



2010 / Number 11

# TRI NEWSLETTER

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Dear colleagues and friends,

The New Year marks several changes for TRI. The most important change is that TRI became a permanent organisation. In 2006, when we started, TRI was conceived as a temporary experiment, driven by the goal to find a cure for tinnitus and by the vision that bringing together clinicians and scientists from all over the world can make a change in tinnitus research.

Now, four years later, we have to admit that there still is no magic bullet for the cure of tinnitus at the horizon. Does this mean that TRI failed? Did Columbus fail when he went out to discover the sea route to India?

We might not have achieved, what has been our primary goal, but we learned, that within the tinnitus field there work many, many people who are driven by the idea that tinnitus can be cured and which are willing to collaborate with other people from other disciplines and other countries. The most important experience of the last years is an overwhelming enthusiasm of many people, to work together for a cure, which we met already at the first TRI meeting in Regensburg in July 2006, and which we never expected in this form. It is this enthusiasm which shows us that we are on the right way and that a cure for more and more people with tinnitus can be achieved in the near future. It is also this enthusiasm, which motivated us to continue with TRI and to change its organisation in a more permanent form. These days the Tinnitus Research Initiative Foundation has been finally established. As a foundation TRI will now be able to accept donations and such donations will also be necessary to support TRI as a permanent organisation. Therefore we invite everybody who is affiliated to TRI by one or the other way to think about possibilities to support the existence of TRI in the future. What we can achieve and how fast we can achieve our goals will depend on the financial possibilities we have.

This year's TRI meeting will be the first big event of the newly created TRI foundation. Together with the University of Texas and with the support of the American Tinnitus Association we will organize this year's biggest tinnitus event and want to invite you to join us there for learning about the recent advances in tinnitus research. We also want to invite you to make use of the extended deadline for abstract submission. Till end of February it will be still possible to submit abstracts for posters or oral presentations (More info at <http://www.utdallas.edu/research/tri/>).

Dirk de Ridder      Ana Belén Elgoyhen      Berthold Langguth      Susanne Staudinger

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## Fourth International TRI Tinnitus Conference Frontiers in Tinnitus Research

Organized by the Tinnitus Research Initiative and The University of Texas at Dallas  
and co-sponsored by the American Tinnitus Association

**June 9 - 11, 2010**

Opening: Tuesday, June 8<sup>th</sup>, 2010, in the late afternoon

Venue: **The Adolphus, 1321 Commerce St, Dallas, TX 75202, USA**

Please register at

<http://www.utdallas.edu/research/tri/>

Proposals for free talks, symposia and posters are welcome!

**Deadline for abstract submission  
February 28<sup>th</sup>, 2010**

Conference Topics will include:

Clinical Management of Tinnitus  
Basic Neuroscience  
Sound therapy  
Hearing Aids  
Brain Stimulation  
Imaging, Neurofeedback  
Tinnitus Subtyping etc...

Diagnosis  
Genetics, Pharmacology  
Auditory Training  
Electrical Stimulation of the cochlea  
Somatosensory Modulation  
Nutrition and Diet

**Speakers, who have already confirmed their participation:**

Dirk de Ridder, Belgium  
Ana Belén Elgoyhen, Argentina  
Tobias Kleinjung, Germany  
Aage Møller, USA  
Ranulfo Romo, Mexico

Luca del Bo, Italy  
Paul Fuchs, USA  
Berthold Langguth, Germany  
Larry Roberts, Canada  
Richard Salvi, USA

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## NEWS

### **Tinnitus Research Initiative Foundation**

With effect from February, 1st, 2010, the Tinnitus Research Initiative has become a Foundation. At week 6th of 2010 we received the certificate of approval from the Foundation's Oversight Committee. Amongst others TRI now is able to accept donations.

### **Ralf Buegers (Germany)**

### **Alex-Motsch-Prize 2009 of the German Society for Functional Diagnostic and Therapy (Deutsche Gesellschaft für Funktionsdiagnostik und –therapie DGFDT)**

Each year the Alex-Motsch-Prize is awarded for the best work in the field of functional theory, diagnostic and therapy in dentistry.

Ralf Bürgers received this award for his research project on „Tinnitus patients with craniomandibular dysfunctions (CMD)“.



**March 2010**

**American Auditory Society, Annual Meeting**

**When:** March 4 – 6, 2010  
**Where:** Scottsdale, AZ, USA  
**Contact:** American Auditory Society  
**Detailed Information:** <http://www.amauditorysoc.org/annual-meeting/reginfo.htm>

**DAGA 2010: 36. Jahrestagung der Deutschen Gesellschaft für Akustik DEGA**

**When:** March 15 – 18, 2010  
**Where:** Berlin, Germany  
**Contact:** Dipl.-Ing. Judith Kokavec  
Technische Universität Berlin  
Institut für Strömungsmechanik und Technische Akustik  
Einsteinufer 25  
10587 Berlin  
**E-Mail:** [info2010@daga-tagung.de](mailto:info2010@daga-tagung.de)  
**Detailed Information:** <http://www.daga-tagung.de/2010>

**13. Jahrestagung der Deutschen Gesellschaft für Audiologie (DGA e.V.)**

**When:** March 17 – 20, 2010  
**Where:** Frankfurt, Germany  
**Contact:** Deutsche Gesellschaft für Audiologie e.V., Geschäftsstelle  
c/o Haus des Hörens  
Marie-Curie-Straße 2  
26129 Oldenburg, Germany  
**Phone:** 0049 (0)4 41 2172 500  
**Fax:** 0049 (0)4 41 2172 550  
**E-Mail:** [info@dga-ev.com](mailto:info@dga-ev.com)  
**Detailed information:** [http://www.uzh.ch/orl/dga-ev/Flyer\\_DGA\\_Frankfurt\\_2010.pdf](http://www.uzh.ch/orl/dga-ev/Flyer_DGA_Frankfurt_2010.pdf)

**April 2010**

**AudiologyNOW ! 2010**

**When:** April 14 – 17, 2010  
**Where:** San Diego, CA, USA  
**Detailed information:** <http://www.audiologynow.org/>

**159th Meeting of the Acoustical Society of America (ASA)**

**When:** April 19 – 23, 2010  
**Where:** Miami, Florida, USA  
**Detailed information:** <http://asa.aip.org/meetings.html>



May 2010

## 81. Jahresversammlung der Deutschen Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie e.V.

**When:** May 12 – 16, 2010  
**Where:** Rhein-Main-Hallen, Wiesbaden, Germany  
**Contact:** Deutsche Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie  
Hittorfstr. 7  
53129 Bonn, Germany  
**Phone:** 0049 (0)2 28/23 17 70  
**Fax:** 0049 (0)2 28/23 17 70  
**E-Mail:** [info@hno.org](mailto:info@hno.org)  
**Detailed information:** <http://www.hno.org/veranstaltungen/ankuendigungen.html>

June 2010

## ESPO 2010 European Society of Pediatric Otorhinolaryngology

**When:** June 05 – 08, 2010  
**Where:** Baluarte Conference Centre, Pamplona, Spain  
**Contact:** Secretaría Científica, ORL Congressos, S.L.  
C/ Fundadores, nº 13  
28028 Madrid, Spain  
**Phone:** 0034 91 575 93 93  
**Fax:** 0034 91 431 26 92  
**E-Mail:** [orlcongresos@seorl.net](mailto:orlcongresos@seorl.net)  
**Detailed information:** <http://www.espopamplona2010.com/>

## Human Brain Mapping Annual Meeting

**When:** June 06 – 10, 2010  
**Where:** Barcelona, Spain  
**Detailed information:** [www.humanbrainmapping.org](http://www.humanbrainmapping.org)

## 4th International TRI Tinnitus Conference. Frontiers in Tinnitus Research

**When:** June 9 – 11, 2010  
**Where:** The Adolphus Hotel, Dallas, Texas, USA  
**E-Mail:** [dallas2010@tinnitusresearch.org](mailto:dallas2010@tinnitusresearch.org)  
**Detailed Information:** <http://www.utdallas.edu/research/tri/>



## 4th World Congress of International Federation of Head and Neck Oncologic Societies (IFHNOS)

**When:** June 15 – 19, 2010  
**Where:** Lotte Hotel, Seoul, Korea  
**Contact:** IFHNOS 2010 Congress Secretariat  
c/o Meci International Convention Services, Inc.  
Rm. 1906, 19th floor, Daerung Post Tower #1 212-8 Guro-dong, Guro-gu  
Seoul 152-790, Korea  
**Phone:** 0082 2 2082 2310  
**Fax:** 0082 2 2082 2314  
**E-Mail:** [ifhnos2010@ifhnos2010.org](mailto:ifhnos2010@ifhnos2010.org)  
**Detailed information:** <http://www.ifhnos2010.org/>

## International Conference on Adult Hearing Screening (AHS) 2010

**When:** June 10 - 12, 2010  
**Where:** Cernobbio, Italy  
**E-mail:** [ahs2010@polimi.it](mailto:ahs2010@polimi.it)  
**Detailed Information:** <http://www.ahs2010.polimi.it/>

## CI2010 11th International Conference on Cochlear Implants and other Implantable Auditory Technologies

**When:** June 30 – July 03, 2010  
**Where:** Stockholm International Fairs (Stockholmsmässan), Stockholm, Sweden  
**Contact:** MCI Stockholm  
Box 6911  
102 39 Stockholm, Sweden  
**Phone:** 0046 8 5465 1500  
**Fax:** 0046 8 5465 1599  
**E-Mail:** [ci2010@mci-group.com](mailto:ci2010@mci-group.com)  
**Detailed information:** <http://www.ci2010.com>

September 2010

## Eighteenth Annual Conference on Management of the Tinnitus Patient

**When:** September 16 - 18, 2010  
**Where:** Iowa, IA, USA  
**Detailed information:** [uihealthcare.com/depts/med/otolaryngology/conferences](http://uihealthcare.com/depts/med/otolaryngology/conferences)

## Herbsttagung Arbeitsgemeinschaft Deutschsprachiger Audiologen und Neurootologen (ADANO)

**When:** September 16 – 19, 2010  
**Where:** Zürich, Switzerland  
**Detailed information:** <http://www.hno.org/adano/tagungen.htm>



## **International Symposium on Objective Measures in Auditory Implants**

**When:** September 23 – 25, 2010  
**Where:** St. Louis, MO, USA  
**Detailed information:** <https://cme.wustl.edu/om2010/>

## **IAPA 2010 - XV International Symposium in Audiological Medicine**

**When:** September 26 – 29, 2010  
**Where:** Krakow Poland  
**Contact:** Professor Mariola Sliwinska-Kowalska  
**Detailed Information:** <http://iapa-online.org/symposia/future-symposia/>

## **American Academy of Otolaryngology, Head and Neck Surgery Annual Meeting**

**When:** September September 26 – 29, 2010  
**Where:** Boston, MA, USA  
**Detailed information:** <http://www.entnet.org/ConferencesAndEvents/upcomingconferences.cfm>

**October 2010**

## **55th International Congress of Hearing Aid Acousticians**

**When:** October 13 – 15, 2010  
**Where:** Messe Hannover, Germany  
**Detailed information:** <http://www.euha.org>

**November 2010**

## **ASHA 2009 Annual Convention**

**When:** November 18 – 20, 2010  
**Where:** Philadelphia, PA, USA  
**Detailed information:** <http://www.asha.org/about/events/convention/>



## I Epidemiology

### **Hearing loss and Tinnitus-the hidden healthcare time bomb.**

Drug Discov Today. 2010 Jan 27. [Epub ahead of print]

**Goldman DR, Holme R.**

RNID, 19-23 Featherstone St, London EC1Y 8SL, United Kingdom.

Hearing loss and severe tinnitus affect 16% and 1% percent of the population respectively; the prevalence of both conditions increasing with age. In the next 10 years, the number of individuals over the age of 65 years is set to outnumber those under the age of 5 years for the first time in history [1], and by the year 2040 the number of elderly worldwide is set to soar to 1.3 billion [1]. Such changes in demographics will undoubtedly shape new global approaches to healthcare, with a clear need to address conditions more often faced by the elderly, greatly affecting quality of life but currently dismissed as a 'natural' part of the aging process. Copyright © 2010. Published by Elsevier Ltd

### **Tinnitus in children without hearing impairment.**

Int J Pediatr Otorhinolaryngol. 2009 Dec;73S1:S13-S15.

**Savastano M, Marioni G, de Filippis C.**

Department of Medical-Surgical Specialities, Section of Otorhinolaryngology, University of Padua, Padua, Italy.

