The Use of Hearing Aids in Managing Chronic Bothersome Subjective Tinnitus

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Thank you so much for joining. I didn't think that I was going to love the topic of tinnitus nearly as much as I do. And I say that as an audiologist who's been doing this now for about 22 years. So I'd call myself a mid career audiologist. I think I'm probably going to be doing this for at least another 22, maybe 42 more years.

Because the things that I've been learning this past two years has blown my mind as it relates to how to help take care of patients. Diagnosis and treatment of patients with chronic, bothersome tinnitus is one reason why I got into audiology in the first place. I've taken to telling the story that as an eight year old child back in 1982, I remember sitting at the dinner table with my older brother and my mom and my dad, pacing back and forth, coming to sit down and then getting back up again and then pacing back and forth because he had a noise induced tinnitus. And he talked with our family physician about this and he said the same thing so many of our patients here, well, there's nothing you can do about it. You just have to learn to live with it.

And it became one of my life's missions to become the audiologist that my dad should have had. And so I'm so eager to talk with you all today about how these things can be managed. And that well intentioned but false statement, there's nothing you can do for this. You just have to learn to live with it, is something that is not only wrong, but it is, in fact, highly detrimental to the people that we're taking care of here. So just as a disclosure for you all, so that you know, I am a clinical advisory board member for Neuromod devices, which manufactures a bimodal neuromodulation device.

It's an FDA cleared device. It's something that we use clinically. I'm not talking about that today. That'll be for another talk at some point, if it makes sense. Here specifically for today, we're going to be talking about use of hearing aids, and it's just blanket across all manufacturers.

I really don't talk about any specific manufacturer with that, but that is important. I would like for you all to be familiar and aware that this is something that I do have a disclosure. So here for today, what we're going to talk about is how and when hearing aids that are fitted for patients who have tinnitus as one of the reasons why they're coming to see you, how we might deviate from. What's the standard fitting plan that you may have for your patients who don't have chronic bothersome tinnitus? I'd like for you to be able to think very clearly and be able to explain in an expert level how it is that a significant increase in soft sound enhancement, more so than would be called for by the manufacturer's fitting algorithms or by nal or DSL, why it is that we want to do this and, in fact, do some things that would be antithetical to your typical hearing aid fitting, when the purpose of this is to help to treat tinnitus.

And I'd like for you to be able to assist patients in identifying, like, kind of taking control themselves, how it is that they can effectively mask their tinnitus. Because the way we mask tinnitus is not the same way that we would mask for doing a diagnostic audiogram. Contralateral masking for doing air conduction or bone conduction is something that's called energetic masking. That's where we're delivering a sound and we're adding some other sound, maybe in the contralateral ear, to keep that ear busy. But literally, if we were to add a signal on the same side, ipsilateral masking, we can actually shift your ability to perceive that sound.

That's done energetically. Well, tinnitus is not something that is energetically masked. It's something that is masked more centrally. Or another description for it is informational masking. And so we're not necessarily trying to chase, like a third octave band around that tinnitus center frequency the way you would energetic masking.

It's more a matter of shifting attention, and that's done more on a central level. So we'll talk a little, just briefly, about how many people have tinnitus. There's a lot of numbers out there. These are some of the best numbers I have, just thinking about the scope of

the problem. For those of you who either have tinnitus or are triggered by the sound of tinnitus, I'm going to give you fair warning, but I am going to be presenting examples of tinnitus.

Many of us have a good appreciation for what it is, but I want to make sure we're all on the same page on that one. I want to talk about the assessment of the patient, and that's not specifically around. Here's how you push buttons and collect pure tone thresholds. You all know how to do that. I want to talk about the technology features of hearing aids and where I specifically deviate in this which is mostly just kind of fumbling my way through to figure out, well, why might we adjust something from what the recommended setting would be in the technology?

We'll talk about how amplification alone can be highly beneficial and where masking should or should not be incorporated. And we are going to talk about some specific cases that I think are illustrative of what we're doing.

So, tinnitus itself is what I would describe as circuit noise. So every electrical system has inefficiency in it. So actually, every system, whether it's electrical, mechanical, acoustical, they have this input and there's an output, and in between is what a system is doing with it. So, like a hearing aid, for instance, sounds coming in the microphone, the amplifier is boosting it, and then the output is a higher level signal. But that higher level signal that's coming out the other end is not like a perfect, let's say the amplifier says, boost this by six decibels, and on the other end, it doesn't come out exactly six decibels.

It comes out like at about 5.9. So inside you say, okay, boost at 6.1 to get six out the other side, there's a little bit of a loss that goes on in there. So there's some byproduct of how a system works. That byproduct is noise. Noise in the system.

We hear this as circuit noise in a hearing aid, we heard as noise from the fluorescent lights that are above me right now, that little buzz that's going on. Incandescent lights are highly inefficient of all the energy that they use. It's down around, oh, goodness, 15% of their energy is in giving off light. And most of, but not all of the remainder energy is given off as heat. And so any of you back in the day, in the 80s, had an easy bake oven.

Sorry. An incandescent light bulb is really good at making muffins because you can trap the heat inside this little oven. An example of a byproduct that we've harnessed for a benefit is the heat that's given off of a combustion engine. So our engine is, as we're driving down the road, they heat up from the friction of the pistons running in there. And of course, we use engine oil and we use coolant to try to keep the engine from overheating, but we use that to keep our car warm when it's cold outside.

So that's where we've used the noise in the system to give us something that is in fact, beneficial. So repurposing of the noise. Well, tinnitus is noise in the auditory system, and I am convinced that all mammals and probably all avians, all birds have tinnitus, and it's quite possible that reptiles and amphibians, it's quite possible they also have tinnitus. But those of us who. Well, it's very hard to measure tinnitus in a non human.

