ineffective. Data analysis was performed using GraphPad Prism 10 software; quantitative data of THI scores that met the normal distribution criteria were subjected to paired T-tests; for analyzing factors affecting postoperative tinnitus, count data were used, and chi-square tests were conducted, with $P<0.05$ considered statistically significant. All participants were followed up for 6 months.
Results: The preoperative THI score for all patients in the operated ear was 25.4±23.2 points, and the postoperative THI score was 12.8±15.4 points, with a statistically significant difference in THI scores. The average preoperative air conduction threshold was 42.6±28.8 dB, and the average postoperative air conduction threshold was 28.4±17.6 dB ($P<0.05$).
Conclusion: In patients with otosclerosis accompanied by tinnitus, stapedectomy can lead to the alleviation of tinnitus in some patients.

Keywords: Otosclerosis, Tinnitus, Analysis of Postoperative Efficacy

Oral Presentation 05

Combined Disease/Comorbidities Associated with Tinnitus
OP 05-7

Static compliance value represents tympanic membrane motion is a key factor in patients with ear stuffy and A-type tympanogram

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Objective: To explore the possible influencing factors inducing ear stuffiness symptoms of patients with type A tympanogram and symmetrical pure tone audiometry (PTA) results.
Method: We collected 98 patients (129 ear) with ear stuffiness symptoms (stuffy group) and 100 patients (130 ear) without ear stuffiness (non-stuffy group), and their age ranged 12-75 years old. The tympanic membranes were intact and the auditory immittance examination results presented A-type tympanogram (A, As and Ad) in all patients. For the ear stuffy group, the ear stuffy course last more than 1 month and the PTA results were symmetrical, and other confounding factors such as conductive hearing loss, middle ear effusion, otitis externa, cerumen, getting cold within 1month, sudden deafness and vertigo were excluded. For the non-stuffy group, patients without ear stuffy and PTA results were relatively normal. The tympanic pressure (TP), static compliance value (SC) and slope in tympanogram of the two groups were compared. Photos and videos of tympanic membrane morphology in two groups are record via endoscopy.
Result: In the stuffy group, tympanograms in 77.5% patients are A-type (100/129), 12.4% is As-type (16/129), and 10% is Ad-type (13/129); in the non-stuffy group, 75.2% is A-type tympanogram (97/129), 20.9% is As-type (27/129), and 4.7% is Ad-type (6/129). The mean value of the SC in the stuffy group is 0.7986±0.73 and in the non-stuffy group is 0.5782±0.43, there is significant difference in the two group ($P<0.0031$, Mann-whitney test). The values of TP and slope in the two groups were no significant different.
Conclusion: Combined with photos and videos of tympanic membrane, we found that the tympanic membranes in patients with ear stuffy were thinner and looser than that without ear stuffy. In the next step, we will further evaluate the relationship between Eustachian tube function and SC value in patients with ear stuffy.

Keywords: Static compliance value(SC), A-type tympanogram, Tympanic membrane motion

Oral Presentation 05

Combined Disease/Comorbidities Associated with Tinnitus
OP 05-8

The Impact of Tympanoplasty on Tinnitus Improvement in Patients with Chronic Otitis Media: A Systematic Review and Meta-Analysis

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Purpose: To investigate the changes in tinnitus among patients with chronic otitis media (COM) before and after tympanoplasty.

Methods: A literature search was conducted in the PubMed, EMBASE, and Web of Science electronic databases. Patients with COM alone and preoperative tinnitus who underwent tympanoplasty (with or without ossiculoplasty) and had their tinnitus outcomes evaluated using the Tinnitus Handicap Inventory (THI), the Visual Analogue Scale (VAS), or self-reported symptom changes were included. Patients with concurrent cholesteatoma or those who underwent mastoidectomy were excluded. Meta-analyses of THI scores and self-reported symptom changes were performed using the random-effects model.

Results: Out of the 134 articles identified, nine studies with a total of 483 patients were included. Ossiculoplasty was performed when necessary in three studies. The THI was used in five studies, with mean changes in scores ranging from −24.00 to +1.40. Three studies were included in the meta-analysis, which showed a mean difference of −3.93 (95% confidence interval (CI): −8.61 to 0.76; p = 0.10). The VAS was used in three studies, with mean changes in scores ranging from −3.35 to −0.10. Self-reported symptom changes were recorded in four studies, involving a total of 231 patients. After surgery, tinnitus disappeared in 77 (33.33%) patients, was alleviated in 96 (41.56%) patients, remained unchanged in 45 (19.48%) patients, and deteriorated in 13 (5.63%) patients. In the meta-analysis, the weighted proportions were 42.63% (95% CI: 20.43–66.52%), 41.17% (95% CI: 27.26–55.85%), 13.28% (95% CI: 4.36–26.06%), and 3.86% (95% CI: 0.70–9.41%), respectively.

Conclusion: Although the majority of patients with COM and concurrent tinnitus experienced a reduction in tinnitus severity following tympanoplasty, the meta-analysis did not demonstrate a significant improvement in THI scores. Further multicenter prospective studies are needed to identify the prognostic factors, given the high heterogeneity in patient characteristics and operative methods across the current studies.

Keywords: Chronic otitis media, Tinnitus, Tympanoplasty

Oral Presentation 05

Combined Disease/Comorbidities Associated with Tinnitus
OP 05-9

Determination of Personalogical and Psycho-Physiological Factors Associated with Tinnitus Experience among Industrial Workers

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Tinnitus, a perception of sound(s) in the absence of an external source, has been observed having insidious effects on the productivity, socio-emotional and health status of some industrial workers. Often times, workers exhibit evidence of low morale, lack of concentration, occupational stress and fatigue, reduced auditory performance, high blood pressure and poor health-related quality of life. Thus, this study examined the prevalence of tinnitus among the industrial workers, and the relationships among some personalogical factors (noise exposure, occupational stress and tinnitus experience/reaction), psycho-physiological factors (hearing status, blood pressure, insomnia, anxiety and depression, and general wellbeing) and tinnitus. The study adopted mixed methods design (QUAN + qual), while Multi-stage sampling technique was employed to select 544 participants (Male: 406 and Female -138), who were industrial workers with more than 5years work experience from 7 factories in Lagos, Nigeria. Data were collected using occupational hearing loss (OHLQ), tinnitus reaction (TRQ) and tinnitus handicap (THQ) questionnaires; perceived occupational stress scale, MOS–SF36 Health survey, sphygmomanometer, insomnia severity index, hospital anxiety and depression scale. Quantitative data were analysed using descriptive statistics, while qualitative data were content-analsyed. The findings revealed a high incidence (71%) of poor auditory performance with evidence of moderate and severe hearing loss. Participants (53%) claimed having subjective tinnitus, and this was not peculiar to any gender. Majority (68%) of the participants reported work fatigue, signs of poor social relationships and withdrawal syndrome, feelings of depression and lack of concentration. 65% of the participants had sleep difficulty, while 48% had signs of high blood pressure. Many of the participants claimed having reduced daily living functions, constant headache, loss of appetite and poor general wellbeing. Hearing conservation programmes, comprehensive management of tinnitus and associated conditions, regular medical check –ups and appropriate strategies for improved quality of life were recommended.

Keywords: Industrial workers, Tinnitus, Quality of life

Oral Presentation 06

Basic Research in Tinnitus
OP 06-1

Tinnitus treatment with olanzapine: randomized cross-over versus placebo study" and personality traits .

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Psychological factors were previously related to tinnitus perception and distress, playing a modulatory role. Previous work demonstrated that personality traits may be a predictor of the severity of tinnitus, with impact on the individual response to tinnitus measuring personality, behavior and neurobiological techniques. The big Five model can classify personality traits in order to be evaluated neuroscientifically. Several medications have been used over the last few decades to treat tinnitus, always with partial results. To date, there is no medication approved by the FDA for the treatment of tinnitus..
The dopaminergic pathway can be modulated by receptors and their agonists and antagonists, reducing the perception of tinnitus Dopamine (DA) and norepinephrine (NE) have been repeatedly implicated in neuropsychiatric vulnerability.
Aim: To analyze tinnitus severity amongst different personality traits..
• Method: Fifty tinnitus patients with tinnitus lasting for at least 6 months filled out the questionnaires NEO-FFI and THI, and also VAS scales for volume and distress and CGI)Clinical Global Impress). The THI and VAS scores were statistically correlated to the personality traits. The drug treatment chosen was olanzapine at a dose of 5 mg daily for 3 months. The research lasted 7 months, being cross over against placebo with one month wash out.

Results: Most frequent personality trait scored was neuroticism (36% high and 32% very high).
Olanzapine treated period : Significant effect of the "time" component.
Association of personality traits with response to olanzapine treatment.
It was possible to observe Clinical Trend: (12 patients off)
VAS volume and discomfort drop > 50% - more significant improvement High level of neuroticism, agreeableness and conscientiousness
THI drop > 50% Significant improvement High level of Neuroticism and conscientiousness

Keywords: Tinnitus, Big five, Neuroticism

Oral Presentation 06

Basic Research in Tinnitus
OP 06-2

Neuroprotective Effect of Valproic Acid on Salicylate-Induced Tinnitus

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High-dose salicylate induces temporary moderate hearing loss and the perception of a high-pitched tinnitus in humans and animals. Previous studies demonstrated that high doses of salicylate increase N-methyl-d-aspartate (NMDA) receptor levels, resulting in a rise in Ca2+ influx and induction of excitotoxicity. Glutamate excitotoxicity is associated with failure in the maintenance of calcium homeostasis, mitochondrial dysfunction, and production of reactive oxygen species (ROS). Valproic acid (VPA) is widely used for the management of bipolar disorder, epilepsy, and migraine headaches, and is known to regulate NMDA receptor activity. In this study, we examined the beneficial effects of VPA in a salicylate-induced tinnitus model in vitro and in vivo. Cells were pretreated with VPA followed by salicylate treatment. The expression levels of NMDA receptor subunit NR2B, phosphorylated cAMP response element-binding protein-an apoptosis marker, and intracellular levels of ROS were measured using several biochemical techniques. We observed increased expression of NR2B and its related genes TNFα and ARC, increased intracellular ROS levels, and induced expression of cleaved caspase-3. These salicylate-induced changes were attenuated in the neuronal cell line SH-SY5Y and rat cortical neurons after VPA pretreatment. Together, these results provide evidence of the beneficial effects of VPA in a salicylate-induced temporary hearing loss and tinnitus model using GPIAS, Auditory brainstem response, microPET-CT and immunohistochemistry NR2B in the auditory cortetx.

Keywords: Salicylate, Tinnitus, Valproic acid

Oral Presentation 06

Basic Research in Tinnitus
OP 06-3

Auditory gating in hearing loss and tinnitus

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Tinnitus may arise from decreased neural inhibition, or a reduced suppression of neural signals associated with sound. Recently, inhibition was linked to tinnitus severity using a measure termed auditory gating. This paradigm consists of successive tonal pairs, with S1 being the first tone in the pair and S2 being the second tone. In typical gating, the cortical auditory evoked potential (CAEP) in response to the S2 stimulus should occur at a significantly reduced amplitude (reflecting inhibition) in comparison to the S1 stimulus. Using this approach, sensory inhibition at the thalamocortical level may be quantified through amplitude ratio indices (S2 CAEP/S1 CAEP) or amplitude difference indices (S1 CAEP-S2 CAEP). P50 and N1 gating responses have been correlated with tinnitus severity in adults with normal hearing, while the P2 gating response has been correlated with hearing loss in those with hearing loss, but no tinnitus. Therefore, it remains to be seen how the auditory gating response changes when both tinnitus and hearing loss are present. We recorded the CAEP gating response using high-density EEG in a group with hearing loss and a group with hearing loss and tinnitus. The gating response for each CAEP peak (Pa, P50, N1, P2) was compared at the within-group level, to examine if appropriate gating occurred within each group. In addition, the CAEP gating amplitude ratio and difference indices were compared at the between-group level to determine whether those with tinnitus and hearing loss presented with an atypical gating response as compared to those with only hearing loss. Next, linear regression analyses were made to examine how the factors of age, hearing threshold, and CAEP peak gating amplitude indices contributed to tinnitus severity as measured by the THI. The results of this study have implications for both diagnostics and intervention in tinnitus, which are discussed.

Keywords: Auditory gating, EEG, Inhibition

Oral Presentation 06

Basic Research in Tinnitus
OP 06-4

Temporal Correlates between Auditory Evoked Responses in the Medial Geniculate Body and in Patients with Refractory Tinnitus

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The Medial Geniculate Body (MGB), an early structure in the auditory pathway, is hypothesized to contribute to sensory gating by passing on relevant auditory signals while suppressing irrelevant noise. Dysfunctional sensory gating at the level of the MGB may contribute to a tinnitus perception. To investigate sensory gating in the MGB, we recorded simultaneous EEG and LFP from Deep Brain Stimulation (DBS) electrodes targeting the MGB from four patients with refractory tinnitus. Auditory stimuli consisted out of a 50ms tone at 600 Hz. We compared the temporal profiles of event-related potentials (ERPs) from bipolar derivations between the DBS electrodes with the cortical ERP represented by the EEG electrode CZ. Our results show a robust MGB ERP that followed a typical temporal profile, with an onset that preceded the EEG ERP onset. These findings provide insights into the neurophysiological mechanisms of thalamo-cortical auditory processing in patients with tinnitus.

Keywords: Tinnitus, Auditory evoked potentials, Medial geniculate body

Oral Presentation 06

Basic Research in Tinnitus
OP 06-5

Neural aging as a tinnitus risk-factor

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Tinnitus is commonly understood through neuroscientific models that posit its development as a consequence of hearing damage leading to aberrant neural activity. However, identifying specific and robust "neural correlates" of tinnitus in humans has proven to be challenging. While hearing loss is indisputably the primary risk factor for tinnitus, most individuals with hearing impairment do not experience tinnitus, suggesting that additional factors influence whether a person follows a "tinnitus trajectory." Chronological age is associated with increased tinnitus prevalence, but this relationship is often attributed to the concomitant rise in hearing loss with aging. In this presentation, I argue that aging itself, particularly neural aspects of aging, constitutes a significant and independent risk factor that warrants consideration in tinnitus research. To support this perspective, I will present findings from a large-scale MEG resting-state study (N = 106), demonstrating that distinct spectral features predict tinnitus and that age-related changes, particularly in aperiodic activity, are markedly more pronounced in individuals with tinnitus. Complementing these cross-sectional findings, neuroanatomical (MRI) data from the UK Biobank reveal that pronounced age-related neural changes can already be observed at the time of measurement in individuals without tinnitus, who will, however, prospectively develop the condition. Together, these findings suggest that integrating tinnitus research with the broader field of aging neuroscience may offer novel insights into the mechanisms underlying tinnitus. This approach could also inspire new strategies for treatment and prevention, emphasizing the role of neural aging as a critical factor in tinnitus development.

Keywords: Resting state, MEG, Aging

Oral Presentation 06

Combined Disease/Comorbidities Associated with Tinnitus
OP 06-6

Amygdala multimodal reorganization explains the affective dysfunction in tinnitus patients

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This study aimed to systematically investigate structural and functional alterations in amygdala subregions using multimodal magnetic resonance imaging (MRI) in patients with tinnitus with or without affective dysfunction. Sixty patients with persistent tinnitus and 40 healthy controls (HCs) were recruited. Based on a questionnaire assessment, 26 and 34 patients were categorized into the tinnitus patients with affective dysfunction (TPAD) and tinnitus patients without affective dysfunction (TPWAD) groups, respectively. MRI-based measurements of gray matter volume, fractional anisotropy (FA), fractional amplitude of low-frequency fluctuations (fALFF), regional homogeneity (ReHo), degree centrality (DC), and functional connectivity (FC) were conducted within 14 amygdala subregions for intergroup comparisons. Associations between the MRI properties and clinical characteristics were estimated via partial correlation analyses. Compared with that of the HCs, the TPAD and TPWAD groups exhibited significant structural and functional changes, including white matter integrity (WMI), fALFF, ReHo, DC, and FC alterations, with more pronounced WMI changes in the TPAD group, predominantly within the left auxiliary basal or basomedial nucleus (AB/BM), right central nucleus, right lateral nuclei (dorsal portion), and left lateral nuclei (ventral portion containing basolateral portions). Moreover, the TPAD group exhibited decreased FC between the left AB/BM and left middle occipital gyrus and right superior frontal gyrus (SFG), left basal nucleus and right SFG, and right lateral nuclei (intermediate portion) and right SFG. In combination, these amygdalar alterations exhibited a sensitivity of 65.4% and specificity of 96.9% in predicting affective dysfunction in patients with tinnitus. Although similar structural and functional amygdala remodeling were observed in the TPAD and TPWAD groups, the changes were more pronounced in the TPAD group. These changes mainly involved alterations in functionality and white matter microstructure in various amygdala subregions; in combination, these changes could serve as an imaging-based predictor of emotional disorders in patients with tinnitus.

Keywords: Tinnitus, Amygdala, Affective dysfunction

Oral Presentation 06

Combined Disease/Comorbidities Associated with Tinnitus
OP 06-7

Global, regional, and national prevalence of hearing loss from 1990 to 2021: a burden and trends analyses based on the Global Burden of Disease Study 2021

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Background
Hearing loss, is a major public health issue that leads to many burdens including tinnitus. To emphasize this severe public health issue, we investigated the prevalence and the disability-adjusted life years (DALYs) of age-related and other hearing loss (ARoHL) over the last 32 years and further predicted its changes in the next 20 years based on the demographic factors and epidemiological changes. Moreover, we quantified the cross-region ARoHL inequalities, using the Global Burden of Diseases.

Methods
Based on the Global Burden of Disease (GBD) database from 1990 to 2021, this study focused on analyzing the prevalence of ARoHL and DALYs. It evaluated the changing trends in the burden of ARoHL using the estimated annual percentage change (EAPC) and percentage change, presented point estimates with 95% uncertainty intervals (UIs).

Results
(1) In 2021, the prevalence of ARoHL was 1545.7 (95% UI 1480.4 - 1618.7) with the age-
standardized rate (ASR) of 18070.3 (95% UI:17299.4 - 18923.8) per million Worldwide, showing an increase trend from that in 1990 with the estimated annual percentage change (EAPC) of 0.16(95% UI:0.15,0.17).
(2) In 2021, the DALYs of ARoHL was 44.4 (95% UI :30.7 - 62) with the ARoHL DALYs number of 525.9 (95% UI :364.2 - 732) per million Worldwide, showing a 14% (95% UI :15.1% to 13%) increase from that in 1990.
(3) In terms of 5 SDI regions, the Middle-SDI region recorded a highest ASR of prevalence, at 19715.5 (18863.7 - 20676.8) per million with the highest DALYs of 15.3 (95% UI :10.5 - 21.3)
(4) In terms of 21 regions, East Asia recorded a highest EAPC of prevalence ASR of 0.20((95% UI:0.18,0.22).

Conclusions
In the past 32 years, the burden of age-related hearing loss and other hearing losses has increased in most regions.

