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Turning Down Tinnitus: Giving Veterans their Peace and Quiet

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Turning Down Tinnitus

Giving veterans their peace and quiet

by Amy Oprean

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For many people, it's a temporary annoyance – the high-pitched ringing in the ears that comes after working with a power saw, a leaf blower or perhaps most commonly, the unwanted souvenir from a concert. But while tinnitus may be a transient hassle for many, there is another group of people for which it's a permanent and debilitating phenomenon. Military personnel stationed in the warzones of Iraq and Afghanistan experience the "phantom sound" of tinnitus much like civilians do, but for troops, the perpetual exposure to roadside bombs, gunfire, and rocket-propelled grenades exacerbates the condition to the point of no return.

Wayne State researchers Anthony Cacace, Ph.D., and Jinsheng Zhang, Ph.D., are working to change that with two potential treatments for chronic tinnitus. Different by design but united with a common goal of suppression, these potential treatments pose the possibility of curing an injury that stays with soldiers long after other battle wounds have healed.

"Imagine you have this ringing in your ears. It disrupts your sleep, it disrupts your concentration; it's really loud and it never goes away," said Dr. Cacace, professor of otolaryngology in WSU's School of Medicine, and communication sciences and disorders in the College of Liberal Arts and Sciences. "Some people can deal with it and it doesn't bother them, but then there's a segment of people who have a very difficult time dealing with it, and these are the ones we are trying to help."

Dr. Jinsheng Zhang, associate professor of otolaryngology

Dr. Anthony Cacace, professor of otolaryngology and communications sciences and disorders

Tinnitus, which is believed to result from hyper neural activity in the ear or brain, is most commonly produced by repeated exposure to noise levels above the 80 to 85 decibel threshold, the level of average traffic. In soldiers exposed to noise levels exceeding 200 decibels on a daily basis, about 50 percent will develop tinnitus, hearing loss, or both. According to the Department of Veterans Affairs, nearly 70,000 of the more than 1.3 million troops who have served in the two war zones are collecting disability compensation for tinnitus, and 58,000 are on disability for hearing loss. Together, that amounts to $500 million spent each year – an amount expected to increase 18 percent a year,

Turning Down Tinnitus continued

Dr. Avril Genene Holt, assistant professor of anatomy and cell biology and project collaborator, demonstates repetitive transcranial magnetic simulation

according to an analysis of VA data by the American Tinnitus Association.

"One of the things that we're trying to do now is develop a model of blast-induced tinnitus analogous to what the soldiers are going through in Iraq or Afghanistan, so that we can potentially try to diagnose it, treat it, and most importantly, try to prevent it," Dr. Cacace said.

With a grant from the Tinnitus Research Consortium, Dr. Cacace is studying a potential method of tinnitus suppression called repetitive transcranial magnetic stimulation, or rTMS. The noninvasive procedure consists of placing a magnet coil on the side of a patient's head and delivering a low frequency magnetic pulse through the skull, potentially suppressing tinnitus. To test the effectiveness of the procedure, Dr. Cacace is administering a "sham-controlled crossover design" to tinnitus patients, wherein patients are given both a sham rTMS regimen and the real treatment over the course of two weeks. The crossover trials will allow him to assess for any placebo effect in patients. He is also using magnetic resonance spectroscopy to assess changes in the brain chemistry following treatment, and will evaluate any changes in brain chemistry using another MRI analysis tool called voxel-based morphometry. He is collaborating with Jiani Hu, Ph.D., an MR physicist in the Department of Radiology in the School of Medicine and noted expert in magnetic resonance spectroscopy.

Dr. Zhang, associate professor and assistant research director of otolaryngology and the director of the Laboratory of Auditory Prostheses Research in the Department of Communication Sciences and Disorders, is studying a significantly different approach to tinnitus suppression. He is testing the direct electrical stimulation of the auditory cortex – the region of the brain associated with hearing. Clinically, it has been shown that direct electrical stimulation of the auditory cortex can actually suppress the "phantom sound" caused by damage

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to the peripheral and central auditory system. The effectiveness of the treatment, however, varies greatly from patient to patient. Zhang's ultimate goal is to develop a permanent prosthesis that, when implanted in the auditory cortex, will rid the brain of tinnitus by continuous electrical impulses. In addition, Dr. Zhang has recently been awarded a grant from the Tinnitus Research Initiative to study the potential of tinnitus suppression by electrically stimulating certain acupoints in the human body.

Dr. Zhang is developing an animal model for tinnitus suppression using electrical stimulation of the auditory cortex. From this novel method, which combines electrical stimulation, electrophysiology and behavioral testing, he will test whether animals develop tinnitus following noise exposure, and determine whether tinnitus-positive animals experience suppression following electrical stimulation of the auditory cortex. Working with collaborators from Henry Ford Hospital, Dr. Zhang will then test his new stimulation targets in the brain and new stimulation strategies.

Although the technique is invasive, other implants have progressed to safe and effective clinical use, Dr. Zhang said, one of the most notable being the cochlear implant for hearing loss. Implants to the cochlea – the spiral shaped cavity of the inner ear – take on the job of damaged hair cells by converting acoustic sound into electrical signals. "Three decades ago, the cochlear implant was developed, and at the time, everyone thought it was crazy," he said. "And now it's considered the most successful bionic implant used today. Similarly, we believe that with help from advancing engineering technology, it is possible to develop miniaturized and less invasive implantable devices to suppress tinnitus."

Using another grant from the Tinnitus Research Initiative, Dr. Cacace is also utilizing several MRI methods to comparatively examine numerous aspects of brains with noise-induced hearing loss with and without tinnitus. Methods like magnetic resonance spectroscopy are of high interest to Cacace and Zhang, since having a chemical model of tinnitus would open the door for researchers to develop medication that counters these chemical changes.

Whether Dr. Cacace's noninvasive rTMS method of tinnitus suppression, Dr. Zhang's electrical stimulation, or a pharmaceutical will provide the most effective treatment is yet to be determined, and could actually vary from person to person, Dr. Cacace said.

"What we do know is that some people respond to medicines, some don't, some respond to rTMS, or direct electrical stimulation, and others don't – and we don't know exactly know why this is," he said. "But we hope to make all these methods more effective, so that returning vets and anyone else with this chronic problem can finally get some permanent relief."

About Dr. Anthony Cacace: Dr. Cacace received a B.S. in speech pathology and audiology from the State University of New York at New Paltz. He received an M.S. in audiology and a Ph.D. in communication sciences and disorders (audiology) and neuroscience from Syracuse University. He obtained his postdoctoral fellowship training in neurophysiology at the Wadsworth Laboratories of the New York State Health Department. He spent 20 years in the ear, nose, otolaryngology and neurology departments at the Neuroscience Institute and Advanced Imaging Research Center of Albany Medical College. He joined Wayne State University in August 2007.

About Dr. Jinsheng Zhang: Dr. Zhang received a B.S. in biology and an M.S. in physiology from Hebei Normal University in China, and a Ph.D. in auditory neurophysiology at University of Fribourg in Switzerland. He serves on the board of the Lions Hearing Institute of Michigan. Dr. Zhang joined Wayne State University in 1997.

PAGE 35