It's not that hard to measure it in primates and in dogs and cats and gerbils. It's not that hard. It can be done and researchers do that, but it's obviously, it's a whole lot easier to ask a person, hey, do you have a ringing, buzzing, hissing noise in your ears? And if they say, yes, well, you have tinnitus. Tinnitus is this circuit noise that exists.

That's part of the byproduct of how the auditory system works. There's a resting firing rate of all the neurons throughout our body, and that firing of those nerves is part of just their normal function. Now, is it important and necessary? Well, it actually is,

because if these nerves don't randomly fire occasionally, they don't get fed with the chemical that our body produces. That's called neurotrophic growth factor.

Neurotrophic growth factor. That's a chemical that keeps that nerve cell alive. And if they don't fire, they don't get fed. The fact that they don't get fed is part of how we get pruning away of neurons that aren't being used, and that can be good and bad. Well, so when that resting firing rate is above our auditory cortex's threshold of detection, then it is perceived as a phantom ringing, buzzing, hissing noise.

It can be perceived on one side. On the other side, it could be in both ears and perceived in the ears, or it could be perceived in the middle of the head or somewhere else, and it's perceived in the absence of external sound. So that is the definition of tinnitus. Now, what's ironic about the tinnitus is anyone who has bothersome tinnitus hears their tinnitus and says, make it go away. It's so loud, make it go away.

Well, what's interesting is, of all the people who have tinnitus, only a relatively small percentage of them are actually bothered by it. So there's all these people who have perceptible tinnitus and they're not bothered. They're not the people who are coming in the door. And studies that take a big sample of people who have bothersome tinnitus. And people who have non bothersome tinnitus, you do pitch matching, loudness matching, minimum masking level tests.

So the psychophysical tests of, gee, what's your tinnitus like between the two groups, the bothersome and the non bothersome group, there's no difference in the loudness of the tinnitus, the pitch of their tinnitus, or what sound level is required in order to mask it, just minimally mask their tinnitus.

So perception of the tinnitus, it would seem, then, is actually not the problem. The problem is in the emotional reaction that people have to that tinnitus, and there's a

specific personality type that is more likely to react to their tinnitus. And so when everyone comes in and says, just if there's anything you can do to make it go away, I just want my tennis to go away. Can you cure it? We have to really think that one through and say, ironically, whether the tinnitus is there or is not there, that doesn't matter.

It's whether or not you have a reaction to it.

Because the tinnitus, it's a sensation, just a sensation like many other sensations. It's a body sensation. It's an otherwise benign body sensation that in the majority of people who experience this sensation are not triggered by it, whereas in other people, the minority of them, there's a network of neurons that assigns that sensation as being a threat. Okay, so how does that work? It works by this bundle, the very incredibly important bundle of neurons that's called our thalamus.

The thalamus is our attention center. Think of this as the spotlight for a Broadway musical. Who are the important people up on stage acting? Well, the spotlight is going to be on the person giving a solo, and then it may shift to somebody else who's important and should be attended to. A really good example of how our thalamus works and how it doesn't work is when we're trying to text and drive, we're not good at putting our attention on two different high cognitive load activities.

So driving is a high cognitive load activity where you're getting information in from vision and from hearing, and some metasensory like, hey, what's my wheel doing? So that's integrating a lot of inputs, and you're focused on what you're doing there. Now, if I take my hand off and I'm using my thumb and I'm typing out something that is a high language, high cognitive burden, because it's me utilizing language, I am not able to do driving at the level that I really need to be able to do it safely. So you can either text

well or drive well or do both poorly, but you can't do both well. And that's because the thalamus really only has one spotlight.

It can only do one thing pretty well at a time. Thalamus is below our threshold of consciousness, but it is influenced significantly by consciousness. And so when we perceive the tinnitus, we may have our thalamus shift and observe that. And if we don't get triggered by it, if emotionally we don't get triggered by it, and instead we observe it as something that's a benign body sensation. Okay.

Our attention will shift over to something else that might be important or something else or. Okay, well, what's this? Oh, I want to read. I want to watch this tv show, and the tennis is there, and it just is there, and it doesn't matter. That's where our thalamus has shifted it away to other more important things.

But when we get triggered, when there's a part of our body that assesses threat, and this is down in the limbic system, which is a very primitive area of the brain, all animals have a limbic system. In lizards and amphibians, the limbic system is the only brain. Mostly, it's the majority of the brain. This is instinct. This is reaction.

Well, the part of our limbic system that is responsible for primal emotions, this is a network of neurons called the amygdala. And the amygdala, when it's activated, it takes on a context of anxiety. And if it's a low level activation, then we have this lower level, ill at ease sensation. And a lot of us walking around who have some level of anxiety that's just always there, depending on what level it is and how much it influences our behavior can be described as a generalized anxiety disorder. This is oversimplifying things, but when our amygdala, just at baseline, is more activated, and it's activated to a level where it starts to cause some changes in our behavior or in our other emotional responses, that may be something where we need talk therapy, medications, combination of the two.

Well, when the amygdala gets really activated, like a sharp, hard, quick activation, this can cause a panic reaction or a fight or flight reaction. And in our patients who observe tinnitus, the perception of it and their thalamus detects that and sees it and shines its spotlight on it, and then that feeds down into the amygdala, and they get a panic reaction that actually feeds back into the thalamus to say, that's dangerous, that's a threat. Don't take your eyes off that. Oh, no, see, that's bad. We don't want the amygdala to be telling the thalamus, watch that like a hawk.

That is so important. Well, all you've really done is you've reinforced the significance of the tinnitus, causing a stronger limbic system reaction, which causes greater attention to it. And as that pathway of this kind of cycle between the amygdala to thalamus, amygdala, thalamus, this only causes the sensation of the tennis to appear to be louder. It is not necessarily recruiting more auditory neurons into firing faster, therefore perceived as louder or changing pitch or anything like that. It is the level of attention given to it.