Keywords: Hearing loss, Disease burden, GBD 2021

Oral Presentation 06

Combined Disease/Comorbidities Associated with Tinnitus
OP 06-8

Higher Rates of Internalizing Psychopathology in Chronic Tinnitus Patients Without Hearing Loss

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Background: Chronic tinnitus is often associated with psychiatric comorbidities, irrespective of hearing loss (HL). This study explores these comorbidities within transdiagnostic, dimensional psychopathology frameworks in tinnitus patients with and without HL.
Methods: A total of 687 chronic tinnitus patients underwent pure-tone audiometry and completed two diagnostic self-report measures: the ICD-10 Symptom Rating (assessing depression, agoraphobia, OCD, health anxiety, and anorexia) and the Structured Clinical Interview-I Screening (assessing social anxiety, specific phobia, bulimia, alcohol/drug dependency, mania, and psychosis). Diagnoses and their associations with tinnitus-related distress (TRD) were analyzed. Factor analysis examined diagnostic covariation.
Results: Nearly all patients (96%) affirmed at least one screening item ($\tilde{x} = 5$). HL was present in 47% of patients. Those without HL showed higher rates of agoraphobia, OCD, social anxiety, bulimia, and drug dependency, but lower rates of anorexia. Most conditions correlated with TRD. Factor analysis identified three dimensions: internalizing psychopathology, substance misuse, and fear-related perceptions.
Conclusions: Chronic tinnitus patients, especially those without HL, exhibit high psychological vulnerability, marked by internalizing psychopathology. Future research should focus on these patients' psychological profiles and the underlying transdiagnostic mechanisms driving diagnostic covariation.

Keywords: Internalizing Psychopathology, Psychiatric diagnoses, Comorbidity patterns

Oral Presentation 06

Combined Disease/Comorbidities Associated with Tinnitus
OP 06-9

Tinnitus and its associations with gut microbiota: A Mendelian randomization study

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OBJECTIVE To investigate the association between tinnitus and gut microbiota through two databases (MiBioGen database and IEU OpenGWAS).
METHODS Based on a bidirectional two-sample Mendelian Randomization (MR) analysis, we employed three MR methods: MR-Egger, inverse variance weighted, and weighted median to investigate the association between gut microbiota and tinnitus using two publicly available Genome-Wide Association Studies summary data from two large consortia (MiBioGen and IEU OpenGWAS). Sensitivity analysis, including MR-Egger, MR polygenic score residual and outlier tests, weighted median, Cochran's Q test, leave-one-out analysis, and potential pleiotropy analysis, were performed to ensure the robustness of the results.
RESULTS The bidirectional two-sample MR analysis found that 19 gut microbiotas significantly causally associated with tinnitus. Among them, Agathobacter sp000434275, CAG-145 sp002320005, CAG-510 sp002432425, CAG-882 sp003486385, CAG-977, Leclercia, Saccharofermentanaceae, UBA1409, SM23-33 and Thermococcaceaeis were linked to a decreased risk of tinnitus. Conversely, F0428, Flavonifractor sp002159265, Pandoraea, RUG420 sp900317985, Ruminococcus E sp003521625, Turicibacteraceae, Ezakiellaceae, UBA2922 sp900313925 and UBA3855 sp900316885 were associated with an increased risk of tinnitus. Furthermore, there were 16 gut microbes with a reverse causal relationship in reverse mendelian randomization analysis. Notably, the abundance of Mycobacteriaceae, UBA7748 sp900314535, CAG-145 sp000435615, CAG-145, CAG-273 sp003534295, CAG-448 sp003150135, and CAG-448 could be increased by tinnitus. In contrast, the abundance of Aneurinibacillaceae, Aneurinibacillales, Bacteroides sp003545565, Barnesiellaceae, Barnesiella, CAG-632, Faecalicatena glycyrrhizinilyticum, Ruminococcus A sp000432335, and UBA2821 could be decreased due to tinnitus. Sensitivity analysis suggested that the results were stable.
CONCLUSION The present MR study provides evidence of a bidirectional relationship between tinnitus and the gut microbiota. The specific gut microbes identified might serve as promising targets for tinnitus prevention and therapeutic intervention.

Keywords: Mendelian randomization study, Tinnitus, Gut microbiota

Oral Presentation 07

Diagnosis of Tinnitus
OP 07-1

Comparison of Loudness Discomfort Level by the Testing Method in Patients with Bilateral Chronic Tinnitus and Hearing Loss

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Objectives: There are several variations in the technique for measuring loudness discomfort levels (LDL). The aim of this study was to evaluate LDL by measuring pure tone and narrow-band noise (NBN) in patients with bilateral chronic tinnitus and sensorineural hearing loss and in adults with normal hearing, and to analyze the correlation of LDL at different frequencies.
Method: Bilateral chronic tinnitus patients with hearing loss (n=42) with the pure tone average of 52 dB HL and normal listeners without tinnitus (n=41) with the pure tone average of 12 dB HL and were enrolled in this study. Pure tone audiometry and LDL test by pure tone and NBN were performed twice in all participants at 250, 500, 1 k, 2 k, 3 k, 4 k, and 8 kHz.
Results: The LDL test showed some inter-subject variability with the mean being 106.2±11.1 dB, 107.0±9.4 dB by pure tone, and 98.7±7.8 dB, 99.4±9.1 dB by NBN (right and left ear, respectively) in the tinnitus group. There were no significant differences between LDL average by pure tone or NBN between tinnitus group and normal control. Two serial tests showed high test-retest reliability. There was no difference in LDL between the two groups at each frequency, except for LDL by pure tone at 8 kHz in the left ear. High correlation of LDL was observed between different frequencies, except between 8 kHz and the other frequencies.
Conclusion: LDL by pure tone and NBN were consistent with or without tinnitus, and high correlation of LDL between different frequencies were shown except at 8 kHz in this study population. It might be sufficient to measure LDL once by pure tone only, including 8 kHz in patient with tinnitus and hearing loss.

Keywords: Tinnitus, Loudness perception, Pure-tone audiometry

Oral Presentation 07

Diagnosis of Tinnitus
OP 07-2

Spontaneous Otoacoustic Emission as a Novel Method to Screen Pulsatile Tinnitus Caused by Sigmoid Sinus wall Abnormalities

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Objective: To evaluate the diagnostic potential of spontaneous otoacoustic emissions (SOAE), distortion product otoacoustic emissions (DPOAE), and pure-tone audiometry (PTA) in patients with pulsatile tinnitus (PT) caused by sigmoid sinus wall anomalies (SSWA).

Methods: This study included 20 PT patients and 20 matched healthy controls. SOAE, DPOAE, and PTA were assessed before and with compression of the internal jugular vein. Statistical analysis included paired t-tests to compare differences in SOAE amplitude, DPOAE signal-to-noise ratios, and PTA thresholds , while independent t-tests assessed age differences, and one-way ANOVA evaluated mean PTA thresholds.

Results: SOAE average amplitudes were significantly higher in ipsilesional ears compared to contralesional and control ears within the tinnitus frequency range. DPOAE showed a significant difference in 0.5 kHz S/N-ratio between ipsilesional and contralesional ears. PTA revealed higher thresholds in ipsilesional ears at low frequencies compared to contralesional and control ears.

Conclusion: The SOAE method emerges as a highly sensitive and objective diagnostic tool for PT associated with SSWA. The significant differences in SOAE outcomes between ipsilesional and unipsilesional ears, along with the pronounced changes observed following IJV compression, highlight the utility of SOAE in assessing both the presence and severity of PT. The convenience and ease of performing the SOAE method, in conjunction with IJV compression, make it a valuable addition to standard diagnostic protocols for PT. This approach could improve diagnostic accuracy and provide evidence of PT acoustic transmission within the middle ear, thereby enhancing the effectiveness of subsequent treatment interventions.

Keywords: Pulsatile tinnitus, Sigmoid sinus wall anomalies, Spontaneous otoacoustic emissions

Oral Presentation 07

Diagnosis of Tinnitus
OP 07-3

Psychological effects on the auditory brainstem response in tinnitus patients

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The auditory brainstem response (ABR) evoked by click trains represents a standard diagnostic tool to objectively assess the state of the inner ear, with smaller and delayed responses in case of cochlear hearing loss. Additionally, the ABR serves to distinguish between tinnitus patients and control subjects, as Wave I tends to be smaller and delayed in the former group. More recently, it has also been reported that the ABR differs between certain subgroups of tinnitus patients, such as patients with and without hyperacusis and with intermittent versus constant tinnitus. Here, we attempted to replicate and extend these findings by utilising a large clinical dataset consisting of ABR recordings as well as audiometric data, a range of tinnitus-related and psychometric questionnaires, and sociodemographic data. The results were broadly consistent with the reported differences between patient subgroups but showed that the ABR was also affected by psychological factors such as anxiety, stress, and depression. Hence, even at the level of the auditory periphery, concurrently obtained psychometric data explained additional variance and should be considered when attempting to adequately explain the measured responses. These findings are thus consistent with the notion that the ABR is also affected by top-down processes, rather than representing a purely stimulus-driven evoked response.

Keywords: Tinnitus subgroups, Auditory brainstem response, Biomarkers

Oral Presentation 07

Diagnosis of Tinnitus
OP 07-4

Predictive Analysis of Tinnitus Characteristics and Hearing Loss at Specific Frequencies Using Machine Learning Models

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Background: Tinnitus, a common auditory condition often associated with hearing loss, requires understanding its relationship with hearing thresholds across frequencies for better diagnostic and therapeutic strategies. This study examines the predictive value of tinnitus-related factors for hearing loss at specific frequencies using both linear and non-linear machine learning models.
Method: Data from 744 tinnitus patients, including demographics (age, sex), tinnitus characteristics (nature, type, duration), diagnosis, and audiometric data (PTA values), were analyzed. Linear regression assessed relationships between predictors and hearing thresholds at higher frequencies (PTA-2000 to PTA-8000). Non-linear models, such as Random Forest and Neural Networks, were applied to explore non-linear patterns, with hyperparameter tuning to optimize performance.
Results: Linear regression demonstrated strong predictive accuracy at higher frequencies, with R^2 values of 0.70 (PTA-2000), 0.84 (PTA-3000), 0.76 (PTA-4000), 0.62 (PTA-6000), and 0.45 (PTA-8000), indicating predominantly linear relationships between tinnitus characteristics and hearing loss. Non-linear models, including Random Forest and Neural Networks, exhibited poor predictive performance, with R^2 values below 0.05 across all frequencies. Feature engineering and hyperparameter tuning did not significantly enhance non-linear model performance, suggesting minimal non-linear interactions in the dataset.
No significant correlation was observed between tinnitus type and average frequency hearing thresholds. However, tinnitus type was significantly associated with boundary frequency values, defined as the frequency at which thresholds begin to decline below 30 dB. Additionally, the nature of tinnitus (unilateral or bilateral) was significantly associated with PTA values, highlighting a meaningful relationship between hearing thresholds and tinnitus characteristics.
Conclusion: Linear models demonstrated higher efficacy in predicting hearing loss at higher frequencies compared to non-linear approaches. The findings suggest that the relationship between tinnitus characteristics and hearing thresholds in the analyzed cohort is largely linear, which seems to have a predictive value in diagnosing sensorineural tinnitus.

Keywords: tinnitus characteristics, Hearing thresholds, Linear model

Oral Presentation 07

Epidemiology of Tinnitus
OP 07-5

The Longitudinal Association between Diet and Risk of Tinnitus in Older Adults

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Diet may be an important modifiable risk factor in the management and prevention of tinnitus symptoms. However, there is a lack of large epidemiological studies that have assessed the link between habitual dietary intake and risk of tinnitus in older adults.

This longitudinal study aims to address this gap by establishing the association between intakes of a range of key macro- and micro-nutrients and incident tinnitus over 10 years, in 2,012 participants aged ≥50 years. A validated semi-quantitative food frequency questionnaire was used to determine intakes of dietary vitamins and minerals.

The key significant findings are described. After multivariate adjustment, lower versus higher intakes of fruit fibre and cereal fibre were significantly associated with a 65% (Hazard Ratios, HR=1.65; 95% CI: 1.15–2.36) and 54% (HR=1.54; 95% CI: 1.07–2.22) increased risk of developing tinnitus over 10 years, respectively. After age-sex adjustment, participants in the third versus first quartile of proanthocyanidin (a dietary flavonoid) intake were significantly less likely to develop incident tinnitus by 36% (HR=0.64; 95% CI 0.43-0.96). Following multivariable adjustment, this protective trend was non-significant. Intakes of dietary iron and zinc were significantly associated with incident tinnitus. There was a 44% (multivariate-adjusted HR=1.44, 95% CI: 1.07-1.93) increased risk of developing incident tinnitus with lower zinc intakes and a 35% increased risk with lower iron intakes (multivariate-adjusted HR1.35, 95% CI: 1.00-1.80).

This epidemiological study is unique as it suggests that a healthy diet consisting of a range of micro- and macro-nutrients could be protective against the development of tinnitus symptoms in older adults. As the current literature lacks robust data, particularly on links between food-based sources of nutrients and tinnitus risk, future research efforts should focus on high-quality study designs, such as those from large cohort studies and randomised controlled trials, to confirm our findings.

Keywords: Dietary intake, Cohort study, Older adults

Oral Presentation 07

Epidemiology of Tinnitus
OP 07-6

COVID-19-RELATED TINNITUS PREVALENCE DECREASE ALONG THE PANDEMICS TIMELINE

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Background and Aim: COVID-19 is a respiratory disease caused by the new coronavirus SARS-CoV-2, for which the first cases were reported in China, by December 2019. Viral infections, including those related to respiratory virus, may cause hearing loss and, by extent, tinnitus. A systematic review on inner ear related symptoms in patients with COVID-19 reported 4.5% occurrence rate of tinnitus, with high variance of prevalence between the studies. Our aim is analyze the prevalence of new tinnitus onset following COVID-19 in the city of Volta Redonda, Brazil, along the pandemics timeline. Methods: Two hundred and eight patients aged 18 years old and more previously diagnosed with COVID-19 were included. Patients with tinnitus that already existed before COVID (chronic tinnitus, CT) were excluded and the resulting sample was subdivided in no-tinnitus (NT) and post-COVID tinnitus (PCT) patients. Data concerning COVID symptoms, drugs prescribed for COVID-19, tinnitus characteristics, comorbidities and other otological symptoms were collected. Tinnitus patients fulfilled the Tinnitus Handicap Inventory (THI) and visual-analog scales (VAS) for loudness and distress. Results: From the 208 patients, seventeen reported PCT (8.17%), Considering the year of COVID infection, rates of PCT were 10.84% (2020), 8.62% (2021), 6% (2022), and no PCT cases were reported in 2023 and 2024. Conclusion: As with other viral infections, inner ear symptoms may be associated with COVID. Our data show a clear decrease of PCT along the COVID timeline. Three factors may explain this feature: first, the advent of vaccination, starting in 2021. Second, the emergence of the omicron variant in the end of 2021, and third, the decrease of the anxiety and depression triggered by COVID-19. Nevertheless, as with other COVID symptoms, tinnitus may add significant burden to the post-COVID scenario.

Keywords: COVID-19, Tinnitus, Hearing loss

Oral Presentation 07

Epidemiology of Tinnitus
OP 07-7

Recreational noise exposure and auditory outcomes – a scoping review

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Aims
To create an overview of current scientific work and outcomes on the association between recreational sound exposure and auditory outcomes. The focus was on identifying contexts that researchers consider potentially risky for noise-induced hearing loss, tinnitus or other auditory outcomes, as well as on the scientific methods applied to study this association.

Methods
A scoping review was performed. PubMed and Embase were search for empirical, peer-reviewed articles in English or Dutch, that evaluated relationships between recreational sound exposure from amplified sound and auditory outcomes (e.g., hearing loss, tinnitus). Two researchers independently screened the literature and extracted study data after inclusion. Outcomes extracted included type of context, study design, population, auditory outcomes, and reported exposure parameters (sound intensity, duration, frequency).

Results
149 articles were included (111 cross-sectional, 38 longitudinal studies). Most studies examined the context of portable music players (PMPs; 40% of the cases), followed by various contexts together ('total leisure noise'; 31%), discotheques (9%), concerts (7%), festivals (2%) and sports (2%). Of the longitudinal studies, most had an experimental design (68%), often focusing on short-term effects. Most included teenagers or young adults. Hearing loss measured via pure tone audiometry was most often reported (29%), followed by self-reports of tinnitus or hearing impairment, or oto-acoustic emissions. The parameters were often measured subjectively, or were (partly) estimated.

Discussion
Studies on the potentially risky contexts of sports, gaming, cinema, and festivals as well as on a young age group <12y were scarce and indicate a need for studies focusing on recreational sound in the wide context. Longitudinal studies using objective and standardized outcomes are needed to shed more light on both short- and long-term effects of noise exposure and be able to advance the field on prevention from auditory damage.

Keywords: Recreational sound-induced hearing loss, Tinnitus, Scoping review

Oral Presentation 07

Diagnosis of Tinnitus
OP 07-8

Electrocochleography in Chronic Tinnitus: Correlations with Audiological Profiles and Psychological Distress

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Objectives: This study aimed to explore the electrophysiological characteristics of patients with chronic tinnitus through electrocochleography (ECochG) findings and determine if these findings correlate with specific audiological patterns that could differentiate tinnitus patients from those without this condition.

Materials and methods: A retrospective analysis of medical records from patients who visited a tinnitus clinic at a tertiary university hospital between March 2020 and December 2023 was conducted. Inclusion criteria were non-pulsatile subjective tinnitus lasting over three months, and ECochG performed at initial evaluation. Audiological assessments and ECochG results were analyzed, with the SP/AP ratio being a focal point.

Results: Among 256 patients, an elevated SP/AP ratio was observed in 37.5 % of patients. No significant difference in ECochG outcomes was noted based on tinnitus laterality. Patients with an elevated SP/AP ratio reported more sleep disturbances, higher depression scores, attention problems, and aural fullness. These patients also exhibited lower loudness discomfort levels and low-frequency hearing losses. Significant correlations were found between elevated SP/AP ratios and DPOAE responses.

Conclusions: The findings highlight the SP/AP ratio in ECochG as a valuable biomarker for assessing clinical and psychological aspects of tinnitus, indicating its potential utility in tailoring treatment strategies. Elevated SP/AP ratios were associated with sleep disturbances, depression, attention problems, aural fullness, hyperacusis, and low-frequency hearing loss, suggesting a complex interplay between cochlear pathology and tinnitus perception. This study underscores the need for a nuanced understanding of ECochG results in the clinical evaluation of tinnitus, potentially guiding more personalized management approaches.

Keywords: Electrocochleography, Tinnitus, Management

Luncheon Symposium

LS

A Comprehensive Overview of the Lenire Tinnitus Treatment - The Road to Approval and Beyond

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Introduction:
The journey to regulatory approval is extensive and rigorous but does not stop once approval has been obtained. This presentation will give an overview of the data available for the Lenire device from proof-of-concept to real-world evidence from independent commercial clinics and future directions.

Initial Concept to FDA Approval:
Neurophysiological data in animals have demonstrated that one of the strongest drivers of brain plasticity within the auditory cortex and midbrain was achieved with electrical stimulation of the tongue compared to other body regions. These positive findings are further supported by large-scale parameter optimization studies and a controlled pivotal clinical trial that confirmed that, for those with moderate or more severe tinnitus symptoms, a clinically significant superior performance of bimodal neuromodulation was achieved compared to sound-only stimulation. This final study was designed with guidance from the FDA and ultimately led to the FDA De Novo approval of the Lenire device in the United States.

Post Approval
After regulatory approval, a key question remains: how will Lenire perform in a real-world clinical environment, which is less controlled and involves a more diverse patient population compared to clinical studies? Real-world evidence provides confirmation that the treatment efficacy of the Lenire device can be successfully translated and replicated into a clinical practice setting.

Conclusions:
Tinnitus is a well-known heterogenous disorder that demands experienced clinicians with a deep knowledge of available methods and technologies to help patients effectively manage their symptoms. New treatments require rigorous testing to gain regulatory approval. However, it is important to continue tracking their effectiveness in real-world settings to ensure that care pathways for tinnitus patients are evidence-based. Lenire has demonstrated safety and efficacy in clinical trials, and similar results are now being observed in real-world clinical settings with continuous development planned for the future.

