

[MUSIC PLAYING]

**LORI ZITELLI:** I'm very pleased to be invited to discuss this topic, because it's something that I spend a lot of my time thinking about professionally and personally. So I know many of you probably see patients with tinnitus that's bothersome to them or issues with sound intolerance, and so I hope that this will be helpful for you, just so that you know that there's some place that these people can go to for help.

So Dr. [INAUDIBLE] had mentioned there's a research group that we work with that's focusing a lot on locating the generation site of tinnitus. But my hope is clinically, is to help these people cope with the tinnitus that they're experiencing or the sounds that they're experiencing.

So I'd like to give you a kind of a brief overview of the program. Tinnitus retraining therapy is a method aimed at habituating the body reactions induced by tinnitus and habituating the perception of the tinnitus signal itself. So the tinnitus retraining therapy program that we offer is a clinical implementation of the neurophysiological model of tinnitus, which I'm going to talk about a few slides later.

So the first center to use tinnitus retraining therapy was in the late 1980s, I believe in London and shortly after in Baltimore in the early 90s. And as of last year I think there's more than 33 countries around the world documented that provide-- that have clinics that provide this service, one way or another.

So we try to help patients to understand that this treatment program is not a cure. It's not a medical treatment. There's no procedure that we can offer them or pill-- as Dr. [INAUDIBLE] had mentioned-- that's going to cure their tinnitus or get rid of their tinnitus.

So the next best thing that we can do is to help them cope with it or try to change the reaction that they're having to it. And this process requires a lot of time. It's not something that happens overnight.

The majority of people who decide to do this end up enrolling in this program for a year to a year and a half to sometimes two years. It really just depends. There's a training course that you can attend that will give you all the resources and tools that you need and training to do this.

And when we think about tinnitus retraining therapy, there's really two main aspects of the program. The first is an informational counseling. And I almost kind of think of this as a little bit of a misnomer, because when you say "counseling" to patients, they think that they're going to be enrolling in therapy. And I'm not a therapist-- I'm an audiologist.

So the goal of the informational counseling is to help the patient learn to reclassify the tinnitus that they're experiencing into the category of something that's neutral. So if they are bothered by their tinnitus, it's something that is considered negative. So they can never get to the point where they get beyond it unless they're able to reclassify it as something that has no meaning at all or is neutral.

The other half of the training or the other part is the sound therapy. And the goal of that is to decrease the strength of the neuronal activity that's related to the tinnitus within the brain. Because Dr. [INAUDIBLE] always says, tinnitus is generated by the brain, not necessarily the ears.

So I think in terms of what makes tinnitus retraining therapy unique, I don't really care about the etiology of the tinnitus because what I care about and what I can help with is managing the reaction. So my goal is to help patients who are suffering from tinnitus or other sounds get to the point where, even though they may still experience them, it's not affecting them negatively or impacting their lives significantly.

So the goal of the program as a whole is to facilitate habituation of the tinnitus-- "habituation" is something that I'll be talking about-- or sound-induced reactions and perception resulting in a decreased awareness and annoyance of the tinnitus or the sounds that are bothersome. So if we can do that, there's really no need to find a cure for tinnitus because, if it's not bothersome, why does it matter? And it doesn't.

So tinnitus retraining therapy is-- it's called "tinnitus retraining therapy" but it's not only designed to treat tinnitus. So I want to talk a little bit through the three categories of problems that we tend to target when we're doing this program.

So first, of course, is tinnitus. Tinnitus is any phantom auditory perception that's not related to an external sound. So it's not linked to any actual vibratory or mechanical action in the cochlea. It can sound like pretty much anything. Most commonly we hear ringing, buzzing, hissing, chirping, humming, roaring, rushing-- those kinds of things. And for my purpose, for this program, it doesn't matter what the tinnitus sounds like. All that matters is that the patient is bothered by it.

There are two types of tinnitus-- there's subjective and objective tinnitus. Subjective tinnitus is something that the patient perceives and no one else can hear or measure. There are some types of tinnitus that can be considered objective because there's a reason for them, there's something physiologically causing that sound, whether it's a blood flow issue or a muscle contraction. If I put my ear up to someone else's ear who's experiencing objective tinnitus, I may be able to hear it. The majority of patients that I'm seeing for my program have subjective tinnitus, which is difficult to treat because there's no way to objectively measure it-- which is part of the problem.

So the second category of problems that we try to focus on is hyperacusis. So "hyperacusis" is a decreased tolerance for sound. So the reaction for hyperacusis that the patient has is based purely on the physical characteristics of the sound; meaning how loud it is, what the frequency spectrum, the timbre, things like that. So the context that they're hearing the sound in is totally irrelevant. It does not matter where they are, who's with them, what they're doing, what the environment is. Every time they hear that sound, they will have a reaction in the exact same way.

**SPEAKER 2:** So is this like fingernails on a blackboard? Some of you probably don't know what blackboards are. They were in school rooms when I was a kid. And there was this sound that you would make, that you pulled your fingernails on the-- is that hyperacusis?

**LORI ZITELLI:** It certainly could be. If there is a little bit more going on than just the sound, like for instance, if there's a previous association with that sound or some sort of learning reaction to that sound, that's actually a different category of decrease sound tolerance called misophonia, which is a perfect segue, so thank you.

So "misophonia" literally means "hatred of sound." And this type of reaction is defined by a reaction to a specific sound in a specific context. So in this case, the physical characteristics of the sound are kind of a secondary issue and what really matters is the environment, the context, the person making the sound, any previous learned experiences that the person has with the sound.

