Superglue: a Solution for Tinnitus?

With more than 250 participants from 35 countries, the 6th TRI meeting did not gather as many people as the Olympic Games in London, but it was the largest meeting ever organized by TRI. It extended the topics of the conference from clinical research, auditory and neuroscience to history of innovation and art and this made these special days both fascinating and stimulating. Thanks again to the local organizers for extending our horizons.

Did the meeting reach its goal? As always the answer is: we don’t know yet. It will depend on how many new ideas have been generated and how many new connections have been made, but also on how much these new ideas and connections influence our daily work both in the labs and in the clinics.

For those, who did not have the opportunity to attend, a summary of the meeting, written by Scott Mitchell, the former director of the ATA for the ATA magazine Tinnitus Today is included in this Newsletter on page 5. Selected presentations are also still available as video on the meeting website. Finally the feedback from the evaluation forms can be found in this newsletter (page 7).

Further feedback is still welcome, since this feedback will be essential for guiding the planning of the 7th TRI meeting which will be held from May 15th till May 18th in Valencia - Spain under the motto “Tinnitus: a treatable disease”.

After announcing this motto of the 7th TRI meeting many mails from patients reached us, asking whether this announcement means that a new treatment for tinnitus will be available by then. This suggests that we have hit the bull’s eye with this motto.

In spite of all the advances in the understanding of tinnitus and in the development and evaluation of new treatments, there is still the widespread opinion, that tinnitus cannot be effectively treated. A short look to the research presented in this Newsletter demonstrates how wrong this is: By comparing “treatment as usual” with a multidisciplinary stepped-care treatment approach which is essentially based on cognitive behavioral therapy, Cima et al. were able to demonstrate a highly significant advantage for the stepped-care approach.

continue next page
What is innovative about the study was the excellent methodological approach, but not the treatment. By just combining well-established treatments to a standardized approach the authors are able to demonstrate that it is outmost important whether clinicians care for tinnitus patients and offer them a standardized treatment instead of neglecting and ignoring available treatment options. In addition, this Newsletter also illustrates that there are highly effective innovative treatments. Several studies deal with the use of cochlear implants for patients with tinnitus and deafness (Olze et al., Crathorne et al.). Only a few years after the first presentation, cochlear implants have developed to become an effective treatment strategy for a subgroup of tinnitus patients. Moreover, many case reports highlight the relevance of exact diagnosis, especially for pulsatile tinnitus. In many such cases a cure is possible as reported in this newsletter (Kumar et al.) in an 52-year-old lady from India: transarterial embolization of an arteriovenous malformation with cyanoacrylate, better known as „superglue“, has stopped her tinnitus.

These examples illustrate that there are effective treatments for the various forms of tinnitus. It is up to us to make the existing treatments available to as many patients as possible and to keep on seeking for new and better treatments.

If mankind can get to mars, it should also be able to stop the ringing in the ears.

Ana Belén Elgoyhen  Dirk De Ridder  Berthold Langguth  Sylvia Dorner-Mitschke
RESEARCH HIGHLIGHTS


Many tinnitus patients complain about difficulties in auditory perception. This study demonstrates an impairment of the sound localization ability in tinnitus patients.


This randomized controlled trial demonstrating the efficacy of a CBT based stepped care treatment approach as compared to treatment as usual received high media attention.


A relationship between tinnitus and depression is well known from cross-sectional studies. Depression has frequently been interpreted as a consequence of tinnitus. By demonstrating that depression represents also a risk factor for the development of tinnitus this prospective longitudinal study demonstrates that there is a complex interplay between depression and tinnitus. The findings also suggest that co-morbid depression should always be treated in tinnitus patients.


This work demonstrates, that neuronal plasticity induced by auditory training depends on the localisation (primary versus secondary auditory cortex) and differs between tinnitus patients and controls.


In this study the theoretical prediction, that auditory deprivation leads to tinnitus was experimentally confirmed in healthy participants who developed transient tinnitus after unilateral ear plugging. Psychophysical measurements indicated that the tinnitus spectra corresponded to the frequencies affected by the ear plugs and confirmed homeostatic plasticity as a relevant mechanism in tinnitus generation.


This study aimed to disentangle alterations of oscillatory brain activity related to hearing loss versus tinnitus. By revealing increased delta activity as a reliable correlate of tinnitus the study partly confirmed the thalamocortical dysrhythmia model.


This paper from a multinational and multidisciplinary author group reflects the effort to improve methodologic standards for clinical trials in tinnitus.
Fournier P, Hébert S. *Gap detection deficits in humans with tinnitus as assessed with the acoustic startle paradigm: Does tinnitus fill in the gap?* Hear Res. 2012 Jun 9. [Epub ahead of print]

Startle prepulse inhibition by gap detection is an increasingly used paradigm for detecting tinnitus in animals. This study investigated for the first time tinnitus patients with this paradigm and found a reliable deficit in gap detection in tinnitus patients.


Based on epidemiological data from surveys between 1993 and 2010, this study demonstrates an increase in the prevalence of tinnitus over time after correction for age.
If conventional medicine could effectively treat tinnitus, such conferences would not be necessary. But for many, tinnitus does not respond to off-the-shelf drugs or current clinical treatments. Why is this such a tough nut to crack? One answer might be that tinnitus has many causes and many aspects in different patients. Another consideration is that recent research has shown that tinnitus is a complex brain issue, not just an auditory malady. And the brain, with all of its crackling synapses, layered rhythms and interactive parts, just gets more complex the more we learn about it.

Arthur Conan Doyle’s Sherlock Holmes first said, “When you have eliminated the impossible, whatever remains, however improbable, must be the truth.” The scientists who presented their research at this conference showed that when you eliminate conventional medical treatment as a cure for tinnitus, then whatever remains, however improbable, needs to be investigated.

The Main Event
Approximately 300 researchers, audiologists, and medical doctors attended the conference. Six years ago about 70 attended the TRI conference, so attendance alone shows the growing interest and resources of tinnitus research. The keenest minds on cutting-edge tinnitus research came from many countries to share ideas.

Dirk De Ridder, M.D., Ph.D., Ana Belén Elgoyhen, Ph.D., Berthold Langguth, M.D., Ph.D., Paul Van de Heyning, M.D., Ph.D., and Sven Vanneste, M.D., Ph.D., organized the conference into a mixture of general sessions, smaller group lectures, and presentations of scientific papers on posters. And with each gathering – questions, always questions! A sense of urgency to find a cure as soon as possible seemed to drive the proceedings. Dr. De Ridder, a pioneer of deep brain stimulation for tinnitus by surgically-implanted electrodes and ATA Scientific Advisory Committee (SAC) member, quoted Napoleon’s maxim: “First you engage, and then you see what happens,” as a way to approach tinnitus research.

The organizers also invited the famed artist Jan Fabre to discuss how art is created. Dr. De Ridder asked, “Do you start work first and see where it takes you, (First engage, then see what happens) or do you contemplate until a creative vision forms in your mind?” In other words, is the cure for tinnitus a hideously complicated Rubik’s Cube of false paths and endless roadblocks, or is it something so fundamental that the answer will come with a flash of inspired scientific creativity?

ATA is a Major Player
Several additional past and current members of SAC made significant contributions as well. Most recent past SAC Chair Anthony T. Cacace, Ph.D., moderated the session on functional imaging, on ways we can “see” tinnitus in the brain; former SAC Chair Richard Tyler, Ph.D., managed the session on treatments; New SAC Chair Susan E. Shore, Ph.D., led the presentation on pathophysiology; and former SAC Chair Richard J. Salvi, Ph.D., contributed to presentations on the genetics of tinnitus and the effects of certain chemical compounds on the part of the brain that experiences anxiety.

“When you have eliminated the impossible, whatever remains, however improbable, must be the truth.”

- Sherlock Holmes, The Sign of the Four
connected to tinnitus. All of these are examples of how our tinnitus investigators have gallantly retooled their expertise to cover multiple disciplines and to look at tinnitus from every possible angle. Longtime ATA-supporter Soraya Hoover, M.D., an ENT and independent researcher from Houston, Texas, referenced the role of stress in many kinds of tinnitus with emphasis on the neuroimmunoendocrine circuit.

As mentioned above, one way scientists offer their research is to summarize their studies in poster presentations, which are displayed in a common room. Two posters held particular interest. Dr. Cacace described a technique using nanoparticles that could not only identify tinnitus-related neural activity in the brain but could also be used to deliver drugs to specific brain areas. This could be a major breakthrough. Generally, when you take a drug, it washes over the entire system. But a drug that can be released only in the target area of tinnitus activity could be like a Zen arrow shot into precisely the right location. A poster by Astrid Lehner, Dipl.Psych., and her colleagues demonstrated with a pilot study how targeting repetitive transcranial magnetic stimulation (rTMS) can offer a promising strategy for enhancing treatment effects of rTMS for tinnitus. This project was funded by ATA (read the ATA-Funded Research Report on Page 12), and it was very rewarding as a Board member to see our funding decision produce such positive results.

**In Pursuit of a Cure**

As the conference came to an end, Dr. Langguth, Chair of TRI’s Executive Committee, offered closing thoughts. He recognized that there has been steady progress in many areas of tinnitus research but that a complete cure still eludes us. He said that when he thought about the future of tinnitus research, the following concepts came to mind that apply both to the phenomenon of tinnitus and the quest for its cure:

**FREEDOM** – to try new things, including the freedom to be wrong.

**IMAGINATION** – is as necessary in science as it is in art.

**RHYTHM** – the essence of music, and a fundamental aspect of brain activity.

**MOTION** – our bodies move, things happen inside our brains; we have to continuously engage the imponderables in scientific research, not just reflect on them.

**CONNECTIVITY** – brain research has shown that neurons connect to each other, and act in unison to form fundamental impulses in the brain; likewise, investigators need to stay connected with each other’s work.

**COMMUNICATION** – so that investigators learn from each other.

**REPETITION** – so we keep trying to explore how tinnitus works and how it can be cured.

The next TRI conference will be held in Valencia, Spain, May 13-18, 2013, and we look forward to sharing innovations from the wheels that were set in motion at this year’s event.
Participants’ Feedback from the 6th International Conference on Tinnitus which has been held in June 2012 in Bruges (Belgium)

A survey has been conducted at the end of the 6th TRI meeting in Bruges. We want to thank all participants for their constructive critics, which will provide important orientation in the organization of the 7th TRI meeting in Valencia.

From 258 participants 48 evaluation forms were returned.

The participants answered the following questions
1. What did you like the MOST about the meeting?
2. What would you like seen done differently next year? Please only name 2.
3. Which topics were missing?
4. Do you have any specific suggestions for next year’s meeting?
5. Comments

Location
The whole meeting, its atmosphere and the good turnout were rated positively. Especially the town of Bruges and the venue itself and its city center location were highlighted, as well as the Organization in general and the organizational strategy (“keep it simple”). The participants appreciated the good catering and the possibility “to see the sunlight during coffee breaks”. But some complained the long queues and rush during lunch. Nice additions like dancing after the banquet and an open air barbeque were suggested.

Keynote Speakers/Invited Speakers
The multidisciplinarity, the variety of approaches, the choice of topics, the high scientific quality and the bridging between neurophysiology, neuroanatomy and arts/philosophy as performed by the keynote and invited speakers were some of the most liked features of the meeting. But many votes asked to reduce the number of keynote speakers and generalized keynote lectures and to restrict lectures to more strongly tinnitus-related plenary talks for people with specific expertise to broaden their knowledge. A keynote about cognitive-behavioral-therapy for tinnitus was proposed. One participant criticized the lack of competition among keynote speakers, another one the exaggeration fostering image, gesture and clique backslapping in general. Panel discussions on “cutting edge topics” like Etiology, Diagnosis, Treatment, Prognosis, as suggested by another feedback could enforce the missing competition.

Sessions
While one participant remarked the improved blend of basic and clinical research within the sessions compared to the last years’ conferences, another one wishes a far better balance between basic and clinical research, because the conference was too heavily based on latter. Moreover it was positively mentioned, that two symposia about functional imaging have been held.

Many participants claimed a better synchronisation between sessions, allowing smooth moving between them and they proposed, that a solution could be to offer better categorized sessions or no parallel sessions when the presentations remain diversified.

Since some presentations were too quick to think about the information, session talks should last a little longer and more time and possibilities for discussion, questions, critizism etc. should be given. For single participants the presentations were too numerous.

Fewer talks should be held by members of the same group or by the same speakers and the chairman should not be speaker. Furthermore the organizers should involve leading investigators from various geographic regions of the world in selecting presentations for the program and should use crowd interactive technology to take advantage of a large number of tinnitus experts (“Power of the Crowd”) and to involve more and more people.

Regarding the topics of the sessions the feedbacks contained the following suggestions:

- More basic research talks
- More tech workshops
- Talks about CBT.
- Presentations of paramedical service (like TRT evolution)
- More information on drug therapy approaches
• Try to look back to the ear again (it is the beginning!) and search for mechanisms to quiet tinnitus BEFORE a great neuronal path is chronically involved.
• Focus on patients, have a patient speak
• Proposals for collaborations for multicentric studies based on specific topics

Many feedbacks suggested direct discussions at round table on various tinnitus-related topics:
• Brain storming, Round table discussion about basis of tinnitus
• Direct Discussion of different views of Tinnitus
• Round table on TMS (principles, optimized parameters, results)
• Specificities of noise-induced tinnitus (excitotoxicity, apoptosis, neurotransmitters and pharmacology, spontaneous evaluation, treatments)
• Discussion about new therapeutic concepts of tinnitus on the basis of new knowledge

**Poster Presentations**

The duration of the poster presentation was generally rated too short. There should be more time, space and organized structure for poster presentations. Posters should be up throughout the meeting and at least two presentations should be performed.

Better proof reading of posters of author\'s whose first language isn\'t English was requested, because some of the posters were difficult to understand.

The participants liked very much the idea to have breaks in the same room as the posters were presented.

To value the posters more, a poster award would be nice.

**Schedule/Networking**

Networking is an important part of the conference. Therefore the early end of day and the schedule in general have been well received and, in addition, some participants asked for longer breaks for networking and shorter afternoon sessions ending with networking opportunities. Not only in regard of the networking issue many participants claimed the strict limitation of oral presentations to the time allotted in order to keep the time schedule.

In order not to waste time, the program on the first day should start earlier than 8 pm.

**Organization**

Some organizational details that were addressed in the feedbacks are summarized as follows:

**Corporate design**
• The uniformity of slides has been noticed favourably.
• Badges with affiliation, topic and expertise would facilitate networking.

**Sessions (issues)**
• Too small session rooms.
• Better seating and more comfortable arrangement (e.g. lecture theatre setting rather than flat chair layout).
• Bad air condition in the plenary room.
• Too many technical problems.
• Discussions should be limited, but not completment forbidden because of lack of time.

**Services**
• Pre-organization should be made in advance, some information came very short-term.
• Free WLAN should be available in the conference center.
• Translation service would be appreciated by single persons.

**Fees**
• Some Participants complained the high registration fee - e.g. in comparison to neuroscience conferences. Maybe it would be possible to reduce them or to adapt them according to whether the registered person is sponsored by an industry or not. In addition a student discount for the congress and the gala banquet was suggested.
• The Banquet was too expensive.
Missing Topics

- Basic research (was thin on the ground)
- Effect of media: tinnitus topic (e.g. saying that there is one cure)
- Somatic Tinnitus
- Hyperacusis (only 1 oral presentation)
- Management of hyperacusis
- Psychological treatment approaches to treat tinnitus
- Hearing Aids & Tinnitus
- Hearing aids therapy for tinnitus
- Clinical related topics (practical experience with different approaches
- Systematic review of specific topics
- Developing consensus about clinical outcome measures for tinnitus trials
- Cognitive-behavioral-therapy for tinnitus
- More neurostimulation presentations
- Models (neural simulations)
- Neuroscience of music (Robert Zatorre would have been a great keynote)
- Affective neuroscience
- Prevention of tinnitus: research mainly focuses on therapies but prevention of e.g. noise-induced tinnitus should also be targeted in meetings like this.
- People focussed “chronic tinnitus” most of the time. I missed information about “Treatable causes of tinnitus” in the present and “what to do in order to decrease tinnitus loudness”, not only how to recover quality of life through healing the “reaction” of tinnitus.
- Molecular mechanisms of tinnitus
- Plasticity in the brain causing tinnitus (electrophysiology)
- More about sound therapies
- Opportunities for funding - prosaic but necessary
- Distress was a word mentioned repeatedly by presenters but it can be seen they do not know how wide and important the concept is.
- Controversial concepts of basis of tinnitus
- Maybe Practise workshops
- Long Term TRT results
- Audiology in general
- Animal models of tinnitus
- Diagnostic evaluation of individuals with tinnitus
- Molecular biology of tinnitus
- Epidemiology of tinnitus
- Genetic basis of tinnitus
- Audiologic topics (audiologic assessment of tinnitus, characteristics, epidemiology)
- I would like to see more case reports from individual patients and clinics and some discussion of the evidence base and efficacy of the standard TRT used in many clinics.
- Topics regarding audiology (characteristics, treatment options e.g. hearing aids etc.)
- Psychotherapeutic approaches
- Subjective effects and imaging effects of sound therapy
- Discussion on diagnostic issues, how not to overdiagnose or underdiagnose
- Musical tinnitus
- Somatosensory tinnitus!
- More treatment results, less boring epidemiology.
- Accent should be put on practical aspects
- Less general lectures, more clinical lectures
- Practical guidelines to treat tinnitus
- Back to reality
- flow-chart - like system
- Selecting the right patients for the treatments like TMS
- The neuromodulation like model of Lapperre: pro’s and contra’s
- Purely Methods, maybe some discussions about that.
- Cochlear mechanics and possible contribution to tinnitus. Too much emphasis is placed on the brain’s input to tinnitus that we are forgetting the other vital component!
- To have some patients participate in this conference and to tell their life experiences & if any successful in beating the symptoms
7th International Conference on Tinnitus
Tinnitus: A Treatable Disease
Organized by the
Tinnitus Research Initiative Foundation
and
Hospital Clínico Universitario.
University of Valencia, Spain

Valencia, Spain, 15-18 May, 2013

For more information please look at: http://www.tinnitusresearch.org
Upcoming Meetings

Meetings exclusively dedicated to Tinnitus are marked red

September 2012

49th Inner Ear Biology Workshop and Symposium
When: September 29 – October 02, 2012
Where: Tübingen, Germany
Detailed Information: http://www.conventus.de/ieb2012/

October 2012

Twentieth Annual Conference on Management of the Tinnitus Patient for Patients and Professionals
When: October 5 - 6, 2012
Where: The University of Iowa, Iowa City, IA, USA
Detailed Information: http://www.healthcare.uiowa.edu/otolaryngology/TinnitusCourse/

Tinnitus & Hyperacusis Therapy Masterclass
When: October 8 - 12, 2012
Where: Birkbeck College, University of London, UK
Contact: hashir.aazh@nhs.net
Detailed Information: http://tinnitustherapy.org.uk/

EUHA 2012 - 57. International Congress of Hearing Aid Acousticians
When: October 24 - 26 2012
Where: Congress Center Messe Frankfurt
Detailed Information: http://www.euha.org

November 2012

ASHA 2012 Annual Convention
When: November 15 – 17, 2012
Where: Atlanta, GA, USA
Detailed Information: http://www.asha.org/Events/convention/Future-Conventions/

January 2013

Masterclass: Tinnitus & Hyperacusis in Adults and Children
When: January 22 – 24, 2013
Where: UCL Ear Institute, London, UK
Detailed Information: http://www.ucl.ac.uk/ear/courses/shortcourses/aamc/aamc-pages/tinnitusandhyperacusis
36th MidWinter Meeting of the Association for Research in Otolaryngology (ARO)
When: February 16 – 20, 2013
Where: Baltimore, MD, USA
Detailed Information: http://www.aro.org/mwm/mwm.html

1st International Conference on Hyperacusis: Causes, Evaluation, Diagnosis and Treatment
When: March 01 – 02, 2013
Where: Birkbeck College, University of London, London, UK
Detailed Information: http://www.royalsurrey.nhs.uk/advanced-audiology-seminars

AIA-DAGA 2013 Conference on Acoustics
including the 40th Italian (AIA) Annual Conference on Acoustics and the 39th German Annual Conference on Acoustics (DAGA)
When: March 18 – 21, 2013
Where: Meran, Italy

AudiologyNOW! 2013
When: April 03 – 06, 2013
Where: Anaheim, CA, USA
Detailed Information: http://www.audiologynow.org/

84. Jahresversammlung der Deutschen Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie e.V.
When: May 08 – 12, 2013
Where: Nuernberg Convention Center , Nuernberg, Germany
Detailed Information: http://www.hno.org/veranstaltungen/ankuendigungen.html

7th INTERNATIONAL TRI CONFERENCE ON TINNITUS 2013
Tinnitus: A Treatable Disease?
When: May 15 – 18, 2013
Where: Valencia, Spain
Detailed Information: http://www.tinnitusresearch.org
20th IFOS World Congress
When: June 01 – 05, 2013
Where: Seoul, Korea
Detailed Information: http://www.ifosseoul2013.com/

ICA 2013, 165th Meeting of the Acoustical Society of America, 52nd Meeting of the Canadian Acoustical Association and the 21st International Congress on Acoustics
When: June 02 – 07, 2013
Where: Montreal, Quebec, Canada
Detailed Information: http://www.ica2013montreal.org/

When: June 16 – 20, 2013
Where: Washington Trade and Convention Center, Seattle, WA, USA
Detailed Information: http://www.humanbrainmapping.org/i4a/pages/index.cfm?pageid=3298

13th International Conference on Cochlear Implants and Other Implantable Auditory Technologies
When: June 18 – 21, 2013
Where: Munich, Germany
Detailed Information: http://www.ci2014muc.info/

11th EFAS Congress
When: June 19 – 22, 2013
Where: Budapest, Hungary
Detailed Information: http://www.efas2013.eu/
The Neuroscience of Tinnitus  Jos J. Eggermont

The Neuroscience of Tinnitus is a single-author book which covers neuroscientific mechanisms underlying tinnitus. Jos Eggermont is one of the most renowned scientists in the field of the auditory system and his work has contributed substantially to the current knowledge about the neural correlates of tinnitus.

After an introduction containing a definition of tinnitus and some essential information about its epidemiology and etiology, psychoacoustic and psychological aspects of tinnitus are described. This is followed by a scientifically sound summary of the most important results of human subject research which examines the correlates of tinnitus using neuroimaging and electro-/magnetoencephalography. A large part of the book is then devoted to a critical review of different behavioral animal models for tinnitus and the advances that have been made in studying them. Additionally, recent findings are presented which support the idea of tinnitus being a network disorder. After explaining the relation between tinnitus and aging, the book concludes with a chapter on tinnitus management and an outlook on future research.

All in all, The Neuroscience of Tinnitus provides a comprehensible, detailed and very up-to-date overview over the most important models and findings concerning the mechanisms underlying tinnitus. What is truly remarkable about the book is that – although it is a single-author book - it includes thorough information about animal studies and human research. Having a scientific background in both, Jos Eggermont is perfectly qualified to address and critically review the results coming from both areas – and he succeeds in doing so. Besides the necessity of animal research for developing an in-depth understanding of the neural substrate of tinnitus, the book does not neglect the shortcomings of and inconsistencies between the different animal models. It becomes clear that the changes within the auditory system which are induced by salicylate or noise ("bottom up mechanisms") and which are object of investigation in animal models might only be one part of the process which finally leads to a chronic manifestation of tinnitus. Top-down mechanisms which involve synchronous activity within widespread brain networks constitute the second important part – a part which is mostly known from human research. Animal and human research sometimes seem to coexist without interacting or benefitting from each other. The book is a very important step in the direction of integrating the knowledge from both and might be inspiring for any scientist who is doing research on tinnitus.

Therefore, the book is a must read for anyone who is engaged in the neuroscience of tinnitus and who believes that she/he actually has a lack of knowledge concerning the findings of animal/human research respectively. Furthermore, the book provides an excellent overview for anyone who is new to the topic. In addition to scientists, clinicians who have to treat the tinnitus patient will also benefit from the profound knowledge the book imparts.

Astrid Lehner
University of Regensburg
RESEARCH TOPIC AT Frontiers in Neuroscience:
Ringing ears: the neuroscience of tinnitus. Hosted by: Jos J. Eggermont and Larry Roberts.

The Neuroscience of Tinnitus: Understanding Abnormal and Normal Auditory Perception.
Eggermont JJ, Roberts LE.
Free Article.

I Epidemiology

Prevalence of Leisure Noise-Induced Tinnitus and the Attitude Toward Noise in University Students.
Otol Neurotol. 2012 Jun 18. [Epub ahead of print]
*University Department of Otorhinolaryngology and Head and Neck Surgery, and †Tinnitus Research Initiative Centre, BRAI2N, Antwerp University Hospital, Edegem; ‡Department of Epidemiology and Social Medicine, Medical Sociology and Health Policy, University of Antwerp, Wilrijk; and §Department of Medical Management, Statistical Analysis, Antwerp University Hospital, Edegem, Belgium.

BACKGROUND: Adolescents and young adults often are exposed to potentially damaging loud music during leisure activities. As a consequence, more and more young adults suffer from tinnitus, hearing loss, and hyperacusis. The present study provides prevalence numbers for noise-induced tinnitus (NIT) in this group, the attitude toward loud music, and the factors influencing the use of hearing protection (HP).

METHOD: A questionnaire was undertaken to evaluate the influence of permanent/transient tinnitus after loud music, the attitudes toward noise, influence of peers, and the ability to manipulate HP on the use of HP. The questionnaire was completed by 145 university students.

RESULTS: Approximately 89.5% of the students had experienced transient tinnitus after loud music exposure. The prevalence of transient NIT was higher in female subjects compared with male students. Permanent NIT was experienced by 14.8%. Nevertheless, few respondents were worried, and the degree of HP use was low (11%). However, the presence of permanent tinnitus was a motivation for HP use. Most respondents held a neutral to positive attitude (i.e., pronoise) toward loud music and were not fully aware of the risks of too much noise exposure.

CONCLUSION: NIT is a common phenomenon among young adults. The lack of knowledge in young adults and the underuse of HP in leisure activities provide useful information to refine preventive measures in the future.

Gershon RR, Sherman MF, Magda LA, Riley HE, McAlexander TP, Neitzel R.
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Information on prevalence and risk factors associated with self-reported hearing health among mass transit riders is extremely limited, even though evidence suggests mass transit may be a source of excessive exposure to noise. Data on mass transit ridership were collected from 756 study participants using a self-
administered questionnaire. Hearing health was measured using two symptom items (tinnitus and temporary audiometric threshold shift), two subjective measures (self-rated hearing and hearing ability), and two medical-related questions (hearing testing and physician-diagnosed hearing loss). In logistic regression analyses that controlled for possible confounders, including demographic variables, occupational noise exposure, nonoccupational noise exposure (including MP3 player use) and use of hearing protection, frequent and lengthy mass transit (all forms) ridership (1,100 min or more per week vs. 350 min or less per week) was the strongest predictor of temporary threshold shift symptoms. Noise abatement strategies, such as engineering controls, and the promotion of hearing protection use should be encouraged to reduce the risk of adverse impacts on the hearing health of mass transit users.

Health Outcomes Associated with Military Deployment: Mild Traumatic Brain Injury, Blast, Trauma, and Combat Associations in the Florida National Guard.


