Grand Rounds: Tinnitus Evaluation & Management, in partnership with the University of Mississippi Medical Center

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- [Moderator] I am so delighted to introduce our guest presenters who are from the University of Mississippi Medical Center. This course is our Grand Rounds course: Tinnitus evaluation and management. First, we welcome back Dr. Christopher Spankovich, he's a friendly name to Audiology Online. He is the Associate Professor and vice chair of research for the Department of Otolaryngology, and Communicative Sciences at the University of Mississippi Medical Center. Also, we welcome Dr. Thomas Eby, Professor in the Department of Otolaryngology communication sciences. We also welcome Dr. Vicki Gonzales who is Associate Professor and chief of the Division of Audiology in the Department of Otolaryngology. Dr. Charles Bishop, a tenured professor in the department of Otolaryngology and communicative sciences. And also Dr. Alex Elkins, who is an associate professor in the Department of Otolaryngology and Communicative Sciences at UMMC. Welcome to you all and at this time.

- [Chris] Now it's muted. Thank you very much. Welcome everyone, happy to be here with you today. Here are our presenter disclosures, I'm not going to read these out to all of you, but feel free to review those in your free time. I'll wait, just kidding. We'll move on, here are our learning outcomes overall for this course, one, we wanna discuss types of tinnitus, we'll also mention the recommended nomenclature which has been recently updated by or at least recommendations updated by the American Academy of Otolaryngology Head neck surgery, will identify various applications of technology to tinnitus management, and will describe some different management strategies for tinnitus. A little brief overview of those out there that are not familiar with the University of Mississippi Medical Center. UMMC is the only academic medical center in the state of Mississippi. We're located in Jackson, Mississippi, which is essentially right in the heart of Mississippi. The campus houses seven health science schools including the School of Medicine, School of Dentistry, School of Health Related Professions, Graduate Studies, Population Health and Pharmacy. And of historical note, the first lung transplant and first heart transplant were both performed at the University of Mississippi Medical Center by Dr. James Hardy back in the 1960s.

You can keep that one for your trivia questions in the future. The Department of Otolaryngology-Head and Neck Surgery is what houses all of the speakers today. We recently had a name change and that's why you heard some of the two different names and we were previously the Department of Otolaryngology and Communicative Sciences and now we are the Department of Otolaryngology Head and Neck surgery. The department has 14 audiologists, and 13 otolaryngologist. We have one otologist, neuro-otologist, that's Dr. Eby, who will be presenting today. We also have two pediatric otolaryngologists that also do a number of surgeries for ear related issues including cochlear implants. We have a strong NIH funding record within our department. Most of our research is focused on auditory and vestibular neurosciences and more basic science oriented, but we do some great work here, and we're happy to describe some of our clinical approaches.

At UMMC when it comes to tinnitus, we take a holistic, collaborative and flexible approach to tinnitus management. This all starts with a comprehensive audiological and medical history to understand the patient's chief complaints and initiate our process of differential diagnosis. This also starts the process of determining the type of tinnitus. Recently, the American Academy of Otolaryngology, Head and Neck Surgery recommended an updated nomenclature to describing tinnitus as primary, primary referring to tinnitus of an idiopathic cause, likely linked to hearing loss and then secondary tinnitus referring to a tinnitus of a specific known cause other than sensory neural hearing loss, such as pulsatile tinnitus. A critical component of the patient history is determining the onset of the tinnitus. Was it a sudden perception? Was it a gradual perception? And then of course, the correlation with various factors for example, noise or unnoted toxic drug or some type of disease process. Most of our patients initially receive a medical evaluation that is then followed by an audiological evaluation. This can help provide peace of mind to the patient and help to demystify the tinnitus. For the patient, knowledge that they have undergone a thorough medical and audiological assessment and have ruled out any significant medical pathology can help initiate the process of habituation and or reduce tinnitus reaction. The

components of the medical and audiological evaluation are really dependent on the type of tinnitus that we're dealing with, and the case presentation, meaning not all patients need an MRI. Indeed, most do not. We are also flexible in our management approach. This may include audiological and medical recommendations, though there is no FDA approved drug or surgery for the management of tinnitus, there are some medications that can aid in dealing with tinnitus related side effects such as sleep issues and surgical procedures such as even cochlear implants that may not only improve hearing loss, but also tinnitus complaints. There's not one approach to tinnitus management that is necessarily better than the other. When we look at various approaches like TRT, Tinnitus Retraining Therapy, tinnitus activities treatment, cognitive behavioral therapy, or simple using masking or hearing aids, all can work and none necessarily work more than the other at a group level. However, at the individual patient level, there may be a difference in their effectiveness. And so being flexible in your approach could be very meaningful. On to the speakers, I'm not gonna read everyone's bio for the sake of time, but our speakers today include myself, my name is Chris Spankovich, I'm Associate Professor and vice chair of research in our department, Dr. Charles Bishop who's a tenured full professor and clinical audiologist. Dr. Vicki Gonzales is Associate Professor and chief of the Division of Audiology. Dr. Tom Eby's a tenured professor and our department's otologist neuro otologist, and Dr. Alex Elkins is an associate professor and clinical audiologist. First in our lineup of speakers today is going to be Dr. Charles Bishop and so I am going to mute my mic here and transfer over to him.

- [Dr. Bishop] Okay, thank you Dr. Spankovich. I'm very glad to be here today and presenting on this case. I, over the time, I've just evolved a little bit in how I work with tinnitus patients, it's very patient centred as Dr. Spankovich was saying, and the struggle for a clinician is to find what's gonna work for that individual patient and you may try an approach and have to modify it, so I'm gonna present to you a case based on the outcome of tinnitus retraining or what we can call Tinnitus Habituation Therapy in a patient with single sided deafness secondary to VIIIth nerve resection. So the

patient had a vestibular schwannoma that was, resulted in complete cutting of the auditory nerve. And this was done at a different center but the patient found us through an online referral source. Anyway, and my work is predominantly with adults and I do work with primary tinnitus most often as a associated complaint with hearing loss. So the most of the patients I see are probably also getting hearing aids. Most of the patients we have who have tinnitus and they don't have hearing loss, let's say, we would refer them first to Dr. Spankovich for evaluation and treatment. So the questions I'm gonna try to address today is what is tinnitus habituation or retraining therapy? I use those terms interchangeably. I think habituation is more descriptive. And also, I'm gonna look at how is this kind of therapy done in a patient with single sided deafness, and what additional concerns arise when you have VIIIth nerve resection as opposed to an intact VIIIth nerve? Is everything okay?

