Fitting and Verifying Phonak Frequency-Lowering Technology

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- [Jonathan] All right, good morning everyone. Thank you for joining me this morning. We will go ahead and get started here to talk about the how tos of SoundRecover2 with Phonak. Just little housekeeping here. If you have any issues at all with logging in or audio or anything there's a tech support phone number right in the notes section. So if you do have any issues, please feel free to call that number and they will be able to help you with anything. Right below that you'll be able to see a section with some downloadable handouts for today. So if you like to have those physical things with you or even just download it to have it as a copy on your desktop please do that on this page as well. And if you have any questions for me. There's a Q and A box. So go ahead and type those questions into the Q and A box. I will be able to see those as I'm presenting, may answer it right away or save it until there's a break or if that comes up later on in the presentation.

Now that that's all over, let's get down to business. So I said we're gonna talk about SoundRecover2 today and with hearing aids. Hearing aids are just a tool that we have to help manage our patients who have a hearing loss and manage their hearing loss for them. Now the hearing aids are definitely one of those tools, potentially other technology from that manufacturer in the form of accessories and things like that could definitely be another tool that we could use to help support our patients with their hearing loss. But one huge tool that we have to use for this would also be the software, the manufacturers programming software. And within that there's a lot of tools that we can use. There's tools for counseling aspect of things. There are tools like sound cleaning features such as noise reduction in directionality that can help people manage their hearing loss in difficult situations. Today specifically, we're going to talk about that tool known as frequency lowering technology and specifically Phonak's solution for that known as SoundRecover2. And this tool that is frequency lowering technology just like with any tool is only as good as the person using it.

So the goal of today is to have you leave here feeling more comfortable and confident with this tool so that you can use it 'cause if you don't know how to use it or you don't know the best ways to use it, really it doesn't benefit the patients all that greatly. So after this course you will be able to identify when frequency lowering technology is appropriate. You will also be able to explain how to make proper adjustments to SoundRecover2, while also understanding how those adjustments will affect other things in the programming. Finally, you will be able to explain how to, as well as being able to perform the verification of SoundRecover2. And in very simple terms, we'll just talk about the who use it on? Why you want to and then how.

And just to introduce myself, my name is Jon Brittian. I am one of the clinical trainers with Phonak. I live in the Pacific Northwest, so I'm based out of Portland, Oregon. I'm in cover that part of the country. So first let's think about who do you use frequency lowering technology with. And certainly you will have noticed if you've fit Phonak hearing aids in the past, you will notice that the programming software oftentimes makes that decision for you. Or at least prompts you that it's saying that it thinks that decision should be made to use frequency lowering technology with that patient. And it makes that decision because oftentimes whenever you open up that new fitting session on a first fit for a patient, you see that SoundRecover2 is defaulted to be active. Now sometimes you'll use it, sometimes you don't. But there are certain demographics of patients that you will find that you need to use frequency lowering with more often than not. And those would be either the population that has a severe to profound hearing loss in pediatrics. And we consistently use frequency lowering technology for those two patient populations for different reasons actually. Think of that adult post lingual hearing loss who is now in the severe to profound range they require and benefit from frequency lowering technology because they're missing sounds and because of the degree of the hearing loss. It doesn't matter how much amplification we can provide in the high frequencies, we're just not going to be able to provide audibility for certain speech sounds. So we need to do something else. And in

this case we would activate frequency lowering technology and then manipulate that, those settings to provide the best programming for that patient in terms of benefit as well as preference for the sound quality. Now alternatively, we also consistently use frequency lowering technology with pediatrics and we use frequency lowering technology in kids because we need to give them access to as many speech sounds as possible, especially if they're at that age, whenever they haven't acquired language yet. And if they're in that language acquisition phase, they need consistent access to all speech sounds in order to develop language and continue to grow and meet those milestones as if they had normal hearing.