Mental Health and Behavioral Sciences - Psychology Service, James A. Haley Veterans’ Hospital, Tampa, FL; HSR&D/RR&D Center of Excellence: Maximizing Rehabilitation Outcomes, James A. Haley Veterans’ Hospital, Tampa, FL; Department of Psychiatry and Neurosciences, University of South Florida; Department of Psychology, University of South Florida; Defense and Veterans Brain Injury Center, James A. Haley Veterans Affairs Medical Center, Tampa, FL.

OBJECTIVE: To determine the association between specific military deployment experiences and immediate and longer-term physical and mental health effects, as well as examine the effects of multiple deployment-related traumatic brain injuries on health outcomes. These relationships have important implications for post-deployment monitoring and treatment, but have yet to be fully delineated. DESIGN: Online survey of cross-sectional cohort. Odds ratios were calculated to assess the association between deployment-related factors (i.e., physical injuries, exposure to potentially traumatic deployment experiences, combat, blast exposure, and mild traumatic brain injury) and current health status, controlling for potential confounders, demographics and pre-deployment experiences. SETTING: Non-clinical. PARTICIPANTS: A total of 3098 members of the Florida National Guard (1443 deployed, 1655 not deployed). INTERVENTIONS: Not applicable. MAIN OUTCOME MEASURES: Presence of current psychiatric diagnoses and health outcomes, including postconcussive and non-postconcussive symptoms. RESULTS: Surveys were completed an average of 31.8 months (SD = 24.4, Range = 0 to 95) following deployment. Strong, statistically significant associations were found between self-reported military deployment-related factors and current adverse health status. Deployment-related mild traumatic brain injury (TBI) was associated with depression, anxiety, PTSD, and postconcussive symptoms collectively and individually. Statistically significant increases in frequency of depression, anxiety, PTSD, and a postconcussive symptom complex were seen comparing single to multiple TBIs. However, a pre-deployment TBI did not increase the likelihood of sustaining another TBI in a blast exposure. Associations between blast exposure and abdominal pain, pain on deep breathing, shortness of breath, hearing loss, and tinnitus suggested residual barotrauma. Combat exposure with and without physical injury were each associated with PTSD, but also with numerous postconcussive and non-postconcussive symptoms. The experience of seeing others wounded or killed or experiencing the death of a buddy or leader was associated with indigestion and headaches, but not with depression, anxiety, or posttraumatic stress disorder (PTSD). CONCLUSIONS: Complex relationships exist between multiple deployment-related factors and numerous overlapping and co-occurring current adverse physical and psychological health outcomes. Various deployment-related experiences increased the risk for post-deployment adverse mental and physical health outcomes, individually and in combination. These findings suggest that an integrated physical and mental healthcare approach would be beneficial to post-deployment care. Copyright © 2012 the American Congress of Rehabilitation Medicine. Published by Elsevier Inc. All rights reserved.
Prevalence of Noise Induced Hearing Loss among Traffic Police Personnel Of Kathmandu Metropolitan City.

Shrestha I, Shrestha BL, Pokharel M, Amatya RC, Karki DR.

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Background Noise induced hearing loss (NIHL) is a major preventable occupational health hazard. Objective To measure permanent threshold shift in traffic police personnel due to noise exposure and to examine whether it was associated with duration of noise exposure, years of work and risk factors. Methods Cross sectional, descriptive study conducted at Dhulikhel hospital, Kathmandu University Hospital in 110 responding traffic police personnel. Detailed history and clinical examination of ear, impedence audiometry and pure tone audiometry was performed. Results Mean age group was 29.82 years; 82(74.5%) were males and 28 (25.5%) were females. Mean duration of service is 11.86 years. Twenty six (23.6%) had tinnitus and 39(35.5%) had blocked sensation in ear. Sixty five (59.1%) worked between 10- 19 years. Alcohol and smoking shows positive impact on NIHL (p value =0.00). Odds ratio with 95% confidence interval were 4.481 (1.925-10.432) and 6.578 (2.306- 18.764) respectively. Among 73(66.4%) noise induced hearing loss positive cases, bilateral involvement was seen in 45 (40.9%) and unilateral in 28(25.4 %) cases. Among unilateral cases most were left sided. Hearing threshold at 4 kHz increased according to age and duration of service. Conclusion Traffic police personnel are in constant risk of noise induced hearing loss. Screening for hearing loss is recommended for people exposed to noise.

General Dental Practitioners and Hearing Impairment.
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OBJECTIVE: The problem of hearing impairment (HI) among dentists was considered solved since the eighties. Nevertheless, hearing loss at speech frequencies was recently reported among dentists and dental hygienists. Thus, we investigated prevalence and factors associated with perceived HI among dentists. METHODS: In 2009-2010, 100 general dental practitioners (GDPs) and 115 general practitioners (GPs) (mean ages, 43.7 and 44.4 years) from Rome (Italy), who started their practice ≥10 years ago, were interviewed on a series of occupation- and recreation-related HI risk factors and on HI-associated symptoms (tinnitus, sensation of fullness, hypoacusis). Prevalence of presumptive HI (≥1 symptom perceived during workdays and weekends) was assessed and factors associated with presumptive HI were investigated. RESULTS: Prevalence was 30.0% (95% confidence interval, 21.0%-39.0%) and 14.8% (95% confidence interval, 8.3%-21.3%) among GDPs and GPs, respectively. Occupation (GDP vs. GP), family history of hypoacusis, hypertension, ear diseases and smoking were significantly associated with presumptive HI. Within GDPs alone, significant associations were found for frequent use of ultrasonic scalers, use of dental turbines aged ≥1year and prosthetic dentistry as prevalent specialty. CONCLUSIONS: GDPs resulted at higher HI risk than GPs. Such a risk was not generalized to all dentists, but was specific for those who frequently used noisy equipment (aged turbines, ultrasonic scalers) during their daily practice. CLINICAL SIGNIFICANCE: GDPs with 10 or more years of practice who routinely use potentially noisy equipment, could be at risk of HI. In order to prevent such condition, daily maintenance and periodical replacement of dental instruments is recommended. Copyright © 2012. Published by Elsevier Ltd.
Generational differences in the reporting of tinnitus.


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OBJECTIVES: Recent research suggests that hearing impairment is declining among older adults compared with earlier generations of the same age. Tinnitus is often associated with hearing impairment, so one might hypothesize that the prevalence of tinnitus is declining in a similar manner. The purpose of this study was to use multigenerational data with repeated measures to determine whether the prevalence of tinnitus is declining among more recent generations. DESIGN: Using data from the Epidemiology of Hearing Loss Study (1993-1995, 1998-2000, 2003-2005, and 2009-2010) and the Beaver Dam Offspring Study (2005-2008), the authors examined birth cohort patterns in the report of tinnitus for adults aged 45 years and older (n = 12,689 observations from 5764 participants). Participants were classified as having tinnitus if they reported tinnitus in the past year of at least moderate severity or that caused difficulty falling asleep. A low-frequency (500, 1000, and 2000 Hz) and high-frequency (3000, 4000, 6000, and 8000 Hz) pure tone average from the worse ear was used to summarize hearing status. Other potential risk factors for tinnitus were also explored to determine if changes in the prevalence of these factors over time could explain any observed birth cohort differences in the prevalence of tinnitus. These included the following: education, history of head injury, history of doctor-diagnosed ear infections, history of cardiovascular disease (myocardial infarction, stroke, or angina), current noisy job, longest-held job, target shooting in the past year, number of concerts ever attended, alcohol use in the past year, doctor diagnosis of arthritis, current aspirin use, regular exercise, and consulting with a physician in the past year about any hearing/ear problem. Birth cohort effects were modeled with alternating logistic regression models which use generalized estimating equations to adjust for correlation among repeated measurements over time that are nested within families. RESULTS: The report of tinnitus tended to increase with more recent birth cohorts compared with earlier birth cohorts. For example, at ages 55 to 59 years, 7.6% of participants born between 1935 and 1939 reported tinnitus, compared with 11.0% of those born in 1940 to 1944, 13.6% of those born between 1945 and 1949, and 17.5% of those born between 1950 and 1954. Similarly, at ages 65 to 69 years, 7.9% of participants born between 1925 and 1929 reported tinnitus, compared with 10.0% of those born between 1930 and 1934, 11.9% of those born between 1935 and 1939, and 13.7% of those born between 1940 and 1944. Final alternating logistic regression model results indicated that, on average, after adjusting for age and other factors, participants in a given generation were significantly more likely to report tinnitus than participants from a generation 20 years earlier (odds ratio = 1.78, 95% confidence interval = 1.44, 2.21). CONCLUSIONS: Increased reports of tinnitus may reflect increased prevalence of symptoms, increased awareness of symptoms, or higher health expectations among more recent generations of adults. Regardless of the reasons, the increasing prevalence of tinnitus suggests that health care providers may see an increased number of patients bothered by this common but little understood symptom.
II Pathophysiology

Long-term, but not transient, threshold shifts alter the morphology and increase the excitability of cortical pyramidal neurons.


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Partial hearing loss often results in enlarged representations of the remaining hearing frequency range in primary auditory cortex (AI). Recent studies have implicated certain types of synaptic plasticity in AI map reorganization in response to transient and long-term hearing loss. How changes in neuronal excitability and morphology contribute to cortical map reorganization is less clear. In the present study, we exposed adult rats to a 4-kHz tone at 123 dB, which resulted in increased thresholds over their entire hearing range. The threshold shift gradually recovered in the lower-frequency, but not the higher-frequency, range. As reported before, two distinct zones were observed ten days after the noise exposure, an enlarged lower-CF zone displaying normal threshold, enhanced cortical responses, and a higher-CF zone showing higher threshold and disorganized tonotopic map. Membrane excitability of layer 2-3 pyramidal neurons increased only in the higher-CF, but not the lower-CF, zone. In addition, dendritic morphology and spine density of the pyramidal neurons were altered in the higher-CF zone only. These results indicate that membrane excitability and neuronal morphology are altered by long-term, but not transient, threshold shift. They also suggest that these changes may contribute to tinnitus, but are unlikely to be involved in map expansion in the lower-CF zone.

Amino acid concentrations in the hamster central auditory system and long-term effects of intense tone exposure.


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Exposure to intense sounds often leads to loss of hearing of environmental sounds and hearing of a monotonous tonal sound not actually present, a condition known as tinnitus. Chronic physiological effects of exposure to intense tones have been reported for animals and should be accompanied by chemical changes present at long times after the intense sound exposure. By using a microdissection mapping procedure combined with high-performance liquid chromatography (HPLC), we have measured concentrations of nine amino acids, including those used as neurotransmitters, in the cochlear nucleus, inferior colliculus, medial geniculate, and auditory cortex of hamsters 5 months after exposure to an intense tone, compared with control hamsters of the same age. No very large differences in amino acid concentrations were found between exposed and control hamsters. However, increases of glutamate and γ-aminobutyrate (GABA) in some parts of the inferior colliculus of exposed hamsters were statistically significant. The most consistent differences between exposed and control hamsters were higher aspartate and lower taurine concentrations in virtually all regions of exposed hamsters, which reached statistical significance in many cases. Although these amino acids are not considered likely neurotransmitters, they indirectly have roles in excitatory and inhibitory neurotransmission, respectively. Thus, there is evidence for small, widespread, long-term increases in excitatory transmission and decreases in inhibitory transmission after a level of acoustic trauma previously shown to produce hearing loss and tinnitus. © 2012 Wiley Periodicals, Inc.
Does tinnitus affect the sound localization ability?

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OBJECTIVE: To investigate whether tinnitus affects sound localization ability. STUDY DESIGN: Prospective controlled study. SETTING: Tertiary referral center. PATIENTS: Forty tinnitus patients (mean age, 36.7 ± 14.3 yr; hearing threshold, <20 dB HL; tinnitus group) and 40 controls (mean age, 39.3 ± 12.9 yr; hearing threshold, <20 dB HL; control group). METHODS: We performed a sound localization test (SLT) with 7 speakers positioned in a semicircle on the horizontal plane at a distance of 1 m from the subject, at 30-degree intervals. Subjects were asked to identify the stimulus-presenting speaker, through a forced-choice procedure. The error score was calculated by scoring 1 point for each 30 degrees of difference between the stimulus-presenting speaker and the speaker identified by the subject. RESULTS: The mean SLT total error score (TES) of the tinnitus group (18.8 ± 9.2) was significantly higher than that of the control group (13.1 ± 7.5) (p < 0.05). Regarding SLT responses for stimulation from speakers located at each side of the listener, mean TES in patients with tinnitus on the same side as the speaker was higher than that in patients with opposite side or bilateral tinnitus. Age showed a positive correlation with TES in the tinnitus (r = 0.44, p < 0.05) and control groups (r = 0.35, p < 0.05). CONCLUSION: We consider that tinnitus interferes with sound localization ability and that interference is worse for sound originating from the same side as the tinnitus. Age is a worsening factor in sound localization ability.

An active loudness model suggesting tinnitus as increased central noise and hyperacusis as increased nonlinear gain.
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The present study uses a systems engineering approach to delineate the relationship between tinnitus and hyperacusis as a result of either hearing loss in the ear or an imbalanced state in the brain. Specifically examined is the input-output function, or loudness growth as a function of intensity in both normal and pathological conditions. Tinnitus reduces the output dynamic range by raising the floor, while hyperacusis reduces the input dynamic range by lowering the ceiling or sound tolerance level. Tinnitus does not necessarily steepen the loudness growth function but hyperacusis always does. An active loudness model that consists of an expansion stage following a compression stage can account for these key properties in tinnitus and hyperacusis loudness functions. The active loudness model suggests that tinnitus is a result of increased central noise, while hyperacusis is due to increased nonlinear gain. The active loudness model also generates specific predictions on loudness growth in tinnitus, hyperacusis, hearing loss or any combinations of the three conditions. These predictions need to be verified by experimental data and have explicit implications for treatment of tinnitus and hyperacusis. Copyright © 2012 Elsevier B.V. All rights reserved.
Tinnitus severity is reduced with reduction of depressive mood - a prospective population study in Sweden.
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Tinnitus, the perception of sound without external source, is a highly prevalent public health problem with about 8% of the population having frequently occurring tinnitus, and about 1-2% experiencing significant distress from it. Population studies, as well as studies on self-selected samples, have reported poor psychological well-being in individuals with tinnitus. However, no study has examined the long-term co-variation between mood and tinnitus prevalence or tinnitus severity. In this study, the relationship between depression and tinnitus prevalence and severity over a 2-year period was examined in a representative sample of the general Swedish working population. Results show that a decrease in depression is associated with a decrease in tinnitus prevalence, and even more markedly with tinnitus severity. Hearing loss was a more potent predictor than depression for tinnitus prevalence, but was a weaker predictor than depression for tinnitus severity. In addition, there were sex differences for tinnitus prevalence, but not for tinnitus severity. This study shows a direct and long-term association between tinnitus severity and depression. Free PMC Article.

Neural plasticity expressed in central auditory structures with and without tinnitus.
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Sensory training therapies for tinnitus are based on the assumption that, notwithstanding neural changes related to tinnitus, auditory training can alter the response properties of neurons in auditory pathways. To assess this assumption, we investigated whether brain changes induced by sensory training in tinnitus sufferers and measured by electroencephalography (EEG) are similar to those induced in age and hearing loss matched individuals without tinnitus trained on the same auditory task. Auditory training was given using a 5 kHz 40-Hz amplitude-modulated (AM) sound that was in the tinnitus frequency region of the tinnitus subjects and enabled extraction of the 40-Hz auditory steady-state response (ASSR) and P2 transient response known to localize to primary and non-primary auditory cortex, respectively. P2 amplitude increased over training sessions equally in participants with tinnitus and in control subjects, suggesting normal remodeling of non-primary auditory regions in tinnitus. However, training-induced changes in the ASSR differed between the tinnitus and control groups. In controls the phase delay between the 40-Hz response and stimulus waveforms reduced by about 10° over training, in agreement with previous results obtained in young normal hearing individuals. However, ASSR phase did not change significantly with training in the tinnitus group, although some participants showed phase shifts resembling controls. On the other hand, ASSR amplitude increased with training in the tinnitus group, whereas in controls this response (which is difficult to remodel in young normal hearing subjects) did not change with training. These results suggest that neural changes related to tinnitus altered how neural plasticity was expressed in the region of primary but not non-primary auditory cortex. Auditory training did not reduce tinnitus loudness although a small effect on the tinnitus spectrum was detected. Free PMC Article.
Resequencing of the auxiliary GABA(B) receptor subunit gene KCTD12 in chronic tinnitus.  
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Tinnitus is a common and often incapacitating hearing disorder marked by the perception of phantom sounds. Susceptibility factors remain largely unknown but GABA(B) receptor signaling has long been implicated in the response to treatment and, putatively, in the etiology of the disorder. We hypothesized that variation in KCTD12, the gene encoding an auxiliary subunit of GABA(B) receptors, could help to predict the risk of developing tinnitus. Ninety-five Caucasian outpatients with a diagnosis of chronic tinnitus were systematically screened for mutations in the KCTD12 open reading frame and the adjacent 3’ untranslated region by Sanger sequencing. Allele frequencies were determined for 14 known variants of which three (rs73237446, rs34544607, and rs41287030) were polymorphic. When allele frequencies were compared to data from a large reference population of European ancestry, rs34544607 was associated with tinnitus (p = 0.04). However, KCTD12 genotype did not predict tinnitus severity (p = 0.52) and the association with rs34544607 was weakened after screening 50 additional cases (p = 0.07). Pending replication in a larger cohort, KCTD12 may act as a risk modifier in chronic tinnitus. Issues that are yet to be addressed include the effects of neighboring variants, e.g., in the KCTD12 gene regulatory region, plus interactions with variants of GABA(B1) and GABA(B2).  

Is the effect of tinnitus on auditory steady-state response amplitude mediated by attention?  
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Objectives: Auditory steady-state response (ASSR) amplitude enhancement effects have been reported in tinnitus patients. As ASSR amplitude is also enhanced by attention, the effect of tinnitus on ASSR amplitude could be interpreted as an effect of attention mediated by tinnitus. As N1 attention effects are significantly larger than those on the ASSR, if the effect of tinnitus on ASSR amplitude were due to attention, there should be similar amplitude enhancement effects in tinnitus for the N1 component of the auditory-evoked response. Methods: MEG recordings which were previously examined for the ASSR (Diesch et al., 2010a) were analyzed with respect to the N1m component. Like the ASSR previously, the N1m was analyzed in the source domain (source space projection). Stimuli were amplitude-modulated (AM) tones with one of three carrier frequencies matching the tinnitus frequency or a surrogate frequency 1½ octave above the audiometric edge frequency in controls, the audiometric edge frequency, and a frequency below the audiometric edge. Single AM-tones were presented in a single condition and superpositions of three AM-tones differing in carrier and modulation frequency in a composite condition. Results: In the earlier ASSR study (Diesch et al., 2010a), the ASSR amplitude in tinnitus patients, but not in controls, was significantly larger in the (surrogate) tinnitus condition than in the edge condition. Patients showed less evidence than controls of reciprocal inhibition of component ASSR responses in the composite condition. In the present study, N1m amplitudes elicited by stimuli located at the audiometric edge and at the (surrogate) tinnitus frequency were smaller than N1m amplitudes elicited by sub-edge tones both in patients and controls. The relationship of the N1m response in the composite condition to the N1m response in the single condition indicated that reciprocal inhibition among component N1m responses was reduced in patients compared against controls. Conclusions: In the present study, no evidence was found for an N1-amplitude enhancement effect in tinnitus. Compared to controls, reciprocal inhibition is reduced in tinnitus patients. Thus, as there is no effect on N1m that could potentially be attributed to attention, it seems unlikely that the enhancement effect of tinnitus on ASSR amplitude could be accounted for in terms of attention induced by tinnitus.  

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Reversible Induction of Phantom Auditory Sensations through Simulated Unilateral Hearing Loss.

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Tinnitus, a phantom auditory sensation, is associated with hearing loss in most cases, but it is unclear if hearing loss causes tinnitus. Phantom auditory sensations can be induced in normal hearing listeners when they experience severe auditory deprivation such as confinement in an anechoic chamber, which can be regarded as somewhat analogous to a profound bilateral hearing loss. As this condition is relatively uncommon among tinnitus patients, induction of phantom sounds by a lesser degree of auditory deprivation could advance our understanding of the mechanisms of tinnitus. In this study, we therefore investigated the reporting of phantom sounds after continuous use of an earplug. 18 healthy volunteers with normal hearing wore a silicone earplug continuously in one ear for 7 days. The attenuation provided by the earplugs simulated a mild high-frequency hearing loss, mean attenuation increased from <10 dB at 0.25 kHz to >30 dB at 3 and 4 kHz. 14 out of 18 participants reported phantom sounds during earplug use. 11 participants presented with stable phantom sounds on day 7 and underwent tinnitus spectrum characterization with the earplug still in place. The spectra showed that the phantom sounds were perceived predominantly as high-pitched, corresponding to the frequency range most affected by the earplug. In all cases, the auditory phantom disappeared when the earplug was removed, indicating a causal relation between auditory deprivation and phantom sounds. This relation matches the predictions of our computational model of tinnitus development, which proposes a possible mechanism by which a stabilization of neuronal activity through homeostatic plasticity in the central auditory system could lead to the development of a neuronal correlate of tinnitus when auditory nerve activity is reduced due to the earplug. Free PMC Article.

Prevalence of tinnitus in elderly individuals with and without history of occupational noise exposure [Prevalência de zumbido, em idosos com e sem história de exposição ao ruído ocupacional].
International Archives of Otorhinolaryngology 16 (2), pp. 222-225.

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Introduction: The various metabolic and circulatory alterations that are related to noise exposure may cause the onset of several symptoms, including tinnitus. Objective: The purpose of the study was to assess the prevalence of tinnitus complaints in elderly individuals with and without history of occupational noise exposure. Method: This prospective study was conducted in a sample population consisting of 502 individuals aged over 60 years, by anamnesis and audiological evaluation. The variables that were studied were the frequency of tinnitus and the history of occupational noise. Logistic regression was used to control for potential confusion or modifications caused by the effects of the other variables on the associations of interest. Results and Discussion: Tinnitus was reported in 50% of the cases, with tinnitus reported in 40% of the elderly individuals with history of occupational noise exposure, and in 43% of controls (elderly individuals without history of occupational noise exposure). A high frequency of tinnitus was detected in the population under investigation, but there were no statistically significant associations between the presence of tinnitus and history of occupational noise exposure. Conclusion: The results of this study may have occurred due to other factors such as the age of the individuals without history of occupational noise exposure.
Vestibular symptoms in factory workers subjected to noise for a long period.

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Background: Noise can cause permanent or temporary hearing loss. High levels of noise may stimulate the vestibular system and thereby cause disturbances in the balancing mechanism. Objective: To determine the effect of long-term exposure to occupational noise on the vestibular system. Methods: A dizziness questionnaire was administered to 20 factory workers who were exposed to occupational noise for more than 10 years. The results were compared with 2 control groups. The control group 1 consisted of 20 people who had similar physical activity during work but were not exposed to high level of noise. Control group 2 consisted of 20 students never exposed to hazardous noise. Results: There was significant difference between the experimental group and the 2 control groups in terms of frequency of vestibular symptoms. However, most of the symptoms were subtle in nature. Tinnitus was significantly (p<0.05) more frequent in the experimental group than the 2 control groups. Conclusions: Long-term exposure to noise may cause vestibular symptoms before clinically detectable hearing loss. The symptoms are subtle for which they are mostly neglected; the symptoms do not affect the functional ability of workers.

Intrinsic modulators of auditory thalamocortical transmission.

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Neurons in layer 4 of the primary auditory cortex receive convergent glutamatergic inputs from thalamic and cortical projections that activate different groups of postsynaptic glutamate receptors. Of particular interest in layer 4 neurons are the Group II metabotropic glutamate receptors (mGluRs), which hyperpolarize neurons postsynaptically via the downstream opening of GIRK channels. This pronounced effect on membrane conductance could influence the neuronal processing of synaptic inputs, such as those from the thalamus, essentially modulating information flow through the thalamocortical pathway. To examine how Group II mGluRs affect thalamocortical transmission, we used an in vitro slice preparation of the auditory thalamocortical pathways in the mouse to examine synaptic transmission under conditions where Group II mGluRs were activated. We found that both pre- and post-synaptic Group II mGluRs are involved in the attenuation of thalamocortical EPSP/Cs. Thus, thalamocortical synaptic transmission is suppressed via the presynaptic reduction of thalamocortical neurotransmitter release and the postsynaptic inhibition of the layer 4 thalamorecipient neurons. This could enable the thalamocortical pathway to autoregulate transmission, via either a gating or gain control mechanism, or both. Copyright © 2012 Elsevier B.V. All rights reserved.
Tinnitus and insomnia: Is hyperarousal the common denominator?
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Tinnitus is an auditory sensation that is generated by aberrant activation within the auditory system. Sleep disturbances are a frequent problem in the tinnitus population. They are known to worsen the distress caused by the tinnitus which in turn worsens sleep quality. Beyond that, disturbed sleep is a risk factor for mental health problems and distressing tinnitus is often associated with enhanced depressivity, anxiety, and somatic symptom severity. Moreover there is evidence that therapies which alleviate tinnitus-related distress have a positive influence on sleep quality and help interrupt this vicious cycle. This suggests that distressing tinnitus and insomnia may both be promoted by similar physiological mechanisms. One candidate mechanism is hyperarousal caused by enhanced activation of the sympathetic nervous system. There is increasing evidence for hyperarousal in insomnia patients, and animal models of tinnitus and insomnia show conspicuous similarities in the activation pattern of limbic and autonomous brain regions. In this article we review the evidence for this hypothesis which may have implications for therapeutic intervention in tinnitus patients with comorbid insomnia. Copyright © 2012 Elsevier Ltd. All rights reserved.

Compromise of auditory cortical tuning and topography after cross-modal invasion by visual inputs.

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Brain damage resulting in loss of sensory stimulation can induce reorganization of sensory maps in cerebral cortex. Previous research on recovery from brain damage has focused primarily on adaptive plasticity within the affected modality. Less attention has been paid to maladaptive plasticity that may arise as a result of ectopic innervation from other modalities. Using ferrets in which neonatal midbrain damage results in diversion of retinal projections to the auditory thalamus, we investigated how auditory cortical function is impacted by the resulting ectopic visual activation. We found that, although auditory neurons in cross-modal auditory cortex (XMAC) retained sound frequency tuning, their thresholds were increased, their tuning was broader, and tonotopic order in their frequency maps was disturbed. Multisensory neurons in XMAC also exhibited frequency tuning, but they had longer latencies than normal auditory neurons, suggesting they arise from multisynaptic, non-geniculocortical sources. In a control group of animals with neonatal deafferentation of auditory thalamus but without redirection of retinal axons, tonotopic order and sharp tuning curves were seen, indicating that this aspect of auditory function had developed normally. This result shows that the compromised auditory function in XMAC results from invasion by ectopic visual inputs and not from deafferentation. These findings suggest that the cross-modal plasticity that commonly occurs after loss of sensory input can significantly interfere with recovery from brain damage and that mitigation of maladaptive effects is critical to maximizing the potential for recovery. Free full text.
Exposure of Wistar rats to 24-h psycho-social stress alters gene expression in the inferior colliculus.
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Recently, we have demonstrated that the exposure of Wistar rats to psycho-social stress results in a transient auditory hypersensitivity. Here, to learn more about modifications occurring in auditory brainstem, we have analyzed gene expression pattern in inferior colliculus using quantitative RT-PCR. As targets, we have chosen genes associated with: neural activity (FBJ osteosarcoma viral oncogene, cFos), hypoxia (nitric oxide synthase inducible, iNos; superoxide dismutase 2, Sod2), neuroprotection (nerve growth factor beta, Ngfb; heat shock factor 1, Hsf1; heat shock protein 70, Hsp70) and inflammation (tumor necrosis factor alpha, Tnfa; tumor necrosis factor alpha receptor, Tnfar; substance P, Sp; cyclooxygenase 2, Cox2).