So something that I hear very, very commonly is that patients with misophonia are very bothered by mouth noises-- chewing, sniffing, coughing, lip smacking, things like that. And it's often a very specific person making these sounds that are bothersome. So, for example, a person with misophonia may not be bothered by their own chewing but the chewing of their father may be very, very bothersome for them. So it's more about the context and the associations that are present whenever the sound is occurring that cause the reaction in this case.

So together hyperacusis and misophonia create a category of problems that we refer to collectively as "decreased sound tolerance." So when you hear me saying that in the future, I could mean either one or the other. But if I'm referring specifically to one, I will mention it.

So tinnitus retraining therapy is an appropriate treatment recommendation for patients who are suffering from tinnitus or decreased sound tolerance. And I try to make that distinction because people who are merely experiencing tinnitus or merely experiencing sounds in their environments are not going to be a candidate for this, because the goal is to help patients get to the point where they're not bothered by their tinnitus and they're not bothered by sounds in their environment. So if someone is already at that point, I can't really significantly improve that. And-- yes?

**SPEAKER 2:** So me. I have to tinnitus but it doesn't bother me. So that's me.

**LORI ZITELLI:** I can't help you, Dr. [INAUDIBLE]. I'm sorry. And I think it's great that you don't need my help.

So when we look at this pie chart here, we can estimate that 50 million Americans have tinnitus and approximately 70% of them are people who experience it. And, for them, that's kind of the end of it. So if you are someone who works in health care and you're asking your patients as you go through the list of things, do you ever have any ringing or buzzing in your ears? The people who say, oh, yeah, I got that. Had it a long time, I don't notice it most of the time. These are the people who are experiencing tinnitus. So for the remaining approximately 30% of people with tinnitus in this country, it's either something that's a significant enough problem to cause them to seek medical treatment-- about 24%-- or it's something that's totally debilitating them-- about 6%.

So when I'm kind of describing this program to patients I try to help them understand my goal is to move you from this category, where you're suffering from tinnitus or suffering from decreased sound tolerance, into the category of someone who experiences tinnitus or experiences sounds. You probably will still hear the tinnitus if you listen for it specifically. But if you are someone who experiences tinnitus and doesn't suffer from it, it doesn't matter if you hear it because it really doesn't have any meaning. So ultimately that is our goal for these people.

When we think more specifically about decreased sound tolerance, there's a little bit less data available to talk about the prevalence, but the [INAUDIBLE]-- who are the people who kind of developed this program-- they estimate that a little less than 2% of the people in the general population suffer from hyperacusis and just about 3% of people in the population suffer from misophonia. So I think these are more recently recognized issues. And I think a lot of times people who have these issues really struggle to get help because a lot of people don't know that they exist.

They're something that I think a lot about, because it's estimated that almost 2/3 of patients who suffer from tinnitus will also require some sort of treatment for decreased sound tolerance. So it's very common for me to see patients who not only suffer from tinnitus but also have issues with sound tolerance-- sound intolerance as well.

And part of my job during the evaluation is to kind of try to tease out which of the three issues is the primary issue, because that kind of determines how we tackle them. And although the treatment is the same, generally, for all of them, there are specific protocols and different ways that we kind of tackle each of them.

So I had mentioned previously that this treatment program is based on the neurophysiological model of tinnitus, which is created by the [INAUDIBLE], and that this model says that the auditory system actually plays a secondary role whenever tinnitus is bothersome. So typically when you ask patients, what do you think is the brain system that's the most involved? Of course they're going to think of the auditory system, because it's an auditory sensation that they're perceiving. This model says that, for patients who are suffering from tinnitus or sound intolerance, the auditory system is secondary and other brain systems, like the limbic and autonomic nervous systems, are actually the things that are primarily involved.

So this graphic kind of illustrates the connections between all of the systems that become enhanced whenever tinnitus or sounds become bothersome. And all of the arrows that you see indicate how the connections occur and the fact that they become stronger if they're reinforced.

So if we start in the bottom left-hand corner, generally we believe that the auditory periphery is the source of the tinnitus, some sort of dysfunction there. At some point the tinnitus is generated. And when it moves to the auditory subconscious part of the brain, there is a process that results in the tinnitus becoming detected and processed by the brain. If the person perceives the tinnitus and it stays within the auditory system, they're someone who experiences tinnitus and that's the end of it.

The issue becomes when the tinnitus spreads to the other systems in the brain, like the limbic and autonomic nervous systems, because that is how the negative reaction to it becomes involved.

**SPEAKER 2:** So that's why-- the limbic system is the reason that some people with tinnitus are just so miserable, because there's such as emotional overload.

**LORI ZITELLI:** Absolutely. And the reactions that people have when tinnitus is bothersome are the same reactions that they have when these systems are over stimulated-- annoyance, anxiety, panic, irritability, anger, all of those things. I see all of them in these patients, as well.

And all of these things can profoundly impact someone's life. If you're someone who is experiencing all of these things, it's going to be very difficult for you to get through a day and feel productive or like yourself. So tinnitus or sound intolerance can be debilitating.

So if you look at this model and you think about the loop that's created here, if you look at the arrows, if you have a continuous activation of the connections between all of these system, it's just going to result in stronger and stronger reactions.

**SPEAKER 2:** So it's like positive feedback?

**LORI ZITELLI:** Absolutely.

**SPEAKER 2:** Tinnitus makes you miserable, and then you'd have more tinnitus and you're more miserable.

**LORI ZITELLI:** Yep. Absolutely. If you listen for the tinnitus, you're bothered by it, you want to monitor every single variation in its behavior, so you listen for it. And when you're listening for it, you notice it more. When you notice it all the time, you're very bothered by it. And it just kind of creates this vicious loop that the patients can't break or escape from.