Keywords: Lenire, Bimodal Neuromodulation, Real-World Evidence

TRI 2025 Seoul

Posters

Basic Research in Tinnitus

PP 01

Noise induced pericyte-to-myofibroblast-like cell transition, vascular degeneration in cochlea and VEGF-A gene therapy

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Objective: This study was performed in order to investigate whether pericyte(PC)-to- myofibroblast transition is responsible for loud-induced capillary degeneration and the underlying mechanism of it. Transplantation of exogenous neo-PCs as stem cells to restore damaged strial vasculature and auditory function was also evaluated. Methods: Male C57BL/6J mice and NG2DsRedBAC transgenic mice were used in the study. Immunohistochemistry, fluorescence microscopy and transmission electron microscopy, qRT-PCR, ELISIA, Western Blot were conducted to investigate changes of in vitro and in vivo animal models. AAV1-VEGF-A165 viral vector transfection of PCs was performed, then they were injected into inner ear by semicircular canal injection to observe the effect of transplantation of PCs restore. Intra-vital fluorescence microscopy and vessel-window was created on the lateral wall of cochlea to examine the velocity of capillary. ABR and EP were tested to evaluate the aduditory function. Results: We show here that loud sound causes change of phenotype from NG2+/α-SMA- to NG2+/α-SMA+ in some pericytes (PCs) on strial capillaries that is strongly associated with up-regulation of TGF-β1. The acoustic trauma also causes a reduction of capillary density and increased deposition of matrix proteins, particularly in the vicinity of transformed PCs. Transplantation of exogenous neo-PCs isolated from postnatal day ten mice to acoustic traumatized cochleae, however, significantly attenuates the decreased vascular density in the stria. Transplantation of PCs pre-transfected with AAV1-VEGF-A165 under control of a hypoxia-response element markedly promotes vascular volume and blood flow, increases proliferation of PCs and ECs, and attenuates loud sound-caused loss in endocochelar potential and hearing. Conclusion: Our results indicate that loud sound-triggered PC transformation contributes to capillary wall thickening and regression, and young PC transplantation effectively rehabilitates the vascular regression and improves hearing. The PC transition highly associated with TGF-1 signaling, blockage of the TGF-1 signal significantly attenuates the PC-to-myofibroblast transformation in the cochlea.

Keywords: Pericyte, Cochlea, Inner ear microcirculation

Basic Research in Tinnitus

PP 02

A Review on Peripheral Tinnitus, Causes, and Treatments from the Perspective of Autophagy

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Tinnitus is the perception of phantom noise without any external auditory sources. The degeneration of the function or activity of the peripheral or central auditory nervous systems is one of the causes of tinnitus. This damage has numerous causes, such as loud noise, aging, and ototoxicity. All these sources excite the cells of the auditory pathway, producing reactive oxygen species that leads to the death of sensory neural hair cells. This causes involuntary movement of the tectorial membrane, resulting in the buzzing noise characteristic of tinnitus. Autophagy is an evolutionarily conserved catabolic scavenging activity inside a cell that has evolved as a cell survival mechanism. Numerous studies have demonstrated the effect of autophagy against oxidative stress, which is one of the reasons for cell excitation. This review compiles several studies that highlight the role of autophagy in protecting sensory neural hair cells against oxidative stress-induced damage. This could facilitate the development of strategies to treat tinnitus by activating autophagy.

Keywords: Tinnitus, Autophagy, Autophagy activator

Basic Research in Tinnitus

PP 03

The Cochlea: Could its contribution to hearing and tinnitus mechanisms be grossly overlooked? A modern view of its architecture reveals answers to many questions.

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Background:

The cochlea is often viewed as a simple convertor of audio pressure waves to electrical impulses. The view outlined here shows that much more is involved and explains how the cochlea performs the reproduction of fine auditory detail.

As a tinnitus sufferer, former physics teacher and electronics engineer, I've been interested in tinnitus mechanisms for over three decades. I see parallels with the electronic systems now used to convert audio signals into digital form.

Twenty-first century audio communications are almost universally digital; the analogue spectrum is converted to binary data by sampling the signal using a clock at a frequency more than twice the highest audio frequency present. in a CD player the sampling or clock frequency is often about 44.1 kHz. With suitable filtering, known as alias filtering, It is possible that frequency can be reduced to just a few percent above the highest audio frequency present - about 22 kHz.

I believe that, given the upper frequency limit for electrical stimulation of outer hair cells (OHCs) in the cochlea is 25 kHz, the first row of OHCs could provide the sampling 'clock' signal at around 24 kHz. Individuals with normal hearing wouldn't hear this as the cochlear geometry could form suitable alias filtering. The outputs from the inner hair cells are temporal pulses.

In the case of tinnitus, possible damage to the first row of hair cells could result in OHCs in the second row taking over with a 'clock' frequency near 12 kHz. This is within normal hearing range and may be audible. Progressive damage to the second row of OHCs could cause row three to 'clock' at around 8 kHz. Intermodulation between the three 'clocks' could give rise to the range of frequencies experienced in tinnitus. Such clocks could be inter-aural timers for sound location.

Keywords: Cochlea, Sampling, Filtering

Basic Research in Tinnitus

PP 04

Near-Infrared Laser Photobiomodulation for Tinnitus: Animal Studies and Clinical Trials

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Purpose of the Study
This study investigates the effectiveness of photobiomodulation therapy (PBMT) using a near-infrared (830 nm) laser (TINI device) for managing chronic high-frequency tinnitus.

Method
For the animal experiments, twenty-eight mice were used. Tinnitus was induced using sodium salicylate, followed by PBMT. Changes in behavior and molecular markers, specifically the expression of vesicular glutamate transporter 2 in the ipsilateral dorsal cochlear nucleus, were assessed. For the clinical trial, 56 individuals with chronic high-frequency tinnitus participated. A randomized controlled trial was conducted, comparing trans-tympanic PBMT with a sham treatment group.

Result Summary
In the animal experiments, PBMT reduced behavioral signs of tinnitus and reversed the tinnitus-associated upregulation of vesicular glutamate transporter 2 expression ($p < 0.05$). In the clinical trial, no significant difference in tinnitus scores was observed between the PBMT and sham groups at the final time point. However, questionnaires revealed significant improvements in tinnitus symptoms and psychological outcomes after PBMT compared to baseline ($p < 0.05$).

Conclusion
PBMT demonstrates potential for tinnitus management, with encouraging results from animal experiments and participant-reported improvements in the clinical trial. However, its clinical effectiveness remains inconclusive due to complex interactions with other factors. Further research is required to optimize PBMT parameters and fully understand its therapeutic potential in tinnitus treatment.

Keywords: Low-level light therapy, Photobiomodulation, Near-Infrared laser

Basic Research in Tinnitus

PP 05

Tinnitus Generation and Behavioral Changes Caused by Chronic Stress : A Behavioral and Brain Study in a Rat Model

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Objectives: The association between chronic stress and tinnitus along with the anxiety and depression was explored in this study through a behavioral and brain research in a rat model. Methods: Rats were subjected to 2h of daily restraint stress for 10 days. Tinnitus was assessed on the last day of stress exposure using the gap response of pre-pulse inhibition acoustic reflex, measured at 60 dB background sound level at 8, 16, and 20 kHz. Chronic stress-exposed rats were categorized into two groups: restrain stress induced tinnitus (RTG) and non-tinnitus (RNTG). Hearing tests (distortion product otoacoustic emissions and auditory brainstem response), behavioral evaluations (elevated plus maze test, EPM and forced swimming test, FST), and immunohistochemical studies in the auditory and limbic brain regions, were conducted to understand the relationship between chronic stress, tinnitus, and behavioral changes. Results: After chronic restraint stress, 64.3% of the rats exhibited tinnitus without hearing changes. Increased anxiety and depression related behaviors measured by EPM and FST were observed in RTG. Immunohistochemical analyses identified specific alterations in the expression of neurotransmitter receptors within brain regions associated with tinnitus. Specifically, we observed a decrease in γ-aminobutyric acid A receptor α1 expression and an increase in glutamate receptor (N-methyl-D-aspartate receptor subunit 1 and receptor subunit 2B) expression in the limbic system, suggesting a reorganization of the brain network associated with the tinnitus generation as well as the behavioral changes after chronic stress exposure. Conclusion: Chronic stress seems to be a causal factor of tinnitus as well as anxiety and depression through altered neural activities in the limbic system including tinnitus-related brain network.

Keywords: Tinnitus, Stress, Brain

Basic Research in Tinnitus

PP 06

Pathogenesis of idiopathic tinnitus

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Abstract: Tinnitus is one of the common symptoms in otolaryngology, yet its pathogenesis is complex and remains ambiguous. The author contends that the lesion site of tinnitus lies in the brain. Objective: This paper explores the relationship between the central nervous system and tinnitus, and investigates the pathogenesis of tinnitus from the perspective of synaptic plasticity. We conducted a comprehensive literature search in Pubmed using the keywords [tinnitus, neural plasticity] and screened out the literature that met the inclusion criteria. Results: In the neural pathway of audition, the occurrence of synaptic plasticity in the central nervous system constitutes the main pathogenesis of tinnitus.

Keywords: Idiopathic tinnitus, Neuroplasticity, Pathogenesis

Basic Research in Tinnitus

PP 07

Evaluating the Impact of Sigmoid Sinus Wall Reconstruction on Pulsatile Tinnitus Treatment Outcomes: A Longitudinal Follow-up Study

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Objective:
Few studies have examined patients after sigmoid sinus wall reconstruction (SSWR) surgery. This research seeks to link the SSWR and the therapeutic effect of pulsatile tinnitus (PT) treatment, aiming to understand how structural repair affects PT symptom relief.
Materials and Methods:
PT patients with sigmoid sinus wall dehiscence (SSWD) with or without sigmoid sinus diverticulum (SSD) were retrospectively included. Those who underwent SSWR and had both pre- and post-CT arteriography and venography (CTA/V) examination were eventually analyzed in the study. They were classified as a reoccurrence group and a non-reoccurrence group based on their follow-up outcomes. The percent of reconstructed SSWD and SSD were calculated and the differences between the two groups were compared.
Results:
Of the 51 patients, 24 had SSWD only, and 27 had both SSWD and SSD. The reoccurrence probability was 31.4%. Preoperative SSD presence did not affect the outcomes (p=0.135). SSWD repair degree predicted non-recurrence outcome regardless of SSD (only SSWD: p=0.049, OR=1.071, 95% CI [1.005, 1.46]; SSWD+SSD: p=0.014, OR=1.054, 95% CI [1.011, 1.099]). The Receiver Operator Characteristic curve analysis showed that the SSWD repair degree was a good predictor of non-reoccurrence. The optimal cut-off values of SSWD repair degree were 71% and 67% (only SSWD: AUC=0.814, p=0.010, 95% CI [0.614-1]; SSWD+SSD: AUC=0.881, p=0.005, 95% CI [0.715-1]).
Conclusion:
The degree of coverage in the SSWD area is related to the therapeutic efficacy of SSWR surgery.

Keywords: Pulsatile tinnitus, Sigmoid sinus, Diverticulum

Basic Research in Tinnitus

PP 08

Cortico-Cochlear Oscillatory Dynamics and Residual Inhibition in Chronic Tinnitus: Insights from EEG and DPOAE Analyses

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Introduction: Tinnitus, the perception of sound without an external stimulus, involves both peripheral and central auditory pathways. While its cerebral origin is recognized, the role of cortico-cochlear interactions and their modulation by the auditory efferent system remains unclear. Residual inhibition (RI), a temporary suppression of tinnitus induced by broadband noise, offers a paradigm to study these dynamics. This study investigates cortical and cochlear oscillatory activity and their synchronization during RI to uncover mechanisms related to auditory efferent systems underlying tinnitus modulation. Methods: We conducted a case-control study at Hospital Clínico Universidad de Chile with nine participants aged 18-50, all with chronic unilateral tinnitus and normal auditory thresholds. Participants were classified as responders (≥30% reduction in tinnitus perception post-noise, n = 4) or non-responders (<30%, n = 5). Simultaneous EEG (35 channels) and distortion product otoacoustic emissions (DPOAE) recordings were performed before and after 180 seconds of Gaussian noise. Cortical activity was represented by the Cz channel, while cochlear oscillations were derived from DPOAE signals. Relative power in Delta (0.5-4 Hz), Theta (4-8 Hz), Alpha (8-13 Hz), and Beta (13-30 Hz) bands, as well as cortico-cochlear synchronization, were analyzed. Results: In cortical Cz channel, non-responders exhibited lower Delta ($p = 0.01$) and Beta ($p < 0.001$) band power compared to responders pre-noise and higher Alpha power post-noise ($p = 0.014$). Cochlear analysis showed minimal power changes in non-responders, while responders exhibited significant Delta band increases post-noise ($p = 0.01$). These results suggest changes in efferent system engagement in both groups that might reflected in distinct cortico-cochlear oscillatory dynamics. Discusion: This study identifies potential biomarkers for predicting response to tinnitus therapies and highlights the importance of cortico-cochlear interactions in RI. Future work should focus on larger samples, longitudinal data, and exploring individual variability in auditory efferent function.

Keywords: Efferent System, Residual inhibition, EEG

Basic Research in Tinnitus

PP 09

Neuroanatomical changes in gray matter due to tinnitus and hearing loss in military population

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Purpose: The goal was to examine structural gray matter differences in military population due to hearing loss and tinnitus. The hope was that findings in the military population would be more homogenous than the ones in general population.
Methods: Data was collected for 68 participants at Wilford Hall Ambulatory Surgical Center (WHASC) within Joint Base San Antonio (JBSA) at Lackland Air Force Base. For structural MRI data, a 3T Siemens Verio full-body scanner was used. The hearing thresholds were tested between 0.25 and 8 kHz. Voxel-based morphometry (VBM) data was analyzed in Computational Anatomy Toolbox (CAT12) with Statistical Parametric Mapping (SPM12) in MATLAB.
Results:
Behavioral results showed that the tinnitus group had significantly higher age (t=2.179, p=0.033), BAI scores (t=2.57, p=0.013) and PTA (t=3.02, p=0.004). VBM analysis showed no significant findings between groups (TIN and CTR) or subgroups (TIN_HL, TIN_NHL, CTR_HL, CTR_NHL). However, groups were uneven in sizes. When TIN_HL vs CTR_NHL were compared in equal sizes (15 vs 15), significantly smaller right precuneus in the TIN_HL was discovered, suggesting combined structural changes due to tinnitus and hearing loss.
Conclusion:
VBM might not be a sensitive tool for diagnosing tinnitus and hearing loss in military population. However, the structural findings in precuneus are consistent with the findings from the meta-analysis conducted by Moring et al. in 2022 and they may be explained by the precuneus being part of the default mode network (DMN) and indicate a summed effect of sensory deprivation by hearing loss and tinnitus.

Keywords: Tinnitus, Voxel-based morphometry, Hearing loss

Basic Research in Tinnitus

PP 10

DEPP Gene and Autophagy: Hidden Keys in Understanding Tinnitus Mechanism.

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Objectives
This study aims to investigate the role of the autophagy regulator gene, depp (decidual protein induced by progesterone) in the development of tinnitus.

Methods
Ten Male BL6/N mice (8weeks old) were divided into two groups: five received 350mg/kg sodium salicylate injections for five consecutive days to induce tinnitus, while the control group received saline injections. We established tinnitus using the Gap Prepulse Inhibition of Acoustic Startle Reflex (GPIAS) method and conducted auditory assessments using Auditory Brainstem Response (ABR) testing. And We collected samples from brain regions associated with the auditory pathway, including the cochlear nucleus, inferior colliculus, and auditory cortex, as well as from the non-auditory area of the frontal cortex, to perform transcriptomic analysis.

Result
Transcriptomic analysis showed a significant upregulation of the depp gene in multiple brain regions, suggesting a potential role in modulating autophagy processes relevant to tinnitus.

Conclusion
These findings suggest that autophagy may play a critical role in the pathophysiology of tinnitus and provide a potential new target for therapeutic intervention.

Keywords: Autophagy, Depp gene, Tinnitus

Basic Research in Tinnitus

PP 11

Longitudinal Assessment of Tinnitus Classification in Noise-Exposed Mice Based on GPIAS, Auditory Brainstem Response, and GABAA Receptor PET Imaging

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Investigating tinnitus mechanisms in animal models requires an objective method to identify tinnitus while disentangling mechanisms underlying associated hearing loss. Based on preliminary findings, GABAA receptor binding potential may be elevated in tinnitus patients. We aim to assess viability of this biomarker for objectively classifying tinnitus in animals and compare it to existing methods for tinnitus classification.

Awake mice were bilaterally exposed to 10-16 kHz noise at 110, 115, or 120 dB for 1h, followed by a 12-week assessment. Tinnitus classification was evaluated using Gap Prepulse Inhibition of the Acoustic Startle Reflex (GPIAS), Auditory Brainstem Response (ABR) wave V (inferior colliculus) to I (cochlear nerve) amplitude ratios to assess central gain, and PET imaging with [11C]flumazenil to assess GABAA receptor binding. Inner ears and brains were collected for subsequent molecular analyses.

At 12.5 kHz, 110, 115, and 120 dB noise-exposed groups had permanent threshold shifts of 20, 38, and 63 dB, respectively. GPIAS revealed behavioral evidence of tinnitus in the 115 dB group one week after noise exposure, persisting throughout the follow-up. In this group, ABR measurements also demonstrated increased central gain. In total, from the 115 dB-exposed mice, 53% were classified as tinnitus-positive based on behavioral evidence of tinnitus via GPIAS and 50% based on elevated ABR wave V/I ratios. Importantly, these two methods did not yield overlapping classifications.

This study establishes 115 dB bilateral noise exposure as an optimal model for moderate chronic hearing loss. While GPIAS and ABR both detect evidence of tinnitus, their classifications differ, underscoring the need for a multimodal approach for robust and translatable tinnitus classification in preclinical research. Ongoing analysis of inner ear and brain tissues will reveal potential histological differences between classified groups. Ongoing PET analysis will determine whether GABAA receptor binding potential correlates with tinnitus classification based on GPIAS and/or ABR.

Keywords: Tinnitus Classification, Auditory Brainstem Response, Preclinical Research

Combined Disease / Comorbidities Associated with Tinnitus

PP 12

Correlation of non-auditory comorbidities and hearing loss in tinnitus patients

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Tinnitus is a symptom often associated with hearing loss (HL) and is in many cases more burdening to the individual than the HL itself. Many approaches have been made to explain the development and chronification of the phantom percept as well as different treatment strategies to lower the tinnitus related burden. In many studies, the variance of the HL data is high and therefore the interpretation of specific data might be difficult. Here, we attempt to investigate a part of this variance by correlating the effects of non-auditory comorbidity categories with pure-tone audiometric data in a tinnitus patient collective.
In this retrospective study of 136 adult tinnitus patients without any auditory diseases except a possible HL, the pure-tone audiogram and tinnitus frequency and loudness were correlated with their non-auditory comorbidities and age. Non-parametric and parametric analyses were used, where appropriate.
We found age dependent as well as number of non-auditory comorbidity classes (e.g. endocrine diseases) dependent differences in the mean HL of the tinnitus patients as well as differences in the peak HL frequency relative to the tinnitus frequency. The analysis of the age dependent HL within the different non-auditory comorbidities revealed specific – partially opposed – effects of endocrine, circulatory, muscle-skeletal and digestive disease categories on the hearing thresholds of tinnitus patients.
Taken together we argue that in future tinnitus patient studies non-auditory comorbidities should be taken into account as possible covariables that might explain the variance found in the auditory threshold development of these patients.