We found that the expression of all genes was modified following stress, as compared to the controls. Immediately after stress, the number of transcripts encoding iNos, Sod2, Hsf1, Ngfb, Tnfa, Tnfar and Sp was significantly increased, suggesting possible modulation during exposure to stressor. Interestingly, we found that expression of Hsf1 and Ngfb at this particular time was left-right asymmetrical: there were more transcripts of both genes found in the left colliculi, as compared to the right colliculi. Three hours post-stress, iNos, Hsf1, Tnfa and Tnfar were still upregulated, Sod2, Ngfb and Sp went back to baseline and Cox2 was upregulated. Six hours post-stress, cFos mRNA became downregulated. The number of Hsp70 mRNA increased 24h post-stress. Except for the reduced number of cFos transcripts, expression of all other genes tested reached the baseline seven days post-stress. Presented results corroborate the concept of auditory system responding to the psycho-social stress. Post-stress changes in the IC gene expression could likely indicate shift from allostasis to homeostasis in the auditory brainstem. Copyright © 2012. Published by Elsevier Ireland Ltd.

Early hearing-impairment results in crossmodal reorganization of ferret core auditory cortex.
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Numerous investigations of cortical crossmodal plasticity, most often in congenital or early-deaf subjects, have indicated that secondary auditory cortical areas reorganize to exhibit visual responsiveness while the core auditory regions are largely spared. However, a recent study of adult-deafened ferrets demonstrated that core auditory cortex was reorganized by the somatosensory modality. Because adult animals have matured beyond their critical period of sensory development and plasticity, it was not known if adult-deafening and early-deafening would generate the same crossmodal results. The present study used young, ototoxically-lesioned ferrets (n = 3) that, after maturation (avg. = 173 days old), showed significant hearing deficits (avg. threshold = 72 dB SPL). Recordings from single-units (n = 132) in core auditory cortex showed that 72% were activated by somatosensory stimulation (compared to 1% in hearing controls). In addition, tracer injection into early hearing-impaired core auditory cortex labeled essentially the same auditory cortical and thalamic projection sources as seen for injections in the hearing controls, indicating that the functional reorganization was not the result of new or latent projections to the cortex. These data, along with similar observations from adult-deafened and adult hearing-impaired animals, support the recently proposed brainstem theory for crossmodal plasticity induced by hearing loss. Free PMC Article.
Brainstem Auditory Evoked Potentials Suggest a Role for the Ventral Cochlear Nucleus in Tinnitus.


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Numerous studies have demonstrated elevated spontaneous and sound-evoked brainstem activity in animal models of tinnitus, but data on brainstem function in people with this common clinical condition are sparse. Here, auditory nerve and brainstem function in response to sound was assessed via auditory brainstem responses (ABR) in humans with tinnitus and without. Tinnitus subjects showed reduced wave I amplitude (indicating reduced auditory nerve activity) but enhanced wave V (reflecting elevated input to the inferior colliculi) compared with non-tinnitus subjects matched in age, sex, and pure-tone threshold. The transformation from reduced peripheral activity to central hyperactivity in the tinnitus group was especially apparent in the V/I and III/I amplitude ratios. Compared with a third cohort of younger, non-tinnitus subjects, both tinnitus, and matched, non-tinnitus groups showed elevated thresholds above 4 kHz and reduced wave I amplitude, indicating that the differences between tinnitus and matched non-tinnitus subjects occurred against a backdrop of shared peripheral dysfunction that, while not tinnitus specific, cannot be discounted as a factor in tinnitus development. Animal lesion and human neuroanatomical data combine to indicate that waves III and V in humans reflect activity in a pathway originating in the ventral cochlear nucleus (VCN) and with spherical bushy cells (SBC) in particular. We conclude that the elevated III/I and V/I amplitude ratios in tinnitus subjects reflect disproportionately high activity in the SBC pathway for a given amount of peripheral input. The results imply a role for the VCN in tinnitus and suggest the SBC pathway as a target for tinnitus treatment.

The effects of tinnitus and/or hearing loss on the Symptom Checklist-90-Revised test.

**Auris Nasus Larynx. 2012 Jul 21. [Epub ahead of print]**

**Genç GA, Muluk NB, Belgin E.**

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OBJECTIVE: This study aims to evaluate the psychological attitudes of patients with tinnitus by using The Symptom Checklist-90-Revised and to investigate the relationship between hearing loss and attributed psychological attitudes. MATERIALS AND METHODS: 142 subjects (73 female, 69 male) divided into 4 groups: Group 1 (32 patients with tinnitus and hearing loss-), Group 2 (38 patients with tinnitus), Group 3 (36 patients with hearing loss), Group 4 (36 healthy subjects without tinnitus and hearing loss-control group). The Symptom Checklist-90-Revised (SCL-90-R) test was used to detect the subjects’ tendency for psychological problems due to tinnitus and/or hearing loss. RESULTS: Mean values of Somatization (SOM), Obsessive-Compulsive (O-C) and Additional Scale (AS) were higher than cut-off points of 1.00 for Groups 1 and 2 (tinnitus and/or hearing loss). In patients with tinnitus and/or hearing loss, SOM, O-C, Depression (DEP), AS and Global Severity Index (GSI) were significantly higher than patients with hearing loss and control group. By multiple linear regression analysis, tinnitus was the significantly detected confounding factor for increase of SOM, O-C, Interpersonal Sensitivity (I-S), DEP, Hostility (HOS), Paranoid Ideation (PAR), AS and GSI parameters. CONCLUSION: It was concluded that tinnitus could induce some psychological symptoms such as depression; and this is independent of hearing loss. Tinnitus with or without hearing loss is the essential factor for causing psychological problems in patients. Tinnitus duration is not important in the scene of psychological status of the patients. This result shows that, age, gender (male, female), chronic or acute tinnitus experience, and having hearing loss did not cause too much problems in patients. But tinnitus experience in every form (for the present study, intermediate level subjective tinnitus) is significantly important confounding factor for affecting psychological status of the patients. Copyright © 2012 Elsevier Ireland Ltd. All rights reserved.
III Diagnostics

**Temporalomandibular joint disorder complaints in tinnitus: further hints for a putative tinnitus subtype.**

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**OBJECTIVE:** Tinnitus is considered to be highly heterogeneous with respect to its etiology, its comorbidities and the response to specific interventions. Subtyping is recommended, but it remains to be determined which criteria are useful, since it has not yet been clearly demonstrated whether and to which extent etiologic factors, comorbid states and interventional response are related to each other and are thus applicable for subtyping tinnitus. Analyzing the Tinnitus Research Initiative Database we differentiated patients according to presence or absence of comorbid temporomandibular joint (TMJ) disorder complaints and compared the two groups with respect to etiologic factors.

**METHODS:** 1204 Tinnitus patients from the Tinnitus Research Initiative (TRI) Database with and without subjective TMJ complaints were compared with respect to demographic, tinnitus and audiological characteristics, questionnaires, and numeric ratings. Data were analysed according to a predefined statistical analysis plan.

**RESULTS:** Tinnitus patients with TMJ complaints (22% of the whole group) were significantly younger, had a lower age at tinnitus onset, and were more frequently female. They could modulate or mask their tinnitus more frequently by somatic maneuvers and by music or sound stimulation. Groups did not significantly differ for tinnitus duration, type of onset (gradual/abrupt), onset related events (whiplash etc.), character (pulsatile or not), hyperacusis, hearing impairment, tinnitus distress, depression, quality of life and subjective ratings (loudness etc.).

**CONCLUSION:** Replicating previous work in tinnitus patients with TMJ complaints, classical risk factors for tinnitus like older age and male gender are less relevant in tinnitus patients with TMJ complaints. By demonstrating group differences for modulation of tinnitus by movements and sounds our data further support the notion that tinnitus with TMJ complaints represents a subgroup of tinnitus with clinical features that are highly relevant for specific therapeutic management.

**The impact of co-morbid factors on the psychological outcome of tinnitus patients.**
Eur Arch Otorhinolaryngol. 2012 Jun 15. [Epub ahead of print]

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The study was carried out to determine the impact of some co-morbid otological symptoms and demographic factors on the emotional distress and cognitive functioning in patients with tinnitus. One hundred consecutive patients, complaining of constant idiopathic tinnitus, were enrolled into the study. Four tests were administered: Beck Depression Inventory, Hospital Anxiety Depression Scale (HADS, A-anxiety, D-depression), Mini-Mental State Examination (MMSE) and Trail Making Test (TMT). A multivariate stepwise linear regression analysis was performed to estimate the relationship between the results of each of the tests and following co-morbid factors: age, sex, tinnitus duration, tinnitus laterality, hearing status (normal hearing, unilateral hearing loss and bilateral hearing loss) and vertigo/dizziness. It was found that the scores of MMSE and TMT were negatively correlated with age and with hearing status and the scores of HADS-A were slightly correlated with sex. In regression analysis, in HADS-A, sex and to a lesser extent tinnitus duration, in MMSE and TMT age and to a lesser extent tinnitus laterality were the variables that were comprised in the final model. Demographic factors had contributed more than overlapping otological symptoms to the psychological outcome in tinnitus patients.
Prospective evaluation of the clinical profile and referral pattern differences of vestibular schwannomas and other cerebellopontine angle tumors.

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OBJECTIVE: To evaluate the clinical profile, referral pattern, delay in diagnosis, and impact of tumor size of cases involving vestibular schwannomas (VS) versus other cerebellopontine angle (CPA) tumors in an Egyptian population. STUDY DESIGN: Case series study. SETTING: Tertiary referral center. PATIENTS: A prospective study of possible retrocochlear lesions was conducted from 2008 to 2010. INTERVENTION(S): Patients were subjected to a full clinical history, complete otorhinolaryngological examination, a basic audiologic evaluation, auditory brainstem response assay, and gadolinium-enhanced magnetic resonance imaging. According to the findings of magnetic resonance imaging, patients with retrocochlear lesions were divided into 2 groups: those with VS (n = 17) and those with other CPA lesions (n = 14). MAIN OUTCOME MEASURE(S): Diagnostic delay and criteria of VS and CPA tumors. RESULTS: Unilateral hearing loss and tinnitus were presented in 52.9% of VS cases with a diagnostic delay of 15.5 months. For cases involving other CPA lesions, a combination of otologic symptoms was observed in 9 (64%) of 14 cases, and a diagnostic delay of 47.5 months was experienced. An absence of auditory brainstem response waves was identified significantly (p < 0.05) for the affected ears of both groups. Only differences in Wave V latency were significant between the 2 groups (p < 0.05). CONCLUSION: A longer diagnostic delay was associated with cases involving other types of CPA lesions versus cases of VS, and tumor size and volume did not affect the diagnostic delay of the former. Moreover, the only significant difference in clinical presentation for these 2 groups of intracranial tumor involved Wave V latency.

Distortion-product otoacoustic emissions: a useful test for monitoring ototoxicity induced by pegylated interferon and ribavirin treatment in patients with chronic hepatitis C.


Pegylated-interferon (peg-IFN) and ribavirin combination therapy for the treatment of hepatitis C virus (HCV) infection is well known to be associated with significant adverse effects. Several studies have investigated a possible auditory pathway involvement during IFN therapy, but a method to monitor the potential auditory involvement during treatment has not yet been described. The aim of this study is to evaluate possible modifications of the outer hair cell (OHC) function in HCV patients receiving peg-IFN and ribavirin combination therapy. Thirteen adult HCV patients (8 F/5 M, mean age 52±12 years) treated with peg-IFN and ribavirin combination therapy underwent Pure Tone Audiogram and Distortion Product Otoacoustic Emission (DPOAE) tests. We compared mean auditory thresholds (PTA) and mean DPOAE amplitude before, at month 3 during, and at the end of treatment (T0, T3, and Tend, respectively), and 3 months after treatment discontinuation (Tfu). No significant differences were found in hearing levels at the different time points analyzed. During treatment, three patients developed tinnitus, which in 2 cases resolved spontaneously after the end of therapy. Compared to T0 (19.5±0.83), a statistically significant DPOAE increase at T3 (30±1.26) and Tend (28.6±2.16) was found (p<0.05 at both time points), while DPOAEs returned to pre-treatment levels at Tfu (19.3±1.3). In our group, none of the patients reported a permanent auditory impairment, excluding one patient with persistent tinnitus. Peg-IFN could produce an increase of motility of the OHCs by means of intracellular pathways. DPOAE test could be considered a new method for monitoring ototoxicity induced by IFN. On the basis of recent literature and our audiological results, physicians should be aware of the possible ototoxic effects of peg-IFN, requiring appropriate surveillance, and the patient should be informed of the potential side effects of IFN therapy on the auditory pathway.
HRCT analysis of the bone wall between vascular and air cells in temporal bone.

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Objective: To observe the integrity of the carotid artery canal, jugular foramen and sigmoid sinus groove with HRCT. Methods: Totally 166 (332 ears) subjects’ HRCT images regarding the occurrence of dehiscent sigmoid sinus groove, dehiscent jugular foramen and dehiscent internal carotid artery canal were analyzed retrospectively. The volume of temporal bone pneumatization was measured by volume rendering technique with three-dimensional reconstruction, and the volume of temporal bone pneumatization between the dehiscent ears and the intact ones were compared. Results: The incidence of dehiscent carotid artery canal, dehiscent jugular foramen and dehiscent sigmoid sinus groove of 166 subjects was 2.41% (8/332), 0.90% (3/332) and 2.71% (9/332), respectively. The mean volume of temporal bone pneumatization with intact bone walls was (5.43±2.43)ml. The differences in volume between the genders and the sides were not statistically significant (all P>0.05). There was no statistical difference in the volume of temporal bone pneumatization between the dehiscent ears and the intact ones. Conclusion: Dehiscence could happen in the bone wall between vascular and air cells in temporal bone of normal people, which should be distinguished in the diagnosis for vascular pulsatile tinnitus.

Gap detection deficits in humans with tinnitus as assessed with the acoustic startle paradigm: Does tinnitus fill in the gap?
Hear Res. 2012 Jun 9. [Epub ahead of print]

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The measurement of tinnitus in humans relies on subjective measures such as self-report, visual analog scales and questionnaires. Gap detection impairments have been tested in animals in an attempt to objectify the presence of tinnitus. The main purpose of this study was to investigate the gap startle paradigm in human participants with high-frequency tinnitus. Fifteen adults with bilateral high-frequency tinnitus but normal hearing at standard frequencies and seventeen matched controls without tinnitus were tested. The psychoacoustic characteristics of the tinnitus spectrum (pitch and loudness) were assessed using novel participant-directed custom-made methods. The startle task consisted of startle-alone, prepulse inhibition and gap-in-noise condition at low- and high-background noise frequencies. All measurements were retested after several months. Data indicate normal prepulse inhibition but higher reactivity to the startle sounds in the tinnitus group in comparison with controls. Most importantly, the tinnitus group displayed a consistent deficit in gap processing at both low- and high-background noise frequencies. All effects were identified consistently and were reproducible at retest. We propose that the higher reactivity to startle might reflect hyperacusis and that the gap deficit might be an index of abnormal cortical auditory processing in tinnitus.

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Extended Frequency Range Hearing Thresholds and Otoacoustic Emissions in Acute Acoustic Trauma.

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OBJECTIVE: We sought to evaluate the relative value of pure tone audiometry (PTA), extended high-frequency audiometry (EFA) and transiently evoked otoacoustic emissions (OAE) and distortion products when monitoring acute acoustic trauma (AAT). STUDY DESIGN: Controlled prospective clinical study. SETTING: Tertiary referral center. PATIENTS: Seventy one active duty soldiers in the same age with normal hearing. INTERVENTIONS: Forty one soldiers suffered assault-rifle-induced acute acoustic traumas with hearing loss and tinnitus. Thirty soldiers served as a control group. MAIN OUTCOME MEASURES: Pure tone threshold changes detected by PTA and EFA, amplitude and reproducibility changes in transiently evoked OAE, distortion products, and tinnitus analysis based on a visual analog scale. RESULTS: Assault rifle-induced AAT caused unilateral temporary threshold shifts (TTS) in PTA and bilateral TTS in EFA. Two frequency regions with the largest threshold shifts were identified: one between 3 and 6 kHz and another between 11 and 14 kHz. The reproducibility of transiently evoked OAEs revealed changes related to the acoustic trauma in the 3- to 5-kHz frequency window. The amplitudes of the low stimulation level distortion products at 6 kHz were correlated with the audiometric AAT-induced TTS. CONCLUSION: Acute acoustic trauma-induced audiometric TTS are predominantly confined to 2 specific frequency regions. PTA and EFA are both necessary to identify the full extent of acute acoustic trauma. PTA and EFA revealed that the TTSs were correlated to with distortion product OAE amplitude shifts at 6 kHz and changes in the reproducibility of transiently evoked OAE in the 3- to 5-kHz frequency window. PTA remains the most important measurement to monitor AAT. It may be useful to complement it with EFA, focusing on the 11 to 14 kHz frequency range. If used, OAE should be analyzed in the frequency range of 3 to 6 kHz.

Transcranial and cervical duplex: A feasible approach to the diagnosis of pulsatile tinnitus.
[Article in press].

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Pulsatile tinnitus is an uncommon form of tinnitus. Several vascular causes, such as carotid dissection and arteriovenous fistulae, have been associated to pulsatile tinnitus. Methods: We present two patients who complained of pulsatile tinnitus and headache in the last 2 weeks. Results: Transcranial Doppler demonstrated disturbances in systolic blood flow consisting of turbulences in the middle cerebral artery in one patient and disturbances in a vertebral artery in the other. MR and CT angiography confirmed the diagnosis of vertebrobasilar arteriovenous fistula. Daily compression maneuvers reduced the flow and bruit of both fistulas. Conclusions: Hemodynamic changes in cerebral flow through a non-invasive and feasible test such as TCD or duplex can be very useful for the etiological diagnosis of pulsatile tinnitus. © 2012 Elsevier GmbH. All rights reserved.
**Analysis of psychoacoustic characteristics and audiology tests of tinnitus patients with sensorineural hearing loss.**

[Article in Chinese]

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**OBJECTIVE:** Tried to find the relationship between tinnitus and each testing method, provided information for objective diagnosis and treatment for tinnitus patients with sensorineural hearing loss. **METHOD:** The characteristics of audiology tests, including pure tone audiometric, acoustic immittance, middle ear muscle reflexes, matching test, distortion products otoacoustic emission (DPOAE) were compared in 79 ears of 69 tinnitus patients with sensorineural hearing loss. **RESULT:** The RI positive rate was higher in Convergence curve in tinnitus patients of sensorineural hearing loss, with the rate being 51.3%. The detection rates of DPOAE were 15.2% in patients of sensorineural hearing loss tinnitus groups, which were significant lower than those in control group. **CONCLUSION:** Psychoacoustic techniques can produce a useful amount of clinical data regarding tinnitus in different aspects, these data can help clinicians design needed based managements. DPOAE test is helpful for the diagnosis of lesions in some tinnitus patients.

**Psychometric evaluation of Visual Analog Scale for the assessment of chronic tinnitus.**

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**PURPOSE:** The development of therapeutic interventions for chronic tinnitus requires sensitive and clinically responsive tools to measure treatment induced changes in tinnitus loudness and annoyance. This study evaluates the psychometric properties of patient-reported Visual Analog Scales (VAS) for measuring subjectively perceived tinnitus loudness and annoyance. **Methods** Data from a single-blind, randomized, placebo-controlled study of acoustic coordinated reset neuromodulation in patients with chronic tinnitus (trial registration: “RESET study”, NCT00927121) were analyzed to assess the reliability, validity and Minimally Clinically Identifiable Difference (MCID) of the VAS loudness and VAS annoyance. The VAS loudness and VAS annoyance were completed at screening, at baseline and at 5 visits during the 16 weeks of the clinical study. Data were analyzed with respect to test-retest reliability, validity and MCID. **RESULTS:** VAS loudness and VAS annoyance showed good test-retest reliability of 0.8 and 0.79 respectively. In terms of convergent validity VAS loudness and VAS annoyance correlated well with the Tinnitus Questionnaire at all clinical visits (max \( r = 0.67 \), \( p < 0.05 \)). MCID estimates clustered between 10 and 15 points. **CONCLUSIONS:** VAS loudness and VAS annoyance are valid and effective measurements for capturing reductions in tinnitus severity in patients with chronic tinnitus.
IV Imaging

Functional Connectivity Networks in Nonbothersome Tinnitus.

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ObjectiveTo assess functional connectivity in cortical networks in patients with nonbothersome tinnitus compared with a normal healthy nontinnitus control group by measuring low-frequency (<0.1 Hz) spontaneous blood oxygenation level-dependent (BOLD) signals at rest.

DesignCase-control.

SettingAcademic medical center.

ParticipantsNonbothersome, idiopathic subjective tinnitus for at least 6 months (n = 18) and a normal healthy nontinnitus control group (n = 23).

Main Outcome MeasureFunctional connectivity differences in 58 a priori selected seed regions of interest encompassing cortical loci in the default mode, attention, auditory, visual, somatosensory, and cognitive networks.

ResultsThe median age of the 18 subjects was 54 years (interquartile range [IQR], 52-57), 66% were male, 90% were white, median Tinnitus Handicap Inventory (THI) score was 8 (IQR, 4-14), and a median Beck Depression Index score was 1 (IQR, 0-5). The median age for the control group was 46 years (IQR, 39-54), and 52% were male. Of the 58 seeds analyzed, no regions had significantly different functional connectivity among the nonbothersome tinnitus group when compared with the control group.

ConclusionAmong nonbothersome tinnitus patients, the tinnitus percept does not appear to alter the functional connectivity of the auditory cortex or other key cortical regions.

Trial RegistrationClinicalTrials.gov Identifier: NCT01049828.

Abnormal cortical sensorimotor activity during “Target” sound detection in subjects with acute acoustic trauma sequelae: an fMRI study.

Job A, Pons Y, Lamalle L, Jaillard A, Buck K, Segebarth C, Delon-Martin C.

The most common consequences of acute acoustic trauma (AAT) are hearing loss at frequencies above 3 kHz and tinnitus. In this study, we have used functional Magnetic Resonance Imaging (fMRI) to visualize neuronal activation patterns in military adults with AAT and various tinnitus sequelae during an auditory “oddball” attention task. AAT subjects displayed overactivities principally during reflex of target sound detection, in sensorimotor areas and in emotion-related areas such as the insula, anterior cingulate and prefrontal cortex, in premotor area, in cross-modal sensory associative areas, and, interestingly, in a region of the Rolandic operculum that has recently been shown to be involved in tympanic movements due to air pressure. We propose further investigations of this brain area and fine middle ear investigations, because our results might suggest a model in which AAT tinnitus may arise as a proprioceptive illusion caused by abnormal excitability of middle-ear muscle spindles possibly link with the acoustic reflex and associated with emotional and sensorimotor disturbances. Free PMC Article.

Functional Connectivity during Modulation of Tinnitus with Orofacial Maneuvers.


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Objective. To determine changes in cortical neural networks as defined by resting-state functional connectivity magnetic resonance imaging during voluntary modulation of tinnitus with orofacial maneuvers.

Study Design. Cross-sectional study.

Setting. Academic medical center.

Subjects and Methods. Participants were scanned during the maneuver and also at baseline to serve as their own control. The authors chose, a priori, 58 seed regions to evaluate previously described cortical neural networks by computing...
temporal correlations between all seed region pairs. Seed regions whose correlations significantly differed between rest and maneuver (P < .05, uncorrected) entered into a second-stage analysis of computing the correlation coefficient between the seed region and time courses in each of the remaining brain voxels. A threshold-free cluster enhancement permutation analysis evaluated the distribution of these correlation coefficients after transformation to Fisher z scores and registration to a surface-based reconstruction using Freesurfer. Results. The median age for the 16 subjects was 54 years (range, 27-72 years), and all had subjective, unilateral or bilateral, nonpulsatile tinnitus for 6 months or longer. In 9 subjects who could voluntarily increase the loudness of their tinnitus, there were no significant differences in functional connectivity in any cortical networks. A separate analysis evaluated results from 3 patients who decreased the loudness of their tinnitus. Four subjects were excluded because of excessive motion in the scanner. Conclusion. The absence of significant differences in functional connectivity due to voluntary orofacial maneuvers that increased tinnitus loudness failed to confirm prior reports of altered cerebral blood flows during somatomotor behaviors.

Disentangling depression and distress networks in the tinnitus brain.

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Tinnitus is the continuous perception of an internal auditory stimulus. This permanent sound often affects a person's emotional state inducing distress and depressive feelings changes in 6-25% of the affected population. Distress and depression are two distinct emotional states. Whereas distress describes a transient aversive state, interfering with a person's ability to adequately adapt to stressors, depressive feelings should rather be considered as a more constant emotional state. Based on previous observations in chronic pain, posttraumatic stress disorder and depression, we assume that both states are related to separate neural circuits. We used the Dutch version of the Tinnitus Questionnaire to assess the global index of distress together with the Beck Depression Inventory to evaluate the depressive symptoms accompanying tinnitus. Furthermore sLORETA analysis was performed to correlate current density distribution with distress and depression scores, revealing a lateralization effect of depression versus distress. Distress is mainly correlated with alpha 2, beta 1 and beta 2 activity of the right frontopolar cortex and orbitofrontal cortex in combination with beta 2 activation of the anterior cingulate cortex. In contrast, the more permanent depressive alterations induced by tinnitus are associated with activity of alpha 2 activity in the left frontopolar and orbitofrontal cortex. These specific neural circuits are embedded in a greater neural network, with the parahippocampal region functioning as a crucial linkage between both tinnitus related pathways. Free full text.

Neuromagnetic Indicators of Tinnitus and Tinnitus Masking in Patients with and without Hearing Loss.

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Tinnitus is an auditory phenomenon characterised by the perception of a sound in the absence of an external auditory stimulus. Chronic subjective tinnitus is almost certainly maintained via central mechanisms, and this is consistent with observed measures of altered spontaneous brain activity. A number of putative central auditory mechanisms for tinnitus have been proposed. The influential thalamocortical dysrhythmia model suggests that tinnitus can be attributed to the disruption of coherent oscillatory activity between thalamus and cortex following hearing loss. However, the extent to which this disruption specifically contributes to tinnitus or is simply a consequence of the hearing loss is unclear because the necessary matched controls have not been tested. Here, we rigorously test several predictions made by this model in four groups of
participants (tinnitus with hearing loss, tinnitus with clinically normal hearing, no tinnitus with hearing loss and no tinnitus with clinically normal hearing). Magnetoencephalography was used to measure oscillatory brain activity within different frequency bands in a ‘resting’ state and during presentation of a masking noise. Results revealed that low-frequency activity in the delta band (1-4 Hz) was significantly higher in the ‘tinnitus with hearing loss’ group compared to the ‘no tinnitus with normal hearing’ group. A planned comparison indicated that this effect was unlikely to be driven by the hearing loss alone, but could possibly be a consequence of tinnitus and hearing loss. A further interpretative linkage to tinnitus was given by the result that the delta activity tended to reduce when tinnitus was masked. High-frequency activity in the gamma band (25-80 Hz) was not correlated with tinnitus (or hearing loss). The findings partly support the thalamocortical dysrhythmia model and suggest that slow-wave (delta band) activity may be a more reliable correlate of tinnitus than high-frequency activity.