So we know that the connections between the brain systems are governed by conditioned reflexes. So we're all familiar with the story of Pavlov, who was able to condition the dogs by using a sensory stimulus or a bell, and linking that sensory stimulus with food, which created an emotional response from the dog-- whether it was excitement, hunger, happiness, whatever it was. That emotion resulted in a physical body reaction-- or salivation.

So the theory of this model is that for patients who are suffering from tinnitus, it's a very similar mechanism-- they have a sensory stimulus, a tinnitus or a sound that's bothersome for them. They have an emotional reaction to it. Doesn't matter what it is-- anything negative. And then there's actually a physical body reaction where their heart rate increases, their muscles tense up, they start to perspire.

There's a physical reaction as well, which-- you're really not meant to be in that state for any extended period of time. You know, that fight or flight response is supposed to happen, and then when you remove yourself from danger it's supposed to pass. So if you're in that state all day long, at the end of the day, you're going to be exhausted and totally depleted.

And when you talk about these concepts with these patients, it's a way of explaining exactly how they're feeling, and they just didn't know how to put it into those words. And you ask them, can you relate to any of this? And every single one of them is like, yes, that's exactly how I feel at the end of the day. They're just depleted.

So part of the issue and the problem with tinnitus is-- so Pavlov was able to extinguish that reflex by either stopping the bell, removing the sensory stimulus, or stopping the emotional response-- don't provide any more food. So when we think about patients suffering from tinnitus or sounds, it's kind of not that simple, right? So we can't really stop the sensory stimulus or stop the tinnitus or the sounds that they're experiencing.

But what we can do is try to make it less noticeable or softer over time. And the way that we do that is by using sound therapy, which is another thing that I'm going to talk about. So stopping the sensory stimulus or the bell. And the other way to extinguish that reflex is to stop producing the food which produces the emotional response.

So the way that we kind of tackle that end of it is using the counseling. And the goal of the counseling is to demystify the tinnitus and help to remove some of those negative associations that have been developed.

So this type of passive extinction can be effective. It just takes a little bit more time. So it's something that definitely doesn't happen overnight. And for the people who are really suffering, that can be hard to hear, because what they want is a pill. And, unfortunately, we just don't have that to offer them at this point.

So ultimately, for these patients, the goal is habituation. And I think I used that word before. "Habituation" is the process where your brain kind of tunes something out. So if you look at this graphic here, it's the same as the previous slide only all of the connections are removed. And what we have in their place are h's, indicating habituation. So the green h's with the little r indicate habituation of the reaction. So you're not generating the emotional response, you're not generating the physical body reaction.

The blue h with the little P? Is representative of habituation of perception. And not every patient reaches that point, where they don't perceive any tinnitus at all. But many of them do have longer and longer periods of time where they find that they only notice the tinnitus when they specifically listen for it. So many patients do. But even for the ones that don't, if I can get them to the point where they're experiencing tinnitus and not suffering from it, that is a win for this program and for me and for them.

So a big part of that habituation process is to get medical clearance from an otolaryngologist. So you know when you're going to fit hearing aids on that patient, part of that process is medical clearance. So we have to determine that there's nothing medically causing the hearing loss that can be treated or should be treated, and a physician needs to sign off saying that you can proceed with that, or the patient needs to sign the waiver-- if they're over the age of 18-- saying they don't feel that that's necessary.

For this program I don't let people waive clearance, and I force them to see an otolaryngologist because it's really, really important for these patients-- who are concerned about their tinnitus, or afraid of it, or worried about it-- to know that anything medically causing the tinnitus or any other sign of something more seriously wrong is ruled out or treated. And if that does not occur, they're never going to be able to get to the point where they can habituate to it, because your brain will never let you habituate to something that you are frightened of or worried about or have a negative reaction to. So medical clearance is necessary from an otolaryngologist before starting this process.

So for those of you who are considering sending patients for evaluations, I think these are just a few things to consider before you make that referral. So the first thing is it's nice if the patient comes in with a comprehensive audiogram already completed. It's definitely not necessary, because we can do it on the day of the evaluation. But having that information right off the bat is nice. It saves a little bit of time and it kind of gives us a little bit more information right off the bat in terms of which treatment options may be appropriate for sound therapy.

It's really nice if the patient has already undergone any imaging that might be indicated based on their exam or whatever their complaints are. So if you're able to send them for that scan and reassure them that everything is normal in your brain, you know, everything is fine, that helps them to go a very long way in this process. So it's nice if that's done ahead of time.

And then, just thirdly, any other appropriate referrals that you think might be indicated. And when I say that, I mean a mental health professional. The reason I say that is because a lot of the patients that I see who suffer from tinnitus or decreased sound intolerance have co-morbid depression, anxiety, other mental health issues. And I think a lot of the mechanisms that are responsible for that may be similar or among all of these issues. So it's not really something that I used to think about very much, but now when I see people for the day of the initial evaluation, it's something that I outright ask everybody-- do you have any history of this? Are you in treatment? What treatment are you in? Are you adhering to the recommendations? Those kinds of things. So if the patient is or is able to get kind of a head start with that and already for that before they see me, that can also be very helpful.

I also have a little note on the slide about cognitive behavioral therapy. And the reason that's on there is because I have a lot of patients who find that very helpful, especially in conjunction with tinnitus retraining therapy, because cognitive behavioral therapy is all about problem solving. It's all about helping the patient to reframe the way that they're thinking about things that are an issue for them.