Keywords: Retrospective patient study, Audiometry, Non-auditory comorbidities

Combined Disease / Comorbidities Associated with Tinnitus

PP 13

Autonomic dysfunction in chronic subjective tinnitus

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Patients with chronic subjective tinnitus perceive their symptoms as stressful and are often impaired by psychological problems like depression and anxiety, which are known to be related to the activation of the sympathetic nervous system. The overactivation of the sympathetic nervous system contributes to greater mental and physical tension, which may lead to reduced tolerance to tinnitus and further block habituation to tinnitus.
We enrolled adult patients with subjective tinnitus for more than 6 months and two studies were conducted. In the study of subjective measurements using questionnaires, namely Tinnitus Handicap Inventory (THI), Pittsburgh Sleep Quality Index (PSQI), and Hospital Anxiety and Depression Scale (HADS), we found significant correlation between THI and HADS for subjects with sleep difficulty. Compared with patients with slight tinnitus, those with catastrophic tinnitus had higher scores in HADS.
In the other study of objective measurements, patients with and without tinnitus received the cold pressor test (CPT) to assess their autonomic nervous system (ANS) activity. The results showed that patients with tinnitus had higher low frequency/high frequency ratio of heart rate variability and elevated heart rate in CPT. The disequilibrium of ANS as implicated as risk factor for tinnitus.
Taken together, out results showed hints of a dysregulation of the ANS and the comorbid psychological distress in chronic tinnitus, as postulated in psychological and neurophysiological models of chronic tinnitus.

Keywords: Autonomic dysfunction, Chronic subjective tinnitus, Anxiety

Combined Disease / Comorbidities Associated with Tinnitus

PP 15

Prevalence, features and characteristics of stress induced tinnitus in older patients

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Background: Tinnitus, the perception of sound without an external source, is prevalent among older adults, with stress identified as a significant contributing factor. This study investigates the prevalence, features, and characteristics of stress-induced tinnitus in older patients.
Methods: A cohort of 85 patients aged 60 and above, presenting with tinnitus, was assessed. Comprehensive evaluations included audiometric testing, psychological assessments for stress and anxiety levels, and detailed tinnitus profiling. Statistical analyses were conducted to determine prevalence rates and to explore correlations between stress levels and tinnitus characteristics.
Results: The prevalence of stress-induced tinnitus in the study cohort was found to be 33%, aligning with existing literature that reports tinnitus affects approximately one-third of the elderly population. Patients with higher stress levels reported increased tinnitus severity and greater associated distress. Notably, 45% of individuals with tinnitus had an anxiety disorder at some time in their lives. Audiometric evaluations revealed that 60% of patients exhibited high-frequency hearing loss, a common finding in older adults with tinnitus.
Conclusions: Stress-induced tinnitus is prevalent among older adults and is associated with increased severity and distress, particularly in those with concurrent anxiety disorders. The significant correlation between elevated stress levels and tinnitus severity underscores the importance of comprehensive management strategies that address both audiological and psychological components. Interventions aimed at stress reduction may be beneficial in alleviating tinnitus symptoms in this population.

Keywords: Tinnitus, Stress-induced tinnitus, Older adults

Combined Disease / Comorbidities Associated with Tinnitus

PP 16

Multiple Neurovascular Compression Leading to Typewriter Tinnitus and Hemifacial Spasm

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Typewriter tinnitus (TT) is characterized by intermittent staccato sounds and a favorable response to carbamazepine. This report discusses a 65-year-old woman with a one-year history of TT in her left ear. She described irregular "corn-popping" sounds that intensified when lying on her left side and were often accompanied by a sensation of ear fullness. Notably, she did not experience hearing loss or vertigo but reported spasmodic movements of her left eyelid coinciding with the TT episodes. Audiometry revealed normal and symmetric hearing thresholds bilaterally. MRI and MRA identified multiple compression sites of the cochlear and facial nerves by anterior and posterior inferior cerebellar arteries (AICA and PICA), extending from the root entry zone to the internal auditory canal. Treatment with carbamazepine significantly alleviated both TT and hemifacial spasm, and the patient opted against surgical decompression. This case highlights a rare instance of neurovascular compression involving AICA and PICA loops at multiple locations along the 7th and 8th cranial nerves, potentially contributing to concurrent TT and hemifacial spasm on the same side.

Keywords: Typewriter tinnitus, Hemifacial spasm, Neurovascular compression

Combined Disease / Comorbidities Associated with Tinnitus

PP 17

Modality aspecific Aversive Generalization Learning response in Tinnitus: Behavioral and Magnetoencephalographic Correlates

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Psychological distress linked to the onset of tinnitus can be conceptualized through the lens of classical conditioning. In this model, the tinnitus sound acts as a conditioned stimulus repeatedly paired with an aversive emotional state. A maladaptive feedback loop is thus reinforced, where the distressing emotional response heightens the perception of the tinnitus, which in turn further exacerbates the distress. This phenomenon involves a complex network of brain structures ranging from sensory regions to higher-order prefrontal and limbic areas that process inputs from multiple modalities. However, no previous research has investigated whether maladaptive aversive learning in tinnitus patients extends beyond auditory stimuli to involve other sensory modalities.

In this study, we hypothesized that tinnitus patients would show increased aversive and diminished safety learning and overgeneralization to aversive conditioned stimuli in both the tinnitus-related auditory and the tinnitus-unrelated visual domain.

Participants underwent a bimodal conditioning procedure with low and high-frequency tones and visual gratings of low- and high spatial frequency, in which one stimulus of each modality (CS+) was paired with an aversive loud scream (US) while the other was left unpaired (CS-). Before and after conditioning, seven generalization stimuli (GS) of both modalities with frequencies between CS- and CS+ were presented.

Patients and controls showed consistent and comparable generalization effects in their ratings of the GS stimuli of both modalities. Early neural activities matching the expected aversive generalization gradients were observed in the respective sensory brain regions in both groups. The expected successive inhibitory gradients in dorsolateral PFC regions however were visible in the controls only while tinnitus patients showed the opposite activation patterns in both modalities.

These findings suggest that tinnitus patients exhibit maladaptive aversive learning and deviant aversion generalization not only in the auditory domain but across modalities, advancing our understanding of the neurophysiological model of tinnitus distress.

Keywords: Tinnitus Distress, Generalization Learning, Magnetoencephalography

Combined Disease / Comorbidities Associated with Tinnitus

PP 18

Characteristics and lived experiences of people with co-occurring hyperacusis and tinnitus: a mixed methods study

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It is well established that hyperacusis and tinnitus can co-occur. However, there are few studies that focus specifically on people who have both disorders. Important gaps in knowledge exist such as the relative onset of each disorder, the duration of co-occurrence, the primary complaint and how they interact (e.g., in terms of changes in severity).

We used a mixed-methods approach to characterise adults with co-occurring hyperacusis and tinnitus and explore their experiences. The study involved an online survey (n=177) including questionnaire validation, and semi-structured interviews (n=20) to explore lived experiences.

Survey results revealed that both hyperacusis and tinnitus can be long standing co-occurring disorders. Over 70% of participants reported that their ability to tolerate sounds fluctuates. Anxiety and depression were highly prevalent. Themes of fear and worry were pervasive, encompassing concerns about worsening hyperacusis, perceiving hyperacusis as a threat, fear of specific sounds, apprehension about encountering problematic noises, and even worry about the noise exposure of family members. These insights suggest an enhanced awareness and over-monitoring of the auditory environment, fostering a fear-based relationship with sound. The interplay of anxiety and fear emerged as closely intertwined, compounding the psychological burden of these disorders. Many participants reported unmet needs and negative healthcare experiences. Notably, problem ratings for hyperacusis and tinnitus did not correlate, indicating their independence, with equivalent numbers of participants identifying their primary complaint as either hyperacusis, tinnitus, or both. However, interviews revealed a more nuanced perspective, with participants emphasising the interconnectedness of their experiences. Many described how the co-occurrence of hyperacusis and tinnitus exacerbated their challenges, with the combined impact being greater than either disorder alone.

This study provides a multidimensional exploration of the lived experiences, psychosocial impacts, and important nuances of individuals with co-occurring hyperacusis and tinnitus, and the unmet clinical needs to be addressed.

Keywords: Hyperacusis, Fear, Anxiety

Combined Disease / Comorbidities Associated with Tinnitus

PP 19

Correlations of Tinnitus and PTSD in Veterans and Service Members: An Auditory and Neuroimaging Study

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Tinnitus and posttraumatic stress disorder (PTSD) are reported respectively as the first and sixth most prevalent service-connected disabilities by the Veterans Benefits Administration (VBA, 2023). The literature describes these two conditions as highly comorbid, presenting with an array of overlapping symptoms such as difficulty sleeping, concentration issues, avoidance, and irritability. Vanasse et al. (2019) found the auditory system to be the most implicated brain network among individuals with combat-related PTSD, while previous neuroimaging studies have indicated the role of the auditory system in tinnitus (De Ridder et al., 2014; Hussain, 2016; Lv et al., 2017). Individuals with both tinnitus and PTSD have demonstrated worse functional outcomes compared to those with tinnitus only (Fagelson & Smith, 2016). Though there is evidence to suggest similar neurobiological patterns between those with PTSD and those with tinnitus, it remains unclear whether audiological profiles differ based on whether individuals endorse tinnitus or meet criteria for PTSD. It is also unclear how PTSD may impact audiological functioning (e.g., due to attention difficulties, hypervigilance symptoms) and how tinnitus may impact PTSD symptoms. This poster presentation will discuss the study background, methodology, and findings among participants with tinnitus only and participants with both tinnitus and PTSD.

Keywords: Military, Posttraumatic Stress Disorder, Tinnitus

Combined Disease / Comorbidities Associated with Tinnitus

PP 20

Change of subjective tinnitus by the duration of noise exposure in patients with noise-induced hearing loss

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Background and Objectives: Tinnitus, a common complaint of workers who are exposed to noise, can cause substantial negative effects on the quality of life of these workers. The aim of this study was to analyze the characteristics of tinnitus in patients with noise-induced hearing loss and the relationship between tinnitus and the duration of noise exposure.
Subjects and Method: Thirty-three patients with subjective tinnitus and noise-induced hearing loss were included in this study. Tinnitus questionnaire, Tinnitus Handicap Inventory (THI) and audiological examinations were investigated according to the duration of noise exposure.
Results: There was a significant correlation between the tinnitus loudness and the duration of noise exposure. Patients who had longer periods of noise exposure had a louder tinnitus and higher THI score. However, there is no significant correlation between the characteristics of tinnitus and aging process.
Conclusion: The duration of noise exposure influences the loudness and distress of tinnitus. An awareness of tinnitus should be considered as part of hearing conservation program.

Keywords: Hearing loss, Noise, Tinnitus

Combined Disease / Comorbidities Associated with Tinnitus

PP 21

Dental Conditions Influencing Tinnitus: A Scoping Review

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Purpose
Dental conditions are frequently mentioned as influencing factors for tinnitus. Furthermore, tinnitus might develop after dental treatment or orthognathic surgery. Commonly prescribed medications by dentists can have tinnitus as a side effect. Given these potential associations, it is essential for specialists treating patients with tinnitus to be aware of the current evidence on these relationships.
This scoping review provides an overview of the current literature investigating the relationship between tinnitus and dental conditions.

Methods
A search up to February 2025 was performed in PubMed, Embase, and Web of Science to identify all articles dealing with the above-mentioned relationship. The MeSH terms "tinnitus", "stomatognathic diseases", "anti-infective agents" and "oral surgery" were used. A total of 178 studies were selected.

Results
A higher prevalence of tinnitus in patients with temporomandibular disorder (TMD) was found (between 35.8 and 60.7%) compared to an open tinnitus population (prevalence between 10% and 15%) (number of studies [n] = 128). Several studies (n = 24) indicate an improvement in tinnitus symptoms after orofacial treatment (i.e., orofacial physiotherapy and/or splint therapy). Only six case reports are published about the first-time occurrence of tinnitus after dental treatment or orthognathic surgery. For medications regularly prescribed by dentists, i.e., NSAIDs and the antibiotics amoxicillin and metronidazole, tinnitus has been reported as a side effect (n = 24). Additionally, temporomandibular joint herniation in the external auditory canal might also cause tinnitus (n = 12).

Conclusions
Dentists may play a role in the multidisciplinary assessment of tinnitus patients. Given the established link between TMD and tinnitus, dental professionals should evaluate patients for TMD-related symptoms. Additionally, a thorough review of prescribed medications is warranted. Further research is needed to clarify the potential causative relationship between dental procedures, orthognathic surgery, temporomandibular joint herniation and the onset of tinnitus.

Keywords: Dental conditions, Association, Tinnitus

Diagnosis of Tinnitus

PP 22

Clinical Characteristics of Unilateral Subjective Paroxysmal Tinnitus Responsive to Carbamazepine Treatment

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Objective: To clarify the clinical characteristics of patients with unilateral subjective paroxysmal tinnitus that is responsive to carbamazepine treatment.
Methods: We reviewed clinical records of patients who visited the Department of Otorhinolaryngology with tinnitus as their chief complaint. Among them, patients with unilateral subjective paroxysmal tinnitus who were treated with carbamazepine were included. Patient demographics, tinnitus characteristics, symptoms accompanying tinnitus, MRI findings, and responses to carbamazepine treatment were analyzed.
Results: Eighteen patients (mean age: 63.0 years; 11 males and 7 females; 11 with right ear involvement and 7 with left ear involvement) were included. Durations of tinnitus were: less than 5 seconds in 3 patients, less than 30 seconds in 5, less than 60 seconds in 7, and more than 60 seconds in 3. The daily frequency of tinnitus episodes, at its maximum, was fewer than 10 episodes per day in 3 patients, fewer than 50 episodes in 4, fewer than 100 episodes in 11, and more than 100 episodes in 1. Vestibular symptoms were the most common associated symptoms, observed in 14 patients (77.8%). MRI revealed vascular compression of the eighth cranial nerve in 7 patients (38.9%). Treatment responses to carbamazepine were: complete resolution in 6 patients, improvement in 10, and no change in 2, with an overall efficacy rate of 88.9%.
Conclusion: The administration of carbamazepine seemed to be beneficial in patients with unilateral subjective paroxysmal tinnitus whose tinnitus was of short duration, high frequency, and accompanied by vestibular symptoms occurring simultaneously with the tinnitus.

Keywords: Paroxysmal tinnitus, Carbamazepine, Neurovascular compression syndrome

Diagnosis of Tinnitus

PP 23

Quantifying Tinnitus Perception Improvement: Deriving the Minimal Clinically Important Difference of the Minimum Masking Level

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Purpose: Tools that can reliably measure changes in the perception of tinnitus following interventions are lacking. The minimum masking level, defined as the lowest level at which tinnitus is completely masked, is a candidate for quantifying changes in tinnitus perception. In this study, we aimed to determine minimal clinically important differences for minimum masking level.
Method: A 3-month tinnitus intervention combining counseling and sound therapy was conducted in 74 participants with chronic tinnitus. Minimum masking levels were measured at baseline and 3 months. The clinical global impression was evaluated at 3 months to measure changes in participants' self-perception of tinnitus. The minimal clinically important difference of the minimum masking level was calculated using anchored-based, effect size, standard error measurement, and receiver operating characteristic curve analysis.
Results: The minimal clinically important difference analysis of the minimum masking level yielded a –5.5 dB sensation level from the receiver operating characteristic curve, a –8.1 dB sensation level from the standard error measurement, a –9.2 dB sensation level from the effect size, and a –10.3 dB sensation level from the anchor-based analysis. Of these, the minimal clinically important difference value with optimized sensitivity (0.704) and specificity (0.957) was a –5.5 dB sensation level, determined using receiver operating characteristic analysis.
Conclusions: The proposed minimal clinically important difference value of the minimum masking level (-5.5 dB sensation level) provides a good level of sensitivity and specificity. Therefore, the minimum masking level may be an alternative for measuring changes in tinnitus perception.

Keywords: Tinnitus perception, Minimum masking level, Measurement of tinnitus

Diagnosis of Tinnitus

PP 24

The application of auditory brainstem response in detecting retrocochlear lesions in patients with tinnitus

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Tinnitus is a common condition in the field of otolaryngology. The etiologies of tinnitus are diverse, retrocochlear lesions are particularly important to rule out. The aim of this study was to evaluate the utility of auditory brainstem response (ABR) testing in detecting retrocochlear lesions in patients with tinnitus.
Patients with tinnitus who visited the otolaryngology department between August 2023 and July 2024 were included. 129 patients with tinnitus were enrolled in the study. The average age of the participants was 56 years (19–94). Of the 129 patients, 56 were male and 73 were female. In terms of the laterality of tinnitus, 45 patients had bilateral tinnitus, 40 had tinnitus on the right side, and 44 had tinnitus on the left side. The average duration from the onset of tinnitus to the first otolaryngology visit was 2.4 years, with a range from 1 month to 30 years. Pure-tone audiometry results ranged from normal hearing thresholds to severe hearing loss.
All 129 patients underwent ABR testing. In our practice, the interaural latency difference of wave V was compared between the two ears. An interaural difference greater than 0.4 ms was considered indicative of a possible retrocochlear lesion. For those patients with an interaural difference greater than 0.4 ms, a brain MRI was performed for further evaluation.
Among the 129 patients, 23 had an interaural latency difference greater than 0.4 ms, while the remaining 106 patients showed normal results. Brain MRI was performed on the 23 patients with abnormal ABR findings. Of these, vestibular schwannomas were identified in 2 patients, anterior inferior cerebellar artery loops in the inner auditory canal in 5 patients, and the other 16 patients had normal findings.
In conclusion, ABR testing proved to be a useful tool for detecting retrocochlear lesions in patients with tinnitus.

Keywords: Tinnitus, Auditory brainstem response, Retrocochlear lesion

Epidemiology of Tinnitus

PP 25

Age-Dependent Differences in Tinnitus Characteristics

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Background and Objectives: The heterogeneity of tinnitus patient profiles poses significant challenges for research and clinical practice. This study aims to investigate age-dependent variations in tinnitus characteristics and associated factors.
Subjects and Method: A total of 439 tinnitus patients (596 affected ears) were analyzed between January 2019 and March 2021. Evaluations included Pure Tone Audiometry, psychoacoustic testing, the Tinnitus Handicap Inventory (THI), and Visual Analog Scale (VAS) scores. Additional surveys captured information on noise exposure, stress, fatigue, emotional trauma, and accident/injury related to tinnitus onset. The study also explored comorbidities such as hyperacusis, headache, dizziness, neck/jaw pain, and psychiatric symptoms. Patients were categorized into young (≤30 years), middle-aged (31–49 years), and elderly (≥50 years) groups.
Results: Although VAS annoyance and THI scores revealed no significant differences across age groups and stress and fatigue were frequent triggers across all groups, matched loudness (dB SL) was remarkably higher in the young and middle-aged groups compared to the elderly and tinnitus awareness was significantly prolonged in elderly patients while loud noise exposure was more commonly reported by young patients. Comorbidities such as hyperacusis, headache, and dizziness were more prevalent in the young and middle-aged groups, whereas neck/jaw pain and psychiatric symptoms showed no significant age-related variation.
Conclusion: Age-related distinctions in tinnitus characteristics and associated factors emphasize the necessity for personalized, age-appropriate diagnostic and therapeutic approaches for tinnitus management.