**OBJECTIVE:** Tinnitus is not an uncommon symptom in the pediatric population and, despite its incidence, is still an unrecognized problem, particularly in normal hearing children. As tinnitus is frequently described by adults without evidence of ear disease, reports of tinnitus can be obtained also from a group of children without otological pathology. The present review has been performed in order to emphasize the great importance to try to identify children suffering from tinnitus and to recognize the difference between the tinnitus characteristics in children with ear pathology and those one without otological problems. **METHODS:** A review of the literature regarding the nature of pediatric tinnitus and the practical diagnostic approach to this symptom has been carried out. **RESULTS:** Children rarely complain spontaneously of tinnitus but are able to describe it when questioned. In our experience the total percentage of children with tinnitus rises from 6.5% (tinnitus reported spontaneously), to 34% when children are specifically questioned. Most children, more than 50%, have normal hearing; in those with hearing impairment, no particular type or severity of hearing loss has been found. An important point that must be considered much more seriously is tinnitus sequela following head injuries to which children are particularly exposed during their daily activities. Due to the serious consequences that may be caused by tinnitus, it is of great importance to identify and analyze it, so as to minimize its damage, utilizing a protocol of study of pediatric tinnitus which allows to collect interesting informations about tinnitus characteristics. **CONCLUSIONS:** In considering that tinnitus in children exists and may provoke serious consequences, even in absence of ear pathology, it is necessary to investigate and understand more about this symptom in children. From this viewpoint, it is very important to recognize the value of a global evaluation of a child suffering from tinnitus. There is no reason why such an important symptom well reported in adults should not be investigated in the pediatric population in which it seems to be as frequent as in the adult one. It is reasonable to believe that also in children tinnitus may have significant implications for medical and rehabilitative management. Copyright © 2009 Elsevier Ireland Ltd. All rights reserved



## **Dizziness and vertigo in an older population: the Blue Mountains prospective cross-sectional study.**

Clin Otolaryngol. 2009 Dec;34(6):552-6.

**Gopinath B, McMahon CM, Rochtchina E, Mitchell P.**

Centre for Vision Research, Department of Ophthalmology, Westmead Millennium Institute, University of Sydney, Sydney, NSW, Australia.

**OBJECTIVES:** We aimed to reassess the prevalence and personal burden of dizziness/vertigo, and to assess the relationship with hearing loss and tinnitus in older adults. **DESIGN:** Prospective cross-sectional study. **SETTING:** Blue Mountains region, west of Sydney, Australia. **PARTICIPANTS:** We examined 2751 of 2956 (aged 50+ years) Blue Mountains Hearing Study participants. **MAIN OUTCOME MEASURES:** Audiologists screened participants for reported dizziness using a single question. Questions from the Dizziness Handicap Inventory were used to assess the impacts of dizziness/vertigo. Hearing impairment was determined as the pure-tone average of audiometric hearing thresholds at 500, 1000, 2000 and 4000 Hz (PTA(0.5-4 KHz)), defining any hearing loss as PTA(0.5-4 KHz) >25 dB HL. Presence of tinnitus was assessed by a positive response to a single question. Quality of life was measured using the Short Form 36-item Health Survey (SF-36). Each SF-36 dimension was scored from 0 (worst possible health state) to 100 (best possible health state). **RESULTS:** Prevalences of dizziness/vertigo, vestibular vertigo and non-vestibular vertigo were 36.2%, 10.0% and 14.2%, respectively. Of the dizziness/vertigo reports, 27.7% and 39.3%, respectively, were attributed to vestibular and non-vestibular vertigo. Tinnitus was associated with dizziness, odds ratio, OR, 1.99 (95% confidence interval, CI, 1.68-2.35). However, hearing loss was not associated with dizziness/vertigo. Participants reporting dizziness/vertigo had lower quality of life scores ( $P < 0.0001$ ). Participants reporting vestibular vertigo were more likely than those with non-vestibular vertigo to report higher DHI scale scores or a greater handicap. **CONCLUSION:** Our findings highlight the burden imposed by dizziness, indicating dizziness/vertigo are important public health care issues.

## **The effect of tightened hearing protection regulations on military noise-induced tinnitus.**

Int J Audiol. 2009;48(6):394-400.

**Mrena R, Savolainen S, Kiukaanniemi H, Ylikoski J, Mäkitie AA.**

Department of Otolaryngology, Helsinki University Central Hospital, Helsinki, Finland. roderik\_mrena@yahoo.com

The objective of this study was to investigate the effect of tightened hearing protection regulations on tinnitus in the Finnish Defence Forces. The initial study group comprised 252 officers and non-commissioned officers (NCOs), of which 229 were included in the final study group. Subjective symptoms of tinnitus and audiometric test results for these officers and NCOs examined before retirement, from 1984 to 1986 (Period I), and 2003 to 2005 (Period II), were reviewed. Changes in tinnitus reports between the two time periods, during which regulations had been revised, were investigated. Prevalence of tinnitus showed a decline both in officers (from 68% to 63%) and in NCOs (from 76% to 72%) between the two study periods, in accordance with tightened hearing protection regulations. The Cox regression analysis showed a significantly decreased hazard ratio for constant or disturbing tinnitus for Period II. Tinnitus prevalence, especially constant or disturbing tinnitus, in the Finnish Defence Forces was diminished by tightened hearing protection regulations. Tinnitus might be more persistent than hearing loss and does not necessarily improve in direct relation to hearing loss after protective measures



## II Pathophysiology

### **Neural changes in the auditory cortex of awake guinea pigs after two tinnitus inducers: salicylate and acoustic trauma.**

Neuroscience. 2010 Jan 22. [Epub ahead of print]

**Noreña AJ, Moffat G, Blanc JL, Pezard L, Cazals Y.**

Université de Provence, CNRS UMR 6149, Marseille, France.

Tinnitus, also called phantom auditory perception, is a major health problem in western countries. As such, a significant amount of effort has been devoted to understanding its mechanisms, including studies in animals wherein a supposed “tinnitus state” can be induced. Here, we studied on the same awake animals the effects of a high-dose of salicylate and of an acoustic trauma both at levels known to induce tinnitus. Recordings of cortical activity (local field potentials) from chronically implanted electrodes in the same animals under each condition allowed direct comparison of the effects of salicylate and trauma (noise trauma was carried out several days after full recovery from salicylate administration). Salicylate induced a systematic and reversible increase in amplitude of cortical responses evoked by tone bursts over a wide range of frequencies and intensities. The effects of noise trauma, though much more variable than those of salicylate, resulted in both increases and decreases in the amplitude of cortical responses. These alterations of cortical response amplitudes likely reflect associated hypoacusis and hyperacusis. The effects of salicylate administration and noise trauma on spontaneous activity were also studied. Fourier analysis did not reveal any increase in power within any given frequency band; rather, both treatments induced a decrease of power spectrum over a relatively broad frequency band (approximately 10-30 Hz). Entropy rate of spontaneous activity, a measure of complexity (temporal correlations), was found to decrease after salicylate but not after acoustic trauma. The present data on evoked potentials confirm salicylate effects at the cortical level and partially extend such effects to acoustic trauma. While the present study showed that both salicylate and noise trauma induced some changes of spontaneous activity in auditory cortex, none of these changes are interpretable in terms of potential neural correlate of tinnitus. Copyright © 2010 IBRO. Published by Elsevier Ltd. All rights reserved

### **Mild traumatic brain injury (concussion) during combat: lack of association of blast mechanism with persistent postconcussive symptoms.**

J Head Trauma Rehabil. 2010 Jan-Feb;25(1):9-14.

**Wilk JE, Thomas JL, McGurk DM, Riviere LA, Castro CA, Hoge CW.**

Division of Psychiatry and Neuroscience, Walter Reed Army Institute of Research, US Army Medical Research and Materiel Command, Silver Spring, Maryland 20910, USA. [joshua.wilk@amedd.army.mil](mailto:joshua.wilk@amedd.army.mil)

**OBJECTIVE:** To determine whether screening for a blast mechanism of concussion identifies individuals at higher risk of persistent postconcussive symptoms (PCS). **SETTING:** United States Army post. **PARTICIPANTS:** 3952 US Army infantry soldiers were administered anonymous surveys 3 to 6 months after returning from a yearlong deployment to Iraq. **MAIN OUTCOME MEASURES:** Self-reported concussion (defined as an injury that resulted in being “dazed, confused, or ‘seeing stars’”; “not remembering the injury”; or “losing consciousness [knocked out]”); Patient Health Questionnaire 15-item scale for physical symptoms and PCS; Posttraumatic Stress Disorder Checklist; and Patient Health Questionnaire depression module. **RESULTS:** Of the 587 soldiers (14.9% of the total sample) who met criteria for concussion, 201 (34.2%) reported loss of consciousness, and 373 (63.5%) reported only an alteration of consciousness without loss of consciousness; 424 (72.2%) reported a blast mechanism, and 150 (25.6%) reported a nonblast mechanism. Among soldiers who lost consciousness, blast mechanism was significantly associated with headaches and tinnitus 3 to 6 months postdeployment compared with a nonblast mechanism. However, among the larger group of soldiers reporting concussions without loss of consciousness, blast was not associated with adverse health outcomes.



**CONCLUSIONS:** Blast mechanism of concussion was inconsistently associated with PCS, depending on the definition of concussion utilized. A self-reported history of blast mechanism was not associated with persistent PCS for the majority of US soldiers with concussions.

**Polymorphisms in KCNE1 or KCNE3 are not associated with Ménière disease in the Caucasian population.**

Am J Med Genet A. 2010 Jan;152A(1):67-74.

**Campbell CA, Della Santina CC, Meyer NC, Smith NB, Myrie OA, Stone EM, Fukushima K, Califano J, Carey JP, Hansen MR, Gantz BJ, Minor LB, Smith RJ.**

Molecular Otolaryngology Research Laboratories, Department of Otolaryngology - Head and Neck Surgery, University of Iowa, Iowa City, IA 52242, USA.

Ménière disease (MD) is a complex disorder of unknown etiology characterized by the symptom triad of vertigo, sensorineural hearing loss, and tinnitus. Its reported incidence is 1-2 per 1,000 in Caucasians and 0.03-0.37 per 1,000 in Japanese. Doi et al. [Doi et al. (2005); ORL J Otorhinolaryngol Relat Spec 67:289-293] recently reported that two single nucleotide polymorphisms (SNPs) in KCNE1 and KCNE3 are associated with MD in Japanese subjects. Consistent with this possibility, these two genes encode potassium channels that are expressed in the stria vascularis and endolymphatic sac, respectively, and their role in ion transport suggests that they may be important in inner ear homeostasis. To establish whether a similar association exists in the Caucasian MD population, we sequenced the coding regions and exon-intron boundaries of both genes in 180 Caucasian persons with MD and 180 matched Caucasian controls. Neither of the two reported SNPs was significantly associated with MD when compared to the Caucasian controls (KCNE1,  $P = 0.55$ ; KCNE3,  $P = 0.870$ ). Comparison of allele frequencies between the Japanese MD population and our study population revealed no significant difference between groups (KCNE1,  $P = 0.90$ ; KCNE3,  $P = 0.862$ ), suggesting that the significant differences reported in the Japanese study arose from their control population. Six additional SNPs in both KCNE1 and KCNE3 were genotyped and none was associated with MD. Population stratification within our MD and Caucasian control population was excluded. Our data show that SNPs in KCNE1 and KCNE3 are not associated with MD in Caucasians

**Music exposure and hearing disorders: an overview.**

Int J Audiol. 2010 Jan;49(1):54-64.

**Zhao F, Manchaiah VK, French D, Price SM.**

Centre for Hearing and Balance Studies, University of Bristol, Bristol, UK. fei.zhao@bristol.ac.uk

It has been generally accepted that excessive exposure to loud music causes various hearing symptoms (e.g. tinnitus) and consequently leads to a risk of permanent hearing damage, known as noise-induced hearing loss (NIHL). Such potential risk of NIHL due to loud music exposure has been widely investigated in musicians and people working in music venues. With advancements in sound technology and rapid developments in the music industry, increasing numbers of people, particularly adolescents and young adults, are exposing themselves to music on a voluntary basis at potentially harmful levels, and over a substantial period of time, which can also cause NIHL. However, because of insufficient audiometric evidence of hearing loss caused purely by music exposure, there is still disagreement and speculation about the risk of hearing loss from music exposure alone. Many studies have suggested using advanced audiological measurements as more sensitive and efficient tools to monitor hearing status as early indicators of cochlear dysfunction. The purpose of this review is to provide further insight into the potential risk of hearing loss caused by exposure to loud music, and thus contribute to further raising awareness of music induced hearing loss.



## **Further genotype--phenotype correlations in neurofibromatosis 2.**

Clin Genet. 2010 Feb;77(2):163-70. Epub 2009 Nov 23.