Okay, sure, okay, I'll put this down here. All right, so I was told that I was probably a little low. Anyway, I hope you can hear me now. The other question that I'm gonna address today is what can this tell us about tinnitus habituation and how does this play into cognitive behavioral and mindfulness therapies for other disorders? Learning outcomes, after this course we hope that you will be able to describe the basic components of tinnitus, habituation therapy, describe the use of sound therapy, whether that's with amplification or a pure noise generator or a combination, hearing aid with noise generator as an elective aspect of Tinnitus Habituation Therapy, and also apply the basic principles of Tinnitus Habituation Therapy to individuals with single sided deafness with or without VIIIth nerve function. Okay, so on to the history this was a 30 year old, healthy male prior history of left sided VIIIth nerve resection for treatment of his tubular Schwannoma. This was performed at an outside clinic. No other information was available to us on tumor size or location. It was about a year from the time I saw him when the procedure was done. The patient reported complete loss of hearing on the left side and his primary concerns were bothersome complex roaring, ringing tinnitus, but that was his primary concern. His secondary concern was the hearing loss, impaired localization, problems hearing in noise and even problems

hearing the TV, communicating at home, even though he has one normal ear. According to him, the prior hearing test showed complete deafness of the left ear. He had not tried any real medical treatments for tinnitus, or hearing loss, he hadn't tried a CROS hearing aid for instance or anything like that. He was told, at least according to him, he said that he was told nothing can be done about it. And he independently contacted our center for assistance. He did have some residual unsteadiness on his feet, he said he couldn't do certain physical activities like he could before, but he didn't really report true vertigo. But he did have left persistent oral fullness. Okay, so here's just the basic audiologic components.

Obviously his ears were clear, Pure-tone audiometry revealed pure, I mean normal hearing on the right side. Left side was profound across all frequencies, reliability was good. But we did observe some vibro tactile responses in low frequencies. Word recognition was perfectly good on the right side and we couldn't get any responses on the left. So, complete hearing loss on the left side. Otoacoustic emissions present and robust on the right ear, absent on the left, and I do have a reference at the end of this talk that discusses otoacoustic emissions in patients with a resected VIIth nerve and there is pretty much a wide range of responses you can get, you can get normal or partly normal responses, reduced responses or completely absent otoacoustic emissions. Usually over a long period of time, a year or longer, you will see absent responses. Tinnitus Handicap Inventory, the score initially was a 58 which according to the creators of the THI, this is defined as severe or tinnitus is almost always heard leads to disturbed sleep patterns, interferes with daily activities. Tinnitus evaluation, basically we just did the minimal masking level. So, a broadband noise in the better ear of 40 decibels was sufficient to mask the patient's perception of tinnitus. So, we did counseling, Ian are we okay on time? Okay, we, Tinnitus Habituation Therapy or Tinnitus Retraining Therapy is gonna be basically broadly broken into two categories or two aspects. One is the counseling aspect and one is the sound therapy. The counseling aspect is really described as Directive Counseling. Directive counseling is another way of saying education. So psychological counseling is often to people, a

clinician and a patient who are working together for, to discover something about that patient that might help them with their anxiety or personality issue. Directive counseling is really, you the clinician trying to get the patient to understand certain things. And you can't just tell a patient something, you have to work with them to help them understand it. So you're directing information to them. And the primary goal for Tinnitus Habituation Therapy is to demystify the tinnitus percept. And you do this by reviewing the hearing test, you review aspects of what we call the neurophysiological model of tinnitus. Now, you don't necessarily tell the patient, "I'm gonna review the neurophysiological model of tinnitus," because that's, it's a little lofty, but the neurophysiological model though, does tell us how tinnitus is related to hearing impairment, how it can be perceived and amplified in the brain, and how attention to tinnitus exacerbates the percept.

Also, we try to use mindfulness counseling, which is to help patients more effectively live with changes in their abilities and how to live more effectively with things that are annoying. We try to limit patients over evaluating their tinnitus. We don't want them to keep giving it characteristics like it's a good day bad day loud, soft, oh, it's changing. We want them to not be obsessed with focusing on that. But also, we want to limit catastrophic thinking, my life will never be the same, I guess I'm going deaf, what if my tinnitus gets louder and louder? So we try to help in the counseling side to reduce those mindsets. In terms of sound therapy, though, if the patient has a hearing loss, you can use a hearing aid and that often really, really helps people. In this patient, he had a deaf ear and a normal hearing ear, but we did notice with the binaural minimal masking measurement that there was suppression of tinnitus at about 40 decibels in the good ear. So we did put a instrument on the patient's good ear and we, this device was a open fit type device behind the ear, and it did not include the ear canal, and it just had a selectable white noise, pink noise selector, a volume control, and the patient just set the level to what we call the mixing point which is the level where they can hear the noise and the tinnitus at the same time and the goal here is that this would reduce contrast between loud and quiet environments and that the tinnitus percept would be

suppressed. So the outcome really for this guy, he continued use of the noise generator, at least after a year. Now he was driving from out of state, so we didn't see him after the first year. We don't know he was kind of lost the follow up after that. But he did come after a year and he was using the device every day. He reported that he feels more acceptance of the tinnitus and he's less distracted by it. The noise generator he said helps soothe the tinnitus. He said he still heard the tinnitus but it still affected his life negatively. He started taking Ambien which helps to sleep, so he was feeling better about that. And the THI score did step down from 58 to 40, which is from severe to moderate. Okay, so bottom line here is Tinnitus Habituation Therapy is helpful in patients with unilateral impairments and or VIIth nerve resection, however outcome is guarded, noise or sound therapy can be effective on the good or better ear despite complete deafness on the impaired or worse side. Sound therapy is best used in conjunction with directive counseling.

However, this case is approximately 10 years old. So what technology is available now that we didn't have then? Nowadays you can use a wireless CROS hearing aid system, they have integrated amplification or CROS function with noise generator. So that's now kind of standard, and the noise generator can be customized for patient preference and comfort. There are more elaborate phone apps that can be used to help sleep and on the horizon is the possibility of brainstem implants to help patients with severed auditory nerves. But for people who have intact VIIth nerve, a cochlear implant would be a robust option. And going back to the questions, what is Tinnitus Habituation Therapy? How is this done in a patient with SSD? Well, basically it's counseling with sound therapy, and it can be appropriate for a patient with SSD with or without intact VIIth nerve, if you address the better hearing side. And this can be translated to other types of cognitive behavioral therapy. If you wanna do more reading in that regard, CBT as applied to chronic pain, relates to somehow what our goals are with tinnitus patients as well. They don't have pain but they have this chronic annoyance. So the references I put here, I'm not gonna go through them all but I do want to let you know that there are references here that support what we did with this

patient but outcome, as you will see with patients with SSD, Tinnitus Retraining Therapy or use of sound therapy can have mixed results and use of different strategies for SSD can, you'll find that that some approaches may help some patients more than others. So what our goal is to, again, find that patient centered approach. So I'm going to hand it off now and this is a great segue to Dr. Gonzalez, and she's gonna present on Cochlear Implantation for SSD with tinnitus. So, and I'm going to hand.