Cortical habituation deficit in tinnitus sufferers: contingent negative variation as an indicator of duration of the disease.


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Cortical attention and habituation parameters are altered in patients suffering from tinnitus. The aim of the study was to quantify cortical attention and habituation parameters in tinnitus patients by recording the contingent negative variation (CNV) response and to correlate amplitudes of different CNV parameters with duration of disease. Twenty patients suffering from tinnitus (median: 44 years) and twenty age- and sex-matched healthy controls (median: 41 years) were tested by a CNV paradigm. We recorded overall CNV, initial CNV, and terminal CNV and calculated habituation slopes. All CNV parameters were Spearman-correlated with individual duration of disease. Highly significant between groups differences emerged in total (tinnitus: -8.4 uV vs. controls: -3.8 uV), initial (-11.2 vs. -6.0 uV), and terminal CNV (-11.9 vs. -6.5 uV) demonstrating higher negative amplitudes in tinnitus patients. Habituation differed in total and terminal CNV, indicating missing habituation in tinnitus patients. Overall CNV (ϱ = -.365) and initial CNV (ϱ = -.529) showed a medium Spearman correlation with duration of disease. We conclude that the correlation between duration of tinnitus and the initial CNV amplitudes indicates an altered state of cortical excitability that can also be observed in more negative CNV-amplitudes in tinnitus patients. We assume that this state indicates a chronicity process in tinnitus disease.


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In tinnitus, PET and other functional imaging modalities have shown functional changes not only in the auditory cortex but also in nonauditory regions such as the limbic, frontal, and parietal areas. Nonetheless, disparities in task dimension among studies, low statistical power due to small sample size, and the intrinsic uncertainty of a modality that measures activity indirectly limit the comprehensive understanding of the results from PET studies. These difficulties prompted us to undertake a metaanalysis of PET studies on tinnitus using a coordinate-based technique (activation-likelihood estimation) to retrieve the most consistent activation areas across different task dimensions and to compare the results with those from other imaging modalities. METHODS: We performed 2 activation-likelihood estimation metaanalyses on data from 10 studies with 56 foci in which we examined the contrast between tinnitus individuals and controls and the difference in activation between sound stimuli and resting state in tinnitus individuals. RESULTS: The
studies show that the most consistently activated regions in tinnitus subjects, compared with controls, were
the left primary and bilateral secondary auditory cortices, left middle and bilateral inferior temporal gyri, left
parahippocampal area, left geniculum body, left precuneus, right anterior cingulate cortex, right claustrum,
right middle and inferior frontal gyri, and right angular gyrus. The relatively activated area under sound
stimuli, compared with resting state, in tinnitus subjects was the secondary auditory cortex. Our study
reconfirms the findings of previous quantitative electroencephalography or magnetoencephalography
studies because most of the 14 brain areas with significant activation found in our metaanalysis replicate
these earlier data. Our results suggest that the areas described in the tinnitus network are solidly replicable
regardless of the applied functional imaging technique. CONCLUSION: This study proves that PET is a
useful modality for tinnitus research and solidifies human tinnitus research itself by confirming previously
described brain areas involved in the generation and maintenance of tinnitus.

V Pharmacotherapy

Clonazepam Quiets tinnitus: a randomised crossover study with Ginkgo Biloba.
J Neurol Neurosurg Psychiatry. 2012 May 23. [Epub ahead of print]

Han SS, Nam EC, Won JY, Lee KU, Chun W, Choi HK, Levine RA.

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Objective To assess the effect of Ginkgo biloba and clonazepam, a γ-aminobutyric acid (GABA)-receptor
agonist, upon tinnitus.

Methods This was an open-label, randomised, crossover study. 27 men and 11 women
(aged 16-80 (mean 58)) with tinnitus for more than 2 months were enrolled. Participants were randomised
to either clonazepam or G biloba for the first 3 weeks. For the next 2 weeks of washout no medication
was taken. For the final 3 weeks, subjects were given the other drug. The initial dose of clonazepam and
G biloba was one tablet daily (clonazepam 0.5 mg; G biloba 40 mg). Subjects were instructed to increase
the dose by one tablet every 3 days to a maximum of four tablets daily until they perceived a satisfactory
decrease in tinnitus loudness or intolerable side effects. Tinnitus was assessed with pitch and loudness
matching, tinnitus handicap inventory, and visual analogue scales of loudness, duration and annoyance.

Results Comparing before and after each drug, clonazepam significantly improved tinnitus loudness (74%
of subjects), duration (63%), annoyance (79%), and tinnitus handicap inventory score (61%), whereas the
G biloba showed no significant differences on any of these measures.

Conclusion Clonazepam is effective in treating tinnitus; G biloba is ineffective.

[Ginkgo biloba-effect, adverse events and drug interaction].
[Article in Norwegian]

Roland PD, Nergård CS.

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Ginkgo is probably one of the most widely used medicinal herbs in Europe. In Norway products of
ginkgo leaf extract have been approved by the Norwegian Medicines Agency for the following indication:
traditionally used to improve blood circulation, for example, cold hands and feet. Elsewhere, ginkgo is used
for cognitive impairment and dementia, acute ischaemic stroke, intermittent claudication, tinnitus and age-
related macular degeneration. Evidence of the efficacy of ginkgo for these indications has previously been
studied by the Cochrane Collaboration. In this update we have repeated all the searches in Medline and
EMBASE exactly as described in the five Cochrane Systematic Reviews (last search date: 16.02.2011).
We identified two new randomised and placebo-controlled studies on cognitive impairment and dementia
(3187 patients) and one study on acute ischaemic stroke (3069 patients). The results of these studies
gave no reason to change the conclusions of earlier reviews by the Cochrane Collaboration. There is
no convincing evidence that ginkgo is effective for cognitive impairment or dementia, acute ischaemic
stroke, intermittent claudication or tinnitus. There is still a lack of conclusive evidence for the effect on age-related macular degeneration. Ginkgo leaf extract appears to be safe to use, with no excess side effects compared with placebo. It can cause some minor side effects such as stomach upset, headache, dizziness, constipation, forceful heartbeat, and allergic skin reactions. There is some concern that ginkgo leaf extract might increase the risk of bruising and bleeding, and interactions with anticoagulants/antiplatelet drugs cannot be ruled out. As a general precaution, it is recommended withdrawing ginkgo two weeks before elective surgery. Free full text.

[Intratympanic steroid administration: Use in the treatment of profound idiopathic sudden sensorineural hearing loss.]
[Article in German]
HNO. 2012 Jul 7. [Epub ahead of print].

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BACKGROUND: Therapy for idiopathic sudden sensorineural hearing loss is still controversial. Although there are no evidenced-based studies, therapy with systemic steroids is widely accepted as the gold standard. Intratympanic administration of steroids appears to be an alternative or additional method of management without the disadvantage of systemic side effects and, therefore, makes therapy accessible for patients with contraindication for systemic steroids. MATERIAL AND METHODS: This retrospective analysis compares the audiometric results of 25 patients who were treated with standard therapy (prednisolone, hydroxyethyl starch, pentoxyfylline) with 23 patients who additionally received intratympanic steroids (IT group). A total of 4 injections were administered within 10 days. The solution used consisted of 0.3 ml dexamethasone (8 mg/ml) and 0.2 ml hyaluronic acid 0.2%. The pure-tone average (PTA) was evaluated prior to and 3 months after treatment. RESULTS: The PTA 3 months after treatment showed an improvement of 48 dB in the IT group and 38 dB in the standard treatment group. The IT group achieved better recovery with an average PTA improvement of 68% compared to the standard treatment group with an average improvement of 59%. Neither result reached significance. CONCLUSION: Combination therapy with intratympanic steroids showed a tendency for better hearing results without serious side effects. However, because current evidence is not adequate, randomized placebo-controlled multicenter studies are needed.

Intratympanic Steroid Treatment for Sudden Deafness: A Meta-analysis of Randomized Controlled Trials.

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BACKGROUND: The efficacy of intratympanic steroid (ITS) treatment in sudden deafness (SD) remains controversial. To shed light on this issue, we performed a systematic review of randomized controlled trials to assess the overall efficacy of ITS therapy and to clarify whether it is more suitable as a first-line approach (primary treatment) or as a salvage treatment when traditional systemic agents have failed. METHODS: An electronic database search (MEDLINE and PubMed) was performed with the objective of identifying all studies published in the English language between January 1980 and November 2011 on the efficacy of ITS in the treatment of SD. All relevant articles were retrieved, and the related reference lists were reviewed systematically to identify other reports that could be included. Data were synthesized using the Mantel-Haenszel model. Results are expressed as odds ratio (OR) with 95% confidence interval (CI). RESULTS: A total of 11 randomized studies including 472 subjects allocated to ITS and 453 controls were selected. Intratympanic steroid regimens used and treatments administered to controls varied widely across
studies. When considering together trials investigating ITS therapy as a primary (n = 4) or salvage (n = 7) treatment, the common OR for recovery was 1.7 (95% CI, 1.3-2.3). When considering them separately, the common ORs for recovery were 0.9 (95% CI, 0.7-1.6) for primary and 2.9 (95% CI, 1.9-4.5) for salvage therapy. CONCLUSION: Intratympanic steroid therapy seems to confer a certain degree of benefit as a salvage but not as a primary treatment of SD. However, further evidence is needed to clarify some yet uncertain aspects, such as the optimal protocol of therapy.

Investigation of the In Vitro Therapeutic Efficacy of Nilotinib in Immortalized Human NF2-Null Vestibular Schwannoma Cells.  
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Vestibular schwannomas (VS) are a common posterior fossa brain tumor, and though benign can cause significant morbidity, particularly loss of hearing, tinnitus, vertigo and facial paralysis. The current treatment options for VS include microsurgical resection, stereotactic radiosurgery or close surveillance monitoring, with each treatment option carrying associated complications and morbidities. Most importantly, none of these options can definitively reverse hearing loss or tinnitus. Identification of a novel medical therapy, through the use of targeted molecular inhibition, is therefore a highly desirable treatment strategy that may minimize complications arising from both tumor and treatment and more importantly be suitable for patients whose options are limited with respect to surgical or radiosurgical interventions. In this study we chose to examine the effect of Nilotinib on VS. Nilotinib (Tasigna®) is a second-generation receptor tyrosine kinase (RTK) inhibitor with a target profile similar to that of imatinib (Gleevec®), but increased potency, decreased toxicity and greater cellular and tissue penetration. Nilotinib targets not only the BCR-ABL oncoprotein, but also platelet-derived growth factor (PDGF) receptor signalling. In this preclinical study, the human NF2-null schwannoma cell line HEI-193 subjected to nilotinib inhibition demonstrated decreased viability, proliferation and anchorage-independent growth, and increased apoptosis. A daily dose of nilotinib for 5 days inhibited HEI-193 proliferation at a clinically-relevant concentration in a dose-dependent manner (IC(50) 3-5 µmol/L) in PDGF-stimulated cells. These anti-tumorigenic effects of nilotinib were correlated to inhibited activation of PDGFR-α and PDGFR-β and major downstream signalling pathways. These experiments support a therapeutic potential for Nilotinib in VS. Free PMC Article.

Audiology in the Sudden Hearing Loss Clinical Trial.  

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OBJECTIVE: To report the pretreatment and posttreatment population characteristics and the overall stability of the audiologic outcomes found during the Sudden Hearing Loss Clinical Trial (ClinicalTrials.gov: Identifier NCT00097448). STUDY DESIGN: Multicenter, prospective randomized noninferiority trial of oral versus intratympanic (IT) steroid treatment of sudden sensorineural hearing loss (SSNHL). SETTING: Fifteen academically based otology practices. PATIENTS: Two hundred fifty patients with unilateral SSNHL presenting within 14 days of onset with 50 dBHL or greater pure tone average hearing threshold in the affected ear. INTERVENTION: Either 60 mg/d oral prednisone for 14 days with a 5-day taper (121 patients) or 4 IT doses for 14 days of 40 mg/ml methylprednisolone (129 patients). MAIN OUTCOME MEASURE: Primary end point was change in hearing [dB PTA] at 2 months after treatment. Noninferiority was defined as less than 10 dB difference in hearing outcome between treatments. In this article, pretreatment and posttreatment hearing findings will be reported in detail. RESULTS: A general (and stable) effect of treatment and a specific effect of greater improvement at low frequencies were found in both treatment groups. CONCLUSION: Hearing improvements are stable, and a significantly greater improvement occurs with lower frequency after either oral or IT steroid treatment of SSNHL.

A Randomized, Double-Blind, Placebo-Controlled Clinical Study to Assess Safety and Clinical Activity of OTO-104 Given as a Single Intratympanic Injection in Patients With Unilateral Ménière's Disease.


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OBJECTIVE: To evaluate the safety, tolerability, and clinical activity of a single intratympanic injection of OTO-104, sustained-release dexamethasone formulation, in patients with unilateral Ménière’s disease. STUDY DESIGN: Prospective, double-blind, randomized, placebo-controlled, dose-escalation study of 16 weeks’ (4-wk lead-in before dosing; 12-wk follow-up after dosing) duration for each patient. SETTING: Fifteen centers (physician offices and academic or tertiary referral centers). PATIENTS: Forty-four patients aged 22 to 75 years. INTERVENTION: Single intratympanic injection of OTO-104 (3 or 12 mg) or placebo. MAIN OUTCOME MEASURES: Safety and tolerability were assessed via adverse event reports, otoscopy, audiometry, and tympanometry. Clinical activity was assessed primarily as changes in vertigo frequency. RESULTS: OTO-104 was well tolerated, with no impact on hearing function. Plasma levels were observed in a few patients and were barely quantifiable. The most frequently reported adverse event considered related to investigational product was tympanic membrane perforation; no clinical sequelae were associated with these perforations and all were graded mild or moderate. At Month 3, the observed mean ± standard deviation (SD) change from baseline in vertigo frequency was -0.124 ± 0.201, -0.147 ± 0.166, and -0.211 ± 0.153 for the placebo, 3-mg OTO-104, and 12-mg OTO-104 groups, respectively; corresponding to 42%, 56% and 73% reductions in vertigo frequency, respectively. Similar results were observed for tinnitus, measured by the Tinnitus Handicap Inventory (THI-25). CONCLUSION: OTO-104 was safe and well tolerated. Although the sample size was small, the data suggest 12 mg of OTO-104 was associated with a clinically meaningful reduction in vertigo frequency compared to placebo 3 months after treatment.
VI Auditive Stimulation

Electrode Migration in Cochlear Implant Patients: Not an Exception.

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Objective: It was the aim of this study to investigate the occurrence of electrode migration of a cochlear implant in patients with and without complaints. Methods: We performed a retrospective case review in a tertiary referral center. The electrode position was evaluated in 35 cochlear implantees, 16 with a CII HiFocus1 (non-positioner) and 19 with a HiRes90K HiFocus1J, using multiplanar reconstructions of the postoperative CT scans. Of 5 patients, a second scan was obtained to evaluate complaints of performance drop, vertigo, tinnitus, headache or nonauditory stimulation. Displacements of the electrode contacts were calculated and displacements of >1 mm were considered a migration. The possible correlation with implant type, insertion depth or presence of complaints was analyzed. Results: Migrations were detected in 10 patients (29%). There was a significant effect of the implant type in favour of the HiFocus1, but no relation with the original insertion depth of the device. In the 5 patients scanned because of complaints, two migrations were detected. Conclusions: In our patient population, electrode migration was not uncommon and turned out to occur in patients with and without complaints. Copyright © 2012 S. Karger AG, Basel.

Acoustic events and “optophonic” cochlear responses induced by pulsed near-infrared laser.

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Optical stimulation of neural tissue within the cochlea was described as a possible alternative to electrical stimulation. Most optical stimulation was performed with pulsed lasers operating with near-infrared (NIR) light and in thermal confinement. Under these conditions, the coexistence of laser-induced optoacoustic stimulation of the cochlea (“optophony”) has not been analyzed yet. This study demonstrates that pulsed 1850-nm laser light used for neural stimulation also results in sound pressure levels up to 62 dB peak-to-peak equivalent sound pressure level (SPL) in air. The sound field was confined to a small volume along the laser beam. In dry nitrogen, laser-induced acoustic events disappeared. Hydrophone measurements demonstrated pressure waves for laser fibers immersed in water. In hearing rats, laser-evoked signals were recorded from the cochlea without targeting neural tissue. The signals showed a two-domain response differing in amplitude and latency functions, as well as sensitivity to white-noise masking. The first component had characteristics of a cochlear microphonic potential, and the second component was characteristic for a compound action potential. The present data demonstrate that laser-evoked acoustic events can stimulate a hearing cochlea. Whenever optical stimulation is used, care must be taken to distinguish between such “optophony” and the true optoneural response.
**Round window vibroplasty: Long-term results.**  
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Abstract Conclusions: The round window (RW) approach in the use of the Vibrant Soundbridge® (VSB) is a safe and effective treatment of conductive and mixed hearing losses for a period of more than 3 years of device use. Objective: To investigate the long-term safety and efficacy as well as user satisfaction of patients with conductive and mixed hearing losses implanted with the VSB using RW vibroplasty. Methods: Twelve patients with conductive and mixed hearing losses were evaluated after 40 months of daily VSB use. Safety was assessed by evaluating reports of postoperative medical and surgical complications as well as by changes in bone conduction hearing thresholds. Efficacy outcome measures included aided and unaided hearing thresholds, speech recognition in quiet and in noise and subjective benefit questionnaires. Results: The safety results revealed no significant medical complications. One subject experienced sudden hearing loss after 18-24 months of device use, but still continues to wear the device to her satisfaction. With regard to efficacy, there were no significant changes from short- to long-term results in aided word understanding, functional gain or speech recognition threshold, suggesting that the outcomes are stable over time. Subjective questionnaires revealed either the same or better results compared with the short-term data.

**Acupuncture for the treatment of tinnitus: a systematic review of randomized clinical trials.**  
Kim JI, Choi JY, Lee DH, Choi TY, Lee MS, Ernst E.

Background: Complementary and alternative medicine (CAM) has frequently been used to treat tinnitus, and acupuncture is a particularly popular option. The objective of this review was to assess the evidence concerning the effectiveness of acupuncture as a treatment for tinnitus. METHODS: Fourteen databases were searched from the dates of their creation to July 4th, 2012. Randomized clinical trials (RCTs) were included if acupuncture was used as the sole treatment. The Cochrane risk of bias tool was used to assess the risk of bias. RESULTS: A total of 9 RCTs met all the inclusion criteria. Their methodological quality was mostly poor. Five RCTs compared the effectiveness of acupuncture or electroacupuncture with sham acupuncture for treating tinnitus. The results failed to show statistically significant improvements. Two RCTs compared a short one-time scalp acupuncture treatment with the use of penetrating sham acupuncture at non-acupoints in achieving subjective symptom relief on a visual analog scale; these RCTs demonstrated significant positive effects with scalp acupuncture. Two RCTs compared acupuncture with conventional drug treatments. One of these RCTs demonstrated that acupuncture had statistically significant effects on the response rate in patients with nervous tinnitus, but the other RCT did not demonstrate significant effects in patients with senile tinnitus. CONCLUSIONS: The number, size and quality of the RCTs on the effectiveness of acupuncture for the treatment of tinnitus are not sufficient for drawing definitive conclusions. Further rigorous RCTs that overcome the many limitations of the current evidence are warranted. [Free full text](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3374947/)

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Over the past 15 years, we have studied plasticity in the human auditory cortex by means of magnetoencephalography (MEG). Two main topics nurtured our curiosity: the effects of musical training on plasticity in the auditory system, and the effects of lateral inhibition. One of our plasticity studies found that listening to notched music for 3 h inhibited the neuronal activity in the auditory cortex that corresponded to the center-frequency of the notch, suggesting suppression of neural activity by lateral inhibition. Subsequent research on this topic found that suppression was notably dependent upon the notch width employed, that the lower notch-edge induced stronger attenuation of neural activity than the higher notch-edge, and that auditory focused attention strengthened the inhibitory networks. Crucially, the overall effects of lateral inhibition on human auditory cortical activity were stronger than the habituation effects. Based on these results we developed a novel treatment strategy for tonal tinnitus-tailor-made notched music training (TMNMT). By notching the music energy spectrum around the individual tinnitus frequency, we intended to attract lateral inhibition to auditory neurons involved in tinnitus perception. So far, the training strategy has been evaluated in two studies. The results of the initial long-term controlled study (12 months) supported the validity of the treatment concept: subjective tinnitus loudness and annoyance were significantly reduced after TMNMT but not when notching spared the tinnitus frequencies. Correspondingly, tinnitus-related auditory evoked fields (AEFs) were significantly reduced after training. The subsequent short-term (5 days) training study indicated that training was more effective in the case of tinnitus frequencies ≤ 8 kHz compared to tinnitus frequencies >8 kHz, and that training should be employed over a long-term in order to induce more persistent effects. Further development and evaluation of TMNMT therapy are planned. A goal is to transfer this novel, completely non-invasive and low-cost treatment approach for tonal tinnitus into routine clinical practice. [Free Article]

Extra benefit of a second cochlear implant with respect to health-related quality of life and tinnitus.

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OBJECTIVE: To evaluate whether the second cochlear implant (CI) provides any extra benefit with respect to health-related quality of life, tinnitus, and auditory abilities. DESIGN: The data were evaluated using validated questionnaires before and after the first and second CI supply. Preimplantation data were collected retrospectively. PATIENTS: Forty postlingually deafened adults, 11 male and 29 female subjects were included in this study. All patients were sequentially bilaterally implanted with a multi-channel CI for at least 6 months. RESULTS: The health-related quality of life assessed with the Nijmegen Cochlear Implant Questionnaire further increased after the second CI. In patients with initially higher level of tinnitus annoyance measured with the Tinnitus Questionnaire, the scores decreased after the first CI and remained steady after the second CI. Patients with initially lower level of tinnitus annoyance had a further decrease of the Tinnitus Questionnaire score after the second CI. Additionally, the second CI induced further improvement of auditory abilities, as assessed by the Oldenburg Inventory and the Freiburg monosyllable test in quiet and the HSM and Oldenburg sentence tests in noise. The quality of life scores correlated with the auditory abilities, especially after the second CI. CONCLUSION: The present study provides evidence that the second CI leads to further increase in quality of life and reduction of tinnitus annoyance in addition to improvement of auditory abilities as compared with the first CI. Patients with bilateral CIs benefit from additional positive effects in all these fields.
Tinnitus retraining therapy: mixing point and total masking are equally effective.

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OBJECTIVES: Habituation to tinnitus cannot occur with total masking, an argument made by proponents of "tinnitus retraining therapy." We also compared the effectiveness of retraining therapy with mixing-point masking, total masking, and with counseling alone. DESIGN: Forty-eight tinnitus patients were randomly assigned to one of three groups: counseling, counseling plus bilateral noise generators set to completely mask the tinnitus, or counseling plus bilateral noise generators with a focus on the mixing point (partial masking just below total masking). A picture-based counseling protocol was used to assist in providing similar counseling among all three groups. The Tinnitus Handicap Questionnaire was administered before and after about 12 months of treatment. RESULTS: After 12 months, in the counseling group, three of 18 patients benefited significantly, in the mixing-point group, six of 19 patients benefited, and in the total masking group, four of 11 patients benefited from the treatment. The average decrease in the questionnaire was 16.7% for the counseling group, 31.6% for the retraining group, and 36.4% for the total masking group. No significant average differences among groups were observed. CONCLUSIONS: One premise of retraining therapy is incorrect; a focus on mixing-point masking is not required for habituation.

Review: cochlear implants as a treatment of tinnitus in single-sided deafness.

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PURPOSE OF REVIEW: Tinnitus is a symptom that is highly associated with hearing loss. Its incidence is expected to increase due to the detrimental effects of occupational and leisure noise. Even though no standard treatment is currently available, the effect of cochlear implants on tinnitus in single-sided deafness (SSD) is under scientific attention. This review reveals an overview of all publicly available reports about cochlear implant as a treatment for tinnitus in SSD. RECENT FINDINGS: Cochlear implantation in SSD suppresses tinnitus in most of the cases. Some studies even demonstrate complete tinnitus suppression after implantation. No tinnitus worsening is reported in any of the cases. Furthermore, tinnitus does not restore during the electrical stimulation presented by the cochlear implant. The tinnitus level seems to stabilize after 3-6 months after the first fitting. SUMMARY: Although the underlying mechanism responsible for the observed tinnitus suppression is not yet clear, cochlear implantation should be considered as a treatment option for tinnitus arising from SSD. However, appropriate patient selection is essential as it is expected that it is a requirement that tinnitus arises from cochlear deafferentation.
A systematic review of the effectiveness and cost-effectiveness of bilateral multi-channel cochlear implants in adults with severe-to-profound hearing loss.

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Background: In the UK approximately 10,000 people have cochlear implants, more than 99% with a unilateral implant. Evidence shows that adults implanted bilaterally may benefit from binaural advantages; however, systematic review evidence is limited. Objectives of the review: To conduct a systematic review to discover the evidence for effectiveness and cost-effectiveness of using bilateral cochlear implants in adults with severe to profound hearing loss by comparing their effectiveness with unilateral cochlear implantation or unilateral cochlear implantation and acoustic hearing aid in the contralateral ear. Type of review: Systematic review. Search strategy: This examined 16 electronic databases, plus bibliographies and references for published and unpublished studies. Evaluation method: Abstracts were independently assessed against inclusion criteria by two researchers, disagreements were resolved. Selected papers were then retrieved and further independently assessed in a similar way. Included studies had their data extracted by one reviewer and checked by another. Results: Searches yielded 2,892 abstracts producing 19 includable studies. Heterogeneity between studies precluded meta-analysis. However, all studies reported that bilateral cochlear implants improved hearing and speech perception: one RCT found a significant binaural benefit over the first ear alone for speech and noise from the front (12.6±5.4%, p<0.001), and when noise was ipsilateral to the first ear (21±6%, p<0.001); and, another found a significant benefit for spatial hearing at three and nine months post-implantation compared with pre-implantation [mean difference (SD) scores: three months = 1.46 (0.83-2.09), p<0.01]. Quality of life results varied, showing bilateral implantation may improve quality of life in the absence of worsening tinnitus. Limited cost-effectiveness evidence showed that bilateral implantation is probably only cost-effective at a willingness-to-pay threshold above £62,000 per QALY. Conclusions: Despite inconsistency in the quality of available evidence, the robustness of systematic review methods gives weight to the positive findings of included studies demonstrating that bilateral implantation is clinically effective in adults but unlikely to be cost-effective. © 2012 Blackwell Publishing Ltd.