**Selvanathan SK, Shenton A, Ferner R, Wallace AJ, Huson SM, Ramsden RT, Evans DG.**

Department of Genetics, St Mary's Hospital, Manchester, UK.

Neurofibromatosis 2 (NF2) is caused by mutations in the NF2 gene predisposing carriers to develop nervous system tumours. Different NF2 mutations result in either loss/reduced protein function or gain of protein function (abnormally behaving mutant allele i.e. truncated protein potentially causing dominant negative effect). We present a comparison between the clinical presentations of patients with mutations that are predicted to produce truncated protein (nonsense/frameshift mutations) to those that results in loss of protein expression (large deletions) to elucidate further genotype-phenotype correlations in NF2. Patients with nonsense/frameshift mutations have a younger age of diagnosis and a higher prevalence/proportion of meningiomas ( $p = 0.002$ ,  $p = 0.014$ ), spinal tumours ( $p = 0.004$ ,  $p = 0.004$ ) and non-VIII cranial nerve tumours ( $p = 0.006$ ,  $p = 0.003$ ). We also found younger age of diagnosis of vestibular schwannomas ( $p = 0.007$ ), higher mean numbers of cutaneous lesions ( $p = 0.003$ ) and spinal tumours ( $p = 0.006$ ) in these patients. With respect to NF2 symptoms, we found younger age of onset of hearing loss ( $p = 0.010$ ), tinnitus ( $p = 0.002$ ), paraesthesiae ( $p = 0.073$ ), wasting and weakness ( $p = 0.001$ ) and headaches ( $p = 0.049$ ) in patients with nonsense/frameshift mutations. Our comparison shows, additional, new correlations between mutations in the NF2 gene and the NF2 disease phenotype, and this further confirms that nonsense/frameshift mutations are associated with more severe NF2 symptoms. Therefore patients with this class of NF2 mutation should be followed up closely

## **Behavioral assessment and identification of a molecular marker in a salicylate-induced tinnitus in rats.**

Neuroscience. 2010 Feb 17;165(4):1323-1332. Epub 2009 Dec 1.

**Kizawa K, Kitahara T, Horii A, Maekawa C, Kuramasu T, Kawashima T, Nishiike S, Doi K, Inohara H.**

Department of Otolaryngology-Head and Neck Surgery, Osaka University, School of Medicine, 2-2 Yamada-oka, Suita-City, Osaka 565-0871, Japan.

Tinnitus is a non-observable phantom sensation. As such, it is a difficult condition to investigate and, to date, no effective treatment has been developed. To approach this phantom sensation, we aimed to develop a rat behavioral model of tinnitus using salicylate, an active component of aspirin known to induce tinnitus. We also aimed to establish a molecular marker of tinnitus by assessing the expression of transient receptor potential cation channel superfamily V-1 (TRPV1) in the rat auditory pathway during salicylate-induced tinnitus. Animals were trained to perform „an active avoidance task“: animals were conditioned by electrical footshock to move to the other side of the conditioning box when hearing a sound. Animals received a single injection of saline or salicylate (400 mg/kg i.p.) and false positive responses were measured 2 h after injection as the number of movements during a silent period. The number of responses in salicylate-treated animals was highest when the conditioned stimulus was 60 dB sound pressure level (SPL) and 16 kHz. This indicates that animals could feel tinnitus 2 h after salicylate injection, equivalent to that induced by 60 dB SPL and 16 kHz. By means of real-time PCR and western blot analysis, TRPV1 expression was significantly upregulated in spiral ganglion cells 2 h after salicylate injection and this upregulation together with the increase in the number of false positive responses was significantly suppressed by capsazepine (10 mg/kg i.p.), a specific antagonist of TRPV1. This suggests that salicylate could induce tinnitus through activation of TRPV1 in the rat auditory pathway. Copyright © 2010 IBRO. Published by Elsevier Ltd. All rights reserved.



### **The effect of tightened hearing protection regulations on military noise-induced tinnitus.**

Int J Audiol. 2009;48(6):394-400.

**Mrena R, Savolainen S, Kiukaanniemi H, Ylikoski J, Mäkitie AA.**

Department of Otolaryngology, Helsinki University Central Hospital, Helsinki, Finland. roderik\_mrena@yahoo.com

The objective of this study was to investigate the effect of tightened hearing protection regulations on tinnitus in the Finnish Defence Forces. The initial study group comprised 252 officers and non-commissioned officers (NCOs), of which 229 were included in the final study group. Subjective symptoms of tinnitus and audiometric test results for these officers and NCOs examined before retirement, from 1984 to 1986 (Period I), and 2003 to 2005 (Period II), were reviewed. Changes in tinnitus reports between the two time periods, during which regulations had been revised, were investigated. Prevalence of tinnitus showed a decline both in officers (from 68% to 63%) and in NCOs (from 76% to 72%) between the two study periods, in accordance with tightened hearing protection regulations. The Cox regression analysis showed a significantly decreased hazard ratio for constant or disturbing tinnitus for Period II. Tinnitus prevalence, especially constant or disturbing tinnitus, in the Finnish Defence Forces was diminished by tightened hearing protection regulations. Tinnitus might be more persistent than hearing loss and does not necessarily improve in direct relation to hearing loss after protective measures

### **Significance of serotonin transporter gene polymorphism in tinnitus.**

Otol Neurotol. 2010 Jan;31(1):19-24.

**Deniz M, Bayazit YA, Celenk F, Karabulut H, Yilmaz A, Gunduz B, Saridogan C, Dagli M, Erdal E, Menevse A.**

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**OBJECTIVES:** To assess the role of serotonin transporter gene (SLC6A4) polymorphism in tinnitus. **MATERIALS AND METHODS:** Fifty-four consecutive patients experiencing subjective tinnitus and 174 healthy controls were allocated for the study. Psychoacoustic parameters of tinnitus were measured. Beck Depression Inventory was used to assess the depression level of the patients. Tinnitus Handicap Inventory was used to assess the severity of tinnitus. A visual analog scale was designed to measure the impact of tinnitus on quality of life of the patients. The 44-bp insertion-deletion in the promoter region (5-HTTLPR) and 17-bp variable number tandem repeats in the second intron of the serotonin transporter gene were assessed. **RESULTS:** No difference was found between the genotypes and allele frequencies of the patients and controls regarding variable number tandem repeats and 5-HTTLPR polymorphisms ( $p > 0.05$ ). There was no association between the psychoacoustic parameters of tinnitus and SLC6A4 polymorphism ( $p > 0.05$ ). There was a significant association between the 5-HTTLPR polymorphism and scores from the visual analog scale of the patients ( $p < 0.05$ ). **CONCLUSION:** Generation of tinnitus signal is not associated with SLC6A4 polymorphism and possibly with serotonergic mechanisms. However, the „ll“ genotype variant of the SLC6A4 polymorphic promoter region seems associated with the limbic and autonomic nervous system symptoms of the patients with tinnitus. Therefore, serotonergic mechanisms may help explain the neurophysiological model of tinnitus, and serotonin replacement or serotonin reuptake inhibitors may increase the success rate of tinnitus treatment modalities based on the neurophysiologic model of tinnitus.



## **Is there a correlation between vascular loops in the cerebellopontine angle and unexplained unilateral hearing loss?**

Otol Neurotol. 2010 Jan;31(1):48-52.

**Gorrie A, Warren FM 3rd, de la Garza AN, Shelton C, Wiggins RH 3rd.**

School of Medicine & Dentistry, University of Aberdeen, Aberdeen, Scotland.

**OBJECTIVE:** This study was a retrospective analysis of patients who had received magnetic resonance imaging scans of the internal auditory canal (IAC) to evaluate unexplained asymmetric hearing loss. The study aimed to correlate structural features of vascular loops formed by the anterior inferior cerebellar artery (AICA) within the cerebellopontine angle and IAC with asymmetric hearing loss. **STUDY DESIGN:** High-resolution thin-section T2 fast spin echo magnetic resonance imaging scans of 58 patients with asymmetric sensorineural hearing loss were obtained; the structure of the AICA was graded on both sides using 2 scoring systems. The grading senior head and neck radiologist was blinded to the clinical history. The first scoring system used was the Chavda classification, which is based on the anatomic location of the AICA loop. This system identified 92 loops within the cerebellopontine angle; 22 loops extending less than halfway into the IAC and 2 loops extending more than halfway into the IAC. A second classification system was used simultaneously to describe the extent of contact between the AICA loop and the vestibulocochlear nerve. The second system identified 24 loops that were not in contact with the nerve, 60 in which the loop was running adjacent to the nerve but not displacing it; 12 loops were identified that were displacing the vestibulocochlear nerve, and 24 loops were identified running between the facial and the vestibulocochlear nerve. Four loops were classified as both displacing the vestibulocochlear nerve and running between the facial and vestibulocochlear nerves. Tinnitus was present in addition to hearing loss. In 48 of the 58 patients, the statistical analysis was repeated for these patients. **RESULTS:** No statistically significant association was found between loops classified by the Chavda system and hearing loss. No statistically significant association was present between loops that made no contact with the nerve, ran adjacent to the nerve, or displaced the nerve. A statistically significant association was found between loops that ran between the facial and vestibulocochlear nerve and hearing loss, with a p value of 0.0162. The subset who had tinnitus in addition to hearing loss had similar results, with the only significant association being found between loops running between the facial nerve and the vestibulocochlear nerve, and a p value of 0.0433 was obtained. **CONCLUSION:** A correlation between vascular loops and hearing loss did not exist in the majority of the patients in this study. The subset of patients that had a vessel between the facial and vestibular cochlear nerves deserve further investigation.

## **III Diagnostics**

### **The relationship between tinnitus pitch and the edge frequency of the audiogram in individuals with hearing impairment and tonal tinnitus.**

Hear Res. 2010 Jan 12. [Epub ahead of print]

**Moore BC, Vinay, Sandhya.**

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Some theories of mechanisms of tinnitus generation lead to the prediction that the pitch associated with tonal tinnitus should be related to the “edge frequency” of the audiogram,  $f(e)$ , the frequency at which hearing loss worsens relatively abruptly. However, previous studies testing this prediction have provided little or no support for it. Here, we reexamined the relationship between tinnitus pitch and  $f(e)$ , using 11 subjects selected to have mild-to-moderate hearing loss and tonal tinnitus. Subjects were asked to compare the pitch of their tinnitus to that of a sinusoidal tone whose frequency and level were adjusted by the experimenter. Prior to testing in the main experiment, subjects were given specific training to help them to avoid octave errors in their pitch matches. Pitch matches made after this training were generally



lower in frequency than matches made before such training, often by one or two octaves. The matches following training were highly reproducible. A clear relationship was found between the values of  $f(e)$  and the mean pitch matches following training; the correlation was 0.94. Generally, the pitch matches were close in value to the values of  $f(e)$ . Copyright © 2010 Elsevier B.V. All rights reserved

### **Hearing abilities at ultra-high frequency in patients with tinnitus.**

Clin Exp Otorhinolaryngol. 2009 Dec;2(4):169-74. Epub 2009 Dec 31.

**Shim HJ, Kim SK, Park CH, Lee SH, Yoon SW, Ki AR, Chung DH, Yeo SG.**

Department of Otorhinolaryngology, Eulji University College of Medicine, Seoul, Korea.

**OBJECTIVES:** To compare tinnitus patients who have normal hearing between 250 Hz and 8 kHz with normal controls with regard to the ability of each group to hear extended high-frequency pure tone thresholds. **METHODS:** We enrolled 18 tinnitus patients, each of whom had a threshold of HL <25 dB and threshold differences of <10 dB between ears at frequencies of 250 and 500 Hz and 1, 2, 4, and 8 kHz. We also enrolled age- and gender-matched normal volunteers (10 ears), for each patient. Extended high frequency pure tone audiometry was performed, and the mean hearing thresholds at 10, 12, 14, and 16 kHz of each tinnitus ear were compared with those of the 10 age- and sex-matched normal ears. **RESULTS:** Of the 18 patients with tinnitus, 12 had significantly increased hearing thresholds at more than one of the four high frequencies, compared with the normal group. When we assessed results according to frequency, we found that 8 patients had decreased hearing ability at 10 kHz, 10 at 12 kHz, 8 at 14 kHz, and 4 at 16 kHz. **CONCLUSION:** Some patients with tinnitus who have normal hearing below 8 kHz have decreased hearing ability at extended high-frequencies. Thus, the proportion of patients with tinnitus who have normal hearing over the entire audible range is smaller than in previous reports.