So, for example, if the patient is waking up in the morning thinking, oh my god, my tinnitus is so loud today, it's going to be a terrible day. I don't even want to get out of bed. The cognitive behavioral therapist may help them to develop some strategies to kind of think differently about it or just kind of develop a new frame of reference. So rather than saying that, the therapist may help them to say, oh my god, my tinnitus is so loud today. It'll probably be a little bit less noticeable if I get up and start moving. So if they're able to do that several times throughout the day, it may really help them to get through the day. So just things like that can be very, very helpful in helping them to develop strategies that will work for them, and often in conjunction with tinnitus retraining therapy.

So when I see the patient on day of the initial evaluation, if the audiogram has not already been completed, it's part of the testing that I do. The audiogram is also very helpful when we sit down to do the counseling part of the retreatment therapy, because not only do we talk about how human hearing works as a whole but we talk about their specific test results and talk about how their hearing system is working. And I think that understanding kind of helps them to feel more ownership of this process.

We also can do pitch and loudness matching and masking of the most troublesome tinnitus. So the way that we do this is a forced choice procedure. There's no way to objectively measure someone's tinnitus, right? If it's subjective tinnitus. So what we can do is give them two choices and make them pick the one that's closest. So I'm going to give them two tones and I'm going to say, pick the tone-- one or two-- that's closest to the pitch of the tinnitus that you hear. It's OK if it's not exact. It probably won't be exact. Just pick whichever one is closer.

**SPEAKER 2:** So this is like going to the optometrist when they say, which one of these lenses was clearer?

**LORI ZITELLI:** Exactly. One or two? Pick one or two. It doesn't matter if either one is perfect-- you got to pick one. So then after they make their choice, I am going to give them two new options. And we'll continue to do that until we've kind of narrowed it down to a specific pitch that they're consistently choosing. After we do that, we can also focus on the loudness.

So it's important to have the audiogram done first because, if I'm trying to do this testing and I'm presenting tones that are below their hearing thresholds, it's a waste of time. So it's important to know what they're hearing thresholds are before you do this testing.

And the third component of that is the masking, or how much noise is necessary before it totally covers their tinnitus. These measurements can be interesting and they're also something that we track the whole way through the program, if someone has enrolled. And it can be interesting because a lot of times the perception of the loudness of the tinnitus does decrease over time. A lot of times it doesn't. So they can match their pitch and loudness to the same level and frequency every time. But if their annoyance goes from 10 out of 10 to three out of 10, that is a huge improvement. So it's interesting because it really does go both ways.

Something else that we measure are loudness discomfort levels, or uncomfortable loudness levels. And if you look at the audiogram picture in the center, that's what you're seeing there with the u's represented. So this information is really important when we're trying to distinguish hyperacusis, misophonia, what's exactly going on with their sound tolerance levels.

So I will say it's not always helpful, because it's possible to have totally normal uncomfortable loudness levels in misophonia, and it's also possible to have reduced uncomfortable loudness levels in misophonia. So you have to do kind of a little bit more digging. But a positive diagnosis of hyperacusis requires an average loudness discomfort level of less than about 90 decibels. So that can be helpful if it's straight hyperacusis.

Also there are some patterns that you tend to see that would kind of point you in one direction or the other. A lot of times people are less tolerant of high frequency sounds than low frequency sounds. So we use this information in addition to a very detailed and thorough history to try to tease out exactly what's going on.

And then, lastly, distortion product otoacoustic emissions-- which are the two pictures that you see on the far right side of the screen-- are, if I had to pick, I would probably choose this test over any of the other tests. And I think it's so important in teaching the patient about the function of the outer hair cells in their ears. So what-- we're able to put two tones into the ear and then measure the response from the outer hair cell coming back after the sounds mix in the basal membrane. And we're able to plot how loud the response coming back is and compare it to the level of ambient noise in the room.

So what we want to see are these nice big responses from the outer hair cells. And in all the time that I've been doing this, I have never seen one patient who has tinnitus with totally normal outer hair cell function. And we can only measure out to about 1,000 hertz with our equipment. If we could go out even further, I'm sure we would see damage out at the highest frequency region as well.

**SPEAKER 2:** So, Lori, is that the reason why some patients who complain of tinnitus have an absolutely normal audiogram? I mean, I've always suspected they must have hearing loss, it hasn't been detected. Does that make sense?

**LORI ZITELLI:** Absolutely. I think for the people who have normal hearing and suffer from tinnitus, this information is the most important part of the counseling. It's so helpful for them because I think they have a lot of difficulty reconciling that. Everybody tells me, I have normal hearing. Every time I have a test, it's good, but I have this tinnitus. And then I think that creates this mismatch and this worry in them, does this mean that I'm going to lose my hearing? Does it mean I'm going deaf? Is it a sign of something else that's more seriously wrong in my brain? So if you can do the DP test and show them, you have a little bit of damage in the high frequency hair cell regions and, like, that pattern is normal, it's something concrete that they can grasp onto. And I think it really, really helps them to reconcile that.

So we talk a lot about outer hair cells through the counseling process. And I think this information is just so valuable to have because probably nobody has ever talked to them about it before, and they may not really understand it. So it's been estimated that 70 to 80% of patients who have tinnitus have some degree of hearing loss. But we do have this group with normal hearing, and I think this can be very helpful for them.