And in a lot of our patients, they have had this negative repetitive activity where the thalamus is locked onto it and has actually become a new neural network, causing the tinnitus to always be present and never be able to be masked.

So how many people have it? Yeah, that's a great question. So, according to American Tinnitus association, which is a wonderful group, and they do great work, somewhere between ten to 15% of the US population has tinnitus. That's 50 million people. Recent study by Jarek at all.

This is really good. They did a meta analysis of all studies that they were able to incorporate in, and they said it was about a 14.1% prevalence of tinnitus. And that

increases with age. And we know age and hearing loss are highly correlated. And yes, the presence of tinnitus is highly correlated with presence of hearing loss.

Correlated, not perfect. There are plenty of people who have normal hearing sensitivity and have tinnitus, but it's more likely to have tinnitus if you also have hearing loss. So if 14.1% of the US population have tinnitus, 6% of them have bothersome tinnitus, and then about a 10th of that. So 0.6% have debilitating tinnitus, and what we describe as bothersome versus debilitating. It actually turns out we can assess that.

We can put some numbers around whether their tenants is bothersome or debilitating or non Bothersome.

So, quick note here on the top right corner, you'll see question number one. So, in the quiz that will be part of you getting continuing education units for this, here's where answer to question one is going to be chronic bothersome. Tinnitus is associated with hearing loss. And typically, we think of it as sensory neural. But it also turns out that conductive hearing loss can be associated with tinnitus as well, mainly because you have loss of outside, soft outside sounds, causing your auditory system to be activated by external sound, as opposed to by its own internal circuit noise.

It is associated with increased sound sensitivity. So plenty of people who have bothersome tinnitus also report that loud sounds are painful to them. That's an interesting one. And we can quibble over, do they actually have hyperacusis, an abnormal sensitivity to loud sound? Or are they actually guarding against loud sound, triggering their tennis to be louder?

Those are good questions. Chronic bothersome tennis is associated with anxiety, depression, and negative repetitive thoughts. Negative repetitive thoughts is kind of like a bigger picture discussion of people who have obsessive compulsive disorder.

They all have negative repetitive thoughts. But plenty of us who we say, well, I have trouble sleeping at night because my mind is racing.

Well, what's your mind on? Your mind is on negative repetitive thoughts. You've got a lot of things that's running through your mind of, what am I forgetting to do? What am I supposed to do? Oh, my gosh, I forgot to do this.

What if this happens? So chronic bothersome tinnitus is not typically associated with dizziness. The only chronic bothersome tinnitus that is associated with dizziness, at least generally speaking, is menieres. If you have benign paroxysmal positional vertigo, bppv, that is causing dizziness, it's not that you can't also have tinnitus, but the cannulae, the otolus that have broken loose in the semicircular canals or in the other organs of balance. Those don't necessarily cause tinnitus.

They don't necessarily cause hearing loss, for sure. But you certainly can have BPPV and also have tinnitus, and the two are not related. So I call into question whether or not having BPPV also has tinnitus associated with it. It's principally just Meniere's disease. Okay, so fair warning to all of you that if you are triggered by the sensation of tinnitus, I'm going to suggest that you just drop your volume rather dramatically.

I'm going to try not to talk while we're playing. These people describe their tinnitus as being a ringing sound, a buzzing sound, or a hissing sound. And I can tell you the quality of the tinnitus, whether it's a ring, a buzz, or a hiss, is not correlated with how much their tinnitus bother is. Some people will say, oh, if it would only just be a single tone, then it wouldn't bother me so much. Other people who have a ringing tinnitus, a single tone would say, oh, it's just the single tone is like driving right between my eyes.

So just to be on the same page, let's think about this one.

That triggers me a little bit. It does bug me. That'd be a sound that I really wouldn't like to have that in my ears all the time. Okay, here's a hissing noise.

Okay, so a little bit more broadband, but a lot of high frequency emphasis to that. And then let's think about the buzz.

Really useful is to think about some tinnitus intervention strategies that call for pitch matching. If it's a ringing tinnitus, then you're probably going to have a really easy time pitch matching as long as that ring is stable. And not all ringing tinnitus is a stable percept. It oftentimes does fluctuate in its pitch. If it's a buzz or a hiss, you may not be able to pitch match that at all.

I would struggle to pitch match a hiss for sure. Now, here is a simulation of tinnitus of a former extern of mine who's now a phenomenal audiologist who does some really good work and has presented with me on a couple of occasions. He happens to be an audio engineer and musician and audiologist. And so he has mixed down his different multiple components of his tinnitus. Let's listen to.

That's.

That is multitonal. There's a lot of low frequency to it. There is a very high frequency ring in there. There's some buzz in there.

The quality of the tinnitus does not dictate the severity of the tinnitus. The loudness of the tinnitus actually does not correlate with the severity of the tinnitus. What is okay, it's whether or not you have sleep disruption, whether or not you have this sense of loss of control. Loss of control. We're not in control of so many things, and yet we carry this myth with us that I can control many things about me.

That's a myth we are not in control of so very much. But the moment that our brain receives a loss of control, that can trigger people, especially people who are, as I am, a control enthusiast. We're not control freaks. We're control enthusiasts. Well, the moment that our myth of being in control is torn away, then we can have a panic reaction.

Bothersome tinnitus, significantly associated with anxiety and depression, highly likely in people who already have anxiety and depression. And this just exacerbates it because the thalamus gets locked onto it, and that's feeding down into the amygdala. And amygdala is already activated through all these other things between our genetics that has us automatically predisposed to being at higher levels of anxiety as well as our past history. So things that have happened that cause us to be more on edge. Bothersome tinnitus results in annoyance, irritation, inability to relax.