### **Influence of Cochlear Function on Auditory Temporal Resolution in Tinnitus Patients.**

Audiol Neurootol. 2010 Jan 6;15(5):273-281. [Epub ahead of print]

**Sanches SG, Sanchez TG, Carvallo RM.**

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Our aim was to analyze the influence of subtle cochlear damage on temporal auditory resolution in tinnitus patients. Forty-eight subjects (hearing threshold  $\leq 25$  dB HL) were assigned to one of two experimental groups: 28 without auditory complaints (mean age, 28.8 years) and 20 with tinnitus (mean age, 33.5 years). We analyzed distortion product otoacoustic emission growth functions (by threshold, slope, and estimated amplitude), extended high-frequency thresholds, and the Gaps-in-Noise test. There were differences between the groups, principally in the extended high-frequency thresholds and the Gaps-in-Noise test results. Our findings suggest that subtle peripheral hearing impairment affects temporal resolution in tinnitus, even when pure-tone thresholds as conventionally measured appear normal. Copyright © 2010 S. Karger AG, Basel.

### **Correlation between hyperacusis measurements in daily ENT practice.**

Int J Audiol. 2010 Jan;49(1):7-13.

**Meeus OM, Spaepen M, Ridder DD, Heyning PH.**

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The aim of this study was to investigate hyperacusis measurement tools and to assess the correlation between diagnostic methods for hyperacusis in daily ENT practice. We studied two hyperacusis questionnaires: the Hyperacusis Questionnaire (HQ) and the Multiple-Activity Scale for Hyperacusis (MASH), audiometric measurements (uncomfortable loudness level (ULL) and dynamic range (DR)), and the questions 'Do you have a lower tolerance for noise...?' and 'Are you afraid of noise?' Hyperacusis



was assessed in 46 patients presenting with primary complaints of tinnitus. A validated Dutch version of the HQ is provided. A correlation was found between scores on the HQ and the MASH ( $p=0.000$ ,  $R(2)=0.34$ ). Significantly higher scores for both questionnaires were found in patients reporting decreased sound tolerance ( $p=0.000$  and  $0.002$ , respectively) or fear of noise ( $p=0.002$  and  $0.004$ , respectively). Overall, no correlations were found between scores on questionnaires and audiometric values including ULL and DR. The HQ and MASH were confirmed to be valid measurement tools for hyperacusis complaints. No correlations were found between audiometric measurements and hyperacusis complaints.

### **Variety of audiologic manifestations in patients with superior semicircular canal dehiscence.**

Otol Neurotol. 2010 Jan;31(1):2-10.

**Chi FL, Ren DD, Dai CF.**

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**OBJECTIVE:** To present diverse symptoms, signs, and findings on diagnostic tests of 11 patients with superior semicircular canal dehiscence (SSCD) syndrome and surgical treatments for dehiscence of 3 patients. **STUDY DESIGN:** Retrospective case review. **SETTING:** Tertiary neurotologic and audiologic center. **PATIENTS:** Patients with SSCD documented by history, physical examination, vestibular function testing, and high-resolution computed tomographic scans. **INTERVENTION:** Two patients underwent surgical procedures through middle fossa approach, and 1 patient underwent transmastoid repair. The rest underwent conservative treatments. **RESULTS:** Eleven patients were identified as SSCD. The variety of clinical manifestations, including 1) hearing presentations: mix hearing loss (4 of 11), conductive hearing loss (3 of 11), profound sensorineural hearing loss (2 of 11), and normal hearing (2 of 11); 2) vestibular manifestations: chronic disequilibrium (8 of 11), Tullio phenomenon (7 of 11), Hennebert sign (8 of 11), tinnitus (3 of 11), and autophony (3 of 11); and 3) accompanying disorders: encephalomeningocele (1 of 11). Abnormal nystagmus was identified in 3 patients. Dehiscence of bone overlying superior semicircular canal was confirmed by high-resolution computed tomographic scan in all cases. Three patients underwent operative management. (2 through the middle fossa approach and 1 through a transmastoid repair). **CONCLUSION:** Superior semicircular canal dehiscence demonstrates diverse and complex clinical features. Tegmental or petrosal bone rarefaction or mild dehiscences can be a harbinger or an aggressive cause of developing SSCD. No correlation was observed between the size of dehiscence and the severity of vestibular symptoms or the degree of hearing loss. Surgical repair of dehiscence can relieve symptoms with low morbidity.

### **Clinical spectrum of patients with erosion of the inner ear by jugular bulb abnormalities.**

Laryngoscope. 2010 Feb;120(2):365-72.

**Friedmann DR, Le BT, Pramanik BK, Lalwani AK.**

Department of Otolaryngology, New York University School of Medicine, New York, New York 10016, USA.

**OBJECTIVES/HYPOTHESIS:** Anatomic variants of the jugular bulb (JB) are common; however, abnormalities such as large high riding JB and JB diverticulum (JBD) are uncommon. Rarely, the abnormal JB may erode into the inner ear. The goal of our study is to report a large series of patients with symptomatic JB erosion into the inner ear. **STUDY DESIGN:** Retrospective review in an academic medical center. **METHODS:** Eleven patients with JB abnormality eroding into the inner ear were identified on computed tomography (CT) scan of the temporal bone. **RESULTS:** Age at presentation was from 5 years to 82 years with six males and five females. The large JB or JBD eroded into the vestibular aqueduct ( $n = 9$ ) or the posterior semicircular canal ( $n = 4$ ). The official radiology report usually identified the JB abnormality; however, erosion into these structures by the JB was not mentioned in all but one case. All patients were symptomatic with five having conductive hearing loss (CHL) and three



complaining of pulsatile tinnitus. Those with pulsatile tinnitus and four of five with CHL had erosion into the vestibular aqueduct. Vestibular evoked myogenic potential (VEMP) findings in three of six patients were consistent with dehiscence of the inner ear. **CONCLUSIONS:** High riding large JB or JBD can erode into the inner ear and may be associated with CHL and/or pulsatile tinnitus. CT scan is diagnostic and should be examined specifically for these lesions. As patients with pulsatile tinnitus may initially undergo a magnetic resonance imaging scan, identification of JB abnormality should prompt CT scan or VEMP testing to evaluate for inner ear erosion.

### **Is there a correlation between vascular loops in the cerebellopontine angle and unexplained unilateral hearing loss?**

Otol Neurotol. 2010 Jan;31(1):48-52.

**Gorrie A, Warren FM 3rd, de la Garza AN, Shelton C, Wiggins RH 3rd.**

School of Medicine & Dentistry, University of Aberdeen, Aberdeen, Scotland.

**OBJECTIVE:** This study was a retrospective analysis of patients who had received magnetic resonance imaging scans of the internal auditory canal (IAC) to evaluate unexplained asymmetric hearing loss. The study aimed to correlate structural features of vascular loops formed by the anterior inferior cerebellar artery (AICA) within the cerebellopontine angle and IAC with asymmetric hearing loss. **STUDY DESIGN:** High-resolution thin-section T2 fast spin echo magnetic resonance imaging scans of 58 patients with asymmetric sensorineural hearing loss were obtained; the structure of the AICA was graded on both sides using 2 scoring systems. The grading senior head and neck radiologist was blinded to the clinical history. The first scoring system used was the Chavda classification, which is based on the anatomic location of the AICA loop. This system identified 92 loops within the cerebellopontine angle; 22 loops extending less than halfway into the IAC and 2 loops extending more than halfway into the IAC. A second classification system was used simultaneously to describe the extent of contact between the AICA loop and the vestibulocochlear nerve. The second system identified 24 loops that were not in contact with the nerve, 60 in which the loop was running adjacent to the nerve but not displacing it; 12 loops were identified that were displacing the vestibulocochlear nerve, and 24 loops were identified running between the facial and the vestibulocochlear nerve. Four loops were classified as both displacing the vestibulocochlear nerve and running between the facial and vestibulocochlear nerves. Tinnitus was present in addition to hearing loss. In 48 of the 58 patients, the statistical analysis was repeated for these patients. **RESULTS:** No statistically significant association was found between loops classified by the Chavda system and hearing loss. No statistically significant association was present between loops that made no contact with the nerve, ran adjacent to the nerve, or displaced the nerve. A statistically significant association was found between loops that ran between the facial and vestibulocochlear nerve and hearing loss, with a p value of 0.0162. The subset who had tinnitus in addition to hearing loss had similar results, with the only significant association being found between loops running between the facial nerve and the vestibulocochlear nerve, and a p value of 0.0433 was obtained. **CONCLUSION:** A correlation between vascular loops and hearing loss did not exist in the majority of the patients in this study. The subset of patients that had a vessel between the facial and vestibular cochlear nerves deserve further investigation.

### **Jugular foramen tumors: clinical characteristics and treatment outcomes.**

Otol Neurotol. 2010 Feb;31(2):299-305.

**Fayad JN, Keles B, Brackmann DE.**

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**OBJECTIVE:** To describe the diagnosis, management, and treatment outcome of jugular foramen (JF) tumors. **STUDY DESIGN:** Retrospective chart review. **METHODS:** Charts of the 83 patients diagnosed with JF tumors between January 1997 and May 2008 were reviewed. Presenting symptoms, otologic and neurotologic examination, audiologic thresholds, treatment procedure, surgical technique, tumor size



and classification, and postoperative complications were recorded. Facial nerve function was graded using the House-Brackmann scale. Extent of tumor removal was determined at time of surgery, followed by routine radiographic follow-up. **RESULTS:** The mean age of patients with JF tumors was 48.5 years (standard deviation, 16.3 yr), and women (79.5%) outnumbered men (20.5%). Most had glomus jugulare (GJ) tumors (n = 67, 80.7%); 9 patients had lower cranial nerve schwannomas (10.8%), and 7 patients had meningiomas (8.4%). The most frequent initial symptoms included pulsatile tinnitus (84.3%), conductive hearing loss (75.9%), and hoarseness (34.9%). Sixty-one patients (73.5%) underwent surgery, 18.1% had radiotherapy, and 8.4% were observed. Total tumor removal was achieved in 81% of surgery cases. New lower cranial nerve (CN) deficits occurred after surgery in 18.9% of GJ, 22.2% of schwannoma, and 50% of the 4 meningiomas. At last follow-up, 88.1% of surgical patients had normal or near-normal (House-Brackmann I or II) facial function. **CONCLUSION:** Total resection of GJ tumors, meningiomas, and lower CN schwannomas can be a curative treatment. However, subtotal removal may be required to preserve CN function, vital vascular structures, and the brainstem. Postoperative radiotherapy is used to control residual tumor. When postoperative complications develop in patients, early rehabilitation is important to decrease mortality and morbidity. Therefore, patients should be closely followed.

### **DPOAE in estimation of the function of the cochlea in tinnitus patients with normal hearing.**

Auris Nasus Larynx. 2010 Feb;37(1):55-60. Epub 2009 Jun 26.

**Sztuka A, Pospiech L, Gawron W, Dudek K.**

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**OBJECTIVE:** The most probable place generating tinnitus in the auditory pathway is the outer hair cells (OHCs) inside the cochlea. Otoacoustic emissions are used to assess their activity. The objective of the investigation was to measure the features of distortion product otoacoustic emissions (DPOAE) in a group of tinnitus patients without hearing loss, estimate the diagnostic value of the parameters for the analysis of cochlear function in the patients, emphasizing those most useful in localizing tinnitus generators, and determine the hypothetical influence of hyperacusis and misophony on DPOAE parameters in tinnitus patients. **PATIENTS AND METHODS:** The material consisted of 44 patients with tinnitus and without hearing loss. In the control group were 33 patients without tinnitus with the same state of hearing. The tinnitus patients were divided into three subgroups: those with hyperacusis, those with misophonia, and those with neither. After collecting medical history and performing clinical examination of all the patients, tonal and impedance audiometry, ABR, and discomfort level were evaluated. Then DPOAE were measured using three procedures. First the amplitudes of two points per octave were assessed, second the „fine structure“ method with 16-20 points per octave ( $f_2/f_1=1.22$ ,  $L_1=L_2=70\text{dB}$ ), and the third procedure included recording the growth function in three series for input tones of  $f_2=2002$ , 4004, and 6006Hz ( $f_2/f_1=1.22$ ) and  $L_1=L_2$  levels increasing by increments of 5dB in each series. **RESULTS AND CONCLUSIONS:** Hyperacusis was found in 63% and misophonia in 10% of the tinnitus patients with no hearing loss. DPOAE amplitudes in recordings with two points per octave and the fine structure method are very valuable parameters for estimating cochlear function in tinnitus patients with normal hearing. Function growth rate cannot be the only parameter in measuring DPOAE in tinnitus patients, including subjects with hyperacusis and misophonia. The markedly higher DPOAE amplitudes in the group of tinnitus patients without hearing loss suggest that tinnitus may be caused by increased motility of the OHCs induced by decreasing efferent fiber activity, and not by OHC failure. Hyperacusis significantly increases the amplitude of DPOAE in tinnitus patients with no hearing loss. Copyright © 2009 Elsevier Ireland Ltd. All rights reserved.