Also a big part of the counseling that we focus on is nobody really knows at this point where the tinnitus is coming from. It's all kind of nebulous and abstract. But if we can tell the patients, we think the source of the tinnitus is this dysfunction in your cochlea, and then other things are happening in your brain, it's also something concrete for them to grasp onto. So that really helps with the kind of demystifying of what they're experiencing.

So in addition to the testing there are two questionnaires that we use and also with the very thorough history to determine whether people are candidates for this program. And there are a lot of questionnaires that could be used. These are just two that I like and have been using. And I like them because they kind of give me different information. Tinnitus Handicap Inventory is pretty good for an overall picture of their self-perceived handicap that they believe that they experience. And the Tinnitus Functional Index is broken up into more specific, discrete categories. So that's going to look more at how the tinnitus is affecting their sleep, their auditory function, their cognition, their quality of life, emotions, and those kinds of things.

So I like having both of these questionnaires and looking at all the information together because it's possible for someone to have a pretty low Tinnitus Handicap Inventory score overall-- indicating tinnitus is not a problem-- but if you look at the specific subcategories of the Tinnitus Functional Index, you may see that sleep is a huge problem for them. So if you can help them to solve that specific issue then you've really helped them. So it's good to have those pieces of information.

Also when we're doing the history, we ask them to rank on a scale from zero to 10 how severe is your tinnitus? How annoyed are you by it? What's the overall effect on your life? What percentage of time are you aware? What percentage of time are you annoyed? All of these things are things that we ask them when they come back, and it's some of the ways that we track their progress.

And part of the reason why some of these questions are so detailed is because it can be really difficult to separate the effect of hearing loss, the effective tinnitus, and the effect of sound intolerance on someone's life. So if you have a patient who hates going to a noisy restaurant, is it because they feel like they can't follow the conversation at the table and they can't hear it? Is it because they're afraid to loud sounds in the environment are going to exacerbate their tinnitus or make it louder? Is it because they truly can't tolerate the sounds in that environment? You know, you just kind of need to dig a little bit deeper to figure out what the primary issues are, and that will drive your treatment plan.

**SPEAKER 2:** So this is a good time to stop and solicit questions from the viewers, because Lori's gone over sort of the evaluations. So how low does this evaluation take? Do you get this done-- is this like one visit or is this like over a period of time? What's this require?

**LORI ZITELLI:** It's a two hour appointment. It is a long appointment. But in order to get all the information that we really need to help the patient determine whether they're a candidate for this program, we've got to do all of that. So it's a long appointment.

**SPEAKER 2:** So let me encourage any of you out there to forward questions and we'll do our best to field them here.

So I guess my other question would be, at this stage, after you have done your evaluation, can you give some sort of prognostic-- you have some sort of prognostic sense-- is this person a good candidate or am I going to be wasting my time? Can you tell at that stage?

**LORI ZITELLI:** I usually have a pretty good idea. I feel like I've been doing this long enough now that I can tell from their answers to the questionnaires, their answers to my questioning of them, and kind of a little bit from their history as well. If it's someone who's kind of on the borderline, I do tell them, I think you may benefit from this but I also think that there's a chance that you could kind of get yourself there on your own if you made a couple of modifications or considered a couple of other recommendations that I may have.

So sometimes people are borderline. Sometimes those people choose to wait a little bit of time and then kind of reassess, maybe think, you know, wait a month and see if it's any different. Sometimes I have people who come in and they're answering "no" to all of the questions and they're saying, yeah, I have tinnitus but it's, like, not limiting my life. Those people really are not candidates, and that's usually put pretty clear. And then on the other end of the spectrum, the people who are debilitated-- it's usually pretty clear.

So we talked a lot about tinnitus and evaluation of tinnitus, but right now there's currently no validated questionnaire available which assesses the handicap that a patient perceives they experience as a result of their sound intolerance. So tracking progress of that is a little bit trickier and it's more about the patient's perception of their progress. You know, how do they rank the severity of the problem, their annoyance, the effect on their life, and kind of looking at the number of activities that are being limited. Are you able to go to the movies now, and were you not able to when you first started this program? Things like that.

So regardless of whether the chief complaint is tinnitus or hyperacusis or misophonia, the two components of the program are counseling and sound therapy. So, as I said, the goal of the counseling is to achieve some sort of reclassification in their brain or retraining of their brain so that the tinnitus ultimately ends up as something that they perceive as a neutral signal rather than something that's negative.

So when we do the counseling I have a big ear model that I take apart and I show them all the pieces of. I have a binder with a ton of pictures that we look at. I have all of their test results laid out. And we go through each part of the auditory system, I explain ideally how it works and then I explain how theirs is working. And I think it really helps them to get a good idea of what's going on with their system.

We talk a lot about suppression and enhancement of auditory signals, so I tell the patients that your brain actually has to tune some things out in order for you to be able to function. Because if it didn't, you would be sitting here thinking, the lights are too bright, it smells funny in here, my shoes are uncomfortable, my belt is too tight, I can feel the weight of my clothes against my shoulders and the feeling of my glasses against my face. And all of those things would just be overwhelming and you would never be able to put a conscious thought or sentence together or do anything. So your brain has to tune some things out in order to give you the resources to do the things that you want to do.

So that can only occur if something is constant, unimportant, boring, not interesting. And the example that I like to use is that you have habituated to or have suppressed the side of your own nose. So if you do this, you'll only see it, if you're looking for it, but it's not something that you really go through your day thinking, man, I really wish my nose wasn't in the way. You know, it's something that has no meaning. It's always there, it's unimportant, and it's constant. And so as a result, your brain kind of develops a blind spot for it. So, ultimately, if we can get them to the point where they're able to reclassify the tinnitus as something that's totally meaningless, the same should be able to happen with the tinnitus.