That's a really big piece of it, that inability to relax. People just trying to achieve peace and quiet and not feeling they're able to achieve peace and quiet, and it results in difficulty in concentration or confusion. So all of those things that I just listed out under bothersome tinnitus, those five bullets, have nothing to do with the perception of the tennis. They all have to do with the attention to it and the reaction caused.

So can we ask tennis? Okay, well, let's play my former students tinnitus.

All right, let's play a masking soundbook. I can tell you I continue to hear that tinnitus. No problem. Maybe if I made that masker a lot louder, maybe we could. All of us, as we're listening to that, you may quibble and say, well, if you shift the pitch down, if it's lower pitch, if you make it louder, the relative balance between the two, perhaps, sure.

But there are plenty of people that if you put them in a sound booth and you say, raise your hand when you don't hear your tennis anymore and you present to them pink

noise or speech shaped noise or white noise, and you increase the level, increase, increase, increase. You could be presenting 80 decibels, and they're like, yeah, this is all super loud. And it actually is making me nervous. How loud you're playing this, but I still hear my tinnitus. It's no different.

Tinnitus is masked not energetically, but it is masked informationally. Informational masking is around shift of attention. Therefore, it's mediated by the thalamus, not by the auditory cortex. So what should our maskers be like? Our maskers should have some context to them that is equally pleasant as the tinnitus is unpleasant.

I'm going to say that again. Our masker should be equally pleasant as our tinnitus is unpleasant. This is in the auditory channel, and we are utilizing the auditory channel as a therapeutic avenue. And so if the tinnitus is an unpleasant, stressful sensation, we should deliver a sensation that is pleasant. But it's really important that it be something that's not just pleasant?

Ideally, it's vaguely pleasant and it's easy to ignore. Maskers should be vaguely pleasant, but easy to ignore. You see the q two up in the top right hand screen? Yes. That's question number two.

Okay, so now, at a minimum, the masking sound that people have, whether it's through a speaker in their room, or it's played out of their iPhone, or it's out of headphones or out of hearing aids, that masker should be less annoying than the tinnitus is. I have a lot of people who have come to me from other offices where they came with hearing aids with tinnitus masking in it. And they say, yeah, I've stopped using them because the masker just makes my tinnitus worse. I'm like, really? Okay, interesting.

And they'll describe that? Well, yeah, once we put the masking on, I really just keep turning it down and down and down, because the masker is actually worse than my tinnitus. I'd rather listen to my tinnitus.

So in these patients with chronic, bothersome tinnitus, let's think about, well, what do we do with that initial evaluation? All right, if they have not already had this done by another clinic, and I take audiograms from outside clinics all the time, because I'm an independent private practice, I don't have an ENT on staff. Maybe I'll hire one someday as long as he works for me. But otherwise, we'll have medical work up elsewhere when it's indicated. And as such, it's important.

Tinnitus can be associated with underlying medical pathology, and so we need to be mindful of that and watch it. So therefore, we do comprehensive audiometry, pure tone, airborne speech. I actually also do a quick send on every patient because quicksin is tapping into more central activities. And if there is challenges with the ascending auditory pathway, that's going to be more present in hearing, understanding speech and noise, or any other signal and noise type of test. So that may be helpful and appropriate.

I like to do dpoaes as opposed to Te OA and doing as many frequencies per octave as you practically can. Yes. You could have them sit there and do dpoaes for 15 minutes straight. That's not necessarily helpful. So something that's going to be relatively quick, but also help you to identify any kind of pre audiogram damage to the cochlea.

Not that the dpoaes are necessarily going to be directing what your treatment plan might be, but when you show a patient who has chronic bothersome tinnitus, who's been shown, oh, well, your audiogram is normal, so nothing's wrong. Yes, there is. They have chronic bothersome tinnitus. Of course something's wrong. But their pure tone audiogram was not sensitive enough to show what is in fact wrong.

If they happen to have a reduction of their dpoaes that can be so validating for that patient, they immediately lessen their reaction to it. Because it's not like I just made this thing up. There actually is something there. So the diagnostic process can in fact then be therapeutic. I do like to do uncomfortable loudness levels, loudness discomfort levels, whatever terminology you like to use, bearing in mind that that is a very subjective measure, it's highly dependent upon instructions.

That said, I like to get this especially if a patient reports they have sound sensitivity issues, whether or not they allow you to do it well, that's part of where you have to ascend from a level that is comfortably high up to a level that is just below where they're going to feel triggered by the level of the sound. And then you actually document their ldl as being five decibels above the level that they said, okay, that's the loudest sound that I will tolerate. So their ldl would be five decibels up. I do temponometry on everybody, of course, because, well, I got to see just what's happening with that middle ear system. If you can get a person to do acoustic reflexes that you don't just do temp screenings and just let it hit 90, 95, 105 db in a patient who's otherwise sound sensitive, they're going to rip the thing out of their ear and run out the door and never trust you again.

So whether or not I do acoustic reflex thresholds depends on what the patient's history is and what we're trying to do. And if you can do acoustic reflex thresholds, it can be helpful to see and understand are there acoustic reflex thresholds in a normal range? And yet they report that they're hypersensitive to loud sound. That's more of a, you're guarding against loud sounds, causing your tennis to be worse, as opposed to if their acoustic reflex thresholds are 70 decibels or 75, that is well below what is a normal threshold. That suggests that there is something happening in the periphery to cause their reflex to be triggered at a lower level than is normal.

The most important out of all of these, perhaps comprehensive audiometry is super important, but I would bypass everything else in order to get completed tennis questionnaires. And in my office we use the tennis functional index and the tennis handicap inventory, the TFI and ThI. There's other really good tennis questionnaires. As long as they're scientifically validated, they have good test retest reliability, and it's well established. What change from baseline to post treatment?