Keywords: Tinnitus, Age, Difference

Epidemiology of Tinnitus

PP 26

The "Fill-in Phenomenon" Revisited: Tinnitus Pitch, Frequency of Maximum Hearing Loss, and Symptom Duration

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Purpose: Several previous studies have investigated tinnitus pitch in comparison to audiometric data in attempts to explain tinnitus generation and its continuation. This study re-investigated the relationship between tinnitus pitch and the frequency of maximum hearing loss based on the symptom duration, providing new insights into the mechanisms of tinnitus.
Methods: Retrospective data of 823 patients who presented to a tertiary hospital with tinnitus as their primary complaint were enrolled in this study. To minimize confounding factors, patients with mixed or conductive hearing loss, combined or pure objective tinnitus, and bilateral tinnitus were excluded, and a total of 215 patients were included for analysis. Patients were divided into three subgroups according to symptom duration: Group 1 (<6 months), Group 2 (6-12 months), and Group 3 (>12 months). Tinnitus pitch from the initial tinnitogram, pure tone audiometry results, demographic profiles, and subjective measurements of tinnitus handicap index (THI) and tinnitus-VAS scores were analyzed for correlations.
Results: Out of 215 patients, only 49 patients (22.8%) had tinnitus pitch that exactly matched the maximum hearing threshold. The patients with matched tinnitus pitch had no statistically significant demographic differences compared with those unmatched. There was no statistical relationship between tinnitus pitch and the edge frequency of the audiogram. However, in subgroup analysis, Group 2 exhibited a significantly higher matching rate with the frequency of maximum pure-tone threshold (P = 0.006) and a significantly lower VAS score on "Effect on Life" (P = 0.02) compared to other groups.
Conclusion: Tinnitus patients with a symptom duration of 6 to 12 months demonstrated the highest proportion of matching tinnitus pitch with maximum hearing loss. The results of this study may provide a new perspective on the mechanism and transition of tinnitus, perhaps accentuating the importance of active intervention during the first year of onset.

Keywords: Tinnitus pitch, Maximum hearing threshold, Edge frequency

Epidemiology of Tinnitus

PP 27

Economic and Social Burden of Tinnitus in France (2021-2022)

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Objective: This study aims to evaluate the economic burden associated with the management of tinnitus and the potential therapeutic wandering, as well as to estimate the professional and social impact of tinnitus on individuals and their families.

Methods: A comprehensive survey consisting of approximately 137 questions was conducted with 1,563 respondents. The demographic profile included an average age of 55 years (±14.2), with 55.7% being female. The survey covered various aspects such as professional status, socio-economic background, and the impact of tinnitus on daily life.

Results: The study revealed that 55.3% of respondents were professionally active, while 31.3% were retired. Among those on sick leave, nearly half (44.9%) attributed their leave to tinnitus. Tinnitus was medically validated in 68.7% of cases, with identified causes including noise trauma (12%) and other unspecified causes (88%). The impact on professional life was significant, with 16% of respondents reporting at least one day of work absence due to tinnitus, with a median of 15 days. Additionally, 11.4% reported job changes or adjustments, and 19.2% received disability recognition. The economic burden was substantial, with the average annual cost per patient for consultations and examinations being €840.75, of which €296.75 was covered by social security. Equipment costs averaged €1,512.75 annually, with €382.15 reimbursed. The total out-of-pocket expense per patient was estimated at €1,079.85 annually. Nationally, with an estimated 16 million tinnitus sufferers in France, the annual economic burden could reach up to €12 billion for the Healthcare part alone and above €24 billion adding the loss of productivity and sick leaves at work.

Conclusion: Tinnitus imposes a significant economic and social burden on individuals and the healthcare system in France. Effective management strategies and increased awareness are essential to mitigate these impacts.

Keywords: Tinnitus, Out of pocket expense, Sick leave

Epidemiology of Tinnitus

PP 28

Prevalence of tinnitus and hyperacusis in Indian school-going children and its association with music and noise exposure.

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The study explored the prevalence of tinnitus and hyperacusis among Indian school children aged 10–15 years and their associations with music and noise exposure. A cross-sectional survey involving 1045 children (mean age 12.58 years) used a culturally adapted questionnaire assessing auditory complaints, noise exposure, and listening habits.

Listening Characteristics:
Among participants, 90.1% reported listening to music, with 27.6% using headphones, 30.2% earphones, and 32.4% speakers. A significant proportion (54.7%) listened to music at 60% or higher volume levels, and 24.64% did so for over an hour daily. Noise exposure was common; 32.84% attended loud events (e.g., parties, concerts) 2–4 times monthly, yet only 0.08% consistently used ear protection.

Hearing Complaints:
Hearing challenges were reported by 4% of children, rising to 10% in noisy environments. Nearly half (45.8%) reported at least one episode of ear infection, and 12.9% experienced three or more annually. Additionally, 13% reported dizziness or imbalance.

Tinnitus:
Tinnitus was prevalent in 61% of children. Most reported frequent episodes, with 55.6% experiencing tinnitus lasting more than five minutes. Emotional effects included anger (25.5%) and anxiety (17.2%). Tinnitus often co-occurred with hyperacusis (47.14%) and ear infections (52.25%).

Hyperacusis:
Hyperacusis affected 40.8% of children, with 5.2% avoiding playgrounds due to sound sensitivity. The overlap of tinnitus and hyperacusis was 69.95%. Noise exposure may contribute to auditory pathway overstimulation, central gain changes, and neural plasticity, linking both conditions.

Conclusions:
The high prevalence of tinnitus and hyperacusis among children highlights the need for routine ENT evaluations, validated diagnostic tools, and hearing conservation programs. Associations with noise exposure emphasize the importance of educating children about safe listening habits to prevent auditory damage and related disorders.

Keywords: Prevalence, Tinnitus and Hyperacusis, India

Hyperacusis / Misophonia

PP 29

Exploring the Audiological and Emotional Responses to Misophonia: Preliminary Data from South Korea

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Misophonia is a sound tolerance disorder causing strong negative reactions to specific sounds. This study investigates the types of sounds triggering misophonia, the emotional responses to them, and audiological correlates in individuals with symptoms. It is part of the An Inter-Disciplinary Cross-National Study of Misophonia project and presents preliminary data from South Korea. Sixty-three misophonic participants (M:F = 15:48) and 30 controls were recruited. They completed questionnaires, including the Duke Misophonia Questionnaire, the Hyperacusis Questionnaire (HQ), the Tinnitus Handicap Inventory, and the Hearing Handicap Inventory. They also underwent discomfort index measurements for 46 different trigger sounds and audiological assessments, which included the measurement of loudness discomfort levels (LDLs). The misophonic group exhibited a significantly higher overall discomfort index compared to the control group (0.64 ± 0.29 vs 0.30 ± 0.26; $p = 0.007$). Eating-related sounds were rated as the most uncomfortable, in the following order: eating food, soft chewing, slurping while eating, and slurping. Using the diagnostic criteria for hyperacusis (HQ score > 22 and LDL < 90 dB at two or more frequencies), 26 participants in the misophonic group were diagnosed with hyperacusis. The hyperacusis subgroup exhibited a significantly higher overall discomfort index compared to the non-hyperacusis subgroup (0.76 ± 0.28 vs 0.56 ± 0.28; $p = 0.002$), and a significant correlation was found between the HQ score and the overall discomfort index ($R^2 = 0.367$, $p < 0.001$). However, no significant differences in the discomfort index were observed based on the presence of hearing loss or tinnitus, psychiatric treatment history, or age. Misophonia involves heightened sensitivity to specific sounds, particularly eating-related noises. Hyperacusis prevalence was higher in the misophonic group than in the control group, with those having hyperacusis showing greater discomfort to trigger sounds, without links to other auditory abilities or symptoms.

Keywords: Misophonia, Hyperacusis, Discomfort Index

Hyperacusis / Misophonia

PP 30

Exploring the Relationship Between Hyperacusis, Psychological Distress, and Pain: A Multisensory Perspective

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Introduction
Hyperacusis refers to decreased tolerance to sounds and can severely affect the quality of life. Currently, there is no consensus on the mechanisms involved in hyperacusis, including its diagnostic tools or objective measures. However, an interaction between auditory and nociceptive systems in individuals with tinnitus and hyperacusis has been reported, including brain regions associated with cognitive and emotional aspects of pain.
Therefore, sensory and cognitive-affective factors may significantly influence the subjective experience of hyperacusis.
This study examined whether hyperacusis can be conceptualized as a multisensory phenomenon by investigating its relationship with somatosensory measures. It also validates subjective assessments of hyperacusis through objective measures accounting for psychological distress.

Methods
A total of 23 patients with tinnitus (M age = 56.39 years; SD = 11.78) were included in the study. Self-reported hyperacusis was measured using a validated questionnaire (Hyperacusis Inventory; HKI, German version). Independent variables encompassed loudness discomfort levels (LDL), psychological distress from somatization, depression, stress, and anxiety using validated questionnaires, pain pressure algometry (PPA), and demographic factors. Psychological distress (principal component analysis-derived score) was modeled as a quadratic predictor to account for nonlinear relationships. Regression analyses were performed to determine significant predictors of subjective sound sensitivity, examining the relationship between objective (LDL) and subjective measures (HKI) of hyperacusis and PPA.

Results and Conclusion
A negative association was found between LDL and HKI scores (r = -.38, p = .042; (t(14) = -2.22, p =.04; (R2 = .51, F(8, 14) = 1.81, p = .16.), indicating alignment between self-reported and objective measures of hyperacusis.
PPA did not significantly predict subjective or objective measures of hyperacusis. This result argues against a multisensory conceptualization of hyperacusis. However, its association with psychological distress (t(14) = -2.28, p = .04) might point to underlying mechanisms encompassing factors linked to cognitive and emotional aspects of pain.

Keywords: Hyperacusis, Pain, Multisensory Integration

Hyperacusis / Misophonia

PP 31

Neural Correlates of Emotional Processing in Misophonia and Hyperacusis

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Background and Aim: Misophonia is characterized by aversive reactions to specific trigger sounds, leading to negative emotions and behavioral or physiological responses, while hyperacusis is defined as intolerance to a broad range of sounds. Studies suggest these conditions share similarities and involve alterations in the auditory-limbic network, while possibly having differing mechanisms. This study aims to explore differences in emotional processing between the two disorders and investigate their neural correlates to better understand both their shared and unique characteristics.
Methods: Ninety participants (mean age = 20.9 years) completed screening questionnaires, psychological interviews, audiological evaluations, and task-based functional magnetic resonance imaging (fMRI). Participants were classified into four subgroups: misophonia (M; n=27), hyperacusis (H; n=15), both misophonia and hyperacusis (MH; n=22), and controls (C; n=26). During the fMRI scan, participants rated 42 randomly presented sounds, including misophonic triggers, neutral, and unpleasant sounds on their emotional valence.
Results: Participants had normal hearing thresholds in both ears (< 25 dB HL). The MH groups rated significantly more sounds as unpleasant compared to other groups. Both the M and MH groups showed a relatively higher proportion of unpleasant ratings for trigger and unpleasant sounds compared to the C and H groups. Faster reaction times for unpleasant sounds compared to neutral sounds were observed in all groups. Further, the whole-brain fMRI analysis revealed significant interaction effects (group x sound type) in the inferior/medial frontal gyrus and insular regions at corrected thresholds.
Conclusion: The findings reveal significant behavioral and neural differences among individuals with misophonia, hyperacusis, and their overlap. Emotional responses to sounds are more aversive in individuals with misophonia, both alone and comorbid with hyperacusis, compared to those with hyperacusis alone. Brain imaging results indicate that altered activation in the brain involved in cognitive and emotional processing may underlie distinct neural responses to process sound-related emotions.

Keywords: Hyperacusis, Misophonia, Functional brain imaging

Hyperacusis / Misophonia

PP 32

PREVALENCE AND SEVERITY OF MISOPHONIA IN THE INDIAN POPULATION: A LARGE-SCALE CROSS-SECTIONAL STUDY

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Purpose of the Study
This study aimed to determine the prevalence and severity of misophonia, a sound tolerance disorder, in the general population and individuals with tinnitus in India. Misophonia is characterized by intense emotional or physiological reactions to specific sounds due to increased autonomic nervous system activity. While previous studies reported prevalence rates of 23-49% in student populations and 23% in tinnitus patients, data on the general population and individuals with tinnitus in India were lacking.

Methods
A descriptive cross-sectional survey was conducted with 10,000 adults (6,073 males and 3,927 females) and 500 individuals with tinnitus (365 males and 135 females). Misophonia prevalence and severity were assessed using the Amsterdam Misophonia Questionnaire (A-MISO-S) and S-Five scale. Tinnitus cases were confirmed through the Tinnitus Sample Case History Questionnaire (TSCHQ) and Tinnitus Handicap Inventory (THI).

Results
Misophonia was present in 26% of the general population and 17% of individuals with tinnitus. Among those with misophonia, 66% had mild symptoms, 24% moderate, and 10% severe. Females showed a higher prevalence of misophonia across both groups. The study's findings are consistent with prior research on Indian college students and represent the first large-scale data on misophonia in the Indian general population. It is also the first study in India to report misophonia prevalence among individuals with tinnitus.

Conclusions
The study demonstrates a high prevalence of misophonia in the general population and those with tinnitus in India. It underscores the importance of routine screening and management of misophonia to improve quality of life. The findings provide a foundation for identifying individuals who require attention and suggest further research to generalize results across India's vast population.

Keywords: Misophonia, Tinnitus, Prevalence

Hyperacusis / Misophonia

PP 33

MULTICHANNEL AUDITORY CORTICAL RESPONSES IN MISOPHONIA: A NEUROPHYSIOLOGICAL INVESTIGATION

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Purpose of the Study

Research on auditory evoked potentials (AEPs) in misophonia has shown varied results, with some studies reporting differences in peak latencies or amplitudes while others do not (Aryal & Prabhu, 2023; Schröder et al., 2013, 2014). Multi-channel cortical auditory evoked potentials (CAEPs) can help identify subtle neural differences and abnormal activation patterns in brain regions associated with misophonia. This approach could serve as an objective measure of treatment efficacy and provide insight into its neurophysiological mechanisms. Thus, this study aims to evaluate auditory cortical functioning using late latency responses in normal-hearing individuals with and without misophonia.

Methods

Forty participants (aged 18–30 years) were recruited and divided into two groups: 20 with misophonia and 20 controls. Misophonia was diagnosed using criteria from Schröder et al. (2013) and the MisoQuest Questionnaire (Siepsiak et al., 2020). Auditory late latency responses (ALLR) were recorded using a 32-channel Compumedics Neuroscan system. Latency, amplitude, and spatiotemporal scalp topographic patterns were analyzed and compared between groups.

Results

Individuals with misophonia demonstrated significantly lower ALLR peak amplitudes ($p < .05$) compared to controls, although no significant differences ($p > .05$) were observed in latencies across frontal (Fz), central (Cz), and parietal (Pz) regions. These results are in consensus with previous studies on cortical potentials in individuals with misophonia (Aryal & Prabhu, 2023; Schröder et al., 2014, 2015). Spatiotemporal analysis revealed distinct scalp topographies: fronto-central activation in controls and centro-parietal activation in the misophonia group.

Conclusion

Reduced CAEP amplitudes in individuals with misophonia suggest altered cortical auditory processing. The unique centro-parietal activation pattern observed in this group highlights potential targets for neuromodulation treatments. These findings emphasize the importance of targeting specific brain regions to alleviate misophonia symptoms and provide valuable insights into its underlying neurophysiology.

Keywords: Misophonia, Audiology, Cortical response

Implantable Hearing Devices for Tinnitus Management

PP 34

Efficacy of Cochlear Implantation on Tinnitus Reduction and Auditory Performance Across Age Groups: A Retrospective Analysis

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Objective: This study aimed to evaluate the efficacy of cochlear implantation on tinnitus reduction and auditory performance across different age cohorts, analyzing data from patients aged 27 to 86 years.
Methods: A retrospective analysis was conducted on 150 patients who underwent cochlear implantation between 2006 and 2024. Patients were stratified into four age groups: Group 1 (<65 years, n=59), Group 2 (65-69 years, n=42), Group 3 (70-74 years, n=23), and Group 4 (≥75 years, n=26). Auditory performance was assessed using the Categories of Auditory Performance (CAP) score. Tinnitus severity was evaluated using the Tinnitus Handicap Inventory (THI) and Visual Analog Scale (VAS).
Results: Postoperative CAP scores showed no statistically significant differences across age groups (Kruskal-Wallis test, P=0.104). Regarding tinnitus effects, statistically significant reductions were observed in THI and VAS scores from preoperative to postoperative periods across all age groups (paired t-test and Wilcoxon signed-rank test, $P < 0.001$). Furthermore, comparison of VAS scores and THI from 6 months to 1 year post-cochlear implantation revealed no statistically significant differences in improvement rates across age groups over time (Linear mixed model, P>0.05).
Conclusion: Cochlear implantation appears to be an effective intervention for both tinnitus and auditory rehabilitation, with comparable outcomes across different age groups. Notably, significant improvements were observed in elderly patients, suggesting that advanced age should not preclude consideration of cochlear implantation when clinically appropriate. This intervention offers substantial benefits in tinnitus reduction and hearing rehabilitation across a wide age spectrum, from young adults to the elderly.

Keywords: Cochlear implantation, Elderly patients, Tinnitus

Implantable Hearing Devices for Tinnitus Management

PP 35

Tinnitus Reduction of Active Bone-Conduction Implant in Single-Sided Deafness: A Prospective Multicenter Study

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Objectives:Bone-conduction hearing aids can be selected for single-sided deafness (SSD) patients as a method of auditory rehabilitation. Some SSD patients also experience tinnitus. In this study, the effectiveness of the bone-conduction implant in reducing tinnitus was investigated.

Methods:This investigation was part of a prospective multicenter study involving 15 institutions. The Bonebridge® BCI 602 was implanted in 30 recruited participants. Of these participants, 19 reported tinnitus distress preoperatively. Subjects underwent tinnitogram testing and completed the Abbreviated Profile of Hearing Aid Benefit (APHAB) and the Tinnitus Handicap Inventory (THI) questionnaires.

Results: The average age of the 19 subjects with tinnitus was 47.6±14.8 years. Tinnitus could be matched on the tinnitogram in 13 of the 19 subjects. Among these 13 subjects, 11 (84.6%) exhibited a decrease in loudness levels. Significant changes were observed in THI scores, which decreased from 47.4±30.1 to 31.1±29.1 ($P<0.001$). However, in three subjects, THI scores increased. These three subjects had no residual hearing at 250, 2000, and 4000 Hz. The reduction in THI was significantly greater in patients with residual hearing compared to those without.The 19 patients with tinnitus showed significantly lower scores, particularly in the 'reverberation,' 'background noise,' and 'aversiveness' subcategories at 3 months.

Conclusions: The active bone-conduction implant may have a suppressive effect on tinnitus in patients with SSD. This effect appears to be greater in patients with residual hearing. However, further investigation is necessary to elucidate the mechanism of tinnitus reduction, which could help establish surgical indications for bone-conduction implants as a treatment for tinnitus.

Keywords: Bone conduction implantation, Single-sided deafness, Tinnitus

Implantable Hearing Devices for Tinnitus Management

PP 36

Evaluation of factors predicting tinnitus outcomes following cochlear implantation: a prospective quasi-experimental study

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Background and aims Cochlear implantation is an effective intervention to restore useful aspects of hearing function in adults with severe-to-profound hearing loss. Tinnitus, the perception of sound in the absence of an external source, is common in people with severe-to-profound hearing loss. Existing evidence suggests cochlear implantation may be effective in reducing the negative impact of tinnitus in this population. However, this is contradicted by data suggesting that up to half of cochlear implant recipients experience tinnitus, and that some of these patients who did not have tinnitus before cochlear implantation experience it after surgery or cochlear implant activation. Most evidence on the effects of cochlear implantation on tinnitus comes from secondary data in cochlear implant studies primarily concerned with hearing-related outcomes. Hence, the quality of the evidence for effects on tinnitus is low and not suitable to inform clinical recommendations or decision-making.
Methods Data on tinnitus symptom severity, tinnitus case characteristics, hearing ability, depression, anxiety, insomnia and quality of life will be collected from cochlear implant recipients using the Tinnitus Functional Index (TFI), a tinnitus profiling questionnaire (ESiT-SQ), the Speech, Spatial and Qualities 12 (SSQ-12) Patient Health Questionnaire (PHQ-9), Generalized Anxiety Disorder (GAD-7), Insomnia Severity Index (ISI), Health Utilities Index Mark 3 and EuroQol EQ-5D-5L respectively. Data will be collected before cochlear implantation, 2 weeks after cochlear implantation, immediately after cochlear implant activation, and one, three, and six months post-activation.
Results An interim analysis on a subset of participants reveals short and long-term changes is tinnitus and related outcomes following implantation.
Conclusion This study improves our understanding of the effects of cochlear implantation for tinnitus in adults with severe to profound hearing loss and inform the design of clinical trials of cochlear implantation for tinnitus.