Now in our offices, we know specifically thinking of the severe to profound population. What we're dealing with is this loss of auditory resolution as well as this loss of high frequency hearing and also this need for a better signal to noise ratio than people with normal hearing. So we know that that's what we're working with. Now our patients don't tell us that. They don't tell us that, "Oh, I need a better signal to noise ratio," or, "I kinda feel like my auditory resolution "is lacking a little bit." They don't explain things that way. What we hear in clinic is that, "Speech isn't clear "and I find it difficult to follow conversations." Or, "I can hear but I can't understand things." Or, "Whenever I'm out with my family I can't hear anything." And those are the things that our patients are telling us specifically with these patient complaints or patient issues. We'll be focusing on the loss of high frequency hearing and how frequency lowering technology can help compensate for that loss of high frequency hearing that we see in our patients.

Now severe to profound hearing losses are defined, as having thresholds of 60 DB or greater. And where that number of 60 DB comes from is really where the damage that is causing the hearing loss is located. So we know that if there's damage to the outer hair cells, any degree of hearing loss that can be associated with outer hair cell damage can only be up to 60 DB. So we know that if thresholds are over that 60 DB mark, then there must also be damage to the inner hair cells. And that can pose even

more issues because not only are we dealing with this damage to the outer hair cells, but once that damage starts to affect the inner hair cells, then the ability for that sound or that signal coming into the ear to really be transferred along the nerve appearing is severely diminished. So that's really why we see all of these variability in performance with people who do have a severe to profound hearing loss. And that variability in performance with amplification is demonstrated quite clearly on this graph right here. So on the bottom we have pure tone average. So really the blue markings are really that mild to moderate degree of hearing loss. And with all of the reds, this is where we're really seeing that severe to profound hearing loss. And then on that other access we have any six words.

So we had these patients just perform any six testing and then graft their results right here in relation to the degree of hearing loss. And what we see quite clearly is that people who have that mild to moderate hearing loss generally perform and get quite a good benefit from amplification. But what we see with this severe to profound population is that there really is no pattern. So the variability in the benefit that they receive from amplification is quite great. Where we have some people who do absolutely amazing versus some people who almost get no benefit from their amplification. And ultimately would be better suited to be considered for a cochlear implant. So even at the 60 DB pure tone average, we see this huge variability in how people benefit from amplification. And because of that, we can't treat these patients all the same. We need to use different things. And that may be programming that may be accessories. There's a lot of things that we can use, but we have to treat all of these people as individuals and therefore create tailored management plan that's individual for that person. In the way that we do that is to really approach this patient in a holistic approach. So we're doing that complete hearing diagnostic assessment with them, but we're also listening very closely to that patient to figure out what their needs and goals are for their amplification and what their lifestyle is. So we need to be able to recommend that complete solution to people. And hearing aids aren't always that

complete solution. We know that hearing aids have limitations, especially for people that show this variability and benefit from amplification. So we need to be able to talk to people about accessories. We need to be able to discuss with them about why certain technology levels of amplification would be more beneficial for that person rather than going with something that might be a little bit less sophisticated in terms of the technology.

So generally speaking, whenever we're thinking of those people that are going to use frequency lowering technology consistently, their audiograms look similar to this. So we really are focusing in on that high frequency area and are those thresholds falling into this severe or profound range. And the important thing to keep in mind is that all of the manufacturers have frequency lowering technology in some form. However, we all do it a little bit different. So it's important to understand those differences and understand why one method may be more beneficial to one person over the other. Now with this graph here what we're looking at is really a male S sound. So kind of an S sound centered around 6,000 Hertz. And on the left hand side we see detection thresholds of that six K S sound in severe hearing losses. And then on the right hand side, we have threshold detection thresholds for that six K S sound for severe sorry for profound hearing losses. So it's very clear here that when we don't use frequency lowering technology in the gray, those sounds just have to be a whole lot louder before people can actually hear them. And actually with that profound hearing loss, some people needed it in upwards of like the 80 DB range in order for that S sound to be audible, which isn't great. We don't really want to be pumping out that much high frequency amplification.