Now, what's the magnitude of change required to say, okay, it's different, either better or worse, as long as you've got that any of the questionnaires are really good. The TFI is the one that's been most recently published and is kind of encompassing lots of different good things from other questionnaires. So I've already talked a little bit about this, about whether or not the assessment of the patient should include pitch and loudness matching, minimum masking level, or something called residual inhibition. I will say I'm hit or miss on whether or not to spend time, valuable time, doing pitch or loudness matching. If they don't have tonal tinnitus, it's going to be really hard to pitch or loudness match.

Maybe minimum masking level could be beneficial if we are incorporating masking into it, because that can, in part, show, hey, we are able to establish control over whether or not you do hear your tinnitus, at least here and now while we're doing this testing. So showing people that masking can work could be therapeutic. It's part of that counseling process. See, we're able to do it. And some people, if you are able to mask their tinnitus, leave that masker running for 15, 20 seconds and then turn off the masker.

Obviously, you give instructions in advance and you tell them, all right, so we're masking your tinnitus. You're not hearing it right now. I'm going to change that masker. You may not hear it anymore, turning it off, but I'm going to say, you may not hear it anymore. I want you to push the button.

If your tennis comes back, like the moment your tennis comes back, if it does, I want you to push the button. So residual inhibition, you can measure it, that you've got masker going. That's masking their tennis. They're not pushing the button down saying, okay, their thumb is up, they don't hear the tinnitus. You turn off the tinnitus and you set a stopwatch for how many seconds before they push the button?

If they push the button within 5 seconds of the masker being turned off, that means they don't have residual inhibition of their tinnitus. If they don't push the button going on and on and on, and they're in a sound booth, super quiet, there's no external sound, and they don't push the button, that means that they are experiencing residual inhibition of their tennis, that this masking was highly effective at causing their perception of the tennis to shift, and that it was lasting. It's not exactly indicative of them having easier or harder tennis to manage. It's just another interesting thing about their tennis that suggests that it's highly malleable relative to providing some sound stimulation. And that's really what we're trying to get patients to accept, is that if we provide sound stimulation, we'll be in good shape.

But the most important of all of these, it's not those psychophysical measures, it's getting questionnaires. These questionnaires do not tap into not very much their perception of the tennis, but into their reaction to it. And that really is the most important component of this. So I do like that tinnitus functional index. It gives a global score on a scale of zero to 100, where the higher the number, the more severe the tinnitus.

A score of 25 or above would suggest that the patient really would benefit from clinician directed tinnitus care. A score of around 40 to 50 to 60 means that things are pretty significant. Scores up above about 75 means that they are in a really bad place.

That's a global score. But there are also eight different subdomains that are associated with tennis, father.

And that is how intrusive their experience with it is, whether or not it's challenged their sense of control, interference with cognition, interference with sleep, interference with their ability to hear and understand.

That auditory component is almost always associated with hearing loss on your pure tone audiogram, however, not always. And that auditory component is either hearing loss, not the tinnitus, it's the hearing loss that's interfering with their experience or it's attention. If they have normal hearing or near normal hearing sensitivity, but their auditory score is really high, that means that their thalamus is being locked onto the tinnitus to the exclusion of being able to hear and follow what someone is saying. Interference with relaxation, disruption and quality of life, and then emotional interference are also interesting pieces. So each one of those is on a scale of zero to 100.

And so if some of these, like, say, sleep is at 100, but auditory is at a zero, well, clearly we need to address sleep. And I'm not so concerned about being able to shift your attention and focus or I may not say hey, we need to address the hearing loss. We really need to address the sleep first. A change of greater than or equal to 13 points on the TFI is, in fact, a significant change. Clinically significant change is a 13 point shift.

So the first thing that we're going to do is we're just going to strike this phrase from all lexicon and anyone who comes to you saying, okay, well, this very well intended ent said, there's no cure for this. You'll just have to learn how to live with it. We are going to just strike that right out. Because there is no cure for migraine, there is no cure for fibromyalgia, there is no cure for hearing loss, there is no cure for myopia, there's no cure for presbyopia. We don't cure cancer.

We give the body's immune system a fighting chance to push it off and it goes into remission. We don't cure it. There are so many things we do not cure. So calling tennis something that we need to cure, I would describe it as the same as any other benign body sensation. Like, well, you're right, I can't cure your tennis any more than I can cure your skin.

Feeling the cold outside and needing to put a coat on, that's the body sensation. It told you some information. Hey, it's cold outside, I should put a jacket on. Okay, well, my tennis is kicking up. Well, is it because you're stressed or you drank too much last night or you are just feeling really triggered or anxious?

Well, let's do something about that for symptom management, and that's enhance sound. So let's think about sound enhancement. I'm going to play that tinnitus again.

And it so some of you, that may be triggering for me, I've heard it so many times, it's just kind of like a normal for me. Well, my favorite app, and I am not promoting this particular hearing aid manufacturer. No, I do happen to love this app because it's free, there's no in app purchases, and they don't track whoever, or maybe they do, I don't know, but I've never had anyone describe it as being a problem. Well, with this app, resound relief, you can program in up to five sounds, and you can adjust the relative level of those sounds. So for me, the sound that I most often listen to when my tenderness is bothering me is this.

So I can tell you over the audio with this on my headphones. This is actually a little bit of an annoying sound when it's out of my hearing aids. It actually sounds really normal and natural, but I have a heavy rain going. I have ocean waves crashing that it just now just crashed. Ocean waves.

But I also have monks chanting. You can just barely hear that, the monks chanting. Well, I just mixed the two. Let's see what this sounds like.

So there was a little bit of that ocean wave crashing just now. That was pretty good.