- [Vicki] Hello and thank you all for joining us today. So as Dr. Bishop just mentioned, Cochlear implantation can be a robust option for single sided deafness and this is a case of someone who had single sided deafness with quite significant bothersome tinnitus. So, a male patient experienced a traumatic fall from an eight foot ladder at 44 years of age and he does not remember the actual fall itself. He lost consciousness and woke up in the hospital inpatient, he had a CT scan that revealed a left sided severe longitudinal and transverse temporal bone fracture involving the posterior semicircular canal. And it's important to note that the ossicles did appear intact given his first outpatient audio results. Following this accident, he reported fluctuating hearing loss in the left ear, constant tinnitus that was fluctuating in loudness in the left ear, so not quite a level that was reported bothersome and brief episodes of dizziness. 15 days following the fall, he saw us post op, or excuse me, he saw us outpatient and this was his hearing loss, so he had normal hearing with a high frequency sensorineural hearing loss in the high frequencies in the right ear, and then he demonstrated a severe to profound mixed hearing loss. A flat tympanogram was revealed with normal ear canal volumes, so there was not a perforation as a result of the fall and the otologist notes did indicate that there was likely resolving Hemotympanum so still blood due to the accident in the middle ear cavity causing the conductive component. We saw this patient again three months post fall and he returned to clinic due to some very bothersome loud left sided tinnitus that was now affecting his sleep and mental health. The hearing in the right ear did improve and demonstrated normal hearing sensitivity, and in the left ear there was no longer that conductive component, but a moderately severe to profound sensorineural hearing loss. At this time, tinnitus management and

potentially bone conduction or osteo integrated implantation was recommended. This patient chose to seek several different opinions from otology practices both inside and outside of the state. He was treated through a three year period at these different practices either with oral or intra tympanic steroid injections. At one practice he was fit with a hearing aid with a tinnitus masker just in the left ear. It was not a CROS device and bone conduction implant was recommended at each facility that we had records for. After that, almost exactly three years since he followed up with us, he was seen for a tinnitus evaluation. So this is now three years three months post fall, hearing in the right ear is still within normal limits, and in the left ear, there was some improvement at 250 and 500 hertz but for the most part, he had this moderately severe to profound sensorineural hearing loss. At the last follow up, it wasn't noted what his word recognition score was because it was not performed, but at this, at the tinnitus evaluation it was, and he scored zero percent.

His Tinnitus Functional Index was 51, suggesting a significant impact on his quality of life. His pitch match for the left ear was at 4000 hertz using a narrow band noise signal. And his loudness match was at 82 dB HL, which was 17 dB SL that you'll see reflected on that T in the audiogram. And his minimum masking levels were 20 dB in the right ear, 20 dB or 20 dB HL in the binaural condition and 75 dB HL in the left ear. At the tinnitus evaluation, it was the recommendations that were provided to him was a CROS system. Again, a bone conduction implant, a cochlear implant, or similar to the case that Dr. Bishop had suggested is keeping a hearing well, putting a mild gain hearing aid on the right ear, which was his good ear and that's where I said similar to the last case, and then keeping the hearing aid on the left ear and having a remote mic option because difficulty and background noise was one of his notable complaints. Because that was kind of the direction they were leaning towards at the time of the tinnitus evaluation, two weeks after this eval, he underwent a hearing aid consultation and based on his complaints, so he had four main, he was looking for relief in four main areas. Tinnitus relief, improvement in background noise, improvement in sound localization, and I am missing one, but I think it was three main complaints. He was

referred for a cochlear implant evaluation. This is where I first met this patient. So he saw me at three years five months post-fall. At this point, he was reporting significant effects on his quality of life both a result of the hearing loss and especially due to the tinnitus. So the tinnitus was quite bothersome in the left ear, he found limited to no benefit from the hearing aid in the left ear both with and without the use of the masker option. He expressed significant concerns with his inability to localize sounds, he often had to work in construction sites and he said that it certainly built up a lot of anxiety now having to go into those work situations where he felt like his safety now was compromised. And he was the primary caretaker of three active children who were always playing in a sports setting and so he was now having difficulty communicating in those settings that had significant amounts of background noise.

So the takeaway is, his quality of life was being affected and so occupationally, he was avoiding group meetings and places that he needed to be at. Socially, he was avoiding restaurants, school functions and sporting activities. And prior to the accident, this was a very community active person and his kids began to express frustrations. And I think this is what really led him to find the options that would be best suited for him. Because one, he was having difficulty hearing them and two, he was withdrawing from activities that he would otherwise have them there and be very engaged in. So I completed the Speech Spatial Qualities questionnaire with him and for those of you who are unfamiliar with this questionnaire a zero represents a complete absence of a quality, a complete inability to perform a task or complete, a complete effort that's required and then 10 is the exact opposite. So, things are much easier and these categories do not have an effect on the qualities or on the presence of abilities to perform these tasks. So, as you can see, his numbers are very low. So, for speech hearing, his score suggests extreme difficulties with speech understanding in the presence of competing sounds with multiple talkers and in different background conditions. Spatial hearing, he felt he had an inability to make directional and distance judgments, which is very consistent with his hearing loss. And then qualities, he felt considerable issues with segregation of sounds, speech recognition, clarity and

naturalness of speech and listening efforts. He did report he always felt exhausted at the end of the day. So I should mention, now single sided cochlear implantation for single sided deafness is FDA approved using the MED-EL cochlear implant system. And there is guidelines for assessing candidacy. This testing was done prior to those guidelines, so we have modified our SSD evaluations to meet those guidelines. But prior to that, we were doing AzBio sentences in sound field, both in quiet and noise. And we were presenting the signal to the poor ear and then presenting the multitalker babble to the normal hearing or better hearing ear. The better hearing ear in his case, the right ear, was unoccluded throughout testing, so we did not plug it because we wanted to see what it was like in a real world situation even with the benefit of the right ear. And obviously, the way that this patient was seated was worst case scenario, but certainly reflective of the complaints he was sharing.

So unaided, he scored obviously 100% in Quiet due to that normal hearing right ear. But once we added a plus five signal to noise ratio in that multitalker babble, his score significantly decreased to 19%. We did an aided, we aided the left ear both with a hearing aid and a bone conduction sound processor on headband, and the scores did not differ much, but they increased from that 19% but still not the speech understanding and background noise that you would want. So 43% and 44% respectively. So given these scores, given his subjective report on the SSQ, and how much the tinnitus was affecting his quality of life and mental health, we felt that cochlear implantation would be the best option for him and fortunately, insurance did approve covering implantation at the time. So he underwent cochlear implantation three years, seven months post fall with a MED-EL Synchrony Cochlear Implant System. Two weeks following activation, it was a different person. He was happy, positive, very enthusiastic about what he was experiencing the last two weeks. He felt he was getting excellent benefit, he preferred to have it on versus off, he reported significant improvements in situations with background noise specifically at the sporting games that his sons were attending, and so he felt like he could now communicate effectively with families. And then there was a notable decrease in