Keywords: Tinnitus, Cochlear, Implants

Others

PP 37

The Origin of Tinnitus and Vertigo: Insights from the Long-term Progression of Ménière's Disease

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Purpose
Tinnitus, vertigo, migraine, and hypersensitive brain frequently coexist, suggesting a shared underlying mechanism. This study explores this connection using Ménière's disease (MD) as a model. We hypothesize that MD represents a pressure-release process predominantly driven by top-down neurovascular inflammatory responses originating in the central nervous system and extending to peripheral nerves. The clinical manifestations, including tinnitus, vertigo, and hearing loss, vary depending on the release pathways and energy involved.
Methods
This retrospective series reviewed 300 cases of MD diagnosed between 2001 and 2021. Patients were regularly monitored for hearing function and clinical symptoms, including tinnitus and vertigo. Longitudinal data were analyzed to identify patterns and categorize MD subtypes.
Results
MD cases were categorized into two subtypes: migraine-related Ménière's disease (MrMD) and primary Ménière's disease (PrMD). Approximately 50% of patients belonged to each group. PrMD cases demonstrated progressive hearing loss within 5–10 years, likely resulting from localized inner ear fluid homeostasis disorders, such as endolymphatic hydrops. In contrast, MrMD cases exhibited long-term fluctuating hearing patterns, with some showing recovery to near-normal hearing levels. However, severe and frequent attacks in MrMD led to irreversible hearing loss in certain patients, especially when hearing thresholds exceeded 50 dB. These findings suggest distinct pathways of neurovascular involvement and peripheral nerve impact between the two subtypes.
Conclusion
Based on clinical observations and literature review, tinnitus, vertigo, migraine and hypersensitive brain are known to have a high degree of comorbidity. According to the stress release hypothesis, it represents a predominantly top-down neurovascular inflammatory condition that affects both central and peripheral auditory pathways. The differing courses and outcomes of PrMD and MrMD illustrate distinct pressure-release pathways and energy variations. Therefore, diagnostic and therapeutic approaches should avoid overemphasizing the peripheral mechanisms alone, as the vast majority of cases are influenced by both central and peripheral factors.

Keywords: Ménière's disease, Migraine, Hypersensitive brain

Others

PP 38

Evaluation of the Photobiomodulation Treatment with the TINI Laser Device for Managing Chronic High-Frequency Tinnitus: A Randomized Controlled Trial

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Abstract
Introduction: To evaluate the efficacy of the TINI laser device, a photobiomodulation (PBM) therapy, for managing chronic high-frequency tinnitus in patients with unilateral or bilateral tinnitus.
Methods: A randomized, single-blind, placebo-controlled clinical trial was conducted with 38 participants. Subjects were divided into three groups: the TINI 1 group received 8 active laser treatments over 4 weeks, the TINI 2 group received 4 active treatments followed by 4 sham treatments, and the control group received only sham treatments. The Tinnitus Handicap Inventory (THI), Tinnitus Functional Index (TFI), and Tinnitus Magnitude Index (TMI) were used to assess tinnitus-related outcomes. Psychological assessments were also conducted to measure levels of depression, stress, and anxiety.
Results: Significant improvements were observed in the emotional subscale of the THI, and in the loudness and perception scores of the TMI in the TINI 1 group. The TINI 2 group showed significant reductions in TFI and TMI scores following active treatments, although these effects diminished after sham treatments. No placebo effects were observed except for TFI scores in the control group.
Conclusion: The study indicates that intermittent PBM therapy using the TINI laser may be effective in managing chronic tinnitus. Further research is necessary to explore long-term efficacy and safety.

Keywords: Tinnitus, Photobiomodulation, Randomized Controlled Trial

Others

PP 39

Health utility and quality of life analysis in children with bilateral cochlear implantation

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Aim
Despite extensive research on the objective outcomes of bilateral cochlear implantation (BCI) in children with severe to profound sensorineural hearing impairment (SNHI), its impact on quality of life (QoL) remains less examined with mixed results. This study aims to evaluate the impact of BCI on health utility and QoL, focusing on the differences between unilateral CI (UCI) and BCI, and to compare the results of generic and disease-specific instruments.

Methods
From August 2021 to June 2022, 154 children under 18 with severe to profound SNHI and 67 normal-hearing children were enrolled. The participants were divided into four groups: HA_HA with bilateral hearing aids (N=66), CI_HA with UCI (N=53), CI_CI with BCI (N=35), and NH with normal hearing (N=67). Both generic (EuroQoL five dimensions questionnaire, EQ-5D and visual analogue scale, VAS) and disease-specific instruments (Mandarin Children with Cochlear Implants: Parental Perspectives, MPP and Functioning after Pediatric Cochlear Implantation Instrument, FAPCI) were utilized.

Results
The CI_CI group had similar health utility (0.96±0.08) to NH group (0.93±0.17), with a gain from UCI to BCI of 0.08±0.13. VAS scores were higher in the CI_HA (90.5±9.6), CI_CI (91.9±7.8), and NH (91.2±10.2) than in HA_HA (85.5±11.5) groups (p=0.002).

The CI_CI group scored higher than CI_HA group in MPP, especially in children-related domains. In FAPCI, the CI_CI group had similar QoL scores to NH group, while the HA_HA and CI_HA groups had significantly worse scores. FAPCI was correlated with speech intelligibility (SIR) and auditory performance (CAP) (ρ= 0.769, and 0.841, respectively, p<0.001). VAS and EQ-5D were also weakly correlated with SIR and CAP.

Conclusion
BCI improves health utility and QoL for children with severe to profound SNHI, comparable to normal-hearing children. Auditory and speech performance correlate with QoL. Variations were observed across instruments, highlighting the need for multi-dimensional instruments to ensure comprehensive evaluation.

Keywords: Bilateral cochlear implantation, Quality of life, Health utility

Others

PP 40

Preliminary Findings of Tinnitus Patients Auditory Processing

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Patients with tinnitus exhibit significant alterations in multiple auditory mechanisms, particularly in sound discrimination and verbal processing in specific contexts. These findings emphasize the need for targeted therapeutic approaches focusing on auditory training and compensating for functional losses associated with the central auditory system.
These findings need to be compared with a control group to determine whether the observed alterations are specifically associated with tinnitus or are influenced by other factors, such as age or baseline variability in auditory performance. Such a comparison is essential to ensure the results' clinical relevance and validity.

Keywords: Tinnitus, Auditory processing, Preliminary findings

Others

PP 41

The experience of tinnitus in adults who are Deaf or have severe to profound hearing loss. A mixed methods study in the UK and Saudi Arabia

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Tinnitus and tinnitus disorder are commonly associated with hearing loss, yet there is a lack of research and guidance on how tinnitus on those who are Deaf or have severe-to-profound hearing loss. This population can have limited or no access to sound, and thus to conventional sound- or talking-based therapies commonly used for tinnitus. Most previous reports in this population have discussed tinnitus secondary to cochlear implantation for deafness. Studies on the lived experience of tinnitus are lacking. Here we used mixed methods to examine the lived experience of tinnitus in two populations of adults. Participants were recruited from the United Kingdom (n=13, mostly post-lingual deafness, cochlear implant users) and Saudi Arabia (n=12, mostly pre-lingual deafness, sign language users). Participants completed the Tinnitus Handicap Inventory, the Depression, Anxiety, Stress Scale, and semi-structured interviews.
Tinnitus severity varied, with higher levels of handicap in UK participants. Both samples exhibited high levels of anxiety, and less so depression and stress. Participants described their tinnitus characteristics, its impact, and their experience of healthcare and other forms of support, with notable cultural differences. Even those who had little or no access to sound vividly described their tinnitus sounds, and the confusions it sometimes caused them. Particularly in the UK population, tinnitus had a profound impact on general wellbeing. UK participants struggled with the constancy and loudness of tinnitus, and associated sleep difficulties, exhaustion, and impact on social interactions. The Saudi Arabia population struggled mostly with the loudness of tinnitus, impact on work, and reported associated physical complaints such as headache, nausea, and dizziness.
Adults who have tinnitus and severe-to-profound hearing loss can experience extreme tinnitus handicap, with difficulties confounded by their hearing loss. Further research should address the healthcare needs of this population, identify the most appropriate assessments, and adjust or develop accessible treatments.

Keywords: Deafness, lived experience, Culture

Others

PP 42

The Correlation Between Tinnitus and the Microbial Gut-Brain-Ear Axis: A Meta-Analysis

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Introduction: In recent years, tinnitus has become a common symptom in otolaryngology. However, the mechanism of tinnitus remains unclear. Some studies have found that tinnitus is associated with an increase in neuroinflammatory mediators in the central auditory system. On the other hand, gut dysbiosis plays a crucial role in brain function, and gut dysbiosis has been linked to various neurological disorders. Therefore, this study aims to explore the correlation between tinnitus and gut dysbiosis.

Objective: This study aims to explore the potential role of gut dysbiosis in the pathogenesis of tinnitus, primarily through its impact on the gut-brain-ear axis.

Methods: This study uses a meta-analysis approach, covering experimental studies from the past 10 years that discuss gut dysbiosis, tinnitus, and the gut-brain-ear axis.

Results: In the relevant experimental studies, it was found that gut dysbiosis influences the onset and prognosis of tinnitus by regulating the gut-brain-ear axis. These altered neurotransmitter profiles and pro-inflammatory mediators have also been observed in tinnitus.

Conclusion: Gut dysbiosis may lead to the pathogenesis of tinnitus through the gut-brain-ear axis, triggering neuroinflammatory responses.

Keywords: Tinnitus, Gut-brain-ear axis, Gut dysbiosis

Others

PP 43

A Novel Clinical Model for Tinnitus: Exploring Pathophysiology and Therapeutic Possibilities

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This model provides a framework for understanding and managing tinnitus by integrating biological mechanisms, patient-specific characteristics, and potential therapeutic pathways.
The model identifies four primary domains influencing tinnitus:
• Hearing: The auditory system creates the possibility for tinnitus perception.
• Attention: Dysregulated attention sustains the perception, particularly when attention cannot disengage from the auditory stimulus.
• Psychic/Emotional: Emotional and psychological factors significantly aggravate the condition, often amplifying distress.
• Muscular: Physical influences, including temporomandibular joint dysfunction (TMJ) or bruxism, play a contributory role.
Underlying these domains, personal biology and personality traits combined with neuroinflammation and potentially unconscious mind involvement, with the possibility that autonomic symptoms may also manifest.
This model recognizes that tinnitus rarely exists in isolation. Key associations include:
• Dizziness, balance issues, and proprioceptive dysfunction
• Sleep disturbances, such as insomnia or apnea
• Headache and chronic pain syndromes
• Global or auditory attention deficits
• Visual dysfunction
Additional aggravators include Hyperacusis, Depression, Obsessive Compulsive Disorder, General Anxiety Disorder, Personality disorders, and chronic pain, emphasizing the interplay between mental health and tinnitus perception.
The model considers exploratory links with:
• Diet: Could nutritional habits influence symptom severity?
• Gut-Brain Axis: Potential connections between gastrointestinal health and tinnitus. Is it possible?
• Immunity: Is the immune system a contributing factor?
• Hormonal changes, such as menopause in women, as a neurohormonal disorder
Triggers virtually can be any life events, most commonly with negative and stressful experiences, exacerbating symptoms.
Implications for Treatment
This clinical framework invites a sequential approach in a row to tinnitus management, by identifying the patient's unique physiological and psychological profile, interventions can target specific pathways—whether through auditory therapies, psychological counselling, neuroinflammatory modulation, or lifestyle adjustments. This model advocates for a holistic perspective, combining evidence-based practices with innovative strategies to improve patient outcomes (tinnitus volume and distress).

Keywords: Tinnitus, Clinical model, Innovative

Others

PP 44

Risk Factors for Tinnitus Development in Astronauts

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Purpose:
To identify risk factors for tinnitus development in astronauts through a literature review.

Results:
Tinnitus poses a significant risk to astronauts due to the unique environmental factors encountered during spaceflight.
Hearing loss, a primary risk factor for tinnitus, is frequently encountered in astronauts.
A comparison of the hearing threshold before and after spaceflight shows a temporary shift in the hearing threshold of almost all astronauts, regardless of mission duration. In some cases, the resulting hearing damage was permanent and even led to the specific astronaut being unable to fly again.
Noise damage was initially assumed to be the cause, as the average ambient noise level of 72 dB in the ISS service module is borderline high. However, the hearing loss observed is atypical for noise-induced hearing loss, which is why changes in signal generation and transmission from the cochlea as well as changes in central stimulus processing are also discussed as possible causes of the hearing loss observed. Whatever the cause, the risk of hearing loss is likely to increase with ever longer and farther missions to the Moon and Mars.

In addition to noise, space radiation, astronauts' unique physical demands and unusual body posture in microgravity may induce somatosensory tinnitus.

Therapeutically, conventional noise protection measures (headphones, ear plugs) are primarily used. Male astronauts seem to have an increased risk of earlier and more severe hearing damage. In addition, psychological factors such as long-term isolation and stress can exacerbate the subjective severity of tinnitus symptoms, so that initially harmless symptoms can contribute to a significant reduction in quality of life and performance.

Conclusion: Risk factors for tinnitus in astronauts encompass noise exposure, stress, radiation, and potential skeletomuscular factors. Addressing these through protective measures, stress management, and inflight monitoring may help mitigate tinnitus incidence, enhancing astronaut health and performance.

Keywords: Risk factors, Astronauts, Prevention

Neuromodulation in Tinnitus Treatment

PP 45

Effect of gaze training in 2 cases of gaze-evoked tinnitus

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Gaze-evoked tinnitus (GET) is a rare form of tinnitus characterized by the modulation of tinnitus perception through eye movements. GET is known to occur after certain surgical procedures, such as vestibular schwannoma removal. However, an established treatment for GET is lacking. A case report indicated that GET diminished with the repetition of movements that evoked such modulation. In this study, we applied gaze training to two patients with GET.
Case 1 involved a 61-year-old male with a right-sided vestibular schwannoma. One year post-operation, GET was observed on the right side. Gaze training resulted in partial improvement of tinnitus, encouraging him to continue the training. Case 2 involved a 46-year-old male with a right-sided vestibular schwannoma. After 1.5 years post-operation, GET was noted; however, gaze training did not produce significant changes after six months.
The underlying pathophysiology of GET remains unclear, but some research suggests that GET may result from abnormal interactions between the vestibular nucleus and the cochlear nucleus, potentially due to neural sprouting after surgery. Gaze training consists of a program of exercises involving the repetition of movements that evoke tinnitus, aiming to acclimate the response triggered by gaze. Further research is required to investigate effective treatments for GET, considering the underlying reasons for this phenomenon.

Keywords: Gaze-evoked tinnitus, Gaze training, Case report

Neuromodulation in Tinnitus Treatment

PP 47

Protocol for a randomised controlled pilot study of multiple sessions of transcranial Direct Current Stimulation (tDCS) for tinnitus: the WHITBY study

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Background and aims Tinnitus -the awareness of sound in the absence of an external source- is a common condition associated with hearing loss, mood disorders, insomnia and reduced quality of life. Current treatment options are limited and do not address the tinnitus percept itself. Transcranial Direct Current Stimulation (tDCS) may be a future treatment option, based on the limited available evidence. This protocol outlines a randomised controlled pilot study which seeks to inform a future clinical trial.
Methods Forty participants will be recruited and randomised to receive ten sessions of either active tDCS or sham over a two-week period. Proof of concept will be measured by protocol compliance and attrition. Tinnitus loudness, tinnitus symptom severity, depression, anxiety, treatment satisfaction, adverse effects and spontaneous and auditory-evoked oscillatory brain activity will be measured using self-report measures and electroencephalography (EEG).
Results This study seeks to establish the tolerability of multiple sessions of tDCS, devise an evidence-based treatment regimen, pilot the collection of long-term follow-up data and explore the feasibility of individualised head modelling and computational current flow modelling, using MRI, to inform an optimal treatment regimen. The findings will contribute towards the design of a statistically powered randomised sham-controlled trial to determine the efficacy of repeated sessions tDCS to dorsolateral prefrontal cortex (DLPFC) in reducing tinnitus symptom severity.
Conclusion This study represents an important step towards developing a viable device-based tinnitus treatment that is both safe and minimally invasive. Its results will yield new insights into tinnitus mechanism and treatment-related changes.

Keywords: Tinnitus, TDCS, EEG

Neuromodulation in Tinnitus Treatment

PP 48

Transcutaneous auricular vagus nerve stimulation can modulate fronto-parietal brain networks

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OBJECTIVES: Recent studies have shown that transcutaneous vagal nerve stimulation (tVNS) holds promise as a treatment for neurological or psychiatric disease through the ability to modulate neural activity in some brain regions without an invasive procedure. The objective of this study was to identify the neural correlates underlying the effects of tVNS.

METHODS: Twenty right-handed healthy subjects with normal hearing participated in this study. An auricle-applied tVNS device (Soricle, Neurive Co., Ltd., Gyeongsangnam-do, Republic of Korea) was used to administer tVNS stimulation. A session consisted of 14 blocks, including 7 blocks of tVNS stimulation or sham stimulation and 7 blocks of rest, and lasted approximately 7 minutes (1 block=30 seconds). Functional magnetic resonance imaging (fMRI) was performed during the stimulation.

RESULTS: No activated regions were observed in the fMRI scans following both sham stimulation and tVNS after the first session. After the second session, tVNS activated two clusters of brain regions in the right frontal gyrus. A comparison of the activated regions after the second session of each stimulation revealed that the fMRI following tVNS exhibited four surviving clusters. Additionally, four clusters were activated in the overall stimulated area during both the first and second sessions. When comparing the fMRI results after each type of stimulation, the fMRI following tVNS showed four surviving clusters compared to the fMRI after sham stimulation.

CONCLUSION: tVNS could stimulate some brain regions, including the fronto-parietal network. Stimulating these regions for treating neurological or psychiatric disease might require applying tVNS for at least 3.5 minutes.

Keywords: Transcutaneous vagal nerve stimulation (tVNS), Functional magnetic resonance imaging(fMRI), Neurological / Psychiatric disease

Neuromodulation in Tinnitus Treatment

PP 49

Efficacy of non-invasive home-based Transcranial Random Noise Stimulation (tRNS) therapy in patients with chronic intractable tinnitus

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Objective:
Recent advancements in non-invasive neuromodulation therapies have introduced Transcranial Electrical Stimulation (TES) as a promising treatment for tinnitus. However, there is limited research on transcranial random-noise stimulation (tRNS), which delivers a weak alternating current oscillating at random frequencies. This study aimed to investigate the clinical efficacy of tRNS for alleviating chronic tinnitus symptoms and evaluate the clinical effectiveness and safety of a home-based TES device, which offers ease of use and improved accessibility while achieving similar therapeutic effects.

Method:
Sixty patients with chronic debilitating tinnitus, having a Visual Analogue Scale (VAS) distress score of 6 or more, and unresponsive to over three months of adequate pharmacological treatment participated in the study. Participants were randomly assigned to three groups: 20 in the active experimental group (A), 20 in the active control group (B), and 20 in the placebo control group (C). Subjective tinnitus severity was assessed before and after treatment using a self-reported tinnitus questionnaire (Tinnitus Handicap Inventory (THI), VAS loudness (V-L), and VAS distress (V-D)).