So, on the other hand, if your brain can suppress things that are unimportant, it will also enhance things that are important or it thinks are important. So all of this is happening at kind of a subconscious level. So your brain will never let you habituate to or suppress something that it believes is potentially threatening or harmful to you. And it's good that it does that because that's part of how you stay alive, it's part of your body's security system.

So anytime that there's the possibility of a threat, your senses become heightened. You focus in on things that you wouldn't ordinarily focus on. The example that I like to use is if the patient and I are in the room with all of their test results out in front of us on the table and we're talking about cell responses, and I bring a live tiger into the room and just place it in the corner, I may say to the patient, you can just ignore this tiger. I know it's a live tiger but I've trained him very well. He's never even a patient. So you can just continue to talk to me about hair cells and ignore what's going on over there. And even though I'm a very trustworthy person and even though I say I've trained the tiger very well, the patient may want to believe me, there's no way that they're not going to be looking over in the corner, trying to monitor what's going on. Because they know, in their mind, that even though they may believe me, consciously, subconsciously, that tiger does represent a threat to them and may actually eat them.

So it's a similar thing when your brain has decided that the tinnitus represents a potential threat to you, or the sounds that you experience in your environment represent a potential threat. So when you use these examples and try to help them understand the reactions that they're having, I think it really helps them to put these concepts into words and be able to explain them.

We do a lot of teaching about the mechanisms of tinnitus origin, talking about hair cell damage leading to a lack of input to the nerve fibers in the brain, where there's a spontaneous increase in the firing rate because nothing in your body likes to lie dormant. So when that happens from the auditory nerve, there's this extra energy that your brain really has no choice but to perceive as sound.

So when you explain these things and how tinnitus generally is benign for most people, and that actually most people do experience tinnitus when they're in a very quiet room-- there was a study published in the 50s from a group of researchers who looked at a group of young, normal-hearing adults with no tinnitus, and they put them in a sound booth, and 95% of them described some sort of tinnitus after sitting there for a couple of minutes. So it's normal to happen in that environment. I was curious-- I tried it myself, and my ears were ringing like crazy after four minutes.

So tinnitus is benign. And we teach them all of these things, and it really does help them to understand and demystify what they're experiencing.

**SPEAKER 2:** So what I'm hearing you say is, if they understand where tinnitus originates and that it's not, in and of itself, a problem, then they're more likely to move it from a threat to something that's neutral.

**LORI ZITELLI:** Absolutely. And it is definitely not something that happens overnight. It is something that takes time. And it requires the use of sound therapy to get there, as well, for most people. So those two components really work together.

But the teaching is the first step. We teach them about conditioned reflexes. We teach them, you have been conditioned to respond to this stimulus in this way, and this is how we're going to try to break that reflex.

And then, lastly, we talk about options for sound therapy. And those options are really driven by the type and amount of hearing loss that they have. Because one option is hearing aids. If they have hearing loss that's aidable. Another option is a sound generator, which is a device that looks like a hearing aid but doesn't amplify sound. It produces a low level of noise that we can use to stimulate the nerve fibers that are otherwise not being stimulated due to the damaged hair cells. Or we could actually use a combination instrument that has the capability to do both things at the same time. So it's amplifying sound and, at the same time, there's a feature where we can activate a low level of noise that is kind of distracting them a little bit from the tinnitus.

So the counseling session is really important for high effectiveness of TRT, I think. I think there are a lot of patients who have tinnitus and hearing loss, and when they get fit with hearing aids, it's very helpful for them because it significantly decreases their awareness of the tinnitus.

But some people just need more than that. They need more information and they need to understand what's happening to them. And a lot of the concepts that we talk about in the counseling also apply to decreased sound tolerance. So there's a signal that your brain is responding to inappropriately, and it's resulting in an emotion and a reaction. All of those concepts are the same, whether the bothersome signal is generated internally-- like tinnitus-- or externally-- sounds in the environment.

So the sound therapy is based on the contrast principle, which says that the difference between the strength of a signal and any sort of background neuronal activity will make the signal itself either more or less noticeable depending on how big the difference is. So if you have a room that's very dark and you light a candle, the candle will seem very, very bright. When you walk over to the door in the room and you flick the light switch on, the candle appears to give no light at all, because there's so much other light in the room.

So when we apply that same theory to tinnitus, we can decrease the perception of the tinnitus or their awareness of the tinnitus by providing some sort of other sound in the background in contrast, and it decreases the signal that they're hearing in relation to the other sound that they're hearing as well.

Is there a question?

**SPEAKER 2:** Oh, there is a question.

**LORI ZITELLI:** Great.

**SPEAKER 2:** So we had a question that came in asking, because there is such a high level of anxiety and depression in these patient populations, would it make more sense, rather than going through this, is start off with medication?

**LORI ZITELLI:** A lot of patients do. That is a good question. I think it can be very difficult to separate the effects of medication and the effects of cognitive behavioral therapy and the effects of TRT and the effect of having someone understand what they're going through and listen to them and hold their hand through this process. But I do have a lot of patients coming to see me who are already in treatment for anxiety or depression, and they need more. So I think for many patients those options can help them to manage their reactions. And for some people it's just not enough.

**SPEAKER 2:** And I had another question, and it had to do with-- I think what I'm hearing you say is that sound therapy by itself is not really effective without the informational counseling, whereas the informational counseling may be sufficient for some patients.