Quality of life in patients implanted with the BAHA device depending on the aetiology.
[Article in English and Spanish]

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INTRODUCTION AND OBJECTIVES: Assess the improvement of quality of life in osseointegrated implanted patients, taking into account the indication as well as the use of the implant, and the presence of pre- and postoperative tinnitus. METHODS: Sixty-nine patients implanted between June 2004 and November 2010 were included. The average age of the patients was 40 years. The instruments used to quantify the change in quality of life were the Glasgow Benefit Inventory and a questionnaire including open questions, bone anchored hearing aid (BAHA) use, change in tinnitus and postoperative pain. RESULTS: The average total benefit score with the Glasgow Benefit Inventory was 38, and the general, social, and physical scores were 51, 15 and 7, respectively. There was no significant association between sex, age and bilaterality or unilaterality of the process with quality of life. Nevertheless, there were significantly better results in patients with conductive hearing loss than in those with unilateral deafness, the results were positive although in both groups. The tinnitus rate went from 37.5 to 20.8% following BAHA, with this difference being significant. CONCLUSIONS: Our results show that the use of BAHA is associated with a great improvement in quality of life for patients with conductive hearing loss, whereas indications in unilateral deafness have to be individually studied. Moreover, the study shows that BAHA has a positive effect upon tinnitus. Copyright © 2012 Elsevier España, S.L. All rights reserved.
VII Brain Stimulation

Infrared light excites cells by changing their electrical capacitance.

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Optical stimulation has enabled important advances in the study of brain function and other biological processes, and holds promise for medical applications ranging from hearing restoration to cardiac pacing. In particular, pulsed laser stimulation using infrared wavelengths >1.5 μm has therapeutic potential based on its ability to directly stimulate nerves and muscles without any genetic or chemical pre-treatment. However, the mechanism of infrared stimulation has been a mystery, hindering its path to the clinic. Here we show that infrared light excites cells through a novel, highly general electrostatic mechanism. Infrared pulses are absorbed by water, producing a rapid local increase in temperature. This heating reversibly alters the electrical capacitance of the plasma membrane, depolarizing the target cell. This mechanism is fully reversible and requires only the most basic properties of cell membranes. Our findings underscore the generality of pulsed infrared stimulation and its medical potential. Free PMC Article.

Differences between a single session and repeated sessions of 1 Hz TMS by double-cone coil prefrontal stimulation for the improvement of tinnitus.
Brain Stimul. 2012 May 14. [Epub ahead of print]

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Tinnitus related distress is associated with increased activity in the anterior cingulate cortex (ACC). In a recent study, it was demonstrated that a single session of low frequency prefrontal TMS using a double-cone coil (DCC) modulating the ACC (AC/DC TMS, anterior cingulate cortex targeted modulation by Double-Cone coil) yields a transient improvement in subjects with chronic tinnitus. An increasing number of studies demonstrated that repeated sessions of low frequency TMS to the temporoparietal area can significantly improve tinnitus complaints. Our aim is to determine the extent to which repeated sessions of AC/DC TMS can modulate tinnitus in comparison to a single session. Seventy-three tinnitus patients received a single (N = 46) or repetitive (N = 27) session(s) of TMS using a DCC placed over the prefrontal cortex. Our results indicate that both single sessions as well as multiple sessions (i.e. 8 sessions) of AC/DC TMS suppress both tinnitus distress (respectively 7.60% vs. 26.19%) and tinnitus intensity (respectively 7.12% vs. 19.60%) transiently. It was further shown that multiple sessions of AC/DC TMS generate a higher suppression effect in comparison to a single session of AC/DC TMS and that more patients responded to repeated sessions of 1 Hz stimulation in comparison to a single session. Our findings give further support to the fact that non-auditory areas are involved in tinnitus intensity and tinnitus distress and that more patients respond to repeated sessions with a higher suppression effect in comparison to patients who received a single session, suggesting that the approach of daily TMS sessions is relevant. Copyright © 2012 Elsevier Inc. All rights reserved.
The involvement of the left ventrolateral prefrontal cortex in tinnitus: a TMS study.
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Tinnitus is an auditory phantom percept with a tone, hissing or buzzing sound in the absence of any objective physical sound source. Tinnitus is considered to be an auditory phantom phenomenon analogous to somatosensory phantom pain. Controllable versus uncontrollable pain is characterized by an increased activity in the ventrolateral prefrontal cortex (VLPFC), and activation in the VLPFC correlating with perceived control over pain results in a decrease in subjective pain intensity. Depressed individuals show less activation than healthy controls in the left VLPFC in response to sad autobiographical scripts, and greater relative left prefrontal activation is related to a greater disposition to approach-related, positive affect with a greater ability to regulate negative affect. Based on the theory that non-pulsatile tinnitus can be considered the auditory analogue for deafferentation pain, we hypothesize that the left VLPFC might also be involved in control of tinnitus. We conducted a transcranial magnetic stimulation (TMS) study verifying whether modulating the left VLPFC by TMS can modulate the loudness of tinnitus. We studied 60 patients with chronic tinnitus of which 21 patients received in random order sham and 1-Hz stimulation, while 39 patients received in random order sham and 10-Hz stimulation. Our results show that 10-Hz stimulation can modulate tinnitus loudness, while 1-Hz stimulation does not seem to exert the same effect. Our findings give further support to the fact that non-auditory areas are involved in tinnitus.

Parietal double-cone coil stimulation in tinnitus.
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Non-pulsatile tinnitus is considered to be an auditory phantom percept. The extremely emotional context of disabling tinnitus often leads to a higher level of selective attention directed toward the tinnitus. As such, tinnitus is a continuously distracting auditory event. Auditory attention is associated with the activation of the intraparietal sulcus (IPS), and modulating the IPS with 10 Hz transcranial magnetic stimulation (TMS) creates the ability to ignore salient distractors. Thus, it can be expected that modulating the parietal area might interfere with the perception of tinnitus. The effect of TMS on tinnitus is evaluated using a double-cone coil tilted to the left parietal area in 24 individuals (study 1) and in 40 individuals with the double-cone coil symmetrically overlying both parietal areas (study 2). When transient tinnitus suppression is noted, the patient is asked to estimate the decrease in tinnitus in percentage using the numeric rating scale. The procedure is repeated with stimulations at sham, 1 and 10 Hz, each stimulation session consisting of 200 pulses for study 1 and for study 2 stimulations at sham, 1, 5, and 10 Hz, each stimulation session consisting of 200 pulses. For both studies, the order of the different stimulation frequencies was randomized over the participants. For study 1, patients report a significant transient reduction of the tinnitus percept for 10 Hz stimulation in comparison with, respectively, pre-treatment, sham, and 1 Hz stimulation, with a suppression effect of 11.36 %. No significant effect was obtained for 1 Hz stimulation with the coil tilted toward the left parietal area. For study, 2 patients revealed a significant suppression effect on 1, 5, and 10 Hz in comparison with pre-treatment. However, only stimulation at 5 and 10 Hz had a significant difference in comparison with sham with a suppression effect of, respectively, 8.78 and 9.50 %. Our data suggest that the parietal area is involved in tinnitus perception and that 10 Hz TMS using the double-cone coil overlying the parietal area can modulate tinnitus.
Auditory cortex stimulation to suppress tinnitus: Mechanisms and strategies. 
Hear Res. 2012 Jun 6. [Epub ahead of print]

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Brain stimulation is an important method used to modulate neural activity and suppress tinnitus. Several auditory and non-auditory brain regions have been targeted for stimulation. This paper reviews recent progress on auditory cortex (AC) stimulation to suppress tinnitus and its underlying neural mechanisms and stimulation strategies. At the same time, the author provides his opinions and hypotheses on both animal and human models. The author also proposes a medial geniculate body (MGB)-thalamic reticular nucleus (TRN)-Gating mechanism to reflect tinnitus-related neural information coming from upstream and downstream projection structures. The upstream structures include the lower auditory brainstem and midbrain structures. The downstream structures include the AC and certain limbic centers. Both upstream and downstream information is involved in a dynamic gating mechanism in the MGB together with the TRN. When abnormal gating occurs at the thalamic level, the spilled-out information interacts with the AC to generate tinnitus. The tinnitus signals at the MGB-TRN-Gating may be modulated by different forms of stimulations including brain stimulation. Each stimulation acts as a gain modulator to control the level of tinnitus signals at the MGB-TRN-Gate. This hypothesis may explain why different types of stimulation can induce tinnitus suppression. Depending on the tinnitus etiology, MGB-TRN-Gating may be different in levels and dynamics, which cause variability in tinnitus suppression induced by different gain controllers. This may explain why the induced suppression of tinnitus by one type of stimulation varies across individual patients. Copyright © 2012. Published by Elsevier B.V.

Tinnitus suppression by electrical stimulation of the rat dorsal cochlear nucleus. 
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Previous studies indicate that the dorsal cochlear nucleus (DCN) may serve as a generator and/or modulator of noise-induced tinnitus. This prompted an interest to investigate the modulatory role of the DCN in tinnitus suppression. In this study, we chronically implanted the DCN of rats with behavioral evidence of intense tone-induced tinnitus. Behavioral evidence of tinnitus was measured using a gap detection acoustic startle reflex paradigm. Our results demonstrated that electrical stimulation of the DCN suppressed behavioral evidence of tinnitus, especially at high frequencies. The data suggest that the DCN may be used as a target to suppress tinnitus through a bottom-up neuromodulation approach. The underlying mechanism of DCN-stimulation-induced tinnitus suppression was discussed by comparing it with other stimulation modalities. Copyright © 2012 Elsevier Ireland Ltd. All rights reserved.
Effectiveness of Repetitive Transcranial Magnetic Stimulation for Chronic Tinnitus: A Systematic Review.

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Objective This systematic review aimed to assess the effectiveness of repetitive transcranial magnetic stimulation (rTMS) treatment for chronic tinnitus. Data Sources Relevant electronic databases and a reference list of articles published up to January 2012 were searched. Randomized controlled clinical trials of all types of rTMS treatment for patients with chronic tinnitus were included. Review Methods A literature search was conducted with structured criteria to select studies evaluated for systematic review. Results Five trials (160 participants) were included in this review. Repetitive transcranial magnetic stimulation treatment showed benefits in the short term, but the long-term effects are questionable. The Tinnitus Handicap Inventory (THI) and the visual analog scale (VAS) were the major assessment methods used. After active TMS stimulation, the reduction in the THI total score and VAS was significant compared with baseline at the first time point assessed and in the short term (2 weeks and 4 weeks). The longest follow-up time was 26 weeks after treatment, and the shortest follow-up time was 2 weeks. No severe side effects were reported from the use of rTMS. Differences in age, hearing level, duration of tinnitus of the included patients, and the condition of sham treatment may influence the effect. Conclusion Repetitive transcranial magnetic stimulation could be a new therapeutic tool for the treatment of chronic tinnitus, and thus far we have not been able to demonstrate any substantial risk from rTMS treatment. However, the long-term effects of rTMS treatment for tinnitus are not clear and will require further study.

Morphometry and localization of the temporal transverse Heschl’s gyrus in magnetic resonance imaging: a guide for cortical stimulation of chronic tinnitus.


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PURPOSE: Subjective tinnitus is considered a phantom auditory phenomenon. Recent studies show that electrical or magnetic stimulation of the cortex can alleviate some tinnitus. The usual target of the stimulation is the primary auditory cortex (PAC) on Heschl’s gyrus (HG). The objective of this study was to specify the anatomy of HG by magnetic resonance imaging (MRI). METHODS: Cerebral MRI of 60 patients with chronic tinnitus, carried out before neuronavigated repetitive transcranial magnetic stimulation targeting the auditory cortex, were included. 3D-T1 MRI was reformatted in Talairach-Tournoux’s stereotactic space, then the following steps were performed: morphometry of HG, localization of the probabilistic center of the PAC (pcPAC) chosen at the junction between the medial third and the lateral two-thirds of HG, relative to external and cortical landmarks, and identification of its coordinates relative to the bicommissural line (AC-PC). RESULTS: In relation to external landmarks, the pcPAC was identified around 5 cm above the root of the helix of the ear in the direction of a point on the vertex located 4 cm behind the coronal suture, for both sides. In Talairach-Tournoux’s stereotactic space with the anterior commissure as the origin, the pcPAC coordinates were x = 43, y = -20, z = 6.8 on the right side, and x = -42.5, y = -21.5, and z = 6.5 on the left. Probabilistic maps of the presence of HG pointed to a relative contraction of data in space, despite inter- and intraindividual differences. CONCLUSION: The choice of our stimulation target was established in the middle of the theoretical position of the PAC. MRI allows a reliable identification of the target structure.
Efficacy of different protocols of transcranial magnetic stimulation for the treatment of tinnitus: Pooled analysis of two randomized controlled studies.


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Objectives. Tinnitus is related to alterations in neuronal activity of auditory and nonauditory brain areas. Targeted modulation of these areas by repetitive transcranial magnetic stimulation (rTMS) has been proposed as a new therapeutic approach for chronic tinnitus. Methods. Two randomized, double-blind, parallel-group, controlled clinical trials were performed subsequently and pooled for analysis. A total of 192 tinnitus patients were randomly allocated to receive 10 stimulation sessions of either sham rTMS, PET-based neuronavigated 1 Hz rTMS, 1Hz rTMS over the left auditory cortex, or combined 20 Hz rTMS over the left frontal cortex, followed by 1 Hz rTMS over the left auditory cortex. Results. rTMS treatment was well tolerated and no severe side effects were observed. All active rTMS treatments resulted in significant reduction of the TQ as compared to baseline. The comparison between treatment groups failed to reach significant differences. The number of treatment responders was higher for temporal rTMS (38%) and combined frontal and temporal rTMS (43%), as compared to sham (6%). Conclusions. This large study demonstrates the safety and tolerability of rTMS treatment in patients with chronic tinnitus. While the overall effect did not prove superior to placebo, secondary outcome parameters argue in favour of the active stimulation groups, and specifically the combined frontal and temporal rTMS protocol.

Transcutaneous Vagus Nerve Stimulation: Retrospective Assessment of Cardiac Safety in a Pilot Study.


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Background: Vagus nerve stimulation has been successfully used as a treatment strategy for epilepsy and affective disorders for years. Transcutaneous vagus nerve stimulation (tVNS) is a new non-invasive method to stimulate the vagus nerve, which has been shown to modulate neuronal activity in distinct brain areas. Objectives: Here we report effects of tVNS on cardiac function from a pilot study, which was conducted to evaluate the feasibility and safety of tVNS for the treatment of chronic tinnitus. Methods: Twenty-four patients with chronic tinnitus underwent treatment with tVNS over 3-10 weeks in an open single-armed pilot study. Safety criteria and practical usability of the neurostimulating device were to investigate by clinical examination and electrocardiography at baseline and at several visits during and after tVNS treatment (week 2, 4, 8, 16, and 24). Results: Two adverse cardiac events (one classified as a severe adverse event) were registered but considered very unlikely to have been caused by the tVNS device. Retrospective analyses of electrocardiographic parameters revealed a trend toward shortening of the QRS complex after tVNS. Conclusion: To our knowledge this is one of the first studies investigating feasibility and safety of tVNS in a clinical sample. In those subjects with no known pre-existing cardiac pathology, preliminary data do not indicate arrhythmic effects of tVNS. Free full text.
Repetitive Transcranial Magnetic Stimulation Noise Levels: Methodological Implications for Tinnitus Treatment.
Otol Neurotol. 2012 Aug 5. [Epub ahead of print]

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OBJECTIVE: To measure noise levels generated by repetitive transcranial magnetic stimulation. INTERVENTION: Repetitive transcranial magnetic stimulation (rTMS). MAIN OUTCOME MEASURES: rTMS noise levels measured in equivalent continuous sound level (LAeq) and in peak level (LC, peak), as a function of maximum power output of the equipment. METHODS: rTMS noise levels were measured for an active and a corresponding sham coil, as a function of distance and percentage power output of a MagPro X100 system (Medtronic) and compared with occupational noise exposure standards, using parameters classically used for rTMS tinnitus treatment. RESULTS: Significant differences in frequency composition and intensity levels were observed between sham and active coil noises. The active coil noise reached, at 50% power, 96 LAeq (peak at 132 LC, peak), varying by 3.9 LAeq (3.9 LC, peak) per 10% of power increase, whereas the sham coil reached 87 LAeq (114 LC, peak), varying by 3.2 LAeq (3.6 LC, peak) per 10% of power increase. CONCLUSION: rTMS noise levels differ significantly between active and sham coils, and can go beyond the American and European legal occupational noise limits, hence making ear protection a specific issue, particularly relevant to rTMS treatment for tinnitus.

Frontal cortex TMS for tinnitus.

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Both invasive and non-invasive neuromodulation of the dorsolateral prefrontal cortex (DLPFC) are capable of suppressing tinnitus loudness. Repetitive transcranial magnetic stimulation (rTMS) of the DLPFC has an add-on effect for auditory cortex (AC) rTMS in improving tinnitus-related distress. We aimed to investigate whether TMS and rTMS of the DLPFC is capable of reducing tinnitus loudness and what mechanism might be involved. Two TMS studies targeting the right DLPFC were performed. Study 1 investigated 44 tinnitus patients who underwent either 1 or 10 Hz real or sham TMS (200 pulses at 80% motor threshold). In Study 2 we performed rTMS (10 sessions of 600 pulses) in responders of study 1. Changes on the Visual analog scale (VAS) loudness were evaluated. All patients underwent a pre-TMS electroencephalography: differences in functional connectivity between responders and non-responders were evaluated using sLORETA. Only 1 Hz TMS was capable of significantly reducing tinnitus loudness for 11 patients with a mean suppression of 39.23%. RTMS for these 11 patients yielded a 21% improvement in VAS loudness, and in 7 of 11 rTMS was successful, with, a mean suppression of 27.13%. The responders were characterized by a difference in lagged linear connectivity in the theta band among the DLPFC, anterior cingulate cortex (ACC), parahippocampus and AC. In summary, 1 H, TMS and rTMS of the right DLPFC can transiently reduce the perceived tinnitus loudness mediated via functional connections between the DLPFC and a network consisting of the ACC, parahippocampus and AC. Copyright © 2012 Elsevier Inc. All rights reserved.
Vagus is Latin for Wandering and the vagus nerve fully deserves this name due to its extensive distribution through the body. Indeed, one of the lines of the song that accompanied the 2012 GL Brown Lecture exaggerates this diversity, “My function’s almost anythin’, and Vagus is my name.” Altering vagal activity was first investigated in the 1880s as a treatment for epilepsy and vagus nerve stimulation (VNS) is now an approved treatment for refractory epilepsy and depression in the US, despite an incomplete understanding of the mechanisms involved. VNS could be beneficial in many other conditions including heart failure, tinnitus, chronic hiccups, Alzheimer’s and inflammatory diseases. Inhibition of vagal activity could also be beneficial in some conditions e.g. reducing activation of vagal respiratory afferents to treat chronic cough. This review discusses evidence underlying some current and potential therapeutic applications of vagal modulation, illustrating the wonders of the Wanderer! Free full text.

VIII Behavioral Therapy

Specialised treatment based on cognitive behaviour therapy versus usual care for tinnitus: a randomised controlled trial.

Cima RF, Maes IH, Joore MA, Scheyen DJ, El Refaie A, Baguley DM, Anteunis LJ, van Breukelen GJ, Vlaeyen JW.

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BACKGROUND: Up to 21% of adults will develop tinnitus, which is one of the most distressing and debilitating audiological problems. The absence of medical cures and standardised practice can lead to costly and prolonged treatment. We aimed to assess effectiveness of a stepped-care approach, based on cognitive behaviour therapy, compared with usual care in patients with varying tinnitus severity. METHODS: In this randomised controlled trial, undertaken at the Adelante Department of Audiology and Communication (Hoensbroek, Netherlands), we enrolled previously untreated Dutch speakers (aged >18 years) who had a primary complaint of tinnitus but no health issues precluding participation. An independent research assistant randomly allocated patients by use of a computer-generated allocation sequence in a 1:1 ratio, stratified by tinnitus severity and hearing ability, in block sizes of four to receive specialised care of cognitive behaviour therapy with sound-focused tinnitus retraining therapy or usual care. Patients and assessors were masked to treatment assignment. Primary outcomes were health-related quality of life (assessed by the health utilities index score), tinnitus severity (tinnitus questionnaire score), and tinnitus impairment (tinnitus handicap inventory score), which were assessed before treatment and at 3 months, 8 months, and 12 months after randomisation. We used multilevel mixed regression analyses to assess outcomes in the intention-to-treat population. This study is registered with ClinicalTrials.gov, number NCT00733044. FINDINGS: Between September, 2007 and January, 2011, we enrolled and treated 492 (66%) of 741 screened patients. Compared with 247 patients assigned to usual care, 245 patients assigned to specialised care improved in health-related quality of life during a period of 12 months (between-group difference 0.059, 95% CI 0.025 to 0.094; effect size of Cohen’s d=0.24; p=0.0009), and had decreased tinnitus severity (-8.062, -10.829 to -5.295; d=0.43; p<0.0001) and tinnitus impairment (-7.506, -10.661 to -4.352; d=0.45; p<0.0001). Treatment seemed effective irrespective of initial tinnitus severity, and we noted no adverse events in this trial. INTERPRETATION: Specialised treatment of tinnitus based on cognitive behaviour therapy could be suitable for widespread implementation for patients with tinnitus of varying severity. FUNDING: Netherlands Organisation for Health Research and Development (ZonMW). Copyright © 2012 Elsevier Ltd. All rights reserved.
Anxiety and depression in tinnitus patients: 5-year follow-up assessment after completion of habituation therapy.

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Treatment programs based on a neurophysiological model have shown a positive effect on anxiety and depression in tinnitus patients. The aim of this paper was to assess the long-term effect of tinnitus habituation therapy. Sixty-eight individuals were treated with a comprehensive therapy program. The degree of anxiety and depression was assessed before, after, and five years after intervention using the Hospital Anxiety and Depression Scale. The positive and significant changes achieved after habituation therapy (pre = 1.10, post = 0.92 for anxiety and pre = 0.77, post = 0.62 for depression) were maintained five years after treatment ended (0.87 for anxiety and 0.52 for depression). A regression analysis revealed that individual evaluation of the treatment lectures, self-reported health condition, individual experiences of hyperacusis, and hearing loss could explain 44.3% of the variation in anxiety and 30.5% of the variation in depression posttreatment. Five years after, individual evaluation of the treatment lectures and self-reported health condition explained 22.2% of the variation in anxiety. These factors and individual experiences of hyperacusis could further explain 34.9% of the variation in depression. The effect of a neurophysiologic-based management treatment was maintained five years after treatment ended, indicating that the patients continued the improvement process without becoming dependent on professionals. Free PMC Article.

Effectiveness of Ericksonian hypnosis in tinnitus therapy: preliminary results.

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INTRODUCTION: The present study was performed to evaluate the efficacy of Ericksonian hypnosis in reducing the impact of tinnitus on patients' quality of life. PATIENTS AND METHODS: A controlled prospective longitudinal study was designed. The severity of tinnitus was assessed with Tinnitus Handicap Inventory (THI) before hypnotherapy and then 1 week, 1 month, 3 months, and 6 months after therapy. Health Survey SF-36 was used to assess health-related quality of life before and after hypnotherapy. Thirty-nine patients with severe idiopathic subjective tinnitus were enrolled in the study. RESULTS: The mean SD age of the patients was 44.5 +/- 12.5 years, ranging from 21 to 65 years; 48% were female. Mean THI scores assessed at the beginning and 4 times after commencement of therapy were evaluated. The changes in THI scores were significant. Health Survey SF-36 was assessed separately. The greatest increases were seen in physical role followed by emotional role difficulty. CONCLUSION: The preliminary results of our study demonstrated the effectiveness of Ericksonian hypnosis in the study group.
Somatic Tinnitus

Musical hallucination following whiplash injury: case report and literature review.

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INTRODUCTION: A musical hallucination is defined as a form of auditory hallucination characterised by the perception of music in the absence of external acoustic stimuli. It is infrequently cited in the literature, although population studies suggest a greater prevalence. The aetiology of this unusual disorder remains unclear. CASE REPORT: A 70-year-old man with acquired hearing loss suffered a whiplash injury in a low-speed road traffic accident, and subsequently presented with bilateral ‘tinnitus.’ On closer questioning, he described hearing orchestral music. There was no evidence of psychosis, delirium or intoxication, and the patient was managed expectantly. CONCLUSION: This patient represents the first published case of musical hallucination precipitated by whiplash injury. We explore the possible pathophysiological underpinnings of musical hallucination and highlight the need for a greater awareness of this disorder. A management strategy is suggested.

Influence of tinnitus on pain severity and quality of life in patients with temporomandibular disorders.

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OBJECTIVE: The aim of this cross-sectional study was to evaluate the relationship among pain intensity and duration, presence of tinnitus and quality of life in patients with chronic temporomandibular disorders (TMD). MATERIAL AND METHODS: Fifty-nine female patients presenting with chronic TMD were selected from those seeking for treatment at the Bauru School of Dentistry Orofacial Pain Center. Patients were submitted to the Research Diagnostic Criteria anamnesis and physical examination. Visual analog scale was used to evaluate the pain intensity while pain duration was assessed by interview. Oral Health Impact Profile inventory modified for patients with orofacial pain was used to evaluate the patients’ quality of life. The presence of tinnitus was assessed by self report. The patients were divided into: with or without self report of tinnitus. The data were analyzed statistically using the Student’s t-test and Pearson’s Chi-square test, with a level of significance of 5%. RESULTS: The mean age for the sample was 35.25 years, without statistically significant difference between groups. Thirty-two patients (54.24%) reported the presence of tinnitus. The mean pain intensity by visual analog scale was 77.10 and 73.74 for the groups with and without tinnitus, respectively. The mean pain duration was 76.12 months and 65.11 months for the groups with and without tinnitus, respectively. The mean OHIP score was 11.72 and 11.74 for the groups with and without tinnitus, respectively. There was no statistically significant difference between groups for pain intensity, pain duration and OHIP scoreS (p>0.05). CONCLUSION: Chronic TMD pain seems to play a more significant role in patient’s quality of life than the presence of tinnitus. Free full text.
Functional Connectivity during Modulation of Tinnitus with Orofacial Maneuvers.

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Objective. To determine changes in cortical neural networks as defined by resting-state functional connectivity magnetic resonance imaging during voluntary modulation of tinnitus with orofacial maneuvers. 

Study Design. Cross-sectional study. 

Setting. Academic medical center. 

Subjects and Methods. Participants were scanned during the maneuver and also at baseline to serve as their own control. The authors chose, a priori, 58 seed regions to evaluate previously described cortical neural networks by computing temporal correlations between all seed region pairs. Seed regions whose correlations significantly differed between rest and maneuver (P < .05, uncorrected) entered into a second-stage analysis of computing the correlation coefficient between the seed region and time courses in each of the remaining brain voxels. A threshold-free cluster enhancement permutation analysis evaluated the distribution of these correlation coefficients after transformation to Fisher z scores and registration to a surface-based reconstruction using Freesurfer.

Results. The median age for the 16 subjects was 54 years (range, 27-72 years), and all had subjective, unilateral or bilateral, nonpulsatile tinnitus for 6 months or longer. In 9 subjects who could voluntarily increase the loudness of their tinnitus, there were no significant differences in functional connectivity in any cortical networks. A separate analysis evaluated results from 3 patients who decreased the loudness of their tinnitus. Four subjects were excluded because of excessive motion in the scanner.