Results:
This study reported no major side effects after home-based tRNS treatments. A Wilcoxon signed-rank test showed no significant differences in V-D, V-L, and THI scores between pre-treatment and post-treatment in all groups. Similarly, a Friedman test indicated no statistically significant differences in pre-treatment scores across groups. The pre-treatment scores revealed varying levels of tinnitus severity across the groups, but no meaningful changes were observed after treatment. This supports the finding that the intervention did not produce significant therapeutic effects.

Conclusion:
This study assessed the effectiveness and satisfaction of tinnitus treatment using a home-based TES device. Although home-based tRNS treatment was proven to be safely applicable, the therapeutic benefits were limited. Further studies with larger sample sizes are needed to refine treatment protocols and explore more effective approaches.

Keywords: Tinnitus, Transcranial Random Noise Stimulation, Transcranial Electrical Stimulation

Neuromodulation in Tinnitus Treatment

PP 50

Mechanistic Study of Photobiomodulation in Alleviating Subjective Tinnitus via Modulation of Central Excitability

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Objective
This study investigated the therapeutic effects of photobiomodulation (PBM) on subjective tinnitus in a mouse model, focusing on its regulatory roles in central excitability and synaptic plasticity. The study also aimed to elucidate the underlying molecular mechanisms through transcriptomic analysis, validating PBM as a non-invasive neuromodulation strategy.
Methods
C57 mice were exposed to 115 dB noise for 1 hour to establish a tinnitus model. One week later, the Gap Pre-pulse Inhibition of the Acoustic Startle Reflex (GPIAS%) was used to screen tinnitus mice. These mice then received transcranial auditory cortex irradiation with an 830 nm laser for 5 minutes daily over 3 consecutive days. Post-treatment GPIAS% measurements verified the therapeutic effects. Transcriptomic analysis was performed on auditory cortex samples from three tinnitus mice and three PBM-treated mice to identify differentially expressed RNAs and their enriched pathways.
Results
PBM significantly improved tinnitus symptoms, with a cure rate of 83.33% ($n = 5$ cured; $n = 1$ uncured; $p = 0.0079 < 0.01$). Transcriptomic analysis revealed significant differences in RNA expression between tinnitus and PBM-treated mice. Differentially expressed RNAs were enriched in pathways related to angiogenesis, ion transmembrane transport, G protein-coupled receptor signaling, and inflammation. PBM upregulated genes associated with angiogenesis and ion channel regulation while downregulating those related to inflammation and oxidative stress, indicating that these pathways are crucial for PBM's therapeutic effects.
Conclusion
This study demonstrates that PBM alleviates subjective tinnitus by modulating central excitability and key molecular pathways, including angiogenesis and ion channel regulation. These findings provide insights into PBM's neuromodulatory mechanisms and support its potential as a tinnitus treatment strategy. Future research should explore PBM's application in tinnitus and optimize treatment parameters to enhance clinical efficacy.

Keywords: Tinnitus, Non-invasive Neuromodulation, Photobiomodulation

Objective Tinnitus

PP 51

Clinical Characteristics and Surgical Outcomes of 152 Cases of Sigmoid Sinus-Derived Pulsatile Tinnitus

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Objective: To elucidate the clinical features, surgical approach selection, and outcomes of vascular pulsatile tinnitus originating from the sigmoid sinus, with the aim of better optimizing treatment strategies.
Methods: A total of 152 patients with vascular pulsatile tinnitus originating from the sigmoid sinus, who underwent surgery between January 2015 and December 2023, were selected. All patients underwent physical examinations, including otoscopic examination, jugular compression test, water infusion test, and periauricular auscultation. Additional diagnostic tests included brain CTA+CTV, temporal bone CT, Pure tone audiometry. Among them, 94 cases had sigmoid sinus diverticulum, 32 had sigmoid sinus bony wall defects, 22 had cavum patients, and 4 had patients with ligated temporal superficial artery and mastoid emissary vein. Tinnitus assessment times were preoperative, postoperative, one month postoperative, and three months postoperative.
Results: Among all patients, 94 cases of pulsatile tinnitus were observed in patients with sigmoid sinus diverticulum, including 6 males and 88 females. Tinnitus was present on the left side in 23 cases and on the right side in 71 cases.Three months post-surgery, the effective rate of tinnitus relief was 93.24%. Among the 32 patients with sigmoid sinus bone wall defects, there were 3 males and 29 females. Three months post-surgery, the effective rate was 83.95%. Among the 22 patients with resonance cavity issues, there were 4 males and 18 females. Three months post-surgery, the effective rate was 78.57%. Among the 4 patients with procedures such as the ligation of the superficial temporal artery and mastoid emissary veins, including 1 male and 3 females, the effective rate was 50%. The two groups showed significant statistical differences, with $P<0.05$.
Conclusion: This study suggests that conditions such as sigmoid sinus diverticulum, bone defects, or resonance cavities can achieve definite therapeutic effects after local surgical treatment, making them worthy of clinical promotion and application.

Keywords: Pulsatile Tinnitus, Surgical treatment, Sigmoid sinus

Objective Tinnitus

PP 52

The management strategies of Jugular sinus venous thrombosis-related tinnitus

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Purpose: Jugular sinus venous thrombosis-related tinnitus is one of the common forms of objective tinnitus in clinical practice. This study aims to explore the surgical strategies and complications associated with its treatment.
Methods: A retrospective study was conducted to collect 87 patients with objective tinnitus caused by jugular sinus region lesions who were treated in our department. There were 80 female cases and 7 male cases, with an average age of 35.3 ± 10.7 years. There were 56 cases on the right side (56/87, 64.4%) and 31 cases on the left side (31/87, 35.6%). The duration of the disease was more than 6 months, causing significant distress in daily life. 11 patients had jugular sinus diverticulum (11/87, 12.6%), ,9 patients had jugular sinus bony wall defects (9/87, 10.3%) and 67 cases of jugular sinus protrusion (67/87, 77%). Before surgery, it is necessary to complete imaging examinations to rule out arteriovenous fistulas and transverse sinus stenosis, such as temporal bone CT, CTA, CTV, or DSA . All patients completed the follow-up over 6 month.
Results: Vascular tinnitus related to the jugular sinus predominantly occurs in the dominant side of the jugular sinus, with a cure rate of 78%, an effective rate of 10%, and an ineffective rate of 12%. Under general anesthesia, key steps for successful surgery include grinding down part of the bony wall of the jugular sinus and using bipolar coagulation to address the protruding jugular sinus. Merely performing a repair has a low rate of effectiveness.
Conclusion: The primary cause of jugular sinus venous thrombosis-related tinnitus is the formation of blood flow vortices in the region of the protruding jugular sinus. The protruding jugular sinus is the most significant anatomical factor for vascular tinnitus and is the key area that requires attention during surgery.

Keywords: Jugular Sinus Venous Thrombosis-Related Tinnitus, Management, Strategies

Objective Tinnitus

PP 53

A case report of vascular pulsatile tinnitus caused by maxillary arteriovenous fistula

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Case Report: A 50-year-old male patient presented to our hospital in April 2024 due to "left-sided pulsatile tinnitus for over 5 months." The patient had undergone two consecutive percutaneous balloon compression procedures at another hospital in November 2023 for "left-sided trigeminal neuralgia." Post-surgery, the trigeminal neuralgia improved, but he developed a persistent left-sided, pulsating, blowing sound synchronized with his pulse. Physical examination findings included: 1) Compression of the neck: Positive, as tinnitus was alleviated by pressing on the affected side of the neck; 2) Auscultation around the ear: Positive, with a blowing sound audible over the cheek in front of the ear.Relevant auxiliary examination findings: 1) Audiometry: Pure tone audiometry shows normal low to mid-frequency hearing bilaterally, with mild sensorineural hearing loss at high frequencies; 2) Cranial MRI with contrast: Close relationship between the trigeminal nerve and microvessels, no other abnormalities observed; 3) DSA: Identified the presence of a maxillary arteriovenous fistula; 4) Tinnitus Questionnaire assessment: THI score of 80, VAS score of 9. Clinical diagnosis: Left-sided maxillary arteriovenous fistula. The patient underwent treatment in May 2024, which involved occlusion of the maxillary artery fistula and embolization with Onyx glue, resulting in complete resolution of tinnitus post-surgery.Follow-up for 7 months showed that the tinnitus remained absent, with no other discomfort reported by the patient.
Discussion: The cause of the maxillary arteriovenous fistula in this patient is likely related to the percutaneous balloon compression procedure performed during the treatment of trigeminal neuralgia. However, such an association is rarely reported in the literature. This case was diagnosed through targeted maxillary artery DSA, which identified the location of the arteriovenous fistula. The condition was subsequently resolved through arterial embolization, eliminating the tinnitus. This scenario is prone to misdiagnosis in clinical practice and requires close collaboration between otolaryngology and neurosurgery for effective treatment.

Keywords: Vascular pulsatile tinnitus, Arteriovenous fistula, Vascular Interventional Therapy

Objective Tinnitus

PP 54

Tinnitus Occurring in Synchrony with Eye Blinking

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Tinnitus is a common auditory phenomenon associated with many otological diseases, and is usually subjective. Objective tinnitus can be generated by para-auditory structures, usually derived from vascular or myogenic sources, or the Eustachian tube. We present a rare case of intermittent unilateral tinnitus associated with eye blinking. Otoendoscopic examination showed that the external auditory canals and tympanic membranes were normal; however, rhythmic movements of both tympanic membranes, concomitant with the tinnitus, were evident whenever the patient blinked. The tympanometry and stapedial reflexes measured via impedance audiometry exhibited saw-tooth patterns; movement of the tympanic membrane was associated with eyelid blinking. The patient was managed conservatively, with reassurance and medication, and the condition became well-controlled. Here, we present this educational case and review the literature.

Keywords: Tinnitus, Middle ear myoclonus, Tympanometry

Objective Tinnitus

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Long-Term Effects of Middle Ear Tendon Resection on Middle Ear Myoclonic Tinnitus, Hearing, and Hyperacusis

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Objective: To evaluate the therapeutic effects of middle ear tendon resection (METR) on middle ear myoclonic tinnitus (MEMT) and to investigate its long-term effects on hearing and hyperacusis.
Materials and Methods: Thirty-seven patients with MEMT with a mean age of 33.2 ± 11.8 years were included in this study. METR was performed on all 37 MEMT patients (41 ears) between November 2004 and August 2016. The mean follow-up period was 16.1 months. We examined changes in tinnitus and accompanying stress and depression in patients after surgery, and examined the hearing changes and the occurrence of complications including hyperacusis.
Results: After surgery, 34 (91.9%) patients exhibited complete resolution of MEMT during their follow-up period, and 3 patients showed a partial response. The mean Visual Analog Scale (VAS) scores for tinnitus severity, the Tinnitus Handicap Inventory (THI), and stress index decreased significantly after surgery ($p < 0.05$, paired t test). No patient developed hearing loss or hyperacusis following surgery.
Preexisting hyperacusis even improved in most of the patients with intractable MEMT after surgery.
Recurrence of the symptom occurred in only 1 patient, who underwent revision surgery with improvement. We observed 1 case of postoperative delayed facial palsy with complete recovery in 2 weeks.
Conclusions: METR seems to be an effective and safe treatment option for intractable MEMT, considering its high control rate of tinnitus and no long-term harmful effects on hearing and hyperacusis.

Keywords: Myoclonus, Middle ear tendon resection, Tinnitus

Objective Tinnitus

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Navigation image-guided surgery for treatment of pulsatile tinnitus caused by sigmoid sinus diverticulum or dehiscence

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Background
Sigmoid sinus diverticulum (SSD) with or without co-concurred wall dehiscence (SSWD) is a commonly cause of pulsatile tinnitus. For cases of severe and annoying tinnitus, trans-mastoid excisional surgery and repair of the bony defect are effective treatments. Traditional mastoidectomy creates a large cavity to locate the diverticulum/dehiscence, and the dura is fragile and easily bleeds, which largely increases the operative time. Navigation image guidance has been widely applied in otorhinolaryngology, such as sinus and skull base surgery. It allows the surgeons to determine the boundaries of important anatomical structures and surgical paths more precisely.
Methods
The navigation system of the Karl Storz KSSC Navigation Panel Unit (NPU) optical navigation system image guidance facilitated the localization of SSD/SSWD. Under the image guidance, diverticulum/dehiscence was easier to be located. A retro-auricular mastoidectomy was then performed, and the diverticulum was exposed and skeletonized.
Results
From February 2018 to May 2024, total 16 patients diagnosed with SSD or SSDW were included in this study. All patients underwent tinnitus assessment after surgery. The follow-up period ranged from one to 13 months. Ten patients (62.5%) experienced complete resolution (cured) of pulsatile tinnitus and six patients (37.5%) experienced partial resolution.
Conclusions
The novelty of our approach and methods include precisely locating the dehiscence/diverticulum site via image-guided navigation surgical techniques which
avoided unnecessary sacrifice of the mastoid air cells to preserve the original air pulsation transmission barrier and save time.

Keywords: Pulsatle tinnitus, Sigmoid sinus diverticulum, Navigation surgery

Sound Therapy and Behavioral Therapy for Tinnitus

PP 57

Impact of Tinnitus Frequency on the Effectiveness and Prognosis of Acoustic Therapy

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Purpose
This study evaluates the influence of tinnitus frequency on the efficacy and prognosis of acoustic therapy in chronic subjective tinnitus patients.
Methods
A total of 135 patients with subjective tinnitus were categorized into three groups: low frequency (<1 kHz, 42 cases), mid frequency (1–3 kHz, 40 cases), and high frequency (4–8 kHz, 43 cases). Each group received customized acoustic therapy tailored to their tinnitus frequency and loudness levels, combined with tinnitus cognitive behavioral therapy. Tinnitus loudness and efficacy rates were evaluated pre- and post-treatment.
Results
The low-frequency group achieved the highest efficacy rate (93.55%), followed by the mid-frequency group (82.88%) and the high-frequency group (58.82%) ($p < 0.05$). Significant reductions in tinnitus loudness were observed in low- and mid-frequency groups, with the high-frequency group showing the least improvement. Combined acoustic therapy and CBT were most effective for low-frequency tinnitus, while high-frequency tinnitus required extended treatment durations for optimal outcomes.
Conclusion
Tinnitus frequency significantly influences the effectiveness of acoustic therapy. Low- and mid-frequency tinnitus respond more favorably, while high-frequency tinnitus presents challenges requiring prolonged intervention. Frequency-specific customization of therapy offers valuable insights for improving clinical outcomes in tinnitus management.

Keywords: Tinnitus frequency, Acoustic therapy, Cognitive behavioral therapy

Sound Therapy and Behavioral Therapy for Tinnitus

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Efficacy of Customized Sound Therapy for Tinnitus Patients is Superior to Non-customized in All Aspects

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Objective: Sound therapy is a common treatment for tinnitus.This study aims to explore the therapeutic efficacy of non-customized and customized sound therapy for subjective tinnitus.
Methods:The subjects of this study were patients with tinnitus who visited our outpatient department from 2018 to 2022.A total of 732 patients were included.Customized sound therapy is tailored to the patient's specific tinnitus condition, while non-customized sound consists of soothing natural sounds.The daily treatment duration is 2 hours.
Results: The THI score for the non-customized group showed a downward trend at 1 and 3 months after treatment.The HADS-A score also decreased 3 months after treatment compared to before treatment.The THI scores for the customized group showed a downward trend at 1, 3, 6, 9, and 12 months after treatment.The HADS-A/D scores decreased at 1, 3, and 6 months after treatment. The efficacy of the customized group was greater than that of the non-customized group 1 month after treatment.
Conclusion: Both sound therapies can alleviate tinnitus severity and reduce anxiety in the short term.Customized sound therapy is superior to non-customized therapy in terms of short-term efficacy. Additionally, customized sound therapy is more effective than non-customized therapy in alleviating tinnitus severity and managing anxiety and depression over a longer period.Therefore, customized sound therapy may be a more effective treatment option for subjective tinnitus.

Keywords: Customized Sound Therapy, Non-customized Sound Therapy, Sound Therapy Effect

Sound Therapy and Behavioral Therapy for Tinnitus

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Efficacy of customised music therapy is independent of whether tinnitus pitch lies within the frequency of the hearing loss

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Objective: To investigate whether the efficacy of customized music therapy for patients with subjective chronic tinnitus is affected by the relationship between tinnitus pitch and hearing loss frequency.
Methods: Data from 216 patients with chronic subjective tinnitus were included. Based on the relationship between tinnitus pitch and hearing loss frequency, these patients were categorized into three groups: tinnitus pitch within the frequency range of hearing loss (Group A, 55 patients), tinnitus pitch outside the frequency range of hearing loss (Group B, 71 patients), and tinnitus patients with normal hearing (Group C, 90 patients). All patients received customized music therapy for a period of 3 months and questionnaires including Tinnitus Handicap Inventory (THI), Hospital Anxiety and Depression Scale (HADS) and Visual Analogue Scale (VAS) were collected before and after therapy.
Results: Of the 216 patients in this study, 58.3% had hearing loss. After 3 months of customized music therapy, the effective rates of tinnitus disorders in the Group A, Group B and Group C were 60.0%, 53.5% and 68.9%, respectively; the effective rates of anxiety were 64.1%, 75.0% and 69.6%; and the effective rates of depression were 79.2%, 56.3% and 64.3%, respectively. However, there were no significant differences in the effectiveness rate, the distribution of THI/HADS scores, and the reduction of the scores in these three groups before and after therapy.
Conclusion: Customized music therapy can improve tinnitus disorders, related anxiety and depression in patients with subjective chronic tinnitus, regardless of whether the tinnitus pitch is within the frequency range of hearing loss.

Keywords: Customised music therapy, Tinnitus pitch, Frequency range

Sound Therapy and Behavioral Therapy for Tinnitus

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Combining sound therapy and cardiac coherence for the management of chronic pain and tinnitus in Canadian veterans

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Acoustic therapy is widely used in tinnitus patients to help them cope with their phantom sensation. Acoustic stimulation aims to interfere with tinnitus perception (by masking, residual inhibition and/or central mechanisms) but also to provide a control tool enabling patients to manage tinnitus intensity. Recently, we showed that amplitude-modulated sound was effective in producing residual inhibition of tinnitus. In this context, we thought it would be interesting to use amplitude-modulated sound stimulation, at a modulation frequency that is both pleasant and relaxing for the patient. In this context, we came up with the idea that acoustic stimulation, chosen to interfere with the perception of tinnitus, could also be used as an auditory breathing guide for cardiac coherence exercises (the amplitude modulation period is 10 seconds). Cardiac coherence is well known for balancing the activation of the sympathetic and parasympathetic systems, and thus for reducing stress and anxiety. An android application has been developed to play amplitude-modulated natural sounds or filtered noises. This approach was tested on Canadian veterans (n=30). We evaluated the benefit of regular training in a 5-minute cardiac coherence exercise (at least three times a day: before breakfast, before lunch around 12:00 and in the late afternoon) on pain and tinnitus intensity and on disability using the new application over a one-month period. This approach combining regular sound stimulation and cardiac coherence is effective in reducing disability and the intensity of chronic tinnitus, pain and post-traumatic stress in veterans. In addition, this approach seems to promote better sleep quality and less interference of tinnitus on sleep. Although these data are preliminary, the approach is a promising addition to the arsenal of simple tools patients can use to cope quickly and effectively with their tinnitus.