## IV Imaging

### **Functional and structural aspects of tinnitus-related enhancement and suppression of auditory cortex activity.**

Neuroimage. 2010 Jan 26. [Epub ahead of print]

**Diesch E, Andermann M, Flor H, Rupp A.**

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The steady-state auditory evoked magnetic field was recorded in tinnitus patients and controls, both either musicians or non-musicians, all of them with high-frequency hearing loss. Stimuli were AM-tones with two modulation frequencies and three carrier frequencies matching the “audiometric edge”, i.e. the frequency above which hearing loss increases more rapidly, the tinnitus frequency or the frequency 1(1/2) octaves above the audiometric edge in controls, and a frequency 1(1/2) octaves below the audiometric edge. Stimuli equated in carrier frequency, but differing in modulation frequency, were simultaneously presented to the two ears. The modulation frequency-specific components of the dual steady-state response were recovered by bandpass filtering. In both hemispheres, the source amplitude of the response was larger for contralateral than ipsilateral input. In non-musicians with tinnitus, this laterality effect was enhanced in the hemisphere contralateral and reduced in the hemisphere ipsilateral to the tinnitus ear, especially for the tinnitus frequency. The hemisphere-by-input laterality dominance effect was smaller in musicians than in non-musicians. In both patient groups, source amplitude change over time, i.e. amplitude slope, was increasing with tonal frequency for contralateral input and decreasing for ipsilateral input. However, slope was smaller for musicians than non-musicians. In patients, source amplitude was negatively correlated with the MRI-determined volume of the medial partition of Heschl’s gyrus. Tinnitus patients show an altered excitatory-inhibitory balance reflecting the downregulation of inhibition and resulting in a steeper dominance hierarchy among simultaneous processes in auditory cortex. Direction and extent of this alteration are modulated by musicality and auditory cortex volume. Copyright © 2010 Elsevier Inc. All rights reserved

### **Functional brain abnormalities localized in 55 chronic tinnitus patients: fusion of SPECT coincidence imaging and MRI.**

J Cereb Blood Flow Metab. 2010 Jan 13. [Epub ahead of print]

**Farhadi M, Mahmoudian S, Saddadi F, Karimian AR, Mirzaee M, Ahmadizadeh M, Ghasemikian K, Gholami S, Ghoreyshi E, Beyty S, Shamshiri A, Madani S, Bakaev V, Moradkhani S, Raesali G.**

Iran National Science Foundation (INSF), Otolaryngology and Head and Neck Research Center, Iran University of Medical Sciences, Hazrate Rasoul Hospital, Tehran, Iran.

Tinnitus is often defined as the perception of sounds or noise in the absence of any external auditory stimuli. The pathophysiology of subjective idiopathic tinnitus remains unclear. The aim of this study was to investigate the functional brain activities and possible involved cerebral areas in subjective idiopathic tinnitus patients by means of single photon emission computerized tomography (SPECT) coincidence imaging, which was fused with magnetic resonance imaging (MRI). In this cross-sectional study, 56 patients (1 subject excluded) with subjective tinnitus and 8 healthy controls were enrolled. After intravenous injection of 5 mCi F18-FDG (fluorodeoxyglucose), all subjects underwent a brain SPECT coincidence scan, which was then superimposed on their MRIs. In the eight regions of interest (middle temporal, inferotemporal, medial temporal, lateral temporal, temporoparietal, frontal, frontoparietal, and parietal areas), the more pronounced values were represented in medial temporal, inferotemporal, and temporoparietal areas, which showed more important proportion of associative auditory cortices in functional attributions of tinnitus than primary auditory cortex. Brain coincidence SPECT scan, when fused on MRI is a valuable technique in the assessment of patients with tinnitus and could show the significant role of different regions of central nervous system in functional attributions of tinnitus. Journal of Cerebral Blood Flow & Metabolism advance online publication, 13 January 2010; doi:10.1038/jcbfm.2009.254.

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## V Pharmacotherapy

### **Caffeine abstinence: an ineffective and potentially distressing tinnitus therapy.**

Int J Audiol. 2010 Jan;49(1):24-9.

**Claire LS, Stothart G, McKenna L, Rogers PJ.**

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The effect of phased caffeine withdrawal and abstinence on tinnitus severity was assessed using a pseudo-randomized, double-blinded, placebo-controlled crossover trial of 30 days duration. Sixty-six volunteers who experienced tinnitus and who usually consumed at least 150 mg/day of caffeine participated. The intervention was a direct replacement of usual caffeinated tea/coffee with double-blinded supplies, under one of two conditions. Condition 1: Maintenance followed by phased withdrawal. Condition 2: Phased withdrawal followed by reintroduction and maintenance. Tinnitus severity was measured by the total score of the Tinnitus Questionnaire on Days 1, 15, and 30. Secondary measures included twice daily self-rated symptoms relevant to tinnitus and caffeine withdrawal. Caffeine had no effect on tinnitus severity, the mean difference between caffeinated and decaffeinated days being -0.04 (95% confidence interval -1.99 to 1.93),  $p=0.97$ . Significant acute adverse symptoms of caffeine withdrawal were observed. No evidence was found to justify caffeine abstinence as a therapy to alleviate tinnitus, but acute effects of caffeine withdrawal might add to the burden of tinnitus.

### **Ginkgo biloba and ginkgotoxin.**

J Nat Prod. 2010 Jan;73(1):86-92.

**Leistner E, Drewke C.**

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Products prepared from Ginkgo biloba are top-selling phytopharmaceuticals especially in Europe and major botanical dietary supplements in the United States. In European medicine, G. biloba medications are used to improve memory, to treat neuronal disorders such as tinnitus or intermittent claudication, and to improve brain metabolism and peripheral blood flow. The whole array of indications is reflected by a number of defined natural product constituents in G. biloba. The most well-known ones are flavonoids and terpenoid lactones, but they also include allergenic and toxic compounds such as ginkgotoxin (1). Consequently, there are reports attributing beneficial as well as adverse effects to G. biloba products. The present paper summarizes recent experiences with G. biloba and its derived products and explains why their restricted use is recommended.

### **Acute auditory and vestibular symptoms associated with heat and transdermal lidocaine.**

Clin J Pain. 2010 Jan;26(1):58-9.

**Shemirani N, Tang D, Friedland DR.**

Department of Otolaryngology and Communication Sciences, Medical College of Wisconsin, 9200 West Wisconsin Avenue, Milwaukee, WI 53226, USA.

**OBJECTIVES:** To describe a case of systemic lidocaine toxicity from the simultaneous use of transdermal patches and a heating pad. **METHODS:** Case report and discussion. **RESULTS:** The focus of this case report are the interesting neuro-otologic signs of central lidocaine toxicity that occurred after a patient fell asleep on a heating pad with his Lidoderm patches in place. Hearing improvement, tinnitus reduction, and severe dizziness and ataxia were present for approximately 48 hours before spontaneous resolution. Based upon his symptoms we estimate an 11-fold increase in plasma concentrations of lidocaine. **DISCUSSION:** Transdermal delivery of medication affords ease of application, ability to provide continuous pharmacological therapy, and ability to supply medication to the affected site.



Due to the superficial application of these medications, external environmental factors may influence the pharmacokinetics of drug delivery. This case highlights the complications that can arise from the combination of heating pads and transdermal pain therapies.

### **Behavioral assessment and identification of a molecular marker in a salicylate-induced tinnitus in rats.**

Neuroscience. 2010 Feb 17;165(4):1323-1332. Epub 2009 Dec 1.

**Kizawa K, Kitahara T, Horii A, Maekawa C, Kuramasu T, Kawashima T, Nishiike S, Doi K, Inohara H.**

Department of Otolaryngology-Head and Neck Surgery, Osaka University, School of Medicine, 2-2 Yamada-oka, Suita-City, Osaka 565-0871, Japan.

Tinnitus is a non-observable phantom sensation. As such, it is a difficult condition to investigate and, to date, no effective treatment has been developed. To approach this phantom sensation, we aimed to develop a rat behavioral model of tinnitus using salicylate, an active component of aspirin known to induce tinnitus. We also aimed to establish a molecular marker of tinnitus by assessing the expression of transient receptor potential cation channel superfamily V-1 (TRPV1) in the rat auditory pathway during salicylate-induced tinnitus. Animals were trained to perform „an active avoidance task“: animals were conditioned by electrical footshock to move to the other side of the conditioning box when hearing a sound. Animals received a single injection of saline or salicylate (400 mg/kg i.p.) and false positive responses were measured 2 h after injection as the number of movements during a silent period. The number of responses in salicylate-treated animals was highest when the conditioned stimulus was 60 dB sound pressure level (SPL) and 16 kHz. This indicates that animals could feel tinnitus 2 h after salicylate injection, equivalent to that induced by 60 dB SPL and 16 kHz. By means of real-time PCR and western blot analysis, TRPV1 expression was significantly upregulated in spiral ganglion cells 2 h after salicylate injection and this upregulation together with the increase in the number of false positive responses was significantly suppressed by capsazepine (10 mg/kg i.p.), a specific antagonist of TRPV1. This suggests that salicylate could induce tinnitus through activation of TRPV1 in the rat auditory pathway. Copyright © 2010 IBRO. Published by Elsevier Ltd. All rights reserved.

### **Sustained delivery of lidocaine into the cochlea using poly lactic/glycolic acid microparticles.**

Laryngoscope. 2010 Feb;120(2):377-83.

**Horie RT, Sakamoto T, Nakagawa T, Tabata Y, Okamura N, Tomiyama N, Tachibana M, Ito J.**

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**OBJECTIVES/HYPOTHESIS:** Lidocaine is a local anesthetic that is known to suppress tinnitus via systemic or local application; however, this effect has only limited duration. The current study aimed to establish a method for the sustained delivery of lidocaine into the cochlea using poly lactic/glycolic acid (PLGA) microparticles. **STUDY DESIGN:** Experimental study. **METHODS:** Lidocaine-loaded PLGA microparticles were produced and their in vitro-release profiles were examined. The lidocaine concentrations in the perilymph were measured at different time points following the application of the lidocaine-loaded PLGA microparticles to the round-window membranes of guinea pigs. The possible adverse effects of the local application of lidocaine-loaded PLGA microparticles were also examined. **RESULTS:** The in vitro analyses revealed that the microparticles were capable of the sustained delivery of lidocaine. The in vivo experiments demonstrated the sustained delivery of lidocaine into the cochlear fluid, and the maintenance of high lidocaine concentrations in the perilymph for up to 3 days after application. Nystagmus and inflammation in the middle ear mucosa were not detected after the local application of lidocaine-loaded PLGA microparticles, although temporary hearing loss was observed. **CONCLUSIONS:** Lidocaine-loaded PLGA microparticles were shown to be capable of the sustained delivery of lidocaine into the cochlea, suggesting that they could be used for the attenuation of peripheral tinnitus.



### **Transtympanic steroids for Ménière's disease.**

Otol Neurotol. 2010 Jan;31(1):162-7.

**Herraiz C, Plaza G, Aparicio JM, Gallego I, Marcos S, Ruiz C.**

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**OBJECTIVE:** To describe the long-term efficacy of transtympanic steroids (TTS) using methyl-prednisolone in the treatment of Ménière's disease (MD). **DESIGN:** Descriptive prospective study. **MAIN OUTCOME MEASURES:** Pure-tone average (PTA) corresponding to the conversational frequencies on the audiogram (0.5, 1, 2, and 3 kHz), visual analog scale on tinnitus annoyance, and number of vertigo spells 24 months after treatment. **RESULTS:** Thirty-four MD patients referred to a tertiary center were treated with TTS. All patients were diagnosed as probable or definitive MD (following American Academy of Otolaryngology-Head and Neck Surgery 1995 criteria) and treated by TTS (3 consecutive doses). Data from 32 patients were achieved after 12 months. Forty-eight percent of the patients reduced the PTA in 10 or more decibels, average improvement was 8.6 dB compared with initial PTA ( $p = 0.004$ ). Tinnitus relief was achieved by 81.5% of the patients. Number of vertigo spells was reduced from 4.3 to 0.3 after 12 months ( $p = 0.002$ ); 81% of the patients were free of vertigo spells, and 92.6% had 1 or less spells of vertigo. Data from 29 patients were achieved after 24 months. A reduction of PTA in 10 or more decibels was shown by the 33.3% of the sample, and PTA improved in 3.3 dB compared with initial PTA (nonsignificant). Tinnitus relief was achieved in 78% of the patients. Number of vertigo spells was reduced from 4.3 to 0.5 ( $p = 0.033$ ). Seventy-eight percent of the cases were free of vertigo, and 96% had none or 1 spell. Because of an increase in any of the symptoms, 12 patients (35.2%) required retreatment with 1 or 2 series of TTS (1-3 doses) along the 2-year period. Two patients of the sample (6.25%) required transtympanic gentamicin for vertigo control due to lack of benefit with TTS (14 and 18 mo since TTS). **CONCLUSION:** Transtympanic steroids in this cohort were associated with good preservation of hearing. Tinnitus control is achieved in more than 70% of the patients, and number of vertigo spells can be dramatically reduced in more than 90% of the patients after a 24-month follow-up.