So by activating frequency lowering, you can see that we clearly get this reduction in the detection threshold for this sound. So we don't have to provide as much gain in that area in order for people to be able to hear that sound and use it. So that is that more male S speech sound. But we also see that same kind of pattern with the female

S sound so centered around 9,000 Hertz. So without frequency lowering technology, that sound has to be a whole lot louder. versus with frequency lowering technology. We don't have to provide as much gain at that sound in order for people to understand it and use it. So there are a lot of different things in terms of signal processing features in hearing aids that go into what makes up a successful fitting. These 10 things that are listed here are really considered those fundamental requirements for hearing aids as it relates to pediatric amplification. And really whenever we go through the health to a verification, we're going to be coming back to this and revisiting it in looking at how the American Academy of audiology really recommends that you verify frequency lowering technology for kids. And so the question is how do you know if you need frequency lowering technology or not? And to be quite honest, the goal standard for you to be able to say that with any definitive definitively at all would be to do really are measurements.

So what we're looking at is something called the maximum audible output frequency. And so that is really trying to figure out what is the loudest sound that is being amplified. And then at what point does that roll off and is no longer audible because of the degree of hearing loss. So kinda right here we would say is that maximum audible output frequency. So anything above that would not be audible just because of the severity of that patient's hearing loss. So that's how we determine if we need it or not. But there are also quite a few considerations that we need to take into account whenever we are choosing to use frequency lowering technology and those are that just because of the nature of it, there are going to be changes to the sound quality that are perceptible to the patient. Now it's also important that however, the frequency lowering technology is done, that it preserves that low frequency information and also that it preserves the familiarity of vowel sounds, specifically thinking of that severe to profound population a lot of the speech understanding comes from vowels. So we really don't want to be manipulating the sound quality of vowel for that patient. So those are the considerations that we have to keep in mind with anytime that we're

using frequency lowering technology. Now the cool thing about SoundRecover2 is that there are a lot of things that have been changed from original SoundRecover in order to to help with those considerations. And those things are that SoundRecover2 is adaptive, it's flexible, it provides less distortion and it's independent. So let's take a look deeper at each of those things and figure out what I mean by that. So when I say that SoundRecover2 is adaptive, what I mean is that it's going to be different based on the audiogram that is input into the programming software. And whenever SoundRecover2 is activated. There are three frequency cutoffs that are determined. The first one is the CT1 or lower cutoff frequency. The second one is called the CT2 or the upper cutoff frequency. And then that final one is called the maximum output frequency. And then there are compression ratios that are occurring between all of these different areas. Now when I say that SoundRecover2 is adaptive. What I mean by that is that this area between CT1 and CT2 is adaptive because when sound comes in, if the energy for that sound falls into that area between CT1 and CT2 compression may or may not occur. Now the only location where frequency compression is always occurring is this area between CT2 and the maximum output frequency. Now this is important because that allows us to preserve a lot more of that natural sound quality for certain sounds especially sounds that do have more lower mid frequency energy like vowel sounds or nasal consonants.

So let's take a look at this on your real ear equipment. So this is an E sound, so a vowel sound. So we see that with SoundRecover2 off in this pink line right here. We see the shift in the frequency sorry SoundRecover2 is often the pink. That natural sound or the shape of that sound. Whenever we look at SoundRecover2 on we see that really that that hump there are the majority of the energy for that E sound is exactly the same location as if SoundRecover2 was off. The only place where we see any frequency shifting is above this area where that sound isn't even audible. By comparing it to SoundRecover2 where it did not have that adaptive area, we see that the, that mid energy sound or the mid frequency energy for that sound was also shifted

quite significantly. So what this would have meant was a perceptible change in the sound quality for that E sound whenever the original version of SoundRecover was being used. But with SoundRecover2 we see that that is maintained. And SoundRecover2 is also very, very flexible because it gives you a lot of opportunities to make adjustments to it for not only audibility but also for sound quality implants. So we see that we have two sliders here, so we have our audibility in distinction slider.

So we have 20 different unique points that we can put there. But within that, then we can also come down and change this clarity versus comfort slider from A all the way through D and that is also going to make some changes based off of where that audibility in distinction slider is set. Now this addition of the flexibility was very key in the ability for SoundRecover2, to provide less distortion compared to SoundRecover original. In the changes in the compression ratios with SoundRecover2 were quite drastic compared to what they were in SoundRecover original. So here we see on the very top left SoundRecover2 at it's