And then it dropped back down. I can hear more of that really high pitch ring, and now it kind of went away there. So masking is not necessarily about causing a person to not be able to hear their tinnitus. If they attend to the tinnitus, it's about whether or not you give them some other sound that's worth attending to that is vaguely pleasant, but then it's hard for them to maintain attention to it. Like the sound of rain on a roof.

I love the sound of rain when I go to sleep. If it's a rainstorm outside and not crashing thunder, but thunder at a distance that, oh, man, I sleep so well because it's just this constant droning sound that. I love the sound. It's pleasant, but it's hard for me to sit there and attend to it for more than maybe a minute. It just fades into the background.

So, as I said, tennis interventions, it's about managing the tinnitus just as it's about managing chronic pain condition, managing anxiety, managing migraine, managing hearing loss. It's management. It's not a cure, and so many things are not a cure. We are looking to habituate the patient's reaction to the tinnitus, not so much cause them to no longer hear it anymore. It is possible through targeted interventions that a person may not hear their tennis anymore.

It may be possible for them to not hear their tennis even without any sound enhancement, any other background noise going on. It's possible for that. But I've never had a patient say, yeah, I don't hear my tennis anymore, without having first habituated their reaction to their tennis. The irony of tennis intervention is you need to get to a place where you don't care whether or not you hear your tennis in order for

your tennis to get quieter. Obviously, if your tennis was quieter, you would care less about it.

Well, that's kind of like an obvious one for one, but we actually have to go the opposite direction. We have to put you in a position where you don't care so much about your tennis in order for us to get to not hearing it so much. So it's reaction first. This is where we deprogram the activation of the amygdala. And this is through reestablishing sense of control, establishing sense of control.

One way to do this is through tennis retraining therapy. Dr. Jastreboff, who founded tennis retraining therapy, is doing some workshops on it. I understand that he's going to have one coming up in the fall. So if you do have an opportunity to be trained by someone who is certified in tennis retraining therapy, please do it.

And if you're able to take one of his workshops, I do recommend you do it. There's also tennis activities, therapies, tat. There's other approaches for tennis therapy. So TRT is not the only one. That just happens to be a pretty well branded one, but just a quick primer on this.

Tennis retraining therapy is about demystifying the cause and the consequence of the tennis, and helping a person understand that there's the reaction to the tinnitus versus their perception of it, and that reaction and perception actually exist in two different areas of the brain, and that any place where we work on this, we can cause reduction in reaction, either through modifying the activity of the amygdala or through giving you vaguely pleasant and easy to ignore sounds and providing soft sound amplification through hearing aids. So the idea, though, with tennis retraining therapy, is that a person never experienced their tennis in the absence of a masker or some other type of sound going on, that it is just 24 hours a day, seven days a week, that they do not experience any breaks in a masker that is just there. And specific to tennis retraining

therapy, it's to identify what is the minimum masking level and then drop that masker by just 1 db so that the tennis is just barely audible. And that presents that masker. Sorry.

That allows the tinnitus in the masker to be out what Dr. Jastreboff refers to as the mixing point. The purpose is not to habituate perception of the tennis. We are allowing the tennis to be present, but we're establishing control by the fact that it's just so barely there that it is allowed to fade into the background. So the purpose of it is to habituate reaction to the tentatives in that whether or not I hear it is something that is under my conscious control.

So now how do we then approach hearing aid fitting? When a person has tinnitus and I fit hearing aids to patients who have normal hearing, I present it in such a way that, okay, so these devices, they're not like standard hearing aids. Even though they're standard hearing aids, these devices are not like standard hearing aids that are trying to help you to hear and understand people. And so often, of course, we know all of the arguments against, oh, I don't need hearing aids, I hear just fine. And you're looking at a person who has a mild to moderate sensory neural loss.

I hear just fine. I don't need the hearing aids to hear and understand people. Lots and lots of barriers behind why people reject use of hearing aids. But when they have tinnitus, we look at it and say, so, you know, this isn't about managing your hearing loss. This is about providing your brain with very good stimulation.

So first and foremost, okay, you got to have their loudness discomfort levels, and you program that in. That should dictate what their MPO is on the hearing aid settings. You reinforce for them that the primary goal is not to improve understanding, whether in background noise or not. It's primarily about the management of the tinnitus. And this is not a quick fix.

This is something that is a process. Yes, we do want to provide them better audibility, improved communication. Yeah, because they're probably a little stressed out, and they're listening really hard to make out what people are saying if they're struggling to hear and understand due to a hearing loss. And that listening effort actually is turning thalamic activity to the auditory channel, which only reinforces the significance of the tinnitus. So that secondary goal of improving communication actually supports the primary goal of tinnitus management, whether or not you have venting.

And I'm a big evangelist for custom. I like to do custom tips on every Ric device. Actually, in my office, we fit custom ear tips on every Ric just by default, no matter what their low frequency hearing looks like. We may ask the lab do the largest possible vent. We'll do like an iros vent on so many, but it means that you're going to always have that receiver in the same location every single time.

You're going to have better noise reduction. You're going to have better feedback management, better directional microphone activity when you have custom on there. That said, even if their audiogram is like 30 to 40 decibels in the low frequencies, I still generally like to provide a large vent because ambient sound is coming in, and I want to be able to utilize that ambient sound as a tinnitus masker. So I also take their soft sound gain, and I boost it a good three decibels above their target. For soft sound gain, I boost low frequency, soft sound gain because the sound of the refrigerator, the sound of their footsteps, the sound of their air conditioner, the fan, all of those sounds that they're like, wow, that stuff's all really loud now.

That's great. I'm really glad it's present to you because you know what? That is stimulating that part of your brain that's really only being stimulated by the tinnitus. Let's give it something else to hear. And so, as noted, whether or not, whatever their

loudness discomfort levels are, you want to make sure that their MPO is on the lower end.