Conclusion. The absence of significant differences in functional connectivity due to voluntary orofacial maneuvers that increased tinnitus loudness failed to confirm prior reports of altered cerebral blood flows during somatomotor behaviors.

[The estimation of the efficacy of manual therapy included in the combined treatment of cochlear-vestibular disorders based on the results of computed stabilography.] 
[Article in Russian]

Shempeleva LE, Lopatin AS, Morozova SV, Gridin LA.


The objective of the present study was to estimate the efficacy of the combined treatment of spondylogenic cochlear-vestibular disorders with the use of both medicamental and non-medicamental modalities. Computed static stabilometry was applied for diagnostics of postural disbalance and evaluation of the treatment outcomes. It was shown that the application of manual therapy for the management of 56 patients presenting with spondylogenic cochlear-vestibular disorders resulted in the decrease of tinnitus and the improvement of vestibular and cochlear functions.
Electrode Migration in Cochlear Implant Patients: Not an Exception.

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Objective: It was the aim of this study to investigate the occurrence of electrode migration of a cochlear implant in patients with and without complaints. Methods: We performed a retrospective case review in a tertiary referral center. The electrode position was evaluated in 35 cochlear implantees, 16 with a CII HiFocus1 (non-positioner) and 19 with a HiRes90K HiFocus1J, using multiplanar reconstructions of the postoperative CT scans. Of 5 patients, a second scan was obtained to evaluate complaints of performance drop, vertigo, tinnitus, headache or nonauditory stimulation. Displacements of the electrode contacts were calculated and displacements of >1 mm were considered a migration. The possible correlation with implant type, insertion depth or presence of complaints was analyzed. Results: Migrations were detected in 10 patients (29%). There was a significant effect of the implant type in favour of the HiFocus1, but no relation with the original insertion depth of the device. In the 5 patients scanned because of complaints, two migrations were detected. Conclusions: In our patient population, electrode migration was not uncommon and turned out to occur in patients with and without complaints. Copyright © 2012 S. Karger AG, Basel.

Gamma Knife surgery for the management of glomus tumors: a multicenter study.

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Object Glomus tumors are rare skull base neoplasms that frequently involve critical cerebrovascular structures and lower cranial nerves. Complete resection is often difficult and may increase cranial nerve deficits. Stereotactic radiosurgery has gained an increasing role in the management of glomus tumors. The authors of this study examine the outcomes after radiosurgery in a large, multicenter patient population.

Methods Under the auspices of the North American Gamma Knife Consortium, 8 Gamma Knife surgery centers that treat glomus tumors combined their outcome data retrospectively. One hundred thirty-four patient procedures were included in the study (134 procedures in 132 patients, with each procedure being analyzed separately). Prior resection was performed in 51 patients, and prior fractionated external beam radiotherapy was performed in 6 patients. The patients’ median age at the time of radiosurgery was 59 years. Forty percent had pulsatile tinnitus at the time of radiosurgery. The median dose to the tumor margin was 15 Gy. The median duration of follow-up was 50.5 months (range 5-220 months). Results Overall tumor control was achieved in 93% of patients at last follow-up; actuarial tumor control was 88% at 5 years postradiosurgery. Absence of trigeminal nerve dysfunction at the time of radiosurgery (p = 0.001) and higher number of isocenters (p = 0.005) were statistically associated with tumor progression-free tumor survival. Patients demonstrating new or progressive cranial nerve deficits were also likely to demonstrate tumor progression (p = 0.002). Pulsatile tinnitus improved in 49% of patients who reported it at presentation. New or progressive cranial nerve deficits were noted in 15% of patients; improvement in preexisting cranial nerve deficits was observed in 11% of patients. No patient died as a result of tumor progression. Conclusions Gamma Knife surgery was a well-tolerated management strategy that provided a high rate of long-term glomus tumor control. Symptomatic tinnitus improved in almost one-half of the patients. Overall neurological status and cranial nerve function were preserved or improved in the vast majority of patients after radiosurgery.
Evolution of otosclerosis to cochlear implantation.  
[Article in English, Spanish]  
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INTRODUCTION: Otosclerosis is an osteodystrophy of the labyrinthine capsule producing conductive hearing loss. If the process invades the cochlea, a sensorineural hearing loss usually takes place. The cochlear implant is a good alternative in these patients. OBJECTIVE: To ascertain the behaviour of cochlear implantation in otosclerosis. MATERIAL AND METHODS: We reviewed a database of 250 patients that underwent cochlear implantation, performing a retrospective study of 13 patients with clinical, audiological and/or imaging findings of bilateral otosclerosis. The 26 ears were studied as to their natural history, previous surgeries, evolution to profound hearing loss, computed tomography images, complications and functional results. RESULTS: Of the cases studied, 46% were female and 54% were men, with a mean age of 26 years at the onset of conductive hearing loss. Stapes surgery was performed in 19 ears (73%), with a mean patient age of 29 years, and 53% of them underwent cochlear implantation. Computed tomography results showed that there were signs of different degrees of radiological affectation in 54% of the ears. A total of 3 complications took place (23%): implant failure, overstimulation of the facial nerve and bilateral tinnitus were found. One year after implantation, the average percentages of correct 2-syllable words were 80% and 85% in open sentences. CONCLUSIONS: Patients having profound bilateral sensorineural hearing loss secondary to otosclerosis obtain great benefit from cochlear implantation. Copyright © 2011 Elsevier España, S.L. All rights reserved. Free full text in Spanish.  
  
Effects of early surgical exploration in suspected barotraumatic perilymph fistulas.  
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OBJECTIVES: Treatment of traumatic perilymph fistula (PLF) remains controversial between surgical repair and conservative therapy. The aim of this study is to analyze the outcomes of early surgical exploration in suspected barotraumatic PLF. METHODS: Nine patients (10 cases) who developed sudden sensorineural hearing loss and dizziness following barotrauma and underwent surgical exploration with the clinical impression of PLF were enrolled. Types of antecedent trauma, operative findings, control of dizziness after surgery, postoperative hearing outcomes, and relations to the time interval between traumatic event and surgery were assessed retrospectively. RESULTS: All patients had sudden or progressive hearing loss and dizziness following trauma. Types of barotrauma were classified by the origin of the trauma: 4 external (car accident, slap injury) and 6 internal traumas (lifting, nasal blowing, straining). Surgical exploration was performed whenever PLF was suspected with the time interval of 2 to 47 days after the trauma. The possible evidence of PLF was found during surgery in 9 cases: a fibrous web around the oval window (n=3), fluid collection in the round window (RW; n=6) and bulging of the RW pseudomembrane (n=1). In every patient, vestibular symptoms disappeared immediately after surgery. The hearing was improved with a mean gain of 27.0±14.9 dB. When the surgical exploration was performed as early as less than 10 days after the trauma, serviceable hearing (≤40 dB) was obtained in 4 out of 7 cases (57.1%). CONCLUSION: Sudden or progressive sensorineural hearing loss accompanied by dizziness following barotrauma should prompt consideration of PLF. Early surgical exploration is recommended to improve hearing and vestibular symptoms. Free PMC Article.
Transmastoid semicircular canal occlusion: A safe and highly effective treatment for benign paroxysmal positional vertigo and superior canal dehiscence.

Beyea JA, Agrawal SK, Parnes LS.

Department of Otolaryngology-Head and Neck Surgery, Schulich School of Medicine and Dentistry, The University of Western Ontario, London, Ontario, Canada.

OBJECTIVES/HYPOTHESIS: Transmastoid occlusion of the superior semicircular canal in superior semicircular canal dehiscence (SSCD) syndrome and the posterior semicircular canal in intractable benign paroxysmal positional vertigo (BPPV) will produce resolution of preoperative symptoms. STUDY DESIGN: Retrospective review, quality assurance. METHODS: Sixteen patients with SSCD and 61 patients (65 ears) with intractable BPPV who underwent canal occlusion were reviewed. All patients underwent occlusion of the affected semicircular canal through a transmastoid approach. RESULTS: Preoperative symptoms (vestibular, 13 patients; pulsatile tinnitus, 2 patients; or hyperacusis, 1 patient) were greatly improved or completely resolved in 15 of the 16 SSCD patients who underwent transmastoid occlusion of the superior canal. Hearing was preserved in 14 patients and improved in two patients. Vestibular symptoms were resolved in all intractable BPPV patients who underwent transmastoid occlusion of the posterior canal. One patient had a late recurrence of atypical BPPV. Almost all BPPV patients with normal preoperative hearing have an initial transient postoperative hearing loss, which when tested for is usually a mild to moderate mixed loss. Delayed sensorineural hearing loss was noted in three patients; one loss was profound whereas two were mild. CONCLUSIONS: The transmastoid approach to canal plugging is successful in the treatment of symptoms in both SSCD and intractable BPPV, and is a familiar approach for the otologist. This is a viable alternative to the middle fossa approach for SSCD, thereby avoiding a craniotomy. Transmastoid is the definitive approach for posterior canal occlusion. Copyright © 2012 The American Laryngological, Rhinological, and Otological Society, Inc.

Transmastoid semicircular canal occlusion: A safe and highly effective treatment for benign paroxysmal positional vertigo and superior canal dehiscence.

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XI Holistic

Long-Term Effect of Acupuncture for Treatment of Tinnitus: A Randomized, Patient- and Assessor-Blind, Sham-Acupuncture-Controlled, Pilot Trial.

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Objective: The aim of this study was to investigate the long-term effect of acupuncture for treatment of tinnitus. Study design: This study is a randomized, patient- and assessor-blind, sham-acupuncture-controlled, pilot trial. Subjects: Participants were adults (18-60 years old) with chronic (≥6 months), unilateral tinnitus, and without moderate or severe hearing loss. Interventions: Thirty-three (33) participants were randomized to one of two treatment groups: real acupuncture and sham-acupuncture (nonmeridian; no specific response, de qi). Participants received 10 sessions of acupuncture treatment (twice a week for 5 weeks), and usual patient care education. Outcome measures: The subjective outcome was the score of Tinnitus Handicap Inventory (THI) and Visual Analogue Scale (VAS) from baseline to 3 months after. Pure Tone Average (PTA) and Speech Discrimination (SD) from baseline to 3 months after were assessed as objective outcomes. Results: A significant interaction between time and group in VAS (p=0.017) was evident, but not in THI, PTA, and SD scores. THI showed significant improvement at the end of treatment and 3 months after, compared to baseline, in real acupuncture (p=0.004). In SD, a significant long-term effect of real acupuncture was observed until 3 months after (p=0.011). However, the effect of real acupuncture in PTA was not maintained until 3 months after the end of treatment. No significant difference in the sham-acupuncture treatment group was evident. No statistical difference in any outcome was observed between real and sham acupuncture. Only in the mean percent change of VAS, real acupuncture showed statistical significance, compared with sham-acupuncture from baseline to 3 months after (p=0.019). Conclusions: Through evaluation of subjective (THI and VAS) and objective outcomes (PTA and SD), this study demonstrates the long-term effect of real acupuncture.

XII Review

Stress and tinnitus - from bedside to bench and back.

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The aim of this review is to focus the attention of clinicians and basic researchers on the association between psycho-social stress and tinnitus. Although tinnitus is an auditory symptom, its onset and progression often associates with emotional strain. Recent epidemiological studies have provided evidence for a direct relationship between the emotional status of subjects and tinnitus. In addition, studies of function, morphology, and gene and protein expression in the auditory system of animals exposed to stress support the notion that the emotional status can influence the auditory system. The data provided by clinical and basic research with use of animal stress models offers valuable clues for an improvement in diagnosis and more effective treatment of tinnitus. Free PMC Article.
The vestibular schwannoma is a benign intracranial tumor of the myelin-forming cells of the vestibulocochlear nerve or cranial nerve VIII. It comprises 8-10% of all intracranial neoplasms in adults. It originates in the vestibular portion of the cranial nerve VIII and it is located in the cerebellopontine angle. This disorder is characterized by ipsilateral hearing loss, tinnitus, disturbed sense of balance and altered gait, facial numbness, muscle weakness or ipsilateral paralysis. This report presents the magnetic resonance imaging of a patient with this rare condition.

Pulsatile tinnitus (Review).
Otorhinolaryngologist 5 (1), pp. 7-14
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Pulsatile tinnitus is a rare form of tinnitus characterized by pulsatile sound that is synchronous with the heartbeat. Unlike idiopathic non-pulsatile tinnitus, an underlying vascular cause may be identified. Common causes include carotid artery atherosclerosis, Arteriovenous malformation or fistulae or vascular tumours. It should be thoroughly investigated using magnetic resonance angiography, computer tomography venography or traditional angiography. Many aetiologies are amenable to either angiographic or surgical intervention. Copyright © 2012 Rila Publications Ltd.

Tinnitus and underlying brain mechanisms.
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PURPOSE OF REVIEW: Tinnitus is the sensation of hearing a sound when no external auditory stimulus is present. Most individuals experience tinnitus for brief, unobtrusive periods. However, chronic sensation of tinnitus affects approximately 17% (44 million people) of the general US population. Tinnitus, usually a benign symptom, can be constant, loud and annoying to the point that it causes significant emotional distress, poor sleep, less efficient activities of daily living, anxiety, depression and suicidal ideation/attempt. Tinnitus remains a major challenge to physicians because its pathophysiology is poorly understood and there are few management options to offer to patients. The purpose of this article is to describe the current understanding of central neural mechanisms in tinnitus and to summarize recent developments in clinical approaches to tinnitus patients. RECENT FINDINGS: Recently developed animal models of tinnitus provide the possibility to determine neuronal mechanisms of tinnitus generation and to test the effects of various treatments. The latest research using animal models has identified a number of abnormal changes, in both auditory and nonauditory brain regions, that underlie tinnitus. Furthermore this research sheds light on cellular mechanisms that are responsible for development of these abnormal changes. SUMMARY: Tinnitus remains a challenging disorder for patients, physicians, audiologists and scientists studying tinnitus-related brain changes. This article reviews recent findings of brain changes in animal models associated with tinnitus and a brief review of clinical approach to tinnitus patients.
XIII Others

An adaptation level theory of tinnitus audibility.

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Models of tinnitus suggest roles for auditory, attention, and emotional networks in tinnitus perception. A model of tinnitus audibility based on Helson’s (1964) adaptation level theory (ALT) is hypothesized to explain the relationship between tinnitus audibility, personality, memory, and attention. This theory attempts to describe how tinnitus audibility or detectability might change with experience and context. The basis of ALT and potential role of auditory scene analysis in tinnitus perception are discussed. The proposed psychoacoustic model lends itself to incorporation into existing neurophysiological models of tinnitus perception. It is hoped that the ALT hypothesis will allow for greater empirical investigation of factors influencing tinnitus perception, such as attention and tinnitus sound therapies. Free PMC Article.

A cohort study of patients with tinnitus and sensorineural hearing loss in a Swedish population.
Auris Nasus Larynx. 2012 May 29. [Epub ahead of print]

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OBJECTIVE: We aimed to describe a large cohort of patients with tinnitus and sensorineural hearing loss (SNHL) in Sweden, and also to explore the possibility of finding potential possible differences between various diagnoses within SNHL. It is also of great interest to see how a multidisciplinary team was used in the different subgroups and the frequency of hearing aids use in patients with tinnitus. METHODS: Medical records of all patients who had received the diagnosis SNHL in Östergötland County, Sweden between 2004 and 2007 were reviewed. Patients between 20 and 80 years with tinnitus and a pure tone average (PTA) lower than 70dB HL were included in the study. Patients were excluded from the analyses if they had a cochlear implantation, middle ear disorders or had a hearing loss since birth or childhood. The investigators completed a form for each included patient, covering background facts, and audiograms taken at the yearly check up. RESULTS: Of a total 1672 patients' medical record review, 714 patients were included. The majority of patients (79%) were in the age group over 50 years. In male patients with bilateral tinnitus, the PTA for the left ear was significantly higher than for the right ear. The results regarding the configuration of hearing loss revealed that 555 patients (78%) had symmetric and 159 (22%) asymmetric hearing loss. Retrocochlear examinations were done in 372 patients and MRI was the most common examination. In all patients, 400 had no hearing aids and out of those 220 had unilateral tinnitus and 180 patients had bilateral tinnitus. 219 patients had a PTA>20dB HL and did not have any hearing aid. Results demonstrated that the Stepped Care model was not used widely in the daily practice. In our study, patients with bilateral-, unilateral hearing loss or Mb Ménière were the most common patients included in the Stepped Care model. CONCLUSION: In a large cohort of patients with SNHL and tinnitus, despite their hearing loss only 39% had hearing aids. It was observed that the medical record review often showed a lack of information about many background factors, such as; patients’ general health condition, which could be a quality factor that needs improvement. Our results show that the Stepped Care model could be an effective option for providing a better access for tinnitus-focused treatment, although the number of patients in this study who were included in the Stepped Care model was low. Copyright © 2012. Published by Elsevier Ireland Ltd.
Chronic tinnitus is a common condition with a high burden of disease. While many different treatments are used in clinical practice, the evidence for the efficacy of these treatments is low and the variance of treatment response between individuals is high. This is most likely due to the great heterogeneity of tinnitus with respect to clinical features as well as underlying pathophysiological mechanisms. There is a clear need to find effective treatment options in tinnitus, however, clinical trials differ substantially with respect to methodological quality and design. Consequently, the conclusions that can be derived from these studies are limited and jeopardize comparison between studies. Here, we discuss our view of the most important aspects of trial design in clinical studies in tinnitus and make suggestions for an international methodological standard in tinnitus trials. We hope that the proposed methodological standard will stimulate scientific discussion and will help to improve the quality of trials in tinnitus. Copyright © 2012 Elsevier Inc. All rights reserved.

An evaluation of the content and quality of tinnitus information on websites preferred by General Practitioners.


Fackrell K, Hoare DJ, Smith S, McCormack A, Hall DA.

BACKGROUND: Tinnitus is a prevalent and complex medical complaint often co-morbid with stress, anxiety, insomnia, depression, and cognitive or communication difficulties. Its chronicity places a major burden on primary and secondary healthcare services. In our recent national survey of General Practitioners (GPs) from across England, many reported that their awareness of tinnitus was limited and as a result were dissatisfied with the service they currently provide. GPs identified 10 online sources of information they currently use in clinical practice, but welcomed further concise and accurate information on tinnitus assessment and management. The purpose of this study was to assess the content, reliability, and quality of the information related to primary care tinnitus assessment and management on these 10 websites. METHODS: Tinnitus related content on each website was assessed using a summative content analysis approach. Reliability and quality of the information was assessed using the DISCERN questionnaire. RESULTS: Quality of information was rated using the validated DISCERN questionnaire. Significant inter-rater reliability was confirmed by Kendall’s coefficient of concordance (Wt) which ranged from 0.48 to 0.92 across websites. The website ‘Map of Medicine’ achieved the highest overall DISCERN score. However, for information on treatment choice, the British Tinnitus Association was rated best. Content analysis revealed that all websites lacked a number of details relating to either tinnitus assessment or management options. CONCLUSIONS: No single website provides comprehensive information for GPs, on tinnitus assessment and management and so GPs may need to refer to more than one if they want to maximise their coverage of the topic. From those preferred by GPs we recommend several specific websites as the current ‘best’ sources. Our findings should guide healthcare website providers to improve the quality and inclusiveness of the information they publish on tinnitus. In the case of one website, our preliminary findings are already doing so. Such developments will in turn help facilitate best practice in primary care. Free Article.
Linking the Tinnitus Questionnaire and the subjective Clinical Global Impression: Which differences are clinically important?


ABSTRACT: BACKGROUND: Development of new tinnitus treatments requires prospective placebo-controlled randomized trials to prove their efficacy. The Tinnitus Questionnaire (TQ) is a validated and commonly used instrument for assessment of tinnitus severity and has been used in many clinical studies. Defining the Minimal Clinically Important Difference (MCID) for TQ changes is an important step to a better interpretation of the clinical relevance of changes observed in clinical trials. In this study we aimed to estimate the minimum change of the TQ score that could be considered clinically relevant. METHODS: 757 patients with chronic tinnitus were pooled from the TRI database and the RESET study. An anchor-based approach using the Clinical Global Impression (CGI) scale and distributional approaches were used to estimate MCID. Receiver Operating Characteristic (ROC) curves were calculated to define optimal TQ change cutoffs discriminating between minimally changed and unchanged subjects. RESULTS: The relationship between TQ change scores and CGI ratings of change was good (r=0.52, p<0.05). Mean change scores associated with minimally better and minimally worse CGI categories were -6.65 and +2.72 respectively. According to the ROC method MCID for improvement was -5 points and for deterioration +1 points. CONCLUSION: Distribution and anchor-based methods yielded comparable results in identifying MCIDs. DeltaTQ scores of -5 and +1 points were identified as the minimal clinically relevant change for improvement and worsening respectively. The asymmetry of the MCIDs for improvement and worsening may be related to expectation effects. METHODS: 757 patients with chronic tinnitus were pooled from the TRI database and the RESET study. An anchor-based approach using the Clinical Global Impression (CGI) scale and distributional approaches were used to estimate MCID. Receiver Operating Characteristic (ROC) curves were calculated to define optimal TQ change cutoffs discriminating between minimally changed and unchanged subjects. RESULTS: The relationship between TQ change scores and CGI ratings of change was good (r=0.43, p<0.05). Mean change scores associated with minimally better and minimally worse CGI categories were -5.6 and +1.2 respectively. According to the ROC method MCID for improvement was -5 points and for deterioration +1 points. CONCLUSION: Distribution and anchor-based methods yielded comparable results in identifying MCIDs. DeltaTQ scores of -5 and +1 points were identified as the minimal clinically relevant change for improvement and worsening respectively. The asymmetry of the MCIDs for improvement and worsening may be related to expectation effects. Free full text.

The application of direct current electrical stimulation of the ear and cervical spine kinesitherapy in tinnitus treatment.
Auris Nasus Larynx. 2012 Jun 7. [Epub ahead of print]

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OBJECTIVE: The aim of the study was to evaluate the effectiveness of electrical stimulations of the hearing organ in tinnitus treatment adapting the frequency of stimulation according to tinnitus frequency, to assess the influence of cervical spine kinesitherapy on tinnitus, as well as to evaluate hearing after electrical stimulations alone and together with cervical spine kinesitherapy. METHODS: The study comprised 80 tinnitus, sensorineural hearing loss patients (119 tinnitus ears) divided into two groups. In group I (n - 58 tinnitus ears) electrical stimulation of the hearing organ was performed, in group II (n - 61 tinnitus ears) electrical stimulation together with cervical spine kinesitherapy. Hydrotransmissive, selective electrical stimulations were conducted using direct, rectangular current. The passive electrode was placed on the forehead, the active - a silver probe - was immersed in the external ear canal in 0.9% saline solution. The treatment involved fifteen applications of electrical stimulations (each lasted for 4min) administered three or four times a week (whole treatment lasted approximately 30days). The evaluation of the results considered
a case history (change from permanent to temporary tinnitus), questionnaires (the increase/decrease of the total points) and the audiometric evaluation of hearing level. RESULTS: Before the treatment, group I comprised 51 ears (87.93%) with permanent, and 7 ears (12.07%) with temporary tinnitus; group II - 55 ears (90.17%) with permanent and 6 ears (9.83%) with temporary tinnitus. After the treatment, in both groups the number of ears with permanent tinnitus decreased considerably obtaining the pauses or disappearing of tinnitus. Directly after the treatment, group I comprised 25 ears (43.11%) with permanent, and 10 ears (17.24%) with temporary tinnitus, in 23 ears (39.65%) tinnitus disappeared; group II - 33 ears (54.1%) with permanent and 11 ears (18.03%) with temporary tinnitus, in 17 ears (27.87%) tinnitus disappeared. Regarding questionnaires, improvement was observed in group I - in 43.11% of ears, in group II - 32.8%. In both groups audiometric improvement of hearing was recognized. CONCLUSIONS: (1) Electrical stimulation of the hearing organ, with the application of current frequencies according to tinnitus frequencies (selective electrical stimulation), was an efficient method in severe tinnitus treatment. (2) Cervical spine kinesitherapy in the treatment of tinnitus, using electrical stimulation, did not have any supporting influence. Copyright © 2012 Elsevier Ireland Ltd. All rights reserved.

Clinical manifestations of aural fullness.
Park MS, Lee HY, Kang HM, Ryu EW, Lee SK, Yeo SG.
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Purpose: Even though aural fullness is ubiquitous among patients presenting to otolaryngology clinics, the association between aural fullness and disease development has not yet been clearly determined. Materials and Methods: Our study was performed on outpatients from June 2006 to February 2010 whose major complaint was „ear fullness”, „aural fullness”, or „ear pressure”. We assessed their demographic and clinical characteristics, including sex, associated diseases, symptoms, otoscopic findings, audiology test results, and final diagnoses. Results: Among 432 patients, 165 (38.2%) were males and 267 (61.8%) were females, with mean ages of 42±19 years and 47±17 years, respectively. Tinnitus, hearing disturbance, autophony (p<0.01) as well as nasal obstruction and sore throat (p<0.05) showed a statistically significant correlation with aural fullness. Among patients who complained of hearing fullness, tests and measures such as impedance audiometry, speech reception threshold, and pure tone audiometry generated statistically significant results (p<0.05). Ear fullness was most frequently diagnosed as Eustachian tube dysfunction (28.9%), followed by otitis media with effusion (13.4%) and chronic otitis media (7.2%). However, 13.4% of patients could not be definitively diagnosed. Conclusion: Among patients complaining of ear fullness, Eustachian tube dysfunction, otitis media with effusion, chronic otitis media were most commonly observed. Performance of otoscopy, nasal endoscopy, the Valsalva maneuver, and additional audiological tests is necessary to exclude other diseases. Free Article.

Willingness to Accept and Pay for Implantable Tinnitus Treatments: A Survey.
Engineer ND, Rosellini WM, Tyler RS.
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Objectives: At present, there is no cure for tinnitus. Neurostimulation techniques have shown great promise, but it is uncertain whether they will gain acceptance because of their invasive nature. We have previously demonstrated that pairing acoustic stimuli with vagus nerve stimulation (VNS) also has potential as a viable tinnitus treatment approach. Methods: We conducted a survey on tinnitus sufferers that emphasized questions related to a willingness to pay for the treatment of tinnitus, including VNS. Four hundred thirty-nine individuals responded to an Internet survey modeled after a recent study by Tyler. Results: The average age was about 47 years. Ninety-four percent reported that they had health insurance. Almost
40% had spent between $500 and $10,000 on tinnitus therapies. Almost three-fourths said that they would be willing to have a device implanted if it reduced tinnitus annoyance by half. About 70% of those with very loud tinnitus would be willing to have a temporary implant, and about 60% would be willing to have a permanent implant even if the device suppressed their tinnitus by only half of its annoyance. Only 10% of patients with SOFT tinnitus would be willing to have a permanent implant if the therapy suppressed their tinnitus by only half of its annoyance. Conclusions: We conclude that implanted devices, such as a VNS, will be an acceptable form of tinnitus treatment for many who suffer from tinnitus. The results of this survey indicate that VNS tone pairing would be an acceptable therapeutic solution for individuals with moderate to severe tinnitus and should be developed for the market. © 2012 International Neuromodulation Society.

Diagnosing Patients with Age-Related Hearing Loss and Tinnitus: Supporting GP Clinical Engagement through Innovation and Pathway Redesign in Audiology Services.