## **VI Auditive Stimulation**

### **Listening to tailor-made notched music reduces tinnitus loudness and tinnitus-related auditory cortex activity.**

Proc Natl Acad Sci U S A. 2009 Dec 28. [Epub ahead of print]

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Maladaptive auditory cortex reorganization may contribute to the generation and maintenance of tinnitus. Because cortical organization can be modified by behavioral training, we attempted to reduce tinnitus loudness by exposing chronic tinnitus patients to self-chosen, enjoyable music, which was modified ("notched") to contain no energy in the frequency range surrounding the individual tinnitus frequency. After 12 months of regular listening, the target patient group ( $n = 8$ ) showed significantly reduced subjective tinnitus loudness and concomitantly exhibited reduced evoked activity in auditory cortex areas corresponding to the tinnitus frequency compared to patients who had received an analogous placebo notched music treatment ( $n = 8$ ). These findings indicate that tinnitus loudness can be significantly diminished by an enjoyable, low-cost, custom-tailored notched music treatment, potentially via reversing maladaptive auditory cortex reorganization.



## **Worldwide experience with sequential phase-shift sound cancellation treatment of predominant tone tinnitus.**

J Laryngol Otol. 2010 Jan 13:1-4. [Epub ahead of print]

**Choy DS, Lipman RA, Tassi GP.**

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**Objective:** To report clinical data from six centres in the US, Western Europe and Asia which have used phase-shift sound wave cancellation for treatment of predominant tone tinnitus, from the first treatment in 2000 to 2009. **Method:** Clinical data were obtained from New York City, London, Erie (Pennsylvania, USA), Antwerp, Grottamare (Italy) and Kuala Lumpur, and summarised. **Results:** A total of 493 patients were treated. A reduction in tinnitus volume (defined as  $\geq 6$  dB) was seen in 49-72 per cent of patients.

## **Auditory discrimination training for tinnitus treatment: the effect of different paradigms.**

Eur Arch Otorhinolaryngol. 2010 Jan 1. [Epub ahead of print]

**Herraiz C, Diges I, Cobo P, Aparicio JM, Toledano A.**

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Acoustic deprivation, i.e. hearing loss, is responsible for a cascade of processes resulting in reorganisation of the cortex. Tinnitus mechanisms are explained by synchronization of the neural spontaneous activity and might be related to cortical re-mapping. Auditory discrimination training (ADT) has demonstrated in both animals and humans to induce tonotopical changes in the auditory pathways through neural plasticity. We hypothesize that ADT could have some effect on tinnitus perception. The objective of this study is to compare the effect on tinnitus following two paradigms of ADT. Only patients from 20 to 60 years of age were recruited. Inclusion criteria were pure tone tinnitus of mild or moderate handicap according to the Tinnitus Handicap Inventory score ( $< 56$ ). ADT patients were randomized in two groups: SAME (ADT in the same frequency of tinnitus pitch, 20 patients) and NONSAME (ADT in the frequency one-octave below tinnitus pitch, 21 patients). Groups of pair of tones (70% standard tones ST, 30% deviant tones ST + 0.1-0.5 kHz) were randomly mixed for 20 min/day during 1 month. Patient had to mark when the two sounds of the pair were similar or different. Control group included 26 patients from the waiting list (WLG). Patients were also divided according to the trained frequency and the deepest hearing-impaired frequency. Outcome parameters were set up according to the answer to the question „is your tinnitus better, same, or worse with the treatment?“ (RESP), the tinnitus handicap inventory (THI) and the visual analogue scale from 1 to 10 on tinnitus intensity (VAS). Tinnitus improved in 42.2% of the patients (RESP). VAS and THI scores were reduced but only THI differences were statistically significant ( $P = 0.003$ ). ADT patients improved significantly compared with WLG in RESP and THI scores ( $P < 0.01$ ). Training frequencies one-octave below the tinnitus pitch (NONSAME) decreased significantly THI scores compared with patients trained frequencies similar to tinnitus pitch (SAME,  $P = 0.035$ ). RESP and VAS scores decreased more in NONSAME group though differences were not significant. We did not find any differences when comparing the group training the deepest hearing-impaired frequency and the group who trained other frequencies. Auditory discrimination training significantly improved tinnitus handicap compared to a waiting list group. Those patients who trained frequencies one octave below the tinnitus pitch had better outcome than those who performed the ADT with frequencies similar to the tinnitus pitch ( $P = 0.035$ ).



**The current status of audiologic rehabilitation for profound unilateral sensorineural hearing loss.**  
Laryngoscope.. [Epub ahead of print]

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**OBJECTIVES/HYPOTHESIS:** Audiologic rehabilitation of individuals with profound unilateral sensorineural hearing loss (USNHL) has traditionally been limited to the use of air-conduction contralateral routing of sound (CROS) hearing aids. Treatment for these individuals has expanded with new applications of the bone-anchored hearing aid (BAHA), transcranial hearing aid (t-CROS), and the cochlear implant. In this article, the authors review the literature that addresses these various treatment options. **STUDY DESIGN:** Contemporary review **RESULTS:** Historical information is available that describes the limited efficacy of air-conduction CROS hearing aids in lifting hearing handicap associated with USNHL. Current investigations on providing cross hearing are generally focused on use of the BAHA. Little is known at present whether new developments in hearing aid technology can improve on conventional air-conduction CROS or t-CROS approaches. Interestingly, the cochlear implant seems to be a viable option for individuals with USNHL and tinnitus who also have intact auditory nerve pathways. **CONCLUSIONS:** There is indication in the literature that BAHA provides greater relief of hearing handicap associated with USNHL than CROS hearing aids; however, both have been found to provide limited patient satisfaction and seemingly fall short of restoring true sound localization. Adequate trials have not been performed comparing BAHA with the best CROS hearing aid technology. Transcranial hearing aids and cochlear implants are experimental methods to treat USNHL and hold promise, although there remains a lack of studies available to fully support this. Laryngoscope, 2010.

## VII Brain Stimulation

## VIII Behavioral Therapy

**The distressed (type d) personality is independently associated with tinnitus: a case-control study.**

Psychosomatics. 2010 Jan;51(1):29-38.

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**BACKGROUND:** Tinnitus is a common and disturbing condition, reported by 10% to 20% of the general population. **OBJECTIVE:** The authors sought to determine personality characteristics associated with tinnitus patients versus a control group of ear-nose-throat (ENT) patients without tinnitus. **METHOD:** Adult chronic tinnitus sufferers (N=265) and ENT patients without tinnitus (N=265) participated in a cross-sectional study. The authors evaluated personality characteristics with tests for distressed personality (Type D), neuroticism, extraversion, and emotional stability. **RESULTS:** As compared with control subjects, tinnitus patients had statistically significant and clinically relevant higher levels of neuroticism, negative affectivity, and social inhibition, on one hand, and lower levels of extraversion and emotional stability on the other hand. Also, tinnitus patients were more likely to have a type D personality. **CONCLUSIONS:** Neuroticism, reduced extraversion, and reduced emotional stability were associated with tinnitus, but the level of prediction of the model improved with the addition of type D personality to the single traits. This might indicate that personality characteristics, and type D personality, in particular, are associated with having tinnitus and might contribute to its perceived severity.



### **Type D personality among noncardiovascular patient populations: a systematic review.**

Gen Hosp Psychiatry. 2010 January - February;32(1):66-72. Epub 2009 Oct 23.

**Mols F, Denollet J.**

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**OBJECTIVE:** This article reviews all available literature concerning the implications of Type D personality (the conjoint effects of negative affectivity and social inhibition) among patients with noncardiovascular conditions. **METHODS:** Published papers were included if they studied Type D personality among noncardiovascular patient populations. Twelve articles met our inclusion criteria and were subjected to a methodological quality checklist (e.g., sample size, response rate, Type D measurement). **RESULTS:** The methodological quality of the selected studies was quite good. The noncardiovascular patient populations included chronic pain, asthma, tinnitus, sleep apnea, primary care patients, vulvovaginal candidiasis, mild traumatic brain injury, vertigo, melanoma and diabetic foot syndrome. Type D personality was associated with an increased number or severity of reported health complaints, heightened the perception of negative emotions (e.g., depression and anxiety), had an adverse effect on health-related behaviors, was associated with poor adherence to treatment and significantly reduced effort to perform during diagnostic testing. **CONCLUSION:** Type D is a vulnerability factor that not only affects people with cardiovascular conditions but also those with other medical conditions. Type D was associated with poor physical and mental health status and poor self-management of the disease. Consequently, including Type D in future studies seems warranted. Copyright © 2010 Elsevier Inc. All rights reserved.

## **IX Somatic Tinnitus**

## **X Surgical Treatment**

### **Conservative management of advanced external auditory canal cholesteatoma.**

Otolaryngol Head Neck Surg. 2010 Feb;142(2):278-280.

**Darr EA, Linstrom CJ.**

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**OBJECTIVE:** To investigate the spectrum of disease presentation and clinical management of primary external auditory canal cholesteatoma (EACC). **STUDY DESIGN:** Case series with chart review. **SETTING:** Specialty teaching hospital. **SUBJECTS AND METHODS:** Ten cases of primary EACC were identified in nine patients treated over 14 years (1995-2009). Cases were reviewed with regard to demographics, presentation, physical examination, CT findings, and clinical management. **RESULTS:** The most common symptoms were otalgia and hearing loss, followed by otorrhea and tinnitus. Erosion was present in the mastoid air cells in seven patients, middle ear in six, temporomandibular joint in two, otic capsule in two, and fallopian canal in one patient. Eight of nine patients were managed with serial debridement. **CONCLUSIONS:** EACC is associated with adjacent bony erosion, most often involving the inferior EAC. Despite the potentially destructive nature of these lesions, most cases can be successfully managed with serial debridement. Copyright © 2010 American Academy of Otolaryngology–Head and Neck Surgery Foundation. Published by Mosby, Inc. All rights reserved.



### **Surgery for Ménière's disease.**

Cochrane Database Syst Rev. 2010 Jan 20;(1):CD005395.

**Pullens B, Giard JL, Verschuur HP, van Benthem PP.**

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**BACKGROUND:** Ménière's disease is characterised by three major symptoms: vertigo, deafness, and tinnitus or aural fullness, all of which are discontinuous and variable in intensity. A number of surgical modalities, of varying levels of invasiveness, have been developed to reduce the symptoms of Ménière's disease, but it is not clear whether or not these are effective. **OBJECTIVES:** To assess the effectiveness of surgical options for the treatment of Ménière's disease. All surgical interventions used in the treatment of Ménière's disease, either to alter the natural history of the disease or to abolish vestibular function, were considered for this review. **SEARCH STRATEGY:** We searched the Cochrane Ear, Nose and Throat Disorders Group Trials Register; the Cochrane Central Register of Controlled Trials (CENTRAL); PubMed; EMBASE; CINAHL; Web of Science; BIOSIS Previews; Cambridge Scientific Abstracts; mRCT and additional sources for published and unpublished trials. The date of the most recent search was 25 February 2009. **SELECTION CRITERIA:** Randomised or quasi-randomised controlled studies of a surgical modality versus a placebo therapy in Ménière's disease. **DATA COLLECTION AND ANALYSIS:** Two authors independently assessed trial quality and extracted data. Study authors were contacted for further information. **MAIN RESULTS:** The only surgical intervention which has been evaluated in randomised controlled trials and met the inclusion criteria was endolymphatic sac surgery. We identified two randomised trials, involving a total of 59 patients; one comparing endolymphatic sac surgery with ventilation tubes and one with simple mastoidectomy. Neither study reported any beneficial effect of surgery either in comparison to placebo surgery or grommet insertion. **AUTHORS' CONCLUSIONS:** The two trials included in this review provide insufficient evidence of the beneficial effect of endolymphatic sac surgery in Ménière's disease.

### **Jugular foramen tumors: clinical characteristics and treatment outcomes.**

Otol Neurotol. 2010 Feb;31(2):299-305.