loudness of tinnitus, so he also mentioned that oftentimes he would fall asleep with it on and it would just fall off while he was sleeping, in order to get relief to fall asleep. So one month post activation, his score in the same scenario that we did for the candidacy eval increased to 63%. Three months after activation, his score increased to 87%. And again, this is worst case scenario, sound presented to the poor ear with the noise, the multi talker babble presented to the good ear. And the tinnitus was very minimally to not at all noticeable with the use of the sound processor. He said he only noticed it at times if somebody specifically asked him about it, but in his day to day life, it was no longer perceptible. I wish I had done the TFI again with him and I apologize I do not have a follow up score for comparison, but I do have a follow up score for his SSQ. And as you can see in all three areas, there was a significant improvement and I recognize that I need to hurry up. So I'm just showing results of two systematic reviews and they demonstrated this first one is in bilateral hearing loss cases, but a greater than 90% of patients experience some degree of tinnitus suppression with cochlear implantation. Complete tinnitus suppression was seen 37 to 61%, and patients with more severe hearing handicaps reported greater suppressive relief. In a more recent systematic review specifically looking at cochlear implantation for SSD, similar 89% experienced some degree of tinnitus perception, 14.9 experienced complete, 7.6 no change and 3% worse. So overall, for suppression of tinnitus, cochlear implantation, especially in single sided deafness is now being shown to be a good treatment option for those who are willing to proceed with it. And I am now going to turn the mic over to Dr. Thomas Eby, thank you all.

- [Thomas] Hello, this is Tom Eby. I'm gonna change gears here a little bit and we're gonna talk about a secondary cause of tinnitus, which is pulsatile tinnitus. So let me just introduce the patient to you. This was a 41 year old African American woman who reported a gradual onset of right hearing loss accompanied by a what she called a swooshing sound and she had put up with this until she developed some intermittent pain and that allowed her to go to a physician, a primary care physician. He examined her and found a red appearing tympanic membrane and so he diagnosed a middle ear

infection and she underwent treatment with antibiotics. However, this did not resolve her problem, so she was eventually referred to Otolaryngology, and she reported that she continued to have intermittent pain, but mostly was bothered by this swooshing sound and when questioned, she said, the swooshing did keep time with her heartbeat. So when we saw her in the clinic, she had normal external auditory canals and the tympanic membranes were intact. However, on the right side, she was seen to have a bright red mass filling the middle ear and this basically filled the entire ear drum. Interestingly, on the opposite side, the left ear, there seemed to be a slight reddish hue, inferiorly under the left tympanic membrane as well. And so there were no other physical findings on her examination and so an audiogram was performed at that point. And that showed that she had essentially normal hearing in her left ear, but as you can see here, a mixed hearing loss with some conductive component in the right ear. And so this was associated with this reddish mass.

So the next step was to obtain a CT scan of this patient's ear. And what you see here is represented a coronal view of the temporal bone on the right side and for orientation, here's the external ear, here's the external auditory canal. So this be about the level of the tympanic membrane and you can also see just the hook portion of the cochlea here, and this is the vestibule, so right about in here is where the stapes should be. And what you can see from this scan is that there's not a normal air shadow, the dark black is air, instead there's a greyish tissue completely filling the middle ear. It is also involves the oval window niche, the round window niche, extends a little bit into the epitympanun. The other remarkable fact there is of the scan where that the bone around the carotid artery as you can see here, it's intact, and on other sections, there was bone covering the jugular bulb as well. So this appears to be a mass limited to the middle ear but completely filling this. So with this information, we were able to diagnose a middle ear tumor, probably benign by the appearance on the scan and surgery was recommended to the patient for diagnosis and also just for removal of the tumor. The surgery was performed the trans canal. So we operate through a speculum in the ear canal and we elevate the tympanic membrane with the tympanomeatal flap.

This is a standard procedure to examine the middle ear used for tympanoplasty and stapedectomy but in this case, we used it to try to remove this tumor. What we found was a small but highly vascular tumor which was inherent to the promontory in the middle ear. But we were able to separate it from the ossicular chain so that its stapes and incus and malleus were preserved, as well as the chorda tympani nerve. Bleeding was brisk, but was controlled with epinephrine pledgets and a CO2 laser. So this small tumor was then submitted to pathology and this is what they found when they looked. Basically, this was a vascular neoplasm with thin vessels and dilated lumens. This pattern called Zellballen pattern with nests of cells is very characteristic for this entity. There was a cytoplasmic margins were ill defined and the nuclei had finely granular chromatin. All of these are characteristics of a paraganglioma, which is also known as a glomus tumor and because of the CT findings, we diagnose the glomus tympanicum, in other words, the tumor arose within the middle ear and not from the jugular bulb or elsewhere.

So postoperatively, the patient recovered from her surgery, she was followed over several years and she had gradual improvement of her hearing. She reported complete absence of the swooshing sound that she had had before. Her audiogram showed improvement of the hearing, but she continued to have the sensorineural hearing loss that she had preoperatively. She was offered a hearing aid but declined that, she felt like she didn't need it. And we did obtain a post operative CT scan, which again, you can see the same areas that we looked at previously, primarily in the middle ear. You can see that there's now an air shadow which replaced the middle ear mass. And the area around the cochlea is normal, the epitympanum is normal, you can see a little bit of the malleus here. So here's the normal tympanic membrane, the ear canal and then the external ear would be out here. We'll just talk for a minute about pulsatile tinnitus which is an unusual type of tinnitus for patients to complain about. Of all tinnitus patients, about 10% will report pulsatile tinnitus. Now on investigation of these patient, usually imaging of some kind is done either a temporal bone CT scan or MRI scan, maybe MRA scan can be done but with imaging, only about 29% had findings on

imaging. Of these, only 12% of patients with pulsatile tinnitus end up having Paragangliomas, and usually these are suspected by the physical examination so that the imaging is secondary, they will determine how large the tumor is, maybe the origin of the tumor and can influence the surgery, but the diagnosis of a paragangliomas is often made just on the examination. Other causes of pulsatile tinnitus, secondary tinnitus, can be caused by an A-V malformation. These can be in the ear or actually in the dura, near the temporal region. Anomalies of the carotid artery that is like dehiscence or even some type of aneurism of the carotid can cause this or a persistent stapedial artery. These of course are very uncommon causes of pulsatile tinnitus. Also reported are jugular vein and sigmoid sinus anomalies such as diverticulum and these sometimes can treat pulsatile tinnitus surgically if they're found, but commonly we have patients who report that they can maneuver or press on the neck and stop the pulsatile tinnitus.