So don't bump up their MPO. Let's keep their MPO down at a relatively low level. Consider in hearing aids that do have transient noise management that you might engage that a bit stronger, because a lot of patients will be hesitant to use hearing aids to manage their tinnitus because they think, well, loud sound makes my tinnitus worse. Thus my hearing aids are these hearing aids or these maskers are only going to make my tinnitus worse. And we really, really reinforce, no, I'm squashing loud sounds.

I'm squashing that. In fact, I can make those loud sounds quieter through your hearing aids than they would be if you didn't have the hearing aids in. But what we're trying to do is we're trying to stimulate the parts of your brain that aren't getting stimulated now without hearing aids, we're trying to deliver these soft environmental sounds to give your brain something else to attend to briefly, and then it'll just ignore those and the tennis will come out with it.

One thing that I do often do is I decrease noise reduction.

So in our hearing aid settings, we can increase noise reduction or decrease noise reduction. And so very often people talk about, oh, the background noise is so distracting. Good. If we're fitting hearing aids for tinnitus and background sounds, ambient sounds are distracting, good. We want them to be there.

Reinforce for the patient through counseling why we want them to be there. Expansion is about giving no amplification for soft sound until we hit some minimum input level, and then it provides gain. We absolutely do not want that. We want no expansion. If they have circuit noise from the hearing aid that they're hearing, good, we want them to have that 65, 75 db inputs, have that below the adult fitting targets.

Do probe mic measures. Do probe mic measures. Do probe mic measures. And there's a reason for that. And I'll show you here in just a minute.

Certainly turn feedback management on and be a little bit more aggressive about your impulse transient noise management. Okay, so I hope that I'm not going to make any hearing aid manufacturer cranky with me, but I got to tell you, green noise, pink noise, notched noise, fractal. The only benefit of fractal noise over white noise is that fractal is a little bit less annoying than white noise is notched noise. There's no clinical evidence that suggests that notching out the frequency of their tinnitus results in them having any less reaction to their tennis compared to using another broadband noise that is not notched. I'm sure someone's going to flame me and say, well, this white paper shows this, or this paper shows that.

The general literature in the referee journals do not show that notch noise does in fact cause on a population level individually, there may be some folks that it actually really works nicely for. And that's great. And so that's where I would encourage the audiologist to be very creative about taking care of that individual. Okay, that said, my opinion around any of these other tinnitus masking features, I actually turn off tinnitus masking on most hearing aids. If the hearing aid is Bluetooth enabled, I have them run the resound relief app or the calm app for sleep.

Or I have them connect into their laptop and just play YouTube like rainforest sound for 12 hours straight. It's key that the masker be vaguely pleasant and easy to ignore and that the masker at least is not as annoying as their tennis is. I do have plenty of patients who like to use IIC hearing aids or CIC hearing aids. I try to have them go for cics so that there is in fact the physical size to put a push button on it so I can give them one program that is just amplification and a second program that does have an onboard masker, given that many CIC hearing aids do not have Bluetooth capability.

Okay, yeah, I basically just said the exact same thing. Do we want them to have limited choice, which is through a CIC, or do we want to have them have limitless choice of what kind of masker? And that's through Bluetooth. So I know I'm close to out of time, but I just want to bring this particular example to your attention. Here is a former patient of mine, 42 year old male.

He's a drummer, he's a professional musician. He had at his work, had had two acoustic traumas that resulted in widespread hearing loss. You see, down to the low frequencies, he's got 30 db loss, and then he's got that standard notched loss. Back at the time, I was actually using the tinnitus reaction questionnaire, the TRQ, his score was up in a catastrophic level for that. He reported that loud sound triggered his tinnitus and so he was always worried and nervous about providing any kind of sound enhancement.

Okay, so I'm just going to play very quickly. This is what music sounds like to him through this HearinG Loss.

Oh, there it is.

It.

Okay, so he's got a lot of hearing loss and that tinnitus is really loud. That actually, I did match his loudness, his pitch and his loudness. That was his tinnitus Relative to about a 70 decibel input. Classical music. So now this is with his hearing aids on and set at Nal Nl two.

It's okay. So I don't know about you, the tennis is still really present, but there's something else to listen to and it's much more audible. So now I'm going to add in the masker.

So if you listen to that a couple of times, you're going to observe that. Wow, the masker actually did help. And if I'm able to ignore the masker, kind of like discipline my thinking around, just make that masker go into the background and I've got other sounds going on that are in fact then amplIfied. It sounds pretty like you are able to shift your attention away from the tinNitus. So here's where probe mic measures really come in very nicely.

He was avoiding having any, like being able, just barely able to hear his masker. He was afraid of the masker, the onboard masker being loud enough for it to actually be beneficial to him because he was afraid of it being too loud to mask his tinnitus. He thought it was going to trigger more tinnitus because his hearing loss came from acoustic trauma. So these two HEre. So in the blue, this is live speech, in the green, this was me talking.

And in the pink, that was. Oh, I'm sorry. No, I was wrong.

Soft speech before I made some adjustments to his hearing aids. Soft speech after I made some adjustments to give him a little bit more audibility, you can see that the pink was where he came to me with these hearing aids fitted outside. Little bit of adjustment to make his low to mid frequencies a little bit more audible to him. And I then showed him when we had the masker going and I just put my probe mic system on, just live, but I had the masker going and I said, turn this to the level where it masks your tinnitus. I promise you it'll be okay.

I showed that the masking sound that was capable of masking his tinnitus, that's in the blue here, that was actually below soft speech that was going through his hearing aids. And he immediately looked at and said, wow, that's really not very loud at all. I guess I can use my masking. And so this gave him permission to take control over his hearing, over whether or not he heard his tinnitus. I know I'm at time, but I'm just going to quickly just indicate here tinnitus interventions.