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**OBJECTIVE:** To describe the diagnosis, management, and treatment outcome of jugular foramen (JF) tumors. **STUDY DESIGN:** Retrospective chart review. **METHODS:** Charts of the 83 patients diagnosed with JF tumors between January 1997 and May 2008 were reviewed. Presenting symptoms, otologic and neurotologic examination, audiologic thresholds, treatment procedure, surgical technique, tumor size and classification, and postoperative complications were recorded. Facial nerve function was graded using the House-Brackmann scale. Extent of tumor removal was determined at time of surgery, followed by routine radiographic follow-up. **RESULTS:** The mean age of patients with JF tumors was 48.5 years (standard deviation, 16.3 yr), and women (79.5%) outnumbered men (20.5%). Most had glomus jugulare (GJ) tumors (n = 67, 80.7%); 9 patients had lower cranial nerve schwannomas (10.8%), and 7 patients had meningiomas (8.4%). The most frequent initial symptoms included pulsatile tinnitus (84.3%), conductive hearing loss (75.9%), and hoarseness (34.9%). Sixty-one patients (73.5%) underwent surgery, 18.1% had radiotherapy, and 8.4% were observed. Total tumor removal was achieved in 81% of surgery cases. New lower cranial nerve (CN) deficits occurred after surgery in 18.9% of GJ, 22.2% of schwannoma, and 50% of the 4 meningiomas. At last follow-up, 88.1% of surgical patients had normal or near-normal (House-Brackmann I or II) facial function. **CONCLUSION:** Total resection of GJ tumors, meningiomas, and lower CN schwannomas can be a curative treatment. However, subtotal removal may be required to preserve CN function, vital vascular structures, and the brainstem. Postoperative radiotherapy is used to control residual tumor. When postoperative complications develop in patients, early rehabilitation is important to decrease mortality and morbidity. Therefore, patients should be closely followed.



### **Effect of tumor removal on tinnitus in patients with vestibular schwannoma.**

J Neurosurg. 2010 Jan;112(1):152-7.

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Comment in:

J Neurosurg. 2010 Jan;112(1):150; discussion 150-1.

**OBJECT:** Tinnitus is one of the most common symptoms in patients with vestibular schwannomas (VSs), but the effect of surgery on this symptom has not been fully evaluated. The aim of this study was to define the effect on tinnitus of tumor removal, cochlear nerve resection, and useful hearing preservation in patients with VSs. **METHODS:** The authors retrospectively analyzed the status of tinnitus before and after surgery in 242 patients with unilateral VSs who underwent surgery via the retrosigmoid lateral suboccipital approach. **RESULTS:** Of 242 patients, 171 (70.7%) complained of tinnitus before surgery; the symptom disappeared in 25.2%, improved in 33.3%, remained unchanged in 31.6%, and worsened in 9.9% of these cases after tumor removal. In the 171 patients with preoperative tinnitus, the cochlear nerve was resected in 85 (49.7%) and preserved in 86 (50.3%), but there was no significant difference in the incidence of postoperative tinnitus between these 2 groups ( $p = 0.293$ ). In the 71 patients without preoperative tinnitus, the symptom developed postoperatively in 6 cases (8.5%). Among those without preoperative tinnitus, the cochlear nerve was resected in 45 cases (63.4%) and tinnitus appeared postoperatively in 3 (6.7%). The authors also analyzed the association between postoperative tinnitus and useful hearing preservation, but could not find any statistically significant association between the 2 factors ( $p = 0.153$ ). **CONCLUSIONS:** Tumor removal via the retrosigmoid lateral suboccipital approach may provide some chance for improvement of tinnitus in patients with VSs; however, neither cochlear nerve resection nor useful hearing preservation affects the postoperative development of tinnitus.

## **XI Holistics**

### **Tinnitus sensation pre and post nutritional intervention in metabolic disorders.**

Pro Fono. 2009 Oct-Dec;21(4):291-7.

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**BACKGROUND:** Different etiologies are related to tinnitus including metabolic disorders (blood glucose and lipids). **AIM:** The aim of this study was compare tinnitus severity by self-report measures pre and post nutritional intervention, using the Tinnitus Handicap Inventory. **METHOD:** Participants of this study were twenty one male and female subjects, with ages ranging from 40 to 82 years. Inclusion criteria involved the presence of tinnitus and metabolic disorder diagnosed by laboratory exams. All subjects were submitted to a nutritional intervention program. Audiological evaluation and the Tinnitus Handicap Inventory were applied pre and post intervention. **RESULTS:** When comparing the presence of tinnitus pre and post intervention, data analysis indicates statistical difference concerning tinnitus sensation--71.5% of the individuals referred less impact of tinnitus in daily activities. **CONCLUSION:** An important difference was observed concerning tinnitus influence in subject's life by self-report measures. A direct relation between tinnitus and metabolic disorders in cases related with this symptom was verified.



## XII Review

## XIII Others

## XIV Case Reports

### **Otogenic pneumocephalus associated with a ventriculoperitoneal shunt.**

Clin Exp Otorhinolaryngol. 2009 Dec;2(4):203-6. Epub 2009 Dec 31.

**Kim YH, Lee WI, Park MN, Choi HS, Kim NH, Han SJ.**

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Otogenic pneumocephalus is a condition of intracranial air originating from the middle ear or mastoid air cells. This communication between the intracranial cavity and the pneumatic cavities is usually associated with trauma after cranial fractures or iatrogenic trauma. We present a rare case of otogenic pneumocephalus arising in the left posterior fossa from well-pneumatized mastoid air cells. The patient complained of roaring tinnitus that developed 29 months after ventriculoperitoneal shunt insertion due to brain tumor surgery. High resolution computed tomography scan of the temporal bones revealed a large pneumocephalus below the left tentorium, and a bony dehiscence was clearly identified in a sagittal view. A left mastoidectomy with preservation of the posterior wall of the external auditory canal was performed, and the expected bony dehiscence site was identified in the posterior fossa dura plate, just posterior to the posterior semicircular canal, below the Donaldson's line. This communication was sealed with a temporalis muscle plug from the deep temporalis muscle fascia and bone dust. Pneumocephalus may be caused by negative intracranial pressure in a patient with very well-pneumatized mastoid bone, and it can be a possible cause of 'wind-like' sound in the ear.

### **Spontaneous Intracranial Hypotension Syndrome Accompanied by Bilateral Hearing Loss and Venous Engorgement in the Internal Acoustic Canal and Positional Change of Audiography.**

J Craniofac Surg. 2010 Jan;21(1):165-167.

**Isildak H, Albayram S, Isildak H.**

From the \*Otolaryngology Head and Neck Surgery Department and daggerRadiology Department, Cerrahpasa Medical School, Istanbul University; and double daggerDepartment of Ophthalmology, Bakirkoy Dr. Sadi Konuk Training and Research Hospital, Istanbul, Turkey.

Hearing loss, tinnitus, and vertigo are very common complaints in otolaryngology practice. Here, we describe spontaneous intracranial hypotension (SIH) as a curable reason of hearing loss, tinnitus, and vertigo. A 29-year-old woman presented to the emergency room with nausea, dizziness, vertigo, instability, hearing loss, tinnitus, and neck and back pain. Cranial computed tomography, magnetic resonance imaging (MRI), and lumbar puncture were performed. The patient stated that the hearing loss and tinnitus became worse after effort or standing for prolonged times. Therefore, we performed audiogram in sitting and standing positions. The tinnitus severity index was used to evaluate tinnitus. Lumbar puncture revealed no cerebrospinal fluid, and cerebrospinal fluid could be obtained by aspiration. Cranial MRI showed dural thickness and venous engorgement in the internal acoustic canals bilaterally. Audiography showed worse hearing capacity in standing position than in sitting position and revealed especially low-frequency hearing loss bilaterally. The patient's tinnitus severity index was 48 of 60. The patient was diagnosed as having SIH and treated with autologous blood punch. Cranial MRI and audiogram were normal after the treatment. The patient had no tinnitus after the treatment. Spontaneous intracranial hypotension, which may cause Ménière syndrome-like symptoms, is a curable reason of hearing loss, tinnitus, and vertigo. In addition, the fluctuation of the hearing loss with positional changes supports the use of positional audiometry when evaluating hearing loss-related SIH. Venous engorgement in the internal acoustic canal may be related to the symptoms.



### **Bilateral subdural hematomas and hearing disturbances caused by spontaneous intracranial hypotension.**

J Med Assoc Thai. 2009 Nov;92(11):1538-43.

**Srimanee D, Pasutharnchat N, Phanthumchinda K.**

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Spontaneous Intracranial Hypotension (SIH) is an uncommon headache syndrome. Patients classically present with orthostatic headache, tinnitus, and diplopia. The authors reported a 43 year-old man who presented with orthostatic headache, tinnitus, and hearing impairment for 3 months. Physical examination was unremarkable except for auditory impairment. The audiogram revealed minimal low-frequency neurosensori hearing loss suggesting a cochlear lesion. Computed tomography of the brain revealed bilateral thin chronic subdural hematomas. He underwent burr-hole surgery. Headache and auditory symptoms persisted and reevaluation of this syndrome was performed MRI of the brain showed diffuse smooth enhanced dura mater low lying position of midbrain, pons, medullar and cerebellar tonsil, as well as enlarged pituitary gland compatible with low CSF pressure syndrome. MRI of the whole spine could not demonstrate the site of CSF leakage. The patient was much improved after conservative treatments with hydration and bed rest. One year after treatment, he had no headache and only mild tinnitus was reported

### **Tinnitus in postherpetic neuralgia.**

J Headache Pain. 2010 Feb;11(1):83-4. Epub 2009 Oct 23.

**De Marinis M, Santilli V.**

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We describe a woman who developed postherpetic neuralgia (PHN) located on the skin areas of the left ophthalmic division of the fifth cranial nerve without ocular involvement. PHN was associated with tinnitus, which was located ipsilaterally to the painful side and increased in proportion to the intensity of pain. Tinnitus was responsive to treatment with duloxetine, 60 mg daily, and subsided when the PHN resolved. This is the first description of tinnitus in PHN

### **An unusual middle-ear mass.**

J Laryngol Otol. 2010 Jan;124(1):108-10. Epub 2009 Jul 9.

**Muller M, Zammit-Maempel I, Hill J, Wilkins B.**

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**OBJECTIVE:** We describe a case of endolymphatic sac tumour confined to the middle ear, which radiologically mimicked a glomus tympanicum, in a 58-year-old woman with tinnitus. **CASE REPORT:** A 58-year-old woman presented with a one-year history of right-sided tinnitus. The clinical, radiological and surgical features were felt to be in keeping with a glomus tympanicum. However, the histopathological picture was that of a low grade papillary carcinoma of the endolymphatic sac, i.e. an endolymphatic sac tumour. **CONCLUSION:** Endolymphatic sac tumours are classically locally aggressive and centred around the petrous temporal bone. Further growth results in complete replacement of the mastoid and petrous pyramid by tumour. To the best of our knowledge, there have been no previous reports of an endolymphatic sac tumour located solely within the hypo- and epitympanum of the middle ear.



**Arteriovenous malformation in the parotid region presenting as pulsatile tinnitus: a case report.**  
Head Neck. 2010 Feb;32(2):262-7.

**Chen MC, Chung WY, Luo CB, Wu HM.**

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**BACKGROUND:** Pulsatile tinnitus is a unique symptom in the general population and often leads patients to medical attention. **METHODS AND RESULTS:** We report a patient who had an arteriovenous malformation of superficial temporal artery in the parotid region causing pulsatile tinnitus and insomnia. Magnetic resonance angiography and carotid angiography were useful tools for the detection of this vascular malformation. Successful treatment of this lesion was achieved by endovascular embolization. **CONCLUSION:** This case illustrates a thorough diagnostic work-up with a high index of suspicion and a proper treatment option is rewarding when dealing with such a rare disease. Copyright 2009 Wiley Periodicals, Inc.