And in these patients when they have normal imaging studies, we think that there's probably some type of turbulent flow through the normal venous system through the jugular bulb which causes transmission of pulsatile tinnitus. In addition to vascular causes, there can be osseous causes. There have been reports of patients with systemic diseases like Paget's disease having pulsatile tinnitus. We know that tumors such as hemangiomas, which involve the temporal bone can also cause pulsatile tinnitus, and even some cases of far advanced otosclerosis have been associated with pulsatile tinnitus. Again, this is uncommon with otosclerosis but has been reported. Now, another increasingly seen cause of pulsatile tinnitus is increased intracranial pressure. I usually see these patients complaining of bilateral pulsatile tinnitus and this should raise your level of suspicion. It's often associated with an elevated BMI. So, in this era with increasing obesity in our patient population, I think we're gonna see more instances of bilateral pulsatile tinnitus associated with increased intracranial pressure. This can be diagnosed obviously with a lumbar puncture, to measure the CSF pressure, but some secondary findings are retinal papilledema, which is seen on an eye exam or a CT scan of the head can sometimes reveal on empty sella which also is

associated with increased intracranial pressure. The tinnitus in these patients may improve if the increased intracranial pressure is treated. So obviously one strategy is to, is weight loss which may not be successful, but Diamox is a diuretic that's sometimes used to reduce intracranial pressure and this may also help with the tinnitus. Just to go back to say a few more words about paraganglioma, which was the cause of the pulsatile tinnitus in this patient. These tumors arise from normal chemoreceptor cells, which are located along the vagus nerve in the neck and the ear. So paragangliomas are commonly found in the neck as well as the ear. And these are generally sporadic but in about seven to 10%, they are genetic in origin. They can be associated in families with autosomal dominant inheritance and they're associated more commonly with bilateral or multiple tumors, which may not necessarily be in the ear, they may be in the neck, such as carotid body tumor. These are, these genetic ones are associated with Succinate dehydrogenase protein mutation, and you can get genetic testing and patients suspected of this. Now, interestingly, our patient did have a little blush in the left ear. This showed up on the CT scan, but the MRI scan did not show any enhancement. She was studied three years later and there was still no enhancement and she had no further problems with the left ear. So the question remains if she has a small lesion in the opposite ear, but it is not symptomatic, so she does not require treatment. So I've just included a couple of references that go over the general patient population with pulsatile tinnitus and their evaluation. And with that, I think I'll turn it over to our next speaker, which is Alex Elkins.

- All right, so I'm gonna do a case of Mr. CM. From this, you should, we're gonna be discussing third window disorders so be able to describe the third window disorders, what they are, explain why third window disorders can cause air-bone gaps in hearing evaluation, and explain most common symptoms related to third window disorders. So let's start with Mr. CM. This is the info I had on chart review. He's a 55 year old male, he's an avid skydiver and occasional scuba diver, so he had a long history of rapid barometric changes, probably some, possibly some parametric trauma. He had a history of chronic Eustachian tube dysfunction accompanied by ear pain, ear pressure,

multiple sets of PE tubes. He had bothersome tinnitus, and dizziness. So from there, he had documented sensorineural hearing loss and the information that we had sent over from outside clinic is likely sensorineural hearing loss as there's no bone conduction that's possibly had previous audios that were not sent that showed no change in hearing. But the it overall looks like a fairly typical noise notch hearing loss as he was an avid skydiver. So he probably had long history in noise exposure and when I say avid skydiver, we found out that he was, took jumps nearly every weekend he would jump out of an airplane. So when I saw him for the first time in clinic, he was highly distressed. He was visibly uncomfortable and literally shaking because of his symptoms. He complained of constant ear pain and ear pressure, possibly related to eustachian tube dysfunction but he also complained of loud bothersome tinnitus, interfered with his sleep, caused significant stress and anxiety, contributed to depression, but his tinnitus was also worse when he was dizzy, which he was also dizzy, he had intermittent dizziness and imbalance, reported occasional spinning sensation but mostly generalized dizziness, and it was worse with head movement when he had it, and it was also worse following a jump from an airplane. What he did deny was a sudden episode of prolonged spinning that we would typically associate with a vestibular neuritis.

So on his first visit, he saw ENT and he had some mild retractions according to the ENT, he was able to valsalva and self insufflate, we did not repeat hearing evaluation at this appointment but we did work him in for a same day vestibular evaluation due to his, we an had availability in his level of distress. He, you can see the tympanogram is here not really much of interest had some hyper compliance in the left ear but, nothing really concerning. So then we went on to the vestibular evaluation. Here, we found a left unilateral vestibulopathy. So this was identified as a left caloric weakness, and he also had abnormal video head impulse testing which localized to the left lateral and posterior semicircular canals, the superior semicircular canal in the left ear had normal video head impulse results. The tests of gaze stabilization, oculomotility, static and dynamic positioning were normal. VEMPS were not performed at this appointment

because of equipment malfunction. We did attempt a fistula test given his jumping out of airplanes, and potential barotrauma, which was negative, which was objectively negative. This was done with envision denied setting with tympanometer manual pressure changes, but also it was done with tragal pressure changes, pumping the tragus with finger. And again, no sudden history of prolonged onset of vertigo, so what was causing this left unilateral vestibulopathy? I think there's still a high suspicion for fistula even though officially the test was negative. But during this vestibular evaluation, we also did some tinnitus counseling.

So we talked about causes of tinnitus, that there's something that can be done, and we also identified a real otologic problem and from the point when he came in highly distressed to when he left this appointment, he was visibly less anxious. He was calmed down, he's no longer shaking, and I think as a result of we identified a real problem that he didn't have in the past. We offered him potential for relief from tinnitus and we developed a plan to move forward. And this was the plan. So he was gonna get a CT of his temporal bones and then follow up with the otologist. He was gonna undergo a formal tinnitus evaluation, then he and I were gonna discuss hearing aid consultation and fitting. This was primarily to address the tinnitus. He did have some hearing loss, but he didn't really have hearing complaints. We also referred and began PT for his diagnosed balance disorder. He also got a psych referral due to his level of distress, anxiety and depression. And the this may be separate but he was also considering Eustachian tube dilation because he consistently was jumping out of airplanes and the irony isn't lost on me that a man would have anxiety, significant anxiety but still be able to jump out of airplanes thousands of feet above the earth but we're moving on to the tinnitus evaluation, it was pretty straightforward tinnitus evaluation. Describe tea kettle sound, he did describe occasional pulsatile tinnitus but that's wasn't what was bothersome, it was the tea kettle sound. Tinnitus had a high TFI score. Pitch matched to 6000 hertz, loudness match at about five dB sensation level in the left and right ears respectively. Reference to the previous audio and it was masked at about 15 decibels of white noise, and binaurally at 20 decibels of white noise now.

But one thing that you might notice is that when we repeated the hearing evaluation, there now appears to be some air bone gaps in that left ear. Now he does have a history of eustachian tube dysfunction, possibly could be related to that but his emittance testing was normal, that includes tympanometry and acoustic reflex thresholds. So now he has this different audiogram with these air-bone gaps with normal emittance measures, which kind of adds an added mystery to what's going on and still at this time, was waiting for CT, and so he was fit with hearing aids with Halo 2s, he liked the idea of the phone connectivity as well. And we put in a tinnitus masking program, he reported the masking noise was comfortable, he reported he could still hear his tinnitus. Now I repeatedly said that you still should be able to hear your tinnitus, the goal isn't to completely mask it out, but is to provide distraction and allow you to habituate to the tinnitus, see they, kind of this kind of set the tone for his overall hearing aid satisfaction because he repeatedly told me that he could still hear his tinnitus but the patient reported satisfaction with the sound quality of the hearing aids and again, we had long discussions regarding anxiety and depression related to tinnitus and his dizziness symptoms as well.