**LORI ZITELLI:** I think it depends on the patient. I have actually had a handful of patients go through the counseling session and then say, I get it. I'm good. I don't need these devices. I think I can cope.

And then I also have patients with tinnitus that is bothersome that are fit with hearing aids. And that's enough to distract them.

But I think for the patients who are severely, severely distressed, for the most highly effective treatment, they really do need both. So we used counseling and sound therapy regardless of what the chief complaint is, but the protocols vary depending on what the chief complaint is. And they can actually be combined when everything exists as a problem together.

So for tinnitus the idea is that we set the level of the devices at what we call the "mixing point," so it's below the level of their tinnitus but it's still audible for them. So if you think about habituation and suppression, your brain can never habituate to a signal that it's not hearing, right? You have to hear it in order to habituate to it. So if you're using other sound to mask your tinnitus and you're not hearing your tinnitus at all, it's kind of a short-term solution to a long-term problem. As soon as that other masking noise goes away, you're right back to where you started. So it's very, very important that we teach the patients exactly where to set the level of the noise and that it's below the level of their tinnitus so that they can still hear it, it's just not the prominent thing that they hear-- there's not a huge contrast.

When we think about decreased sound tolerance, those two categories-- hyperacusis and misophonia-- actually use very different sound therapy protocols. So for hyperacusis it's more of a desensitization. It's about auditory toughening over time and gradually exposing the patient to louder and louder sound while avoiding a sound that's intolerable or very annoying. So it is a slow process, but if it's purely hyperacusis, it's possible to cure it in a matter of months.

I've found that often, the majority of the time, it's not purely hyperacusis. There's very often a misophonic component.

The treatment for misophonia for sound therapy is a little bit more complicated. It's a little bit more psychology. So the idea is to help the patient develop a positive relationship with sounds. And the way that you do that is to, over time, kind of create a positive association that you use with the sound that they like and pairing it with more and more sounds that they dislike, and kind of removing the control over the sound that they hear.

So there are four protocols that we use, and each of them has varying degrees of control over the sound that's used. And they start kind of on the easier side, with full control, and they end with the patient having no control or actively being exposed to things that they dislike.

Unfortunately, the cost of Tinnitus Retraining Therapy are generally not covered by insurance. So the medical and the audiologic evaluations are typically covered-- so the physician appointment, the testing, all of that is billed to insurance, and that's typically not a problem.

There's an enrollment fee that is charged, which is what covers the patient for the duration of the program. And each practice will determine what that fee is. It's designed to be kind of a one time thing that the patient pays whenever they enroll for the counseling, and then it allows them to come back as long as they need to. On average, 12 to 18 months. Some people are done before that, some people come a little bit longer.

The other cost of the treatment is the cost of the devices. So whatever devices they choose to pursue-- whether it's hearing aids, sound generators-- it really just kind of depends on the style of the device and the level of technology that they choose, and that will determine the price point.

So I wanted to share a little bit of data that I've collected from my patients. And these are mean Tinnitus Handicap Inventory scores over time. So there's a lot of variability in these scores but, on average, my patients tend to start somewhere around a severe handicap, and 18 months later-- and somewhere in the mild to slight self-perceived handicap range. Which is great.

But another thing that makes tinnitus so difficult to treat is that there's really no agreed upon method of tracking progress. So not everybody does the Tinnitus Handicap Inventory. Not everybody asks them about severity, annoyance, and effect. People use different questionnaires. People use other metrics. So that kind of makes it difficult to compare studies and methods.

The [INAUDIBLE] who developed this program report a significant improvement in about 80% of the people who are candidates and pursue this program. And I would agree that the majority of patients who are good candidates for it and who don't drop out to pursue other treatment or continue to pursue medical treatment, the majority of them actually do improve. So I think my experience with this program has been very positive.

This is just a little bit more data about from the severity rankings. So, on a scale from zero to 10, how severe is your most troublesome tinnitus? 10 is the most severe, loudest. Zero's nothing at all. On average people tend to start somewhere around an eight. And, again, there's some variability, but when they get to the point where they're 18 months in, on average somewhere between a three and a four. And we're seeing a similar pattern, where there's a pretty big improvement initially at three months, and then it kind of plateaus off over time-- again, starting somewhere around and eight, ending somewhere around a four.

And then, lastly, the overall effect on their life. So 10 would be the biggest or worst effect. Zero is no effect. And, again, starting somewhere between a seven and an eight, on average, and ending somewhere between a two or a three.

**SPEAKER 2:** So this range-- so are there really people who were 10 and then they went down to a four or five?

**LORI ZITELLI:** I gave people who started at 10 and ended at zero.

**SPEAKER 2:** Oh, Really?

**LORI ZITELLI:** Yeah. Absolutely. Not everybody has that big of a change. But if you're able to take someone from a 10 out of 10, it effects every aspect of their life-- even to a five, that is significant. So we hope for as big of a change as we can get, but anything significant is something that we'll take.

So I have a few short cases that I'd like to share, if we have time for that.

**SPEAKER 2:** So we do have time. Feel free to forward any questions for Lori, and we'll field them while she's going over her cases here.

**LORI ZITELLI:** So I'd like you to meet Alan. He's a 59-year-old attorney complaining of tinnitus bilaterally for the past two months. He's the type of person to kind of take charge of this thing. So he's researched it a little bit, he's decided to continue aspirin and caffeine, he's using Ambien for a sleep disorder-- so I think it's helping but he does have some disordered sleep. He's been using masking strategies, which he reported helped slightly throughout the day. He did have a hearing test, which reveal a high frequency pure tone asymmetry and excellent speech understanding bilaterally. This resulted in an MRI being ordered, which ended up being normal-- which is great. And then the physician who saw him referred him for a tinnitus retraining therapy evaluation.