## Clinical Trials

Source: [clinicaltrials.gov](https://clinicaltrials.gov) (2th February 2010)

### Resting-State Neural Connectivity in Patients With Subjective Tinnitus Without Bother

Current status	not yet open for participant recruitment
Sponsors and collaborators	Washington University School of Medicine
Information provided by	Washington University School of Medicine
ClinicalTrials.gov Identifier	NCT01049828
Purpose	<p>Tinnitus is the occurrence of an auditory sensation without the presence of an acoustic stimulus. Approximately, 50 million people in the United States experience chronic tinnitus and 15 million of these people have bothersome tinnitus. Several studies have shown that people who are bothered by their tinnitus have difficulty in concentration and focus. Through imaging modalities we have deranged neural networks responsible for attention. Only 20 percent of patients diagnosed with tinnitus are severely bothered. We seek the following:</p> <ol style="list-style-type: none"><li>1.Match a group of non-bothered tinnitus patients on age and hearing status to an existing cohort of bothered tinnitus patients.</li><li>2.Assess the resting-state neural connectivity in patients with non-bothersome tinnitus. Findings from the comparison of functional connectivity magnetic resonance imaging (fcMRI) from subjects with bothersome tinnitus in our current rTMS clinical trial to normal age-matched controls without tinnitus demonstrates that subjects with bothersome tinnitus have dramatic alterations in cortical attention and control networks. Our hypothesis is that the fcMRI-defined changes in the attention and control networks reflect the impact of excessive auditory stimulation in patients with bothersome tinnitus and explains the difficulty with concentration, short-term memory, and other common problems. To fully test this hypothesis we need to obtain fcMRI of the attention network among subjects with tinnitus but without bother and compare the status of their neural networks with those of tinnitus subjects with bother and with normal controls.</li><li>3.Compare the resting cortical networks in subjects with non-bothersome tinnitus to subjects with bothersome tinnitus and subjects without tinnitus Our null hypothesis is that there are no differences in the resting-state cortical networks, especially the attention and control networks, between tinnitus patients who do not experience bother, tinnitus patients who do experience bother, and subjects without tinnitus. Through fcMRI, we will examine correlations in blood oxygen level dependent (BOLD) signals in established auditory, attention, control, and other brain regions in the resting brain and compare these findings to already collected fcMRI scans of bothered tinnitus patients, and controls (patients without tinnitus).</li></ol>
Condition(s)	tinnitus
Interventions	other: no intervention



Study type and design	Observational; Case-Only, Cross-Sectional
Official title:	Resting-State Neural Connectivity in Patients With Subjective Tinnitus Without Bother
Primary Outcomes	Recruit 20 participants and have them undergo both neuro-cognitive and neuro-imaging testing. [ Time Frame: 8 months ] [ Designated as safety issue: No ]
Biospecimen Retention:	None Retained
Expected total Enrollment	20
Study start	July 2010
Expected study completion date	July 2011
Expected primary completion date	July 2011
Assigned Interventions	Other: No intervention No treatment for tinnitus will occur in this study.
Groups/Cohorts	Slightly or Non-Bothered Tinnitus Group
Participants (age)	18 Years to 60 Years
Gender	both
Accepts health volunteers	yes
Sampling Method:	Non-Probability Sample
Study Population	20 adults between the ages of 45 and 60 years, age and hearing level-matched to the bothered tinnitus cohort from the on-going research at Washington University. Subjects will be recruited from an institutional tinnitus database, from Washington University Otolaryngology Clinics, as well as the general public through poster advertisement on the Washington University grounds
Eligibility Inclusion Criteria	<ul style="list-style-type: none"> <li>- Men and women between the ages of 18 and 60 years</li> <li>- Subjective, unilateral or bilateral, non-pulsatile tinnitus of 6 month's duration or greater</li> <li>- A recent audiogram (within 6 months)</li> <li>- Either "not bothered" or "bothered a little" on the Global Bothersome scale</li> <li>- Able to give informed consent</li> <li>- English-speaking</li> </ul>
Eligibility Exclusion Criteria	<ul style="list-style-type: none"> <li>- Patients experiencing tinnitus related to cochlear implantation, retrocochlear lesion, or other known anatomic/structural lesions of the ear and temporal bone</li> <li>- Patients with hyperacusis or misophonia (hyper-sensitivity to loud noises)</li> <li>- Patients with cardiac pacemakers, intracardiac lines, implanted medication pumps, implanted electrodes in the brain, other intracranial metal objects with the exception of dental fillings, or any other contraindication for MRI scan</li> </ul>



	<ul style="list-style-type: none"> <li>- Patients with an acute or chronic unstable medical condition which, in the opinion of the investigator, would require stabilization prior to initiation of magnetic stimulation</li> <li>- Patients with any active ear disease that, in the opinion of the PI, needs to be further evaluated</li> <li>- Patients with symptoms of depression as evidenced by a score of 14 or greater on the Beck Depression Inventory or, in the opinion of the psychiatric sub-investigator demonstrates active mood symptoms that meet DSM-IV-TR criteria for Major Depressive Disorder</li> <li>- Any psychiatric co-morbidity that, in the opinion of the psychiatric sub-investigator, may complicate the interpretation of study results</li> <li>- Patients with tinnitus related to Workman's Compensation claim or litigation-related event</li> <li>- Weight over 350 pounds</li> <li>- A Mini-Mental Status Exam<sup>42</sup> score less than 27</li> <li>- Patients with a history of claustrophobia</li> <li>- Inability to lay flat for 2 hours</li> <li>- Active alcohol and/or drug dependence or history of alcohol and/or drug dependence within the last year</li> <li>- Any medical condition that, in the opinion of the investigators, confounds study results or places the subject at greater risk</li> <li>- Unable to provide informed consent</li> <li>- Any exclusions from radiology screening</li> </ul>
Contact	<p>Andre M Wineland, MD, phone 3143628641, winelanda@ent.wustl.edu</p> <p>Joyce Nicklaus, phone 3143627508, nicklausJ@ent.wustl.edu</p>
Locations	Washington University, Center for Clinical Studies St. Louis, Missouri, United States, 63110
Study chairs or principal investigators	Andre M Wineland, MD, Washington University School of Medicine
Study ID Numbers	WU01201982
Last Updated	January 14, 2010
Record first received	January 14, 2010
ClinicalTrials.gov Identifier	NCT01049828
Health Authority	United States: Institutional Review Board

### Hearing Loss Prevention for Veterans (HLPP)

Current status	not yet open for participant recruitment
Sponsors and collaborators	Department of Veterans Affairs
Information provided by	Department of Veterans Affairs
ClinicalTrials.gov Identifier	NCT01038336



Purpose	Hearing loss is the most prevalent service-connected disability in the VA. It causes communication difficulties, which contribute to isolation, frustration and depression. A major cause of hearing loss is from exposure to high levels of sound, and is referred to as Noise Induced Hearing Loss (NIHL). Veterans have inevitably been exposed to high levels of sound during military service, and even though they may not yet have NIHL, their ears have been damaged. Continued noise exposure in civilian life will result in NIHL. However, it can easily be prevented by avoiding noise or using hearing protection. Most people are unaware that noise damages hearing, and even when they are, they do not use hearing protection. In this study we will use a randomized controlled trial to evaluate the short- and long-term effectiveness of two forms of education about NIHL that we have developed for Veterans. One is a computerized program; the other is a Hearing Conservation Brochure
Condition(s)	Hearing Loss, Noise-Induced
Interventions	Behavioral: Multimedia hearing loss prevention program Behavioral: Hearing Conservation brochure
Study type and design	Interventional; Prevention, Randomized, Open Label, Parallel Assignment, Efficacy Study
Official title:	Hearing Loss Prevention for Veterans
Arms:	1: Experimental Multimedia hearing loss prevention program 2: Active Comparator Hearing Conservation brochure 3: No Intervention No intervention
Assigned Interventions	1. Behavioral: Multimedia hearing loss prevention program NCRAR interactive, multimedia, computer-based HLPP that provides hands-on education and training about hearing loss, tinnitus, hearing protection, and general hearing health care for Veterans. 2. Behavioral: Hearing Conservation brochure The Hearing Conservation brochure provides information similar to that of the NCRAR HLPP, but in an abbreviated form.
Detailed description	Hearing loss and tinnitus are the two most prevalent service-connected disabilities in the VA system for OEF/OIF Veterans, and Veterans from World War II, Korea, Vietnam, the Gulf War and during Peacetime. Costs associated with health care utilization, provision of hearing aids, rehabilitation services and reduced productivity for Veterans with hearing loss are substantial, and continue to increase. On a personal level, hearing loss results in communication difficulties, and often contributes to social isolation, frustration and depression. A major cause of hearing impairment is cochlear damage from exposure to high levels of sound. The longer the period of exposure and the more intense the sound pressure level, the greater is the damage that occurs. The damage from noise exposure is cumulative over time, and exacerbates the effects of aging. Veterans, who have been exposed to high levels of sound in the military are therefore highly vulnerable to damage in civilian life, thus they must protect their ears from further noise to avoid hearing loss as they age. Unfortunately, most people



	<p>are unaware of the damage noise can do to the auditory system, and even when they are aware, few choose to use hearing protection. It is therefore critical to educate Veterans about the dangers of noise exposure and the simple actions that can be taken to protect hearing.</p> <p>Our long-range goal is to disseminate an effective hearing loss prevention education program that will help to reduce the prevalence and associated costs of noise induced hearing loss in the Veteran population. Ultimately it is our intention to make the program available to all Veterans, military personnel and other members of the public.</p> <p>We have developed two forms of intervention to educate Veterans about hearing conservation. One is a computerized multimedia interactive program; the other is a printed Hearing Conservation Brochure. Both provide information about hearing, the damage noise can do to the auditory system, the impact hearing loss has on communication, and the use of hearing protection. In this study we will use a randomized controlled trial to evaluate the effectiveness of these two forms of intervention at changing knowledge, attitudes and behaviors toward hearing conservation. Effectiveness will be examined in three ways through assessment of: (1) actual behavioral changes, as evidenced by decreased daily noise exposure as measured with noise dosimetry; (2) reported behavioral changes, as evidenced by decreased daily noise exposure assessed using a real-time log of daily activities and use of hearing protection; and (3) increased knowledge, healthier attitudes and improved intended and actual behavior towards hearing protection, as assessed with a self-report questionnaire. Outcomes will be measured at baseline, immediately following the intervention and six month post-intervention.</p> <p>There are many challenges facing military personnel as they reintegrate into society after leaving military service. Reducing their risk of acquiring noise induced hearing loss and the associated problems with communication, will help to make this transition less difficult and traumatic. This study will provide important information about the relative effectiveness of two different forms of hearing conservation education. In the long term it has the potential to reduce the prevalence and associated costs of hearing loss and tinnitus among Veterans, and will demonstrate that prevention of hearing loss can reduce the need for long-term rehabilitation.</p>
Participants (age)	18 Years to 55 Years
Gender	both
Accepts health volunteers	yes
Eligibility Inclusion Criteria	<p>To be included in the study all participants will:</p> <ul style="list-style-type: none"> <li>- be aged 55 years with no exclusions based on ethnicity or gender. The minimum age of 55 years has been selected because hearing conservation programs have the potential to be most effective for younger individuals.</li> <li>- be able to hear speech through headphones without use of hearing aids. To this end, we will require participants to have a pure tone average (mean of thresholds at 0.5, 1.0 and 2.0 kHz) of less than or equal to 55 dB HL in one or both ears.</li> </ul>



	<ul style="list-style-type: none"> <li>- have cognitive abilities sufficient to participate in the study, as determined by an age/and educationally appropriate score on the Mini Mental State Exam (MMSE).</li> <li>- ability to read and comprehend the study interventions (HLPP and Hearing conservation brochure) as reflected by a Broad Reading Score of Grade 5 or above on the Woodcock-Johnson III Tests of Achievement Letter-Word Identification, Reading Fluency and Passage Comprehension subtests.</li> <li>- no known neurological, psychiatric or physical disorders, or co-morbid diseases that would prevent completion of the study as determined by chart review.</li> <li>- adequate vision to participate in the study as determined with the Smith-Kettlewell Institute Low Luminance (SKILL) Card. Participants will be required to have best corrected vision of 20/63 (mild vision loss) or better.</li> <li>- openness to using a wearable noise dosimeter and to logging daily activities using a personal digital assistant for three periods of seven days each, as determined by agreement to participate in the study.</li> </ul>
Eligibility Exclusion Criteria	<p>Individuals will not participate in the study if:</p> <ul style="list-style-type: none"> <li>- they are age &gt;55 years.</li> <li>- have a pure tone average in either ear &gt;55dB HL.</li> <li>- score less than the age- and educational-based norms on the MMSE.</li> <li>- have a Broad Reading score on the Woodcock-Johnson III Tests of Achievement of less than Grade 5.</li> <li>- have neurological, psychiatric or physical disorders, or co-morbid diseases that would prevent completion of the study.</li> <li>- have corrected vision poorer than a Snellen equivalent of 20/63.</li> <li>- be unwilling to use a wearable noise dosimeter and to logging daily activities using a personal digital assistant for three periods of seven days each.</li> </ul>
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responsible party	Department of Veterans Affairs
Principal investigator	Gabrielle Saunders, VA Medical Center, Portland
Study ID Numbers	C7214R, 11-1408, 02383, 05-2409
Last Updated	December 21, 2009
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Health Authority	United States: Federal Government