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The public health challenge of hearing impairment is growing, as age is the major determinant of hearing loss. Almost one in four (22.6%) over 75-year olds reports moderate or severe worry because of hearing problems. There is a 40% comorbidity of tinnitus and balance disorders. Good outcomes depend on early presentation and appropriate referral. This paper describes how the NHS Improvement Programme in England used service improvement methodologies to identify referral pathways and tools which were most likely to make significant improvements in diagnosing hearing loss, effective referrals and better patient outcomes. An audiometric screening device was used in GP surgeries to enable thresholds for effective referrals to be measured in the surgery. Revised referral criteria, the use of this device, new „assess and fit“ technology in the audiology clinic, and direct access pathways can transform audiology service delivery so that patient outcomes are measurably better. This, in turn, changes the experience of GPs, so they are more likely to refer patients who can benefit from treatment. At the end of 2011, 51 GP practices in one of the audiology pilot areas had bought HearCheck screeners, a substantial development from the 4 practices who first engaged with the pilot.

XIV Case Reports

Rare Case of Bilateral Vertebral Artery Stenosis Caused by C4-C5 Spodylotic Changes Presenting with Bilateral Bow Hunters Syndrome.
World Neurosurg. 2012 Jun 18. [Epub ahead of print]

Fleming JB, Vora TK, Harrigan MR.

BACKGROUND: Rotational vertebral artery occlusion syndrome is vertebrobasilar insufficiency as a result of mechanical occlusion or stenosis of the vertebral artery by head rotation. In most cases, symptoms are produced on extension or rotation to one side. No case of bow hunter’s with bilateral presentation at the C4 level has yet been reported. CASE DESCRIPTION: We describe a case of a 54 year old male with symptomatic bilateral bow hunters syndrome induced by head rotation. The patient complained of intermittent dizziness, episodes of double vision, non pulsatile tinnitus and headaches indicative of vertebral artery insufficiency with exacerbation of symptoms on rotation of his head to either side. CTA showed bilateral vertebral artery stenosis and dynamic cerebral angiography revealed bilateral rotational vertebral artery occlusion, with compression of the ipsilateral vertebral artery on head rotation to either side. Bilateral surgical decompression at C4-5 with anterior cervical discectomy and fusion with a plate was performed. CONCLUSIONS: Bony obstruction of the vertebral artery on head rotation tends to occur at levels C4 and below, affecting the ipsilateral side. In this rare case, symptomatic bilateral vertebral artery...
stenosis occurred as a result of bony compression and was symptomatic on head rotation both to the right and to the left. This stenosis was improved with anterior decompression bilaterally and no more events occurred post-operatively. Copyright © 2012. Published by Elsevier Inc.

**Vestibular schwannoma with repeated intratumoral hemorrhage.**


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Repeated hemorrhage from a vestibular schwannoma is very rare. We report a 15-year-old male, to our knowledge the fourth known patient with repeated hemorrhage of vestibular schwannoma, who presented with rapidly progressive right-sided hearing loss and tinnitus. MRI showed a mass lesion in the right cerebellopontine angle. T1-weighted and T2-weighted MRI revealed a hyperintense intratumoral area, indicating subacute hemorrhage within the tumor. Nine weeks after the initial onset, the patient again presented with a sudden onset headache, nausea, and ataxia. A CT scan showed recurrence of an intratumoral hemorrhage. A subtotal resection was achieved. A histopathological examination of the resected specimen showed typical features of schwannoma. We review the pertinent literature and discuss the features of repeated hemorrhage from a vestibular schwannoma. Copyright © 2012 Elsevier Ltd. All rights reserved.

**Giant non-traumatic arteriovenous malformation of the scalp.**

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Arteriovenous malformation (AVM) of the scalp is an uncommon entity. Its management is difficult because of its high shunt flow, complex vascular anatomy, and possible cosmetic complications. The etiology of scalp AVMs may be spontaneous or traumatic. Clinical symptoms frequently include pulsatile mass, headache, local pain, tinnitus; and less frequently, hemorrhage and necrosis. Selective angiography is the most significant diagnosis method. Surgical excision is especially effective in AVMs and the most frequently used treatment method. In this article, we discussed the clinical features and surgical management of scalp AVMs. Free PMC Article.

**Musical hallucination following whiplash injury: case report and literature review.**

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INTRODUCTION: A musical hallucination is defined as a form of auditory hallucination characterised by the perception of music in the absence of external acoustic stimuli. It is infrequently cited in the literature, although population studies suggest a greater prevalence. The aetiology of this unusual disorder remains unclear. CASE REPORT: A 70-year-old man with acquired hearing loss suffered a whiplash injury in a low-speed road traffic accident, and subsequently presented with bilateral ‘tinnitus.’ On closer questioning, he described hearing orchestral music. There was no evidence of psychosis, delirium or intoxication, and the patient was managed expectantly. CONCLUSION: This patient represents the first published case of musical hallucination precipitated by whiplash injury. We explore the possible pathophysiological underpinnings of musical hallucination and highlight the need for a greater awareness of this disorder. A management strategy is suggested.
OBJECTIVE: We report an extremely rare case of an aberrant internal carotid artery in the middle ear, together with a dehiscent high jugular bulb, a combination never previously reported. METHODS: Case report with a review of the literature. RESULTS: A 24-year-old man presented with a five-year history of aural fullness, pulsatile tinnitus and mild hearing impairment in his right ear. Otoscopy revealed a retro-tympanic mass. Computed tomography of the temporal bone revealed protrusion of the right internal carotid artery into the middle-ear cavity, with a dehiscent high jugular bulb. Magnetic resonance angiography showed a reduced diameter and lateralisation of the right internal carotid artery. A diagnosis of an aberrant internal carotid artery with a dehiscent high jugular bulb was made, and the patient was managed with conservative treatment. CONCLUSION: The otologist should be aware of the possibility of an aberrant internal carotid artery when the patient presents with a retro-tympanic mass, hearing loss and pulsatile tinnitus. Radiological investigation is required to make the differential diagnosis. When an aberrant internal carotid artery presents with a dehiscent high jugular bulb, the risk of serious bleeding is elevated. We recommend a conservative approach for cases presenting without bleeding complications.

A case report of onset of tinnitus following discontinuation of antidepressant and a review of the literature.

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This case report describes a 46-year-old woman with long-standing episodic severe depression (ICD-10 code F33) who discontinued venlafaxine over a 4-week taper after taking the antidepressant for 8 years. Severe discontinuation syndrome was experienced. Panic and relapse of depression occurred 2 months after achieving discontinuation, and the development of tinnitus took place concurrently to the discontinuation. The experience of the tinnitus as a side effect of discontinuation is different from cases reported in the literature in which the tinnitus was experienced when the antidepressant was started and ceased when the antidepressant was stopped. Here, the patient experienced the tinnitus as a discontinuation symptom, and it persisted even after the antidepressant was reintroduced. A review of the literature on antidepressant discontinuation syndrome is also provided. Free PMC Article.

Tympanic paraganglioma with extension into the Eustachian tube and nasopharynx: a case report.
[Article in English, Spanish]

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Tympanic paragangliomas usually present as a vascular middle ear mass, with the most common presenting symptoms being pulsatile tinnitus and hearing loss. We report an unusual case of a recurrent tympanic paraganglioma extending along the Eustachian tube and nasopharynx, presenting with recurrent epistaxis. Copyright © 2010 Elsevier España, S.L. All rights reserved. Free Article in Spanish.
The Twists and Turns of Optic Disk Swelling in a Teenager.

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A 17-year-old girl developed headaches, transient visual obscuration, pulsatile tinnitus, and hearing loss during an episode of pneumonia. Neuro-ophthalmologic examination disclosed severe bilateral optic disk swelling and macular exudate in the right eye. Lumbar puncture showed an opening pressure of 55 cm H(2)O without neurochemical abnormalities. Subsequent magnetic resonance imaging showed no mass lesion or signs of venous sinus thrombosis, confirming the diagnosis of idiopathic intracranial hypertension. Following the lumbar puncture, the papilledema resolved but visual acuity decreased to 20/40 in the right eye despite normal color vision. Perimetric signs of psychogenic visual loss developed. This case underscores that hyperacute papilledema can simulate bilateral optic neuritis and illustrates the importance of color vision testing in distinguishing macular visual loss from optic neuropathy. It also illustrates the confounding effect of psychogenic visual loss in judging the clinical course of idiopathic intracranial hypertension. Copyright © 2012 Elsevier Inc. All rights reserved.

Aberrant internal carotid artery causing objective pulsatile tinnitus and conductive hearing loss.

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Abstract Aberrant internal carotid artery (ICA) in the middle ear is a rare, dangerous vascular anomaly and conservative follow-up was usually adopted in most reported cases. Here we report the case of an 8-year-old girl with symptoms of objective pulsatile tinnitus and conductive hearing loss in the right ear. Otoscopic examination, computed tomography, and conventional angiography were performed. An aberrant ICA combined with a 'third mobile window' was suspected preoperatively and confirmed at exploratory surgery of the middle ear. The aberrant ICA was treated, and the pulsatile tinnitus disappeared and hearing recovered after the surgery. This case suggests that surgery is practical to relieve troublesome tinnitus and hearing loss in appropriate cases with aberrant ICA.

A fibrotic nodule arising from the cerebellopontine angle.
Brain Tumor Pathol. 2012 Jun 8. [Epub ahead of print]

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The authors present an extremely rare case of a fibrotic nodule arising from the cerebellopontine (CP) angle. A 57-year-old male had suffered from hearing disturbance and tinnitus for several years. Computed tomography revealed a high-density mass in the left CP angle with little enhancement after intravenous administration of contrast media. Magnetic resonance imaging (MRI) showed a very hypointense mass on T2-weighted imaging. T1-weighted MRI with gadolinium revealed very faint, delayed enhancement of the tumor. The patient underwent surgical resection of the tumor. Histopathologically the lesion comprised entirely fibrotic tissue consisting of thick collagenous fibers and sclerosing blood vessels with a few intervening viable cells with, partly, the immunophenotype of arachnoid cells. Intracranial fibrotic nodules are extremely rare. This tumor, however, had some radiological features similar to those of other, more common, tumors for example meningiomas or solitary fibrous tumors; it was, therefore, difficult to distinguish it from the others. It is believed that intracranial fibrotic nodules usually have benign, non-neoplastic characteristics, although their natural history is not yet fully understood. It is, therefore, necessary to be able to perform a differential diagnosis that will distinguish this rare condition from other intracranial fibrous neoplasms that occasionally have malignant features.
Repetitive Transcranial Magnetic Stimulation for the Treatment of Chronic Tinnitus After Traumatic Brain Injury: A Case Study.
J Head Trauma Rehabil. 2012 Jun 8. [Epub ahead of print]

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Tinnitus is a frequent symptom of traumatic brain injury, which is difficult to treat. Repetitive transcranial magnetic stimulation has shown beneficial effects in some forms of tinnitus. However, traumatic brain injury in the past has been considered as a relative contraindication for repetitive transcranial magnetic stimulation because of the increased risk of seizures. Here we present the case of a 53-year-old male patient suffering from severe tinnitus after traumatic brain injury with comorbid depression and alcohol abuse, who received 5 treatment series of repetitive transcranial magnetic stimulation (1 Hz stimulation protocol over left primary auditory cortex, 10 sessions of 2000 stimuli each, stimulation intensity 110% resting motor threshold). Repetitive transcranial magnetic stimulation was tolerated without any side effects and tinnitus complaints (measured by a validated tinnitus questionnaire and numeric rating scales) were improved in a replicable way throughout 5 courses of transcranial magnetic stimulation up to now.


Department of Voice, Speech and Hearing Disorders, University Medical Center Hamburg-Eppendorf, Hamburg, Germany.

Background Despite the relatively frequent occurrence of multiple primary tumors, namely, 10% of intracranial tumors, metastasis is a rare occurrence within the internal auditory canal (IAC) and cerebellopontine angle (CPA). Intracanalicular metastases of adenocarcinoma are documented, but a primary adenocarcinoma remains unreported. We provide a review of uncommon lesions in the IAC and describe to our knowledge the first instance of a primary adenocarcinoma. Case Report A 60-year-old man presented with nausea and vomiting. Cranial computed tomography scan revealed bilateral nonspecific periventricular and subcortical vascular lesions. He presented 8 months later with left-sided tinnitus, progressive hearing loss, and attacks of vertigo. Magnetic resonance imaging (MRI) showed an extra-axial mass most likely representing a left-sided vestibular schwannoma with characteristic contrast enhancement in the IAC. The follow-up MRI showed an unchanged pattern of contrast enhancement. Due to progressive headaches and dizziness, the patient underwent a left transtemporal craniotomy with subtotal tumor resection. Histological examination revealed blennogenic cylindrical adenocarcinoma. The investigations for the primary tumor site were all negative. The patient’s condition deteriorated gradually. MRI showed an increase of the residual tumor and meningeosis carcinomatosa, and cerebrospinal fluid (CSF) examination was positive for tumor cells. The patient was treated with intrathecal chemotherapy. He died of multiple organ failure. Discussion The discussion focuses on the incidence of extra-axial CPA and IAC lesions with their clinical presentations and their radiological findings. We address the issue of a possible regulation of CPA lesion laterality by asymmetrically expressed genes. In view of the sparse literature on treatment of single intracanalicular metastases, the review is broadened to the current treatment recommendations of single brain metastases. Conclusions The differentiation between benign and malign lesions in the CPA and IAC is important, as it requires diverse treatment protocols. For the physician this differentiation represents a clinical and radiological challenge. For the developmental research the left-right asymmetry might be a field of research. Thieme Medical Publishers 333 Seventh Avenue, New York, NY 10001, USA.
Bilateral sudden sensorineural hearing loss as an initial presentation of myelodysplastic syndrome.

Lee EJ, Yoon YJ.

This study reports an unusual case in which myelodysplastic syndrome presented bilateral sudden sensorineural hearing loss as the first symptom of the disease. The aural symptoms and signs such as tinnitus, dizziness, and hearing impairment of a hematologic disease are common. However, sudden hearing loss as the first manifestation of a hematologic disease is extremely rare. A 76-year-old woman presented with bilateral sudden hearing loss. The patient was found to have myelodysplastic syndrome during a workup for her hearing loss. Unfortunately, the patient's hearing loss did not improve after the medical treatment. Copyright © 2012 Elsevier Inc. All rights reserved.


Kim SK, Chang M, Merrill R.

Orofacial pain bridges an important gap between medicine and dentistry. This article presents the case of a man who reported preauricular pain, tinnitus, and vertigo that began after extraction of an impacted third molar and who was sent for evaluation of a possible temporomandibular joint disorder. However, he was subsequently found to have markers and imaging results consistent with recurrent and more centralized lupus and/or multiple sclerosis.

Cirsoid aneurysm of the right pre-auricular region: an unusual cause of tinnitus managed by endovascular glue embolisation.

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Objective: We report an interesting case of a right temporal pre-auricular arteriovenous fistula (cirsoid aneurysm) causing intractable tinnitus successfully managed by transarterial n-butyl cyanoacrylate glue embolisation. Case report: A 52-year-old female presented with a one-year history of tinnitus and pulsatile swelling in the right pre-auricular region. A colour Doppler ultrasound test and magnetic resonance angiography revealed a high-flow scalp arteriovenous fistula with a feeder vessel from the distal superficial temporal artery, which drained into the corresponding, dilated, tortuous vein. The patient underwent diagnostic digital subtraction angiography. This was followed by transarterial embolisation of the fistula using a 50 per cent mixture of n-butyl cyanoacrylate glue and Lipiodol®, with manual distal venous occlusion. A successful outcome was achieved with instant relief of symptoms. Conclusion: Cirsoid aneurysms of the facial region, an uncommon cause of tinnitus, can be effectively managed by endovascular embolisation. This treatment obviates the need for surgery, which is associated with an increased risk of complications such as scarring, deformity and bleeding.
Monosymptomatic clinically isolated syndrome with sudden sensorineural hearing loss: case report and critical review of the literature.

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INTRODUCTION: Isolated cranial nerve involvement is rare in patients with multiple sclerosis (10.4%) and extremely rare is an eighth nerve palsy, especially in the context of a clinically isolated syndrome (<1%). CASE REPORT: A 34-year-old male presented with a history of left-sided tinnitus and sudden sensorineural hearing loss (SSNHL). Magnetic resonance imaging of the brain revealed >9, nonenhancing periventricular and corpus callosum lesions. Brainstem auditory evoked potentials were abnormal, ipsilateral to the affected ear, consistent with the presumed underlying demyelinating pathology. Visual evoked potentials showed bilateral prolonged P100 latencies. Oligoclonal bands were not detected in the cerebrospinal fluid, but IgG index was marginally elevated. After administration of corticosteroids, the patient recovered auditory function over a several month period. CONCLUSIONS: This report describes a case of SSNHL in the context of magnetic resonance imaging of the brain and electrophysiological findings consistent with a demyelinating etiology. SSNHL is a rare and possibly underrecognized manifestation of clinically isolated syndrome.

Onyx embolization of high flow spontaneous cervical vertebral arteriovenous fistula.

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High flow spontaneous vertebral arteriovenous shunts in patients with fibromuscular dysplasia (FMD) are rare. We present a 59-year-old woman with progressive dizziness, pre-syncopal episodes and tinnitus. Catheter-based angiography identified features of FMD and a high flow, right cervical vertebral artery arteriovenous shunt. Onyx-18 embolization (Onyx liquid embolic system, eV3, Irvine, CA, USA) of the principal draining veins was performed with initial detachable coil placement. Complete disconnection of the shunt was achieved without sacrifice of the parent vertebral artery. Thus, spontaneous high flow vertebral arteriovenous shunts can be successfully occluded with Onyx/detachable coil embolization of the principal recipient veins. To our knowledge, this is the first report of Onyx embolization of the recipient veins with shunt disconnection and preservation of the affected vertebral artery in a patient with FMD. Copyright © 2012 Elsevier Ltd. All rights reserved.

Acute Unilateral Hearing Loss as an Early Symptom of Lateral Cerebral Sinus Venous Thrombosis.


BACKGROUND Increasing availability of neuroimaging has facilitated the diagnosis of cerebral sinus venous thrombosis (CSVT). However, CSVT may also present with unspecific or atypical symptoms, resulting in diagnostic delay. Single reports suggested otologic symptoms as such pitfalls. OBJECTIVE To screen patients with CSVT for otologic symptoms. DESIGN Ten-year retrospective case series. SETTING Primary and tertiary care university clinic. PATIENTS Thirty-eight patients with CSVT. RESULTS Of 38 patients with CSVT, 3 individuals had acute unilateral hearing loss, 2 of which also had concomitant tinnitus and headache, and were initially treated at the ear, nose, and throat department. Magnetic resonance imaging after hospital discharge showed ipsilateral thrombosis of the lateral venous sinus. Two female patients took oral contraceptives, 1 of whom also had a heterozygous factor V Leiden mutation.
CONCLUSIONS Cerebral sinus venous thrombosis may present with unspecific symptoms such as acute unilateral hearing loss. If in conjunction with headache or risk factors for venous thrombosis, the suspicion of ipsilateral lateral CSVT should prompt rapid imaging including venography.

XV Specific Forms of Tinnitus

Borden-Shucart Type I dural arteriovenous fistulas: clinical course including risk of conversion to higher-grade fistulas.


Departments of Neurological Surgery.

Object The goal of this study was to determine the clinical course of Borden-Shucart Type I cranial dural arteriovenous fistulas (DAVFs) and to calculate the annual rate of conversion of these lesions to more aggressive fistulas that have cortical venous drainage (CVD). Methods A retrospective chart review was conducted of all patients harboring DAVFs who were seen at the authors’ institution between 1997 and 2009. Twenty-three patients with Type I DAVFs who had available clinical follow-up were identified. Angiographic and clinical data from these patients were reviewed. Neurological outcome and status of presenting symptoms were assessed during long-term follow-up. Results Of the 23 patients, 13 underwent endovascular treatment for intolerable tinnitus or ophthalmological symptoms, and 10 did not undergo treatment. Three untreated patients died of unrelated causes. In those who were treated, complete DAVF obliteration was achieved in 4 patients, and palliative reduction in DAVF flow was achieved in 9 patients. Of the 19 patients without radiographic cure, no patient developed intracranial hemorrhage or nonhemorrhagic neurological deficits (NHNDs), and no patient died of DAVF-related causes over a mean follow-up of 5.6 years. One patient experienced a spontaneous, asymptomatic obliteration of a partially treated DAVF in late follow-up, and 2 patients experienced a symptomatic conversion of their DAVF to a higher-grade fistula with CVD in late follow-up. The annual rate of conversion to a higher-grade DAVF based on Kaplan-Meier cumulative event-free survival analysis was 1.0%. The annual rate of intracranial hemorrhage, NHND, and DAVF-related death was 0.0%. Conclusions A small number of Type I DAVFs will convert to more aggressive DAVFs with CVD over time. This conversion to a higher-grade DAVF is typically heralded by a change in patient symptoms. Follow-up vascular imaging is important, particularly in the setting of recurrent or new symptoms.

People With Symptoms of Ménière’s Disease: The Relationship Between Illness Intrusiveness, Illness Uncertainty, Dizziness Handicap, and Depression.

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HYPOTHESIS: The goal of this study was to assess the impact of dizziness handicap, illness intrusiveness (in relation to vertigo, tinnitus, and hearing problems), and illness uncertainty on depression in people with the symptoms of Ménière’s disease. BACKGROUND: Ménière’s disease is a progressive disease of the inner ear, the symptoms of which are vertigo, tinnitus, hearing loss, and aural fullness. Although pharmacologic treatments may reduce acute vertigo spells and dizziness, they rarely disappear entirely. Previous research shows that Ménière’s disease is unpredictable and has a negative impact on patients’ quality of life. METHODS: Questionnaires measuring Dizziness Handicap, Illness Intrusiveness, Illness Uncertainty, and Depression were completed by 74 people with self-reported symptoms of Ménière’s disease. Bivariate correlations, repeated-measures analysis of variance, and multiple regression analyses were used to assess the contribution of dizziness handicap, illness intrusiveness, and illness uncertainty to depression. CONCLUSION: Vertigo was more intrusive than tinnitus, hearing problems, and most other
comparator illnesses. The intrusiveness of the symptoms of Ménière's disease accounted for 32% of the variance in depression scores, which were high; illness uncertainty did not account for additional variance. Dizziness handicap accounted for 31% of the variation in depression. Although the symptoms of Ménière's disease may not be alleviated by psychological methods, programs that target cognitions in relation to the embarrassment in front of others, and the feeling of being handicapped, may lessen the psychosocial impact of the symptoms of Ménière's disease, which may reduce some of the depression felt in this group.

Prospective evaluation of the clinical profile and referral pattern differences of vestibular schwannomas and other cerebellopontine angle tumors.

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OBJECTIVE: To evaluate the clinical profile, referral pattern, delay in diagnosis, and impact of tumor size of cases involving vestibular schwannomas (VS) versus other cerebellopontine angle (CPA) tumors in an Egyptian population. STUDY DESIGN: Case series study. SETTING: Tertiary referral center. PATIENTS: A prospective study of possible retrocochlear lesions was conducted from 2008 to 2010. INTERVENTION(S): Patients were subjected to a full clinical history, complete otorhinolaryngological examination, a basic audiologic evaluation, auditory brainstem response assay, and gadolinium-enhanced magnetic resonance imaging. According to the findings of magnetic resonance imaging, patients with retrocochlear lesions were divided into 2 groups: those with VS (n = 17) and those with other CPA lesions (n = 14). MAIN OUTCOME MEASURE(S): Diagnostic delay and criteria of VS and CPA tumors. RESULTS: Unilateral hearing loss and tinnitus were presented in 52.9% of VS cases with a diagnostic delay of 15.5 months. For cases involving other CPA lesions, a combination of otologic symptoms was observed in 9 (64%) of 14 cases, and a diagnostic delay of 47.5 months was experienced. An absence of auditory brainstem response waves was identified significantly (p < 0.05) for the affected ears of both groups. Only differences in Wave V latency were significant between the 2 groups (p < 0.05). CONCLUSION: A longer diagnostic delay was associated with cases involving other types of CPA lesions versus cases of VS, and tumor size and volume did not affect the diagnostic delay of the former. Moreover, the only significant difference in clinical presentation for these 2 groups of intracranial tumor involved Wave V latency.

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OBJECTIVE: To examine the association between postconcussive symptoms and mild traumatic brain injury (MTBI) among combat veterans while adjusting for posttraumatic stress disorder (PTSD) and depression. PATIENTS: Military personnel with provider-diagnosed MTBI (n = 334) or nonhead injury (n = 658) were identified from the Expeditionary Medical Encounter Database. MAIN OUTCOME MEASURES: Post-Deployment Health Assessments and Re-Assessments were used to examine postconcussive symptoms and self-rated health. RESULTS: Personnel with MTBI were more likely to report headache (odds ratio [OR] = 3.37; 95% confidence interval [CI] = 2.19-5.17), back pain (OR = 1.79; 95% CI = 1.23-2.60), memory problems (OR = 1.86; 95% CI = 1.20-2.88), tinnitus (OR = 1.63; 95% CI = 1.10-2.41), and dizziness (OR = 2.13; 95% CI = 1.06-4.29) compared with those with non-head injuries. Among those with MTBI, self-reported decline in health was associated with memory problems (OR = 5.07; 95% CI = 2.56-10.02) and
Evolution of otosclerosis to cochlear implatation.
[Article in English, Spanish]


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INTRODUCTION: Otosclerosis is an osteodystrophy of the labyrinthine capsule producing conductive hearing loss. If the process invades the cochlea, a sensorineural hearing loss usually takes place. The cochlear implant is a good alternative in these patients. OBJECTIVE: To ascertain the behaviour of cochlear implantation in otosclerosis. MATERIAL AND METHODS: We reviewed a database of 250 patients that underwent cochlear implantation, performing a retrospective study of 13 patients with clinical, audiological and/or imaging findings of bilateral otosclerosis. The 26 ears were studied as to their natural history, previous surgeries, evolution to profound hearing loss, computed tomography images, complications and functional results. RESULTS: Of the cases studied, 46% were female and 54% were men, with a mean age of 26 years at the onset of conductive hearing loss. Stapes surgery was performed in 19 ears (73%), with a mean patient age of 29 years, and 53% of them underwent cochlear implantation. Computed tomography results showed that there were signs of different degrees of radiological affectation in 54% of the ears. A total of 3 complications took place (23%): implant failure, overstimulation of the facial nerve and bilateral tinnitus were found. One year after implantation, the average percentages of correct 2-syllable words were 80% and 85% in open sentences. CONCLUSIONS: Patients having profound bilateral sensorineural hearing loss secondary to otosclerosis obtain great benefit from cochlear implantation. Copyright © 2011 Elsevier España, S.L. All rights reserved. Free full text in Spanish.