Okay. There is no medication that decreases the perception of tinnitus. Medications can treat your reaction to it, and in fact, doesn't treat the reaction to the tinnitus specifically. It treats anxiety, or it will treat depression, or it will lessen the likelihood of you having negative repetitive thoughts. So tinnitus is comorbid with anxiety, depression, negative repetitive thoughts, insomnia, as well as attention deficit.

And so medications that treat anxiety, depression, negative repetitive thoughts are really good. The medications that I've understood from psychiatrists I've worked with who are really good at managing tinnitus, or at least the comorbidities with tinnitus, recommend Zoloft, Lexapro as being a deactivating SSRI, and so more likely to address those things specific to something that's activating their amygdala. Benzos can be really helpful at kind of pulling the parachute on a panic reaction, a panic attack, that fight or flight reaction. That said, they are habit forming. You may, in fact, then develop a tolerance to them and so have to escalate the dose in order to achieve the same benefit.

And this is actually a medication that if you are addicted to it and you need to come down from it, it can kill you.

Coming off of a benzo addiction is something that is capable of causing cardiac arrest. And, yeah, it's not good. So we don't want our patients to be jacked up on

clonazepam. There are better ways to do this. Some neurologists like to recommend neurontin.

That's the brand name for gabapentin. It's a blocker for nerve pain. It also can have a bit of a sedative effect. Neurontin is something that oftentimes requires dose escalation. It's not a great one to do for tinnitus.

That said, trazodone, which has been around forever, and it's given to dogs and other animals as a tranquilizer, it's good for people. One of the side effects of trizodone is it can dry out your mucous membranes. So it's not for everybody. But that can be very helpful for helping a person to achieve sleep if sleep is a huge problem for them. So the reaction to the tinnitus, it's not the perception of it.

So we're not trying to cure the perception of the tinnitus, we're trying to help them to manage their reaction to it, in fact, then habituate their reaction over time, which allows their attention to it to shift away and it allows them to have less of a percept of their tinnitus, which can be translated into, my tinnitus is quieter.

Tinnitus is that kind of match between the subconscious and the conscious. It's giving a target for the thalamus to attend to. And so this is a weird combination between physiological and psychological pain, if you will. Tennis. You can think of it as auditory pain.

Yeah, we do our typical workup, but we have to use a lot of tennis questionnaires for a validated tennis questionnaire, behavioral health, tennis retraining therapy or other kinds of approaches for tennis sound enhancement. And certainly making sure that they are connected with a good therapist and a prescriber who can help identify would they benefit from some kind of medications? Where we come in principally is around fitting hearing aids. To emphasize this pun intended, soft sound emphasis, reduce the

noise reduction, turn off expansion. Make sure you capture their ldls and make sure that the way that they are using a vaguely pleasant but easy to ignore sound is one that gives them back some sense of control.

And so some success begets further success. It is a process, you have to be ready for this and interested and eager to take it. But these are some of the most grateful people who will refer every single person under the sun to you and just really help to just enhance your own professional success. So I know I got a little out of time there. Thank you all so much.

I've got a little bit of time here. I'm not in a quick rush, but I'm sure you all, if you have to scoot out, please do. Just. Thank you so much for jumping in. I'm going to jump over to question and answer.

There are a couple of questions here. First one, what's the length of time recommended for the masking sound to be effective? What is the length of time recommended for the masking sound to be effective?

24 hours a day, seven days a week. No. Silence. Silence is not their friend.

Another question that came up. Do you treat manage pulsatile tinnitus than you do standard tinnitus. Okay. Assuming that there's no underlying medical condition. So a lot of people have pulsatile tinnitus and they've had mras and mris and they've been assessed by Ents who are so eager to find a glomus jugulara, only to find out, no, it's actually.

It's just the quality of their tinnitus. It has a pulsatile quality to it. Pulsatile tinnitus, no different from any other quality of tinnitus. If there's no sinister medical thing going on, it is a let's find some way to provide sense of control. Another question came out.

Are there specific questionnaires for hyperacusis and misophonia? Oh, I love this question. So tinnitus questionnaires can be adapted for hyperacusis mostly the way that you approach that is, I don't use the word hyperacusis. I use the phrase sound sensitivity. Sound sensitivity.

So for instance, the tentative functional index is a liked scale of zero to ten where, let's say on a scale of zero to ten over the past week, how significant was your sound sensitivity? Zero being not at all significant. Ten being the most significant. Now what it is on the tinnitus functional index is over the past week, on a scale of zero to ten, how strong or loud was your tinnitus? So you just adapt that and it's essentially looking at how much of an impact did it have on you?

Misophonia is a psychological condition with an auditory trigger. You can do it for misophonia, but it's a really tough one. It's not an auditory disorder, but it is a psychological condition with an auditory trigger. Would I recommend rechargeable hearing aids? Yes, I do recommend rechargeable hearing aids a lot because a lot of people just don't want to deal with batteries and the psychological triggers.

Oh, sorry, that was the previous topic. What I recommend for people who are using hearing aids for tennis management is charge them during the day for 3 hours or 5 hours or whatever when you have something else that's going on, and wear them for sleep. Yes, you can wear hearing aids for sleep. Okay, Kim and Christy, I just banged through a whole bunch of stuff. This has been super exciting.

I know I could have gone quite a bit longer and I'm glad that I didn't. Any other thoughts, questions, folks? Please reach out to me. I know my email is available somewhere. References are at the very end if you're interested.

And curious about where got some of my information.

On that note, thank you all so much for joining me on a Friday afternoon. This was really exciting and fun. I look forward to our next one. Bye.