So then we got the CT results and this is where things I think get interesting. What was found was a posterior semicircular canal dehiscence with a high riding jugular bulb. Now if we look over here at the CT scan, you can see here is the superior semicircular anterior semicircular canal and it is completely encased in bone, that's the white completely surrounding the canal and that's what, that's how it should be. And this is a coronal view, you can see the mastoid air cells here you can see the outer ear here, but if you can see this there, this is where the posterior semicircular canal is and there is, right about there, an opening where there should be bone. There's should, the white bone does not completely cover the posterior semicircular canal, so that has an opening into the labyrinth where there should be bone and there's not. Now, the vast majority of semicircular canal dehiscence are in the superior semicircular canal. But so this is not a very, this is a pretty rare finding to have a posterior semicircular canal dehiscence. But when they do happen, they're almost always as a result of a high

riding jugular bulb. So, after this now we're in discussion with the, with now the patient's in the discussion with the otologist to discuss potential surgical intervention to plug the dehiscence. So, now to talk about dehiscence and what symptoms it is, what it causes. It's a class of, a class of disorders that are referred to as third window disorders. This includes semicircular canal dehiscence, you could have a Cochlear dehiscence, enlarged vestibular aqueduct is included in this third window disorders, but essentially you can have a dehiscence anywhere in the labyrinth, it's just most commonly found in the superior semicircular canal and the third window disorders that we most commonly will see in the clinic will be superior semicircular canal dehiscence or enlarged vestibular aqueduct but they all present themselves in somewhat similar ways.

So the reason it's called the third window disorder is because it adds a third window to the labyrinth. So we have two, typically in a normal year, we have two windows, an oval window and a round window but now with a dehiscence, you've added another window where pressure can be released within the labyrinth, in this case in the posterior semicircular canal. So as I said, layer bone exposes some of the labyrinth the typical symptoms are dizziness to pressure and or loud sounds. So Hanevartz or Tulio phenomenon, increased sensitivity to internal sounds, so hypersensitivity to essentially bone conduction. Now this patient, different patient, as an example, reported he could hear himself walking on gravel internally. But increased sensitivity might have some to your own voice chewing sounds, internal sounds, there is hearing loss, typically it's low frequency air-bone gaps but they also will often have pulsatile tinnitus, especially if in the posterior dehiscence related to that high riding jugular bulb that, the pulsating of the jugular bulb really resonates within the labyrinth because it's right next to the opening. But why is there air-bone gaps? Well, there's two reasons why there are air-bone gaps as a result of an inner ear disorder or result of these third window disorders, you have reduced sensitivity to air conduction stimuli. Typically we have our two windows in a normal ear so we have our oval window and a round window, when that stapes footplate provides pressure at the oval window, that pressure is released at the

round window. But now with a dehiscence, you have another pressure release point and so that pressures from the stapes footplate is now dispersed and that it shunts over to the vestibular side. And so now that pressure is spread out, so you have a decrease in air conduction stimuli, the pressure that enters the cochlear portion of the labyrinth is reduced because of this. And then you also have a hypersensitivity to bone conduction stimuli and that has to do with, you now have this third window which also provides a pressure release point. So you have this increase in difference between the essentially the oval window and the dehiscence and the round window and this greater phase difference between these windows creates a larger displacement of the vasomembrane and vasomembrane displacement is proportional to the perception of loud, so you have this hypersensitivity of bone conduction stimuli but also reduced sensitivity to air conduction stimuli which causes these air-bone gaps. So, now that we have that we continued on with our hearing aid follow up and he was not satisfied with the hearing aids. We had some improvement in hearing but he said they were too loud, he wasn't really a compliant user. I made some slight reduction in gain changes aided by speech-mapped real ear probe mic measures, which I like to do if I'm reducing gain especially close to first fit so I know how much I'm reducing it. But again, he reported that hearing aids were not effective in reducing his tinnitus.

Again he was complaining he could still hear his tinnitus. But he requested that we raise the frequency of the masker, I was not optimistic, but I did it for him anyway. And he noted it was less satisfying sound quality and at a second follow up, he was still unsatisfied and eventually returned the hearing aids. He said the masking noise was now more bothersome than the tinnitus. Hearing aids, they weren't beneficial and he had no real hearing difficulty concerns. So he decided to return the hearing aids but one thing that he did note is that his tinnitus had been less bothersome. It was still there, it was still present, but it was less bothersome, it was less irritating to him and caused less stress and anxiety since that initial appointment that we saw him. So the big question is why did he get improvement in his tinnitus? Well, there's two possibilities, I think. The sound stimulation with the hearing aids, alleviating the effects

of his tinnitus, I think that's unlikely. He was not a good hearing aid user he never liked the sound and I don't think the hearing aids did much to help improve the perception of his tinnitus. But the other possibility is the overall reduced anxiety through his psych appointments, through his tinnitus counseling, through having a plan to address anxiety or a plan to address his real otologic problem and I think that's the most likely reason. Anxiety and depression can impact, definitely impact tinnitus disturbance and it's closely related but also can impact dizziness as well. Jeffrey Star of the Mayo Clinic had done, has done a lot of work on how anxiety or other psych problems can influence dizziness whether pre existing general anxiety disorder causing the dizziness or a real otologic problem that leads to anxiety and exacerbates symptoms that aren't explained by the otologic problem. But and he all if you remember, he also noted that his tinnitus was worse when he was dizzy. So, we also had he was regular visits with psych, placed on SSRIs selective serotonin reuptake inhibitor. He was getting PT, undergoing tinnitus counseling and we had a treatment plan for his present condition and all of these things likely lead to decrease in anxiety and decrease in his tinnitus disturbance. So in summary, this patient had a real otologic problem, now I don't think his tinnitus is, it was caused by his posterior semicircular canal dehiscence it's likely related to his sensorineural hearing loss and his noise exposure. But having a plan to address his problems and reduce his overall anxiety, his overall level of essentially hopelessness and be, allowed his tinnitus become less bothersome. So that's it, so now I'm gonna turn it over to Dr. Chris Spankovich.