Pathologic erythrocyte deformability in patients with sudden sensorineural hearing loss.
[Article in English, Spanish]

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OBJECTIVE: To evaluate if viscoelastic properties of blood influence suffering sudden sensorineural hearing loss and the capacity to respond after a specific therapy. PATIENTS AND METHODS: A longitudinal prospective study included 85 ears bearing sudden deafness. In them, the mean hearing loss compared to the healthy ear and the recovery ratio were measured at the onset and 6 months after a treatment with corticoids and piracetam. In addition, tinnitus or vestibular symptoms, whole blood filterability (WBF) and erythrocyte deformability -by means of the erythrocyte rigidity index (ERI)- were determined and noted at the beginning and the end of the study. RESULTS: Mean hearing loss was 30.3±19.7% at the onset, and 25.8±39% at the end. Forty-one ears showed a recovery of more than 75%. In these (48% of the entire study group), an increase in WBF and a decrease in ERI were observed (P<.001). Ears without tinnitus or vestibular crisis recovered more hearing at 6 months and showed a significant improvement in WBF and ERI, not detected among patients with these clinical findings. There were good correlations between mean hearing loss at onset and WBF, and between recovery and ERI at 6 months, but without statistical significance. Patients with arterial hypertension, cardiopathy and hypercholesterolemia were the most frequently detected, while hypertension and hyperuricaemia showed a better hearing recovery ratio.
CONCLUSIONS: The blood viscosity parameters WBF and ERI offer useful information about the risk of suffering sudden deafness and the capacity to recover hearing with reactive therapies. Copyright © 2011 Elsevier España, S.L. All rights reserved. Free Article in Spanish.

Auditory and Vestibular Symptoms and Chronic Subjective Dizziness in Patients With Ménière’s Disease, Vestibular Migraine, and Ménière’s Disease With Concomitant Vestibular Migraine.

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OBJECTIVE: To compare presentations of Ménière’s disease (MD), vestibular migraine (VM), and Ménière’s disease plus vestibular migraine (MDVM), with and without comorbid chronic subjective dizziness (CSD). STUDY DESIGN: Retrospective review with diagnosis confirmed by consensus conference of investigators using published criteria for MD, VM, and CSD. SETTING: Ambulatory, tertiary dizziness clinic. PATIENTS: Approximately 147 consecutive patients with diagnoses of MD, VM, or MDVM, with/without comorbid CSD. INTERVENTIONS: Diagnostic consultation. MAIN OUTCOME MEASURES: Similarities and differences between diagnostic groups in demographics; symptoms; and results of neurotologic, audiometric, and vestibular laboratory assessments. RESULTS: Seventy-six patients had MD, 55 MD alone. Ninety-two patients had VM, 71 VM alone. Twenty-one patients had MDVM, representing about one-quarter of those diagnosed with MD or VM. Clinical features thought to differentiate VM from MD were found in all groups. Twenty-seven patients with VM (38%) had ear complaints (subjective hearing loss, aural pressure, and tinnitus) during episodes of vestibular symptoms and headache, including 10 (37%) with unilateral symptoms. Conversely, 27 patients with MD alone (49%) had headaches with migraine features that did not meet full IHS diagnostic criteria, migrainous symptoms (photophobia, headache with vomiting), or first-degree relative with migraine. Including MDVM patients, 59% (45/76) of all patients with MD had migrainous features. Thirty-two patients had CSD; most (29; 91%) were in the VM group.’ CONCLUSION: Comorbidity was common between MD and VM, and their symptoms overlapped. More specific diagnostic criteria are needed to differentiate these diseases and address their coexistence. CSD co-occurred with VM but was rarely seen with MD.

Middle ear myoclonus associated with forced eyelid closure in children: Diagnosis and treatment outcome.

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OBJECTIVES/HYPOTHESIS: Forceful eyelid closure syndrome (FECS) was first reported at the Proceedings of the Second International Tinnitus Seminar in 1983. The main symptom of this syndrome is a spontaneous muscular tinnitus related only to forced eye closure, specifically the voluntary contraction of the periorbital muscles. Although investigation of the syndrome was initiated >100 years ago, only four cases have been published in the past 20 years. We report six cases of middle ear myoclonus tinnitus diagnosed as FECS in children and discuss issues surrounding the diagnosis and treatment of this syndrome. STUDY DESIGN: Retrospective case series. METHODS: From 2009 to 2011, six children complaining of clicking or crackling sounds in their ears presented at Seoul St. Mary’s Hospital. Endoscopic examination and recording of the tympanic membrane were performed while the patients were asked to close their eyes forcefully. Audiologic studies including acoustic reflex decay and static compliance were performed for documentation of the movement of the tympanic membrane. Triggering factors of FECS in the children were carefully evaluated. RESULTS: Synchronous movement of the tympanic membrane in
response to forced eye closure on endoscopic examination was the most reliable finding to diagnose FECS. Acoustic reflex decay and other impedance audiogram findings showed irregular perturbations during forced eye closure, which led to diagnosis of the tinnitus as middle ear myoclonus. Most of the patients had triggering factors for FECS. Reassurance and removal of the triggering or causal factors with or without medication improved clicking sounds coming from middle ear myoclonus. CONCLUSIONS: FECS is a rare clinical entity and can be easily missed in routine clinical examination. We suggest that patients, especially children, with clicking or crackling tinnitus should be evaluated for FECS using proper diagnostic tools. A possible mechanism of FECS in children postulated from our case review is suggested. Laryngoscope, 2012. Copyright © 2012 The American Laryngological, Rhinological, and Otological Society, Inc.

[Vestibular schwannoma : Part I: epidemiology and diagnostics].
[Article in German].
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Vestibular schwannoma is with 80% the most frequent of all tumors of the cerebellopontine angle. Usually, this benign, neuroectodermal, mostly unilateral occurring tumor is called acoustic neuroma, although it develops from the Schwann cells of the nerve sheath of the eighth cranial nerve. The tumor is localized in the meatus acusticus internus in the majority of cases. The most common initial symptom is a unilateral or, at least, asymmetric hearing loss. Other symptoms may include tinnitus and feeling of insecurity or vertigo, but adjacent cranial nerves may also be affected. Besides clinical and apparatus-based (neuro-)otological diagnostics, MRI imaging has established itself as the gold standard with a sensitivity and specificity of up to 100%.

Traumatic Tympanic Membrane Perforations: Clinical and Audiometric Findings in 198 Patients.

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OBJECTIVE: To obtain clinical and audiometric findings in traumatic tympanic membrane perforations from a typical patient collective in a Western industrial nation because the appropriate data have an important relevance in medicolegal questions. STUDY DESIGN: Retrospective data collection. SETTING: Germany’s largest university clinic for otorhinolaryngology, head and neck surgery. SUBJECT AND METHODS: From the medical records of 198 patients with traumatic tympanic membrane perforations, the following data were collected: demographic data, date and mechanism of the trauma, otoscopic findings and collateral injuries, kind of therapy and its results, pure tone audiometry, and statement of tinnitus or vertigo in the course. RESULTS: Most patients were young (mean age, 29.2 yr) and male (62%). Men and women are equally represented in perforations resulting from a physical blow to the ear (44.7% vs 46.7%); a collision was more often the cause in men (23.6% vs 14.7%), whereas an accidental perforation by insertion of a cotton bud was approximately 2 times more common on women (13.8% vs 25.3%). The left ear was more often affected than the right ear (58.5% vs 41.5%). Collateral damage was found in only 1% of the cases. In blows, collisions, barotraumas, and the insertion of sharp objects, the inferior parts of the tympanic membrane were most often affected; the most severe (subtotal) perforations were caused by explosions, weld beads, and insertion of cotton buds. For therapy, myringoplasty had an overall success rate of 88.9%; splitting with silicon foils, 51.6%; and „no therapy,” 53.3%. Bone conduction thresholds for the affected ear were higher in low, middle, and high frequencies compared with the contralateral ear by trend, but a statistical difference was only found in the high frequencies. In follow-up examinations, the hearing thresholds in the high frequencies were no longer significantly different. A „c dip“ or „fis dip“ was found
Benign intracranial hypertension: a diagnostic dilemma.
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Benign intracranial hypertension (BIH) (also known as pseudotumor cerebri and empty sella syndrome) remains a diagnostic challenge to most physicians. The modified Dandy criteria consist of, the classic findings of headache, pulsatile tinnitus, papilledema, and elevated cerebrospinal fluid (CSF) pressure, however, these are rarely collectively present in any one patient. Furthermore, these findings can wax and wane over time. Due to the nature of this disease, both signs and symptoms may be intermittent, making definitive diagnosis difficult. Newer imaging studies, particularly the magnetic resonance venogram (MRV) along with a constellation of correlative findings and associated diseases have given new impetus in the diagnosis, treatment, and pathophysiology of this disease. This has led the authors to offer modifications to the classic Dandy criteria. This report presents three representative cases of BIH highlighting many of the newer advances in both diagnosis and treatment of this perplexing disorder.

Endolymphatic hydrops perspectives 2012.
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PURPOSE OF REVIEW: Endolymphatic hydrops remains a significant cause of morbidity secondary to vertigo, hearing loss, and tinnitus. The purpose of this report is to summarize the most clinically relevant publications on endolymphatic hydrops over the past 2 years. RECENT FINDINGS: Hydrops has historically been a diagnosis of exclusion, but recent efforts has shown a role for MRI with intratympanic gadolinium. Cochrane reviews of intratympanic dexamethasone and gentamicin found inadequate level 1 evidence to support their use. SUMMARY: High-level evidence to guide therapy is lacking. MRI holds potential for definitive diagnosis.

Tinnitus in children: Association with stress and trait anxiety.
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OBJECTIVES/HYPOTHESIS: The aim of this study was to investigate associations between tinnitus and stress factors including anxiety in elementary school students. STUDY DESIGN: Cross-sectional study. METHODS: We conducted a cross-sectional questionnaire survey in 940 students aged from 10 to 12 years. Data on 928 students were collected. The questionnaire comprised 96 questions that were classified into six categories: subjects’ symptoms, stress factors, State Anxiety (transitory emotional condition characterized by feeling of tension and apprehension) Inventory for Children (SAIC), Trait Anxiety (general tendency to respond with anxiety to environmental threat) Inventory for Children (TAIC), visual analog scale of tinnitus, and Tinnitus Handicap Inventory (THI). RESULTS: Four hundred thirty-five students (46.9%) had experienced tinnitus more than once, and 41 (4.4%) suffered from it continuously. Self-perception of hearing loss, dizziness, headache, and concerns about obesity had significant differences between tinnitus and nontinnitus groups, whereas other stress factors did not show any difference. TAIC scores showed statistically significant differences according to the frequency
of tinnitus in children experiencing tinnitus, whereas SAIC scores did not. Annoyance, influence on daily life, disturbance of sleep, and study by tinnitus and THI scores showed significant differences according to the frequency of tinnitus. CONCLUSIONS: The present study confirms that many children are aware of tinnitus and that they may be susceptible to stressful environments. In particular, trait anxiety may be associated with tinnitus. Because both tinnitus and anxiety can affect the daily lives and health of children-as with adults-a detailed strategy for the management of tinnitus in children should be established. Copyright © 2012 The American Laryngological, Rhinological, and Otological Society, Inc.


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Idiopathic intracranial hypertension (IIH) is characterized by headache, papilledema, visual field changes and tinnitus with elevated cerebral spinal fluid opening pressures on lumbar puncture. Left untreated, this condition can lead to permanent visual loss. Previous treatment modalities include medical management, therapeutic lumbar puncture and optic nerve sheath fenestration. They have proved to be effective but carry high rates of symptom recurrence or procedural complications. Focal dural venous sinus stenoses have been identified in many patients with IIH, leading to development of treatment through venous sinus angioplasty and stenting. A review of the literature was performed which identified patients with IIH treated with venous sinus stenting. The procedural data and outcomes are presented. A total of 143 patients with IIH (87% women, mean age 41.4 years, mean body mass index 31.6 kg/m(2)) treated with venous sinus stenting were included in the analysis. Symptoms at initial presentation included headache (90%), papilledema (89%), visual changes (62%) and pulsatile tinnitus (48%). There was a technical success rate of 99% for the stent placement procedure with a total of nine complications (6%). At follow-up (mean 22.3 months), 88% of patients experienced improvement in headache, 97% demonstrated improvement or resolution of papilledema, 87% experienced improvement or resolution of visual symptoms and 93% had resolution of pulsatile tinnitus. In patients with IIH with focal venous sinus stenosis, endovascular stent placement across the stenotic sinus region represents an effective treatment strategy with a high technical success rate and decreased rate of complications compared with treatment modalities currently used.


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OBJECTIVES: Some patients with sudden sensorineural hearing loss (SSNHL) are frustrated by residual tinnitus even after accomplishment of the treatment for SSNHL. In the present prospective study, we examined patients’ backgrounds of sex, laterality and age together with changes in hearing level and the tinnitus score after the onset of SSNHL to determine the prognostic factors of residual tinnitus after the final day of medical treatment for SSNHL. METHODS: Forty-four patients with SSNHL were all treated with systemic administration of steroids for 2 weeks and oral intake of vasoactive drugs and vitamin B12 for 6 months before accomplishment of the treatment for SSNHL. The hearing improvement rate (HIR) was determined by comparing the hearing level before and 6 months after the start of treatment. Tinnitus was subjectively evaluated by the tinnitus scoring questionnaire before, 6 and 24 months after the start of treatment. The score of a five-step evaluation of subjective tinnitus feelings, “loudness”, “duration” and “annoyance”, was recorded. RESULTS: HIR was significantly correlated with tinnitus score improvement (TSI) in “duration” at 6 months after the start of treatment compared with before treatment. The tinnitus score of all 3 items was significantly improved 6 months after the start of treatment compared with that before treatment but it was not significantly changed between 6 and 24 months after the start of treatment. TSI in “duration” between 6 and 24 months was significantly correlated with the patients’ age and HIR
using multiple regression analysis. CONCLUSION: According to the tinnitus scoring questionnaire, “duration” is the most reliable item for subjective evaluation of tinnitus accompanied by SSNHL. Generally, subjective feelings for residual tinnitus 6 months after the start of treatment for SSNHL are supposed to be almost the same, even at the 24th post-treatment month. Especially, younger patients with better hearing improvement are predicted to achieve further improvement of tinnitus between 6 and 24 months after the start of treatment. Copyright © 2012 Elsevier Ireland Ltd. All rights reserved.

XVI Animal Models


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In 2006, Turner and colleagues (Behav. Neurosci., 120:188-195) introduced the gap-startle paradigm as a high-throughput method for tinnitus screening in rats. Under this paradigm, gap detection ability was assessed by determining the level of inhibition of the acoustic startle reflex produced by a short silent gap inserted in an otherwise continuous background sound prior to a loud startling stimulus. Animals with tinnitus were expected to show impaired gap detection ability (i.e., lack of inhibition of the acoustic startle reflex) if the background sound containing the gap was qualitatively similar to the tinnitus pitch. Thus, for the gap-startle paradigm to be a valid tool to screen for tinnitus, a robust startle response from which to inhibit must be present. Because recent studies have demonstrated that the acoustic startle reflex could be dramatically reduced following noise exposure, we endeavored to 1) modify the gap-startle paradigm to be more resilient in the presence of hearing loss, and 2) evaluate whether a reduction in startle reactivity could confound the interpretation of gap prepulse inhibition and lead to errors in screening for tinnitus. In the first experiment, the traditional broadband noise (BBN) startle stimulus was replaced by a bandpass noise in which the sound energy was concentrated in the lower frequencies (5-10 kHz) in order to maintain audibility of the startle stimulus after unilateral high-frequency noise exposure (16 kHz). However, rats still showed a 57% reduction in startle amplitude to the bandpass noise post-noise exposure. A follow-up experiment on a separate group of rats with transiently-induced conductive hearing loss revealed that startle reactivity was better preserved when the BBN startle stimulus was replaced by a rapid airpuff to the back of the rat’s neck. Furthermore, it was found that transient unilateral conductive hearing loss, which was not likely to induce tinnitus, caused an impairment in gap prepulse inhibition as assessed with the traditional BBN gap-startle paradigm, resulting in a false-positive screening for tinnitus. Thus, the present study identifies significant caveats of the traditional gap-startle paradigm, and describes experimental parameters using an airpuff startle stimulus which may help to limit the negative consequences of reduced startle reactivity following noise exposure, thereby allowing researchers to better screen for tinnitus in animals with hearing loss. This article is part of a Special Issue entitled “Neuroscience of Tinnitus”. Copyright © 2012. Published by Elsevier B.V.
In Vivo Electrochemical Monitoring of the Change of Cochlear Perilymph Ascorbate during Salicylate-Induced Tinnitus.
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As one of the most important neurochemicals in biological systems, ascorbate plays vital roles in many physiological and pathological processes. In order to understand the roles of ascorbate in the pathological process of tinnitus, this study demonstrates an in vivo method for real time monitoring of the changes of ascorbate level in the cochlear perilymph of guinea pigs during the acute period of tinnitus induced by local microinfusion of salicylate with carbon fiber microelectrodes (CFMEs) modified with multiwalled carbon nanotubes (MWNTs). To accomplish in vivo electrochemical monitoring of ascorbate in the microenvironment of the cochlear perilymph, the MWNT-modified CFME is used as working electrode, a microsized Ag/AgCl is used as reference electrode, and Pt wire is used as counter electrode. Three electrodes are combined together around a capillary to form integrated capillary-electrodes. The integrated capillary-electrode is carefully implanted into the cochlear perilymph of guinea pigs and used both for externally microinfusing of salicylate into the cochlear perilymph and for real time monitoring of the change of ascorbate levels. The in vivo voltammetric method based on the integrated capillary-electrodes possesses a high selectivity and a good linearity for ascorbate determination in the cochlear perilymph of guinea pigs. With such a method, the basal level of cochlear perilymph ascorbate is determined to be 45.0 ± 5.1 μM (n = 6). The microinfusion of 10 mM salicylate (1 μL/min, 5 min) into the cochlear decreases the ascorbate level to 28 ± 10% of the basal level (n = 6) with a statistical significance (P < 0.05), implying that the decrease in ascorbate level in the cochlear may be associated with salicylate-induced tinnitus. This study essentially offers a new method for in vivo monitoring of the cochlear perilymph ascorbate following the salicylate-induced tinnitus and can thus be useful for investigation on chemical essences involved in tinnitus.

Effect of salicylate on the large GABAergic neurons in the inferior colliculus of rats.
Acta Neurol Belg. 2012 May 30. [Epub ahead of print]
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Salicylate, the anti-inflammatory component of aspirin, induces transient tinnitus and hearing loss in clinical and animal experiments. However, the affected sites and mechanisms of generation remain unclear. Recently, down-regulation of inhibitory transmission mediated by γ-aminobutyric acid type A receptors was suggested to be crucial in generating tinnitus. However, the cell-specific pathways involved in this process were far from being understood. Here, we describe changes of inhibitory neurotransmitter, receptor, and glutamatergic axosomatic terminals in certain large GABAergic neurons (LGNs) in the inferior colliculus of rats treated with high doses of salicylate. Based on these results, we suggest that salicylate may affect inhibitory projection pathways from the inferior colliculus to the auditory cortex and lead to neural hyperactivity, perhaps by affecting the function of the LGNs.
Isoflurane blocks temporary tinnitus.
Hear Res. 2012 May 22. [Epub ahead of print]

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Temporary tinnitus is a common consequence of noise exposure, and may share important mechanisms with chronic tinnitus. Noise-induced hearing loss is the most prevalent cause of chronic tinnitus. The reversibility of temporary tinnitus offers some practical experimental advantages. We therefore adapted a behavioral method based on gap detection to measure temporary tinnitus following brief acoustic trauma. Although anesthesia is often used during acoustic trauma exposure, many anesthetics can protect against noise-induced hearing loss. Whether anesthesia during acoustic trauma affects temporary tinnitus therefore remains an open question that directly affects experimental design in tinnitus studies. Here we tested whether anesthetizing rats with isoflurane during trauma had any effect on tinnitus. We found that gap-detection deficits, a behavioral measure of tinnitus, were 5 times stronger and lasted 10 times longer when isoflurane was not used. This suggests that isoflurane largely prevents temporary noise-induced tinnitus. Copyright © 2012 Elsevier B.V. All rights reserved.

Effect of low-level laser treatment on cochlea hair-cell recovery after acute acoustic trauma.

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We investigated the effect of low-level laser radiation on rescuing hair cells of the cochlea after acute acoustic trauma and hearing loss. Nine rats were exposed to noise. Starting the following day, the left ears (NL ears) of the rats were irradiated at an energy output of 100 to 165 mW/cm(2) for 60 min for 12 days in a row. The right ears (N ears) were considered as the control group. Frequency-specific hearing levels were measured before the noise exposure and also after the 1st, 3rd to 5th, 8th to 10th and 12th irradiations. After the 12th treatment, hair cells were observed using a scanning electron microscope. Compared to initial hearing levels at all frequencies, thresholds increased markedly after noise exposure. After the 12th irradiation, hearing threshold was significantly lower for the NL ears compared to the N ears. When observed using an electron microscope, the number of hair cells in the middle turn of the NL ears was significantly larger than that of the N ears. Our findings suggest that low-level laser irradiation promotes recovery of hearing thresholds after acute acoustic trauma.

Gap prepulse inhibition and auditory brainstem-evoked potentials as objective measures for tinnitus in guinea pigs.

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Tinnitus or ringing of the ears is a subjective phantom sensation necessitating behavioral models that objectively demonstrate the existence and quality of the tinnitus sensation. The gap detection test uses the acoustic startle response elicited by loud noise pulses and its gating or suppression by preceding sub-startling prepulses. Gaps in noise bands serve as prepulses, assuming that ongoing tinnitus masks the gap and results in impaired gap detection. This test has shown its reliability in rats, mice, and gerbils. No data exists for the guinea pig so far, although gap detection is similar across mammals and the acoustic startle response is a well-established tool in guinea pig studies of psychiatric disorders and in pharmacological studies. Here we investigated the startle behavior and prepulse inhibition (PPI) of the
guinea pig and showed that guinea pigs have a reliable startle response that can be suppressed by 15 ms gaps embedded in narrow noise bands preceding the startle noise pulse. After recovery of auditory brainstem response (ABR) thresholds from a unilateral noise over-exposure centered at 7 kHz, guinea pigs showed diminished gap-induced reduction of the startle response in frequency bands between 8 and 18 kHz. This suggests the development of tinnitus in frequency regions that showed a temporary threshold shift (TTS) after noise over-exposure. Changes in discharge rate and synchrony, two neuronal correlates of tinnitus, should be reflected in altered ABR waveforms, which would be useful to objectively detect tinnitus and its localization to auditory brainstem structures. Therefore, we analyzed latencies and amplitudes of the first five ABR waves at suprathreshold sound intensities and correlated ABR abnormalities with the results of the behavioral tinnitus testing. Early ABR wave amplitudes up to N3 were increased for animals with tinnitus possibly stemming from hyperactivity and hypersynchrony underlying the tinnitus percept. Animals that did not develop tinnitus after noise exposure showed the opposite effect, a decrease in wave amplitudes for the later waves P4-P5. Changes in latencies were only observed in tinnitus animals, which showed increased latencies. Thus, tinnitus-induced changes in the discharge activity of the auditory nerve and central auditory nuclei are represented in the ABR. Free PMC Article.
Clinical Trials
Source: www.clinicaltrials.gov (September 07, 2012)

**Therapeutic Efficacy of Tiludronic Acid on Inner Ear Involvement in Advanced Otosclerosis (OTOPHOS).**

This study is currently recruiting participants.
Study NCT01617057
Information provided by Assistance Publique - Hôpitaux de Paris
First Received on June 8, 2012.

Otosclerosis is a bone dystrophy localized to middle and inner ears with unknown etiology. It principally concerns adult patients between 30 and 50 years of age. Women present with this disease 2 times more frequently than men. Family cases are observed in 50% with a dominant autosomal transmission and low penetrance (40%). In its early stages, the disease is mainly located at the stapediovestibular joint leading to its ankylosis and a conductive hearing loss. In its advanced stages, the lesions extend around the cochlea and vestibule, induce a sensorineural hearing loss which can progress to severe and profound deafness, and prolonged balance disorders. On CT-scan, disease foci show a demineralization. Their density is inversely correlated to the hearing loss. In early stage, hearing function is currently rehabilitated by conventional hearing aids or surgery. In advanced forms, cochlear involvement is not accessible to surgery, and rehabilitation is insured by hearing aids or cochlear implants. Vestibular dysfunction is dealt with by physiotherapy or symptomatic treatment. Drugs with anabolic activity in bone, such as sodium fluoride and etidronate (first generation bisphosphonate, Didronel ®), appear to reduce the hearing loss and to increase the radiological density of disease foci. However, their efficacy is low and poorly documented. Their effect on vestibular function is unknown.

Moreover, ototoxicity has been reported for etidronate. New biphosphonates such as tiludronic acid (Skelid ®) have a significantly more potent inhibition of bone resorption and do not have an ototoxic effect. They have been used for the treatment or the prevention of postmenopausal osteoporosis and in Paget's disease with mild to moderate adverse effects in the majority of cases.

**rTMS for the Treatment of Chronic Tinnitus: Optimization by Simulation of the Cortical Tinnitus Network (Triple).**

This study is currently recruiting participants.
Study NCT01663324
Information provided by University of Regensburg.
First Received on July 23, 2012.

Tinnitus is the phantom auditory perception of sound in the absence of an external or internal acoustic stimulus. It is a frequent problem which can interfere significantly with the ability to lead a normal life. Treatment remains difficult. Most available therapies focus on habituation rather than treating the cause. Tinnitus has been shown to be associated with functional reorganization of auditory neural pathways and tonotopic maps in the central auditory system. Consequently, low-frequency Repetitive Transcranial Magnetic Stimulation (rTMS) applied to the temporoparietal areas has been investigated for the treatment of tinnitus. Additionally, there is growing evidence that a neural network of both auditory and non-auditory cortical areas is involved in the pathophysiology of chronic subjective tinnitus. Targeting several core regions of this network by rTMS might constitute a promising strategy to enhance treatment effects. A new multisite treatment protocol which is supposed to have an effect on both auditory and non-auditory cortical areas will be examined with regard to feasibility, safety and clinical efficacy in patients suffering from chronic tinnitus in a controlled pilot trial.
Repetitive Transcranial Magnetic Stimulation With Double Cone Coil in Chronic Tinnitus (Ti-CDC).

Verified August 2012 by University of Regensburg.
Study NCT01663311
Information provided by University of Regensburg.
First Received on July 23, 2012.

Tinnitus is the phantom auditory perception of sound in the absence of an external or internal acoustic stimulus. It is a frequent problem which can interfere significantly with the ability to lead a normal life. Treatment remains difficult. Most available therapies focus on habituation rather than treating the cause. Tinnitus has been shown to be generated in the brain, as a result of functional reorganization of auditory neural pathways and tonotopic maps in the central auditory system. Low-frequency rTMS applied to the temporoparietal areas has been investigated for the treatment of hyperexcitability disorders such as auditory hallucinations and tinnitus. Pilot data indicate that taking into account affective components of the multiple overlapping neural networks responsible for the generation of a bothersome subjective tinnitus might enhance the efficacy of Repetitive Transcranial Magnetic Stimulation (rTMS) treatment in chronic tinnitus. A newly developed coil, the so-called double cone coil will be examined with regard to feasibility, safety and clinical efficacy in patients suffering from chronic tinnitus in a controlled pilot trial.

Efficacy of Internet and Smartphone Application-delivered Tinnitus Retraining Therapy.

This study is not yet open for participant recruitment.
Study NCT01663467
Information provided by Seoul National University Hospital.
First Received on August 8, 2012.

The purpose of this study is to prove the efficacy of the internet and smartphone application-delivered tinnitus retraining therapy (TRT).