Keywords: Stress, Cardiac coherence, Relaxation

Sound Therapy and Behavioral Therapy for Tinnitus

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Vulnerability-stress interactions underlying the beneficial effects of hearing aid usage on tinnitus-related distress

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Objectives. While the beneficial effects of hearing aids (HAs) in individuals suffering from chronic tinnitus and significant hearing loss have been affirmed repeatedly, predictor and moderator analyses of these effects are missing in order to optimize therapeutic outcomes. Addressing especially the lack of research on underlying psychological mechanisms, the current study explored the influence of personality, depression, fear of tinnitus, as well as their interactions on improvements of tinnitus-related distress after HA usage.
Design. Data stems from the multicenter "Unification of Treatments and Interventions for Tinnitus Patients (UNITI)" study. Fifty-five participants with chronic tinnitus and mild-to-moderate hearing loss used HAs over the course of a 12-week treatment phase. The Big Five Inventory-2 (BFI-2) measuring five personality domains, the Patient Health Questionnaire (PHQ-9) measuring depression severity and the Fear of Tinnitus Questionnaire (FTQ) measuring tinnitus-related fear were assessed at baseline. For tinnitus-related distress, the Tinnitus-Handicap-Inventory (THI) and the Tinnitus Functional Index (TFI) were applied at baseline as well as after 6 and 12 weeks of treatment.
Results. Higher levels of tinnitus-related distress and lower levels of fear of tinnitus at baseline predicted greater reductions in tinnitus-related distress after HA usage. In the subsequent analysis of vulnerability-stress interactions, depression as well as fear of tinnitus at baseline were associated negatively with reductions of tinnitus-related distress after HA usage in subsamples characterized by low negative emotions, high conscientiousness and high agreeableness. In individuals scoring high on negative emotions, a relationship between higher levels of depression at baseline and greater reductions in tinnitus-related distress after HA usage could be observed.
Conclusions. Our results deliver first evidence for the influence of vulnerability-stress mechanisms on the beneficial effects of HA usage, stressing the need for a closer integration of psychological aspects in the prescription of HAs for patients suffering from chronic tinnitus and hearing loss.

Keywords: Tinnitus-related distress, Hearing aids, Personality

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Cultural Adaptation and Pilot Evaluation of A Psychologically Informed, Audiologist-Delivered, Manualised Intervention for Chronic Tinnitus in Malaysia

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Background:
Chronic tinnitus significantly impacts quality of life, necessitating comprehensive management approaches that address both psychological and auditory components. Psychologically informed interventions show promise in reducing tinnitus-related severity and distress however, cultural adaptation is essential to ensure such interventions respect local values, enhance patient understanding and engagement, and ultimately improve outcomes. This study adapted a UK-developed, audiologist-delivered, manualised tinnitus intervention for Malaysian patients and evaluated its acceptability.

Methods:
Following WHO guidelines for implementing evidence-based psychological interventions, the manual and resources were adapted into Malay with culturally sensitive modifications including language nuances, idiomatic expressions, and culturally incongruent content. Content validity was assessed by seven tinnitus experts using the Content Validity Index (CVI). Ten chronic tinnitus patients without sound tolerance and cognitive disorders participated in the pilot evaluation. Intervention outcomes were measured using the Tinnitus Functional Index (TFI) and the Depression Anxiety Stress Scales (DASS-42). Patients' acceptability of the intervention was explored through semi-structured interviews guided by the Theoretical Framework of Acceptability (TFA).

Results:
Content validity was universally strong across all domains (I-CVI and S-CVI = 1.0). TFI scores demonstrated a significant tinnitus severity reduction from 59.5 at baseline to 40.2 one week post-intervention and 36.8 three months post-intervention ($p<0.05$). However, DASS-42 subscale scores showed no significant changes over time ($p>0.05$). These findings suggest that improvements in tinnitus may result in better TFI scores without necessarily influencing broader mental health symptoms, such as depression, anxiety, or stress. All participants rated the intervention as acceptable on a 5-point Likert scale, highlighting opportunities for further refinement, including enhancing the cultural relevance of the examples provided.

Conclusions:
The adapted intervention demonstrated strong content validity, acceptability, and potential for reducing tinnitus severity and distress in Malaysian patients. These findings have informed the ongoing randomised controlled feasibility trial to evaluate the intervention's effectiveness and scalability.

Keywords: Tinnitus, Audiologist, Cognitive behavioural therapy

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Two-year Observation of Tinnitus Pitch Fluctuations by Sound Therapy

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<Purpose>
The aim of this study is to evaluate the relationship between pitch fluctuations and therapeutic effect or psychological performance during two years of sound therapy.
<Methods>
One hundred and fifty-one patients with chronic tonal or narrow-band tinnitus in which sound therapy was performed for more than 2 years and whose tinnitus did not disappear were enrolled.
The equipment used for treatment is hearing aid and/or sound (noise and/or fractal tones) generator.
At the start and 2-year later, the evaluation was conducted using the pitch match test and the following questionnaires: THI (Tinnitus Handicap Inventory), VAS (Visual Analogue Scale) of annoyance, SDS (Self-rating Depression Scale), STAI (State-Trait Anxiety Inventory).
Comparing the pitch at the start and 2-year later, the patients were divided into two groups: 1) lowered, 2) unchanged or elevated, and the above scores were compared between these two groups with Mann-Whitney test.
As a subjective assessment after 2 years, they underwent the question that how the severity of their tinnitus changed and were divided into two groups: A) improvement, B) invariance or worsening. And associations between these groups (1, 2, A and B) were examined using chi-square test.
<Results>
With treatment, pitch decreased significantly after one year and further after two years.
Regarding the association between subjective improvement and change in pitch, "improvement with lowered in pitch" and "invariance or worsening with unchanged or elevated in pitch" were significantly more common.
When comparing the scores between the "lowered pitch" group and the "unchanged or elevated pitch" group, at the start, no differences were found except for Trait Anxiety score, but after two years, all scores in the "lowered pitch" group were significantly lower.
<Conclusion>
Pitch fluctuations are related to the subjective improvement of tinnitus and scores of various audiological and psychological questionnaires.

Keywords: Tinnitus pitch, Sound therapy, Pitch fluctuation

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Prognostic Factors for Tinnitus Cure Following Tinnitus Retraining Treatment: A Retrospective Study

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Objective: To identify factors influencing tinnitus cure and analyze cure timeframes in patients undergoing Tinnitus Retraining Treatment (TRT).
Methods: "Tinnitus cure" was defined as perceiving tinnitus for less than one minute. A retrospective analysis was conducted on 588 patients (71 cured, 517 non-cured) were analyzed using logistic regression.
Results: Significant factors associated with tinnitus cure were sex, pure tone audiometry threshold, initial Visual Analog Scale (VAS) scores for loudness and awareness, and age. Females had 2.8 times higher odds of cure ($p<0.05$). Higher initial loudness decreased cure odds by 0.862 times ($p<0.05$), higher initial awareness by 0.989 times ($p<0.05$), and increasing age reduced cure possibility by 0.979 times per year ($p<0.05$). Initial Tinnitus Handicap Inventory (THI) scores, sound therapy types, tinnitus duration, number of tinnitus sounds, and underlying causes showed no significant differences ($p>0.05$). The timeframe for achieving cure varied among patients. The majority of cured patients (28.8%) achieved cure between 1-2 years post-TRT, followed by 24.1% between 6 months to 1 year, and 20.6% within 3 months. Smaller percentages achieved cure between 3-6 months (11.8%), 2-3 years (10.6%), and after 3 years (7%).
Conclusion: This study identifies prognostic factors for tinnitus cure following TRT and highlights the variability in time to cure. The significant factors associated with tinnitus cure were sex, pure tone audiometry threshold, initial Visual Analog Scale (VAS) scores for loudness and awareness, and age. Females had higher odds of cure, while higher initial loudness and awareness scores, as well as increasing age, reduced the likelihood of cure. The majority of cured patients (28.8%) achieved cure between 1-2 years post-TRT, followed by 24.1% between 6 months to 1 year. These findings may aid in patient counseling and treatment planning for tinnitus management, providing valuable insights into the expected outcomes and timelines for TRT.

Keywords: Tinnitus Cure, Prognostic Factors, Cure timeframes

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The effects of acceptance and commitment therapy for tinnitus patients.

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1. Introduction
"The Tinnitus Clinical Practice Guidelines" was first published in Japan in May 2019, which recommended cognitive behavioral therapy (CBT) based on its evidence. However, in Japan, CBT has been used only for treating disorders such as depression and considered rarely for the treatment of tinnitus.
We retrospectively examined the cases of tinnitus treated with ACT (acceptance and commitment therapy).
2. Methods
The subjects were 10 patients (3 males and 7 females, mean age: 53.0±7.3 years [42~63]) who visited at the Department of Otolaryngology, Nagoya City University Hospital from July 2018 to August 2019 and received cognitive behavioral therapy. The patients were individually administered ACT by a psychiatrist using the ACT program developed by the Department of Psychiatry, Nagoya City University Hospital (6-7 sessions). We examined THI, HADS, TCQ.
3. Results
The average of tinnitus duration was 126.4±117.5 months, the average of hearing level was 16.9±10.4 dB on the right and 12.2±5.6 dB on the left. Six patients had coexisting psychiatric disorders. All patients had been treated with sound therapy. Two patients had lacked of data and 3 patients dropped out. Before treatment, THI was 67.6 ± 22.1, HADS was 20.8 ± 7.1, and TCQ was 62.3 ± 14.9. After treatment, THI improved to 38.0±28.6, HADS improved to 12.4±6.1, TCQ improved to 40.6±19.8.
4. conclusion
Westin et al. (2011), Hesser et al. (2012) reported the effectiveness of ACT. Our study also showed that ACT was effective. CBT including ACT is a specialized treatment that requires the cooperation of psychiatrists, and the number of facilities that can provide it is limited in Japan. It should be investigated the characteristics of the cases in which CBT is effective in the future.

Keywords: Tinnitus, CBT, ACT

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SilentCloud – Insights from a digital therapeutic for tinnitus

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Introduction: Mobile health applications have seen substantial growth. Such digital applications hold the potential to revolutionize health care delivery by improving accessibility, addressing care gaps, supplementing therapies administered by primary care givers, reducing costs, and by empowering patients in managing their own health. Despite their potential, there is a significant gap in providing a solid scientific foundation for these tools. Most applications available today have not been rigorously tested for their efficacy or effectiveness, raising concerns about their reliability and potential benefits for users. Demonstrating clinical benefits with real-world data is therefore vital to mitigate concerns for both patients and health care professionals and to support informed decision making. This poster presents outcomes from a novel tinnitus management app.
Method: Anonymized real-world data from a tinnitus management app were analyzed. The app combines education and counseling with individually tailored sound therapies and app-based cognitive behavioral therapy (iCBT) for tinnitus. The app is a Class IIa medical device that offers the patient a structured self-paced management program. This poster explores clinical effectiveness of the iCBT as well as user behavior based on usage data.
Results: The data was collected through audiology retail chains and ENT clinics in five European countries and provides first insights in demographics of app users as well as first therapy outcomes of 59 app users that completed the iCBT program. The Tinnitus Handicap Inventory (THI) measured before and after the iCBT module showed an average improvement of 14.54 points. The average time required by app-users to complete the iCBT module was 83 days.
Conclusion: The data provide insights to a tinnitus app and its suitability as a therapy to address the needs of patients with bothersome tinnitus. Results show a positive effect of the app for tinnitus relief reflected in a clinically meaningful reduction of the THI.

Keywords: ICBT, MHealth, Real-world data

Sound Therapy and Behavioral Therapy for Tinnitus

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The Role of the Otolaryngologist in Applying Cognitive-Behavioral Therapy Techniques in Tinnitus Patients: Experience with 100 Cases

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Ent, Isbo, Brazil

In the field of otolaryngology, managing tinnitus requires multifaceted approaches, and Cognitive-Behavioral Therapy (CBT) techniques have gained prominence for their effectiveness in reducing the impact of the symptom.
An otolaryngologist, recognizing the need for a more comprehensive treatment approach, decided to incorporate CBT techniques into the management of their tinnitus patients. Based on their clinical training, specialized courses, and a review of scientific literature, the doctor began applying these strategies to a group of 100 patients diagnosed with chronic tinnitus.
Strategies Implemented
The physician adopted a structured approach, adapting CBT principles to their clinical context:
Tinnitus education, Cognitive restructuring, Relaxation techniques:,Progressive habituation, Regular follow-ups: Monthly follow-up sessions were conducted to adjust strategies and evaluate progress.
Challenges and Learnings
During this period, the physician encountered challenges, such as patients initially resistant to changing thought patterns or struggling to implement relaxation techniques. To overcome these obstacles, the doctor personalized interventions according to individual needs, using empathetic communication and a motivational approach.
Over time, they noticed that continuous practice enhanced their expertise in applying the techniques. Observing the direct positive effects on patients' lives solidified their confidence in the approach, motivating them to share their experiences at conferences and collaborate with psychologists to further refine their strategies.
Conclusion
This experience demonstrates that an otolaryngologist, with appropriate training and an interest in expanding their skills, can successfully apply CBT techniques in managing tinnitus. Throughout the follow-up of 100 patients, the physician not only contributed

Keywords: Tinnitus, ENT doctor, CBT

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The Effectiveness of a Mindfulness-Based Program in Reducing Tinnitus-Related Distress

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Introduction
Tinnitus, a persistent ringing or buzzing sound in the ears, is a prevalent condition that can severely impact patients' quality of life. It is often accompanied by psychological distress, including anxiety, depression, and social isolation. Traditional treatments for tinnitus mainly focus on symptom management; however, recent approaches, such as mindfulness-based interventions, have shown promise in addressing the psychological aspects of the condition. This study aims to evaluate the effectiveness of a mindfulness-based program, integrated with cognitive-behavioral therapy (CBT), in improving tinnitus-related distress, with a primary focus on the Tinnitus Handicap Index (THI).

Methods

A total of 16 participants with subjective tinnitus were recruited from the outpatient clinics from June 2024 and October 2024. The subjects received a 5-week mindfulness program, consisting of weekly 60-minute sessions based on the Mindfulness-Based Stress Reduction (MBSR) curriculum, adapted for tinnitus patients. Outcome measures included the Tinnitus Handicap Index (THI), Beck Depression Inventory (BDI) and Beck Anxiety Inventory (BAI). Pre-treatment, post-treatment, and follow-up assessments were conducted.

Results
Following the intervention, the experimental group showed a significant reduction in THI scores, indicating a decrease in tinnitus-related distress.

Discussion
This study suggests that mindfulness-based interventions, when combined with cognitive-behavioral techniques, can be effective in reducing tinnitus-related distress. Future studies should explore long-term effects and further refine the integration of mindfulness with other therapeutic approaches for tinnitus.

Keywords: Mindfullness, Tinnitus, Cognitive behavioral therapy

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Effect of a Tinnitus Sound Therapy Application on Tinnitus Relief

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Tinnitus, a condition characterized by the perception of sound without external stimuli, affects approximately 14% of adults globally, with prevalence rising with age. Sound therapy has been a widely used treatment, evolving from masking sounds to promoting habituation and reversing maladaptive brain changes. Despite its potential, sound therapy remains optional in clinical guidelines, and its effectiveness, particularly through smartphone applications, is not yet fully established.

This study aimed to evaluate the effectiveness of sound therapy delivered via a smartphone application for individuals with chronic subjective tinnitus. A total of 121 participants were initially recruited, with data from 72 participants analyzed. Over six months, participants used the application and visited the research lab three times at three-month intervals. During these visits, assessments included a tinnitogram, Tinnitus Handicap Inventory (THI), Beck Depression Inventory (BDI), subjective tinnitus-related questions (loudness, annoyance, and stress), and two-channel EEG. Statistical analysis was performed using repeated measures ANOVA with Bonferroni correction.

The results showed significant reductions in THI scores (P=.001), BDI scores (P=.003), tinnitus annoyance in the right (P<.001) and left ears (P=.030), and stress levels (P<.001). EEG findings revealed decreased mid-beta (P=.008), high-beta (P<.001), and gamma (P<.001) power over time. These results indicate that the sound therapy application effectively reduced tinnitus-related distress and psychological symptoms in patients with chronic tinnitus.

In conclusion, this study highlights the potential of smartphone-based sound therapy in alleviating tinnitus symptoms and associated psychological distress. However, further research is required to evaluate its long-term efficacy.

Keywords: Tinnitus, Sound Therapy, Mobile Applications

Sound Therapy and Behavioral Therapy for Tinnitus

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TONIC TENSOR TYMPANI SYNDROME (TTTS) : PREVALENCE AND MANAGEMENT IN A TINNITUS CLINIC IN SINGAPORE

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Objective
Tonic Tensor Tympani Syndrome (TTTS) is found in a subset of tinnitus patients who experience intra-aural and peri-aural symptoms, in addition to their tinnitus, in the absence of clinically detectable pathology. As the syndrome has not been widely reported, this study aims to determine its prevalence and evaluate the effectiveness of current management.

Methods
The tinnitus management clinic records of patients over the past 6 years were assessed to identify TTTS patients and track their progress based on patient-reported tinnitus handicap index (THI) scores. Patients with reversible ear pathology and temporomandibular joint disorder (TMD) were excluded.

Results
Of the 364 patients who attended the tinnitus management clinic from January 2016 to January 2022, 47 were identified as having symptoms consistent with TTTS. This represents 13% of patients who were seen for tinnitus management. Based on their THI scores, 59% had moderate to catastrophic handicap. Tinnitus counselling was carried out for all TTTS patients. Tinnitus matching was performed for 24%, hearing aids/ sound generators fitted for 13%, and 13% of patients received input from Psychiatry in form of therapy as well as medication. 94% of those who returned for follow-up showed improvement in their THI grades.

Conclusions
Our study suggests that TTTS is a significant problem among tinnitus patients and current tinnitus management strategies contribute effectively to helping such patients habituate to their symptoms

Keywords: Tinnitus, Hyperacusis, Tonic Tensor Tympani Syndrome

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Electrophysiological and behavioural evidence of the effects of white noise and a progressive re-categorisation sound therapy on tinnitus

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While sound therapy is a popular means of providing tinnitus relief, tinnitus heterogeneity calls for advancements in such conventional methods. This randomised tinnitus sound therapy trial (n = 29) compared the effects of an effortless auditory categorisation (CAT) training paradigm to conventional sound therapy using white noise (WN). The CAT training sound was a personalised replica of the individual's tinnitus which temporally cross-faded to a broadband nature sound (rain). The study consisted of two parts: (1) acute sound exposure (10-minutes of WN or CAT), (2) chronic sound exposure (30 minutes daily for 30 days). Tinnitus-relevant behavioural measures (Tinnitus Functional Index (TFI), Tinnitus Severity Numeric Scale (TSNS), and Positive and Negative Affect Schedule (PANAS)) and qualitative measures were obtained prior to the study session and following the 30-day training period. Acute neural (electroencephalographic) measures were collected at three time points: baseline (10-minute resting-state sitting in silence), during acute sound exposure, and post-acute sound exposure (10-minutes sitting in silence). WN resulted in significant improvements in tinnitus impact, severity, and negative emotionality independent of counselling; CAT did not. Nine participants from the WN group and three from the CAT group achieved a clinically meaningful improvement in tinnitus severity (determined by a 13-point reduction in TFI score). WN sound therapy gave rise to changes within the default mode network (specifically within the angular gyrus), while CAT led to an overall reduction in activity at the level of the prefrontal cortex, as well as a decrease in gamma-band activity within the auditory cortex. Different neural changes observed using WN relative to CAT suggest that the two modes of sound therapy likely work through different mechanisms or neural pathways, in turn targeting different – but equally significant – neural structures. Targeting multiple tinnitus generating areas through the application of a polytherapeutic sound approach should be explored.

Keywords: Tinnitus, Sound Therapy, Auditory Categorisation

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