- [Chris] Thank you, Dr. Elkins, excellent job. So we're gonna change things up a little bit. This is going to be a case study, but it's gonna be more presented in a illustrative case format. So I'm gonna sort of walk through the idea of how to perform a tinnitus evaluation based on different types of information you may have in terms of the, where the individuals coming from, in terms of their referral, what type of information you have at that initial appointment and sort of how you build from there for the evaluation and then also management considerations. So this is a more of a nuts and bolts type of case. So, with this illustrative case, we wanna take you through the history and also

the chief complaint. So commonly with tinnitus, the tinnitus may be the patient's perceived chief complaint, but in reality, their chief complaint might be something else. So for example, I'll have a number of patients that I see that have a complaint regarding their tinnitus, but essentially they blame their tinnitus for their hearing loss. They'll present and say, "Oh, I have this "ringing buzzing in my ear, and because of that, "I can't hear anymore. "It's covering up my ability to hear." So when you have a patient like that, is their chief complaint, really the tinnitus, or is their chief complaint hearing loss which they are simply just attributing to their tinnitus? We also wanna consider how to measure the functional impact of the tinnitus and I'll talk about different ways of doing so. We'll then discuss the evaluation of the patient themselves. What are the components of particularly focusing on the audiological evaluation of the tinnitus patient? And then we'll talk about different management strategies. So this specific patient is a 60 something year old male patient. He was referred by an outside ear, nose and throat physician in the area. The referral documents that we received via fax included history audiogram and tympanometry. Within the notes provided by the ENT, the patient was reporting a constant high pitch ringing in both ears. The Head neck evaluation was negative for hearing loss.

Of course in this case, this is the ENT asking the patient questions and determining whether they think that individual has a hearing loss based on their communication. It was negative for inner ear pain, negative for vertigo, negative for oral fullness or q-tip use, negative for nose bleed, negative for sinus pain and negative for sore throat. And our local ENT here, our otologist in the room just laughed a little bit because these are sort of some standard phrases they likely use as they're check boxing through all their stuff. All other systems were negative for issues. So they were, in general, a pretty healthy person that had complaints regarding this high pitched ringing in both ears. They were on medications, within the physician's note, it was indicated he was taking a baby Aspirin, was on Lipitor, which is a cholesterol lowering drug, and then on Klonopin, okay? The Head and Neck exam was normal. This patient did actually have an MRI and it was negative for a retro cochlear pathology. So this is the audiometry

and the tympanometry that we received from the outside facility. The tympanometry were not actually scanned, they just provided the results which were type A for each ear. And then the audiometry was essentially showing a mild to borderline moderate high frequency notched hearing loss. There was a slight asymmetry, slightly poor in the left ear. Word recognition was very good in both ears. And again, tympanometry was normal for both ears, and there was no really indications of any air-bone gaps. So now we move to my history. So this was the limited information that I had in the fax materials from the referring physician.

So as I'm talking to the patient, they're letting me know that they've had a long standing tinnitus for over 20 years. The tinnitus was exacerbated, became louder and higher pitch after a recent attendance to a concert, and this was about six weeks prior, okay? This had resulted in significant anxiety and sleep disturbance for this individual. His primary care physician put him on a prescription of Klonopin because of the very high impact it was having not only on his level of anxiety, but also his sleep. One thing the patient noted was that he did not want to take the Klonopin. The Klonopin was something that he felt like it was helping him but he did not wanna have to take a medication. Again, he initially saw his primary care regarding this and then later saw the ENT. To me, he denied any perceptual hearing loss or significant hearing issues or sudden change in hearing beyond some fullness that he experienced after attending the concert that he said then resolved. He did report some difficulty understanding his grandchildren and conversations in noisy environments which he attributed to his tinnitus, okay? So again, a lot of patients don't understand what hearing loss really means. They may, particularly when the symptoms are not experienced in all settings. So in a quiet setting, this gentleman was doing just fine. In a one on one setting, he didn't perceive any hearing issues, so why would he think he has any real significant hearing loss? It wasn't until he was in a more challenging environment was he starting to experience issues, but in this case, he was again, contributing or I should say attributing those issues to the perception of the tinnitus. He also reported a significant noise exposure history, both occupational and recreational. He liked to use firearms, he

was a hunter and also target shooting, and he was a musician, in particular loved to play the electric guitar. He denied any balance issues, he was also taking a lipoflavonoid. And this lipoflavonoid was recommended by his ENT physician, but he had not noticed any type of difference in the tinnitus percept since he started the lipoflavonoid several weeks prior. Gentleman was recently retired, he reported that he did exercise daily, had a moderately healthy diet, did have some other stressors going on, his oldest son was currently in rehab for some drug issues. In terms of the tinnitus, he localized the tinnitus to both ears, louder in the left ear, he described it as a high pitch electrical high wire type of sound and he denied any pulsatile or clicking tinnitus, or more of those secondary forms of tinnitus. He seems to be reporting more of a primary type of tinnitus.

So then we moved on to sort of go over what the functional impact was of this tinnitus on this individual's life. And I like to use two different outcome measures. The first measure I like to use is called the Tinnitus Hearing Survey. The Tinnitus Hearing Survey was developed by Jim Henry and colleagues at the Portland VA and the function of the Tinnitus Hearing Survey is to allow the clinician to try to determine what is the primary complaint of that patient? Is it really the tinnitus? Or is it actually their hearing loss that they are simply just blaming the tinnitus for? And for this individual, it actually turned out that he scored higher on the tinnitus outcome, which is A, the top portion of that versus B. The Tinnitus Hearing Survey is free to use. If you just go to Google and Google Tinnitus Hearing Survey, you'll find it very quickly and it's a great little outcome measure to utilize even prior to seeing that patient to sort of see what their primary complaints are and where you need to go from there before even determining whether they need a true tinnitus evaluation and management session. The second outcome measure I like to use is the Tinnitus Functional Index. Dr. Bishop earlier described the tinnitus functional, I mean the Tinnitus Handicap Inventory, the THI, which has been a long standing outcome measure utilized in the world of tinnitus. I like to use the Tinnitus Functional Index, the Tinnitus Functional Index, it's very comparable to the Tinnitus Handicap Inventory, but the Tinnitus Functional Index was developed in a way

so that it would be sensitive to change relative to treatment. The scoring system moves from a score of zero to as high as 100, going from low to higher significant effect on daily functions. And there's subtyping to Tinnitus Functional Index where you can sort of describe where the greatest impact is on the individual patient's functional level. His highest scores, which means the biggest impact were on concentration, his sleep and hearing. The patient expressed concern about the sudden change that he experienced in his tinnitus, again, he had long standing tinnitus prior to this, it was really that sudden change and this exacerbated perception of the tinnitus that became alarming for him. He expressed concern for the need for medication, and ultimately, he was very concerned about his ability to attend concerts anymore and play music and this was essentially his hobby now that he was retired, was he loved to go to concerts, and he loved playing music.

So, again, at this point, I've gone through my history with the patient and as I'm getting the history on the patient, I really wanna understand where they're coming from, this individual has seen primary care, they've already seen a local otolaryngologist, they've actually already had an MRI, not exactly sure why the MRI was formed, but there is a slight asymmetry here and so they went ahead and performed the MRI and it was negative for retro cochlear pathology, which is, great to have, probably the insurance is not happy they had to pay for it but it at least gives this patient some level of resolve, it helps to demystify the tinnitus that there's not a medical pathology that we can identify, or that's likely of any significant life threatening concern that is underlying this individual's tinnitus perception or the change in their tinnitus perception. So the question is, do we do another audio? What do we do now? Because this patient just had this audio in the past few weeks. And what it comes down to is really medical necessity. If the patient reported to me that they experienced a change in their hearing, if I had concerns regarding the quality of the audiogram itself, then I may repeat the audiogram. In this case, it was coming from a reputable source. All the testing seemed spot on, it was accurate. So there was no need to repeat the full comprehensive audiogram again in this patient, okay? Tympanometry was also previously normal.

Again, there was no conductive pathology or air-bone gaps or anything in the person's report that would make me think I'd need to do tympanometry. I mean, looking at the asymmetry, you go, Oh, maybe we should do reflex. Well, we've already ruled out reticle pathology so that was less of a concern. So in this case, I moved on to the tinnitus assessment, tinnitus evaluation procedure. The tinnitus assessment evaluation involves a pitch match, a loudness match and a minimum masking level, it can also perform residual inhibition as well. You need to do at least those first three to build the code. When I did pitch matching with this individual, he matched the pitch of his tinnitus at 4000 hertz, you can see that is pretty consistent with what his audiogram is showing in both ears. The loudness match was slightly more higher SL on the left ear. Again, this is also consistent with the patient's report and the minimum masking level was 30 dB HL no matter which ear I presented to or if I presented binaurally as well.

So I was able to basically mask out the tinnitus at a fairly low levels with a broadband noise. So based on this information and what we're seeing, we then move to consideration of different management approaches for the patient. So this individual is having a significant reaction to the change in their tinnitus related to their noise exposure. It's affecting their sleep, concentration, hearing and overall quality of life, patient does not wanna be on medication. So what can we do? Well, what we tend to incorporate is some type of counseling that can then be added to some type of sound therapy based treatment approach. I usually advocate for a five step counseling approach which we cover the source of the tinnitus of the patient, we discuss habituation and cognitive restructuring. So understanding when a patient is having maladaptive thoughts and patterns and then providing alternative thoughts and behaviors suggested to the patient to resolve some of those issues. Basic sound therapy recommendations, talking about attention and how that influences reaction to tinnitus and then talking about general health factors such as diet, exercise and sleep. For the patient, you want to be flexible. We wanna look at, again going back to the TFI, what were the things on the TFI that were really impacting this patient? How can we bring that into our conversation with them? For more information on this approach,

there is a whole Audiology Online tinnitus management discussion talk that I give, the link is right there, go check it out, and you can get the full deal on how to do that. So with this patient, with the source, we review their hearing test results, we go over the neuroscience of tinnitus, we talk about why they experience the change, this new reaction relative to that change. And what I'm attempting to do is normalize tinnitus. Tinnitus is a normal thing. Most individuals after they are exposed to a loud noise will experience some tinnitus. If you take healthy young adults and place them in a silent treated room, that's very, very quiet, the vast majority of them will experience ringing and buzzing. It is a reaction really, that is something that's abnormal. And so we talk about those different things and the different parts of the brain that are implicated in that reaction to tinnitus. We also then talk about habituation. We define habituation, we give examples such as the ring on the finger, the watch on the wrist. We talked about maladaptive thoughts and behaviors, and alternative strategies.

So for example, for this gentleman, one of the issues was that he was very opposed at this point to playing his electric guitar. He didn't wanna do it anymore. And so we talked about, well, it's not, that's all we're not thinking, that's a negative thought. Let's move to finding an alternative strategy on how you could still play music and let's get you some musicians earplugs. And then also bringing up early in the discussion, that they are feeling overwhelmed, they're highly stressed to consider cognitive behavioral therapy as a method that could be potentially helpful for them. Talk about different sound therapy recommendations, everything from basic, enriching the environment with sound to hearing aids with a sound generator, and then talk about attention, highlighting the role of attention in modulating tinnitus perception and basic exercises that they can do to demonstrate that they do actually indeed have some level of control over their tinnitus. They can actually have the patient focus on their tinnitus for a minute or two, and then set themselves up to have something that they're gonna do, an activity that's gonna distract them and set a timer on their phone for two hours later. What they'll notice is that over that time, their perception of the tinnitus changes, okay? And then talk about diet, exercise and sleep. You don't have to give the patient a

specific diet plan or an exercise plan, but talk about generally, overall being healthy and what the potential options are. So saw this patient six weeks later, follow up. I was gonna have a hearing a demo with them because this initial reaction that they were having with their tinnitus was very severe. Patient came back, now their Tinnitus Functional Index was at 26. Basically, he was like, "I'm not having difficulty "with the tinnitus anymore." His reaction significantly decreased, he purchased a sound pillow to help with the sleep. He discontinued taking the Klonopin, he stopped taking the lipoflavonoid, he did get some non custom musician earplugs and he ended up declining moving forward with the hearing aid evaluation. He really felt that, he felt much better after our first appointment. And now he knows that the tinnitus is not causing hearing loss and he feels fine. Patient was scheduled for another follow up six months later, canceled. And that's pretty run of the mill standard for a lot of these patients. All they need is someone to sit down and talk with them, get them over that hump, and then that really something that sets them up for the future. All right, we are done with our talk. We're happy to take here for the last couple of minutes any questions that anyone may have for any of the presenters. All to see if Christie's might be typing something. If there aren't any questions, we will be happy to just wrap things up, you can contact us. My email is cspankovich@UMC.edu, that's C-S-P-A-N-K-O-V-I-C-H@UMC.edu not UNC, UMC.edu. And I'm happy to address any questions that people may have later. We thank you for your attention and we were happy to share some of our work with you today.

- [Moderator] Thank you so much, Dr. Spankovich, we do have one question here from Tim. Tim mentions it was an excellent presentation, I do agree with you, Tim. And he also asked, "Just wondering if there was "packing of the bone performed for the client "with the posterial SCCD?"

- [Spankovich] I will ask Dr. Eby that one real quick, was there packing of the bone for the posterior canal SCD for that posterior canal patient? Yes, it was, indeed. That patient did undergo a revision surgery of that third window and reported significant

improvement in actually their vertigo. The problem was that ended up creating a very minimal conductive hearing loss that also resolved with time post the procedure, but that little slight change made his tinnitus a little bit more noticeable. So he went from a place of being highly disturbed by all the vertigo and the vestibular stuff and that was the primary complaint, but now that was resolved, that, it was essentially cured, his vertigo was gone. But now he was noticing the tinnitus more, so now the tinnitus became the primary issue and so luckily, we got him moving forward in a better place with the treatment plan that we came up with. Thank you everyone, again, we appreciate your attention and again, if you have any further questions or would like to reach out to me, my email is provided. Take care.