And on the day that I initially evaluated him, his self-perceived handicap from the Tinnitus Handicap Inventory put him into the severe category. So it was having a pretty big impact on his life. He's aware of the tinnitus 90% of the time-- so almost always-- and severity, annoyance, and effect on life are all sevens and eights out of 10s, which is significant. So he reported that the tinnitus is affecting his concentration, his work, his sleep, his quiet resting activities, and he reportedly is a type A personality. So the major reason that the tinnitus is a problem for him is that it makes him feel like he's not in control of his own life. And for him that's just not OK, it's not something that he can deal with.

So for him we ended up pursuing sound generators, because his pure tones are normal through about 3,000 Hertz, I think. And the right ear was normal and the left ear had a mild high frequency loss, so he wasn't really a candidate for amplification.

But one year later, after using these devices and going through the counseling and setting them appropriately, he reported that he occasionally had days when the tinnitus is bothersome, but really didn't focus on it much anymore. He reported he was better able to concentrate at work, sleeping a lot more deeply, and that overall he was pleased with his progress. He felt that the program gave him the tools that he needed to manage and cope with his tinnitus and kind of regain a little bit of the control that he felt like he had lost.

And this is just kind of an overview of his Tinnitus Handicap Inventory scores on the top left. And then again graphing his annoyance, severity, and effect on his life on a scale from zero to 10-- and it's a similar pattern. Although I do think it's interesting that the bottom left-- the severity-- it only went from a seven to a five. So five is still reasonably loud, if 10 is the loudest thing you could possibly imagine. But if you look at the effect on his life it went from a seven to a two, which is a very big improvement.

And then if we have time I have one more case to go through. There are no other questions?

**SPEAKER 2:** No other questions. Let's go on, Lori.

**LORI ZITELLI:** I would love you to meet Rose. She's a 15-year-old girl suffering from misophonia since she was about seven. And she had a lot of difficulty finding someone to help her because I think nobody understood what she was experiencing. And I think she was having trouble just getting someone to recognize that it was having an effect on her life.

So when we ask her, what's the severity of your problem? How annoyed are you by it? What's the effect on your life? It's all 10 out of 10, 10 out of 10, 10 out of 10. So the most severe problem she could possibly imagine and the biggest effect on her life.

So when we asked her what kind of sounds were bothersome, it was a very long list-- things like gum cracking, a specific classmate clicking on his keyboard during class, her dog drinking, a classmate who was tapping the desk with his foot during class, tongue clicking, birds chirping-- those kinds of things. She did also report some co-morbid anxiety, including situations before the bothersome sound actually occurred, sometimes. So, for example, the desk tapper classmate, if she saw his foot moving out of the corner of her eye, it resulted in that same emotional and physical body reaction for her. So she would tense up, her heart rate would increase-- even if the sound was not occurring yet, just in anticipation of the sound. So it was having a very big impact on her learning at school because all of these things were happening in class.

So she ended up deciding to enroll in the program, pursued [INAUDIBLE] BTE devices behind the ear with zen fractals, which are chimes that sound like-- it's chimes. It's very relaxing for some people. And I did make a recommendation that she consider cognitive behavioral therapy, which she had tried when she was younger but I don't know if she was too young for it or maybe didn't really click with the therapist or what, but for whatever reason it wasn't effective then.

But then when she decided to do it this time, something worked, because we used all four of the protocols in combination with the sound generators and the cognitive behavioral therapy, and when I saw her six months later, she reported that she was doing really well. She was actually working as a server in a restaurant, which is an environment that she never would have set foot in before. She is continuing cognitive behavioral therapy and the anti-anxiety meds with benefit. She's using her sound generator devices as needed-- so she didn't wear them all the time, but she would kind of put them in the case and leave them in her purse. If she knew she was going to enter an environment where difficult or problematic sounds would be possible, she may pull them out to use them, but then she's put them back.

She had discontinued ear over-protection-- which is a huge, huge thing for these people who are bothered by sounds. They tend to want to wear earplugs all the time. And a lot of times they're given recommendations to do that. And that's actually one of the worst things that you can recommend for these people, because when they're wearing earplugs their ears and brain are working overtime to overcome that hearing loss, and when they take the earplugs out everything is much louder and more noticeable and more bothersome. So she had stopped doing that, which is great.

And she reported that sometimes she's still bothered by sounds but she no longer reacts as strongly or stays bothered as long as she used to, which is great. And her mom was coming to these appointments and it was so fun to hear her commentary as they were going through this, because she was saying, Rose actually sat with the family-- the entire family, her dad included-- who was her worst eating trigger-- and ate dinner, and she's not eaten at the table in the presence of anyone else for such a long time. So that is a really big thing.

And at the last that I saw her, she told me, I'm thinking about the future. I thought me I couldn't go to college, but now I really think I can. So it was a huge change in her. It was really exciting to see. So these are her severity, annoyance, and effect on life skills-- all starting at 10, all ending somewhere between 2, 3, or 5.

So, lastly, the take-home I'd like you all to go away with is that Tinnitus Retraining Therapy can be really effective in helping patients manage their reactions to tinnitus or other bothersome sounds. And I hope this has helped you to think about how you may incorporate it into your practice. And I thank you very much for your attention. And if there are any other questions, I'd love to try to answer them, but if you want to contact me later my information is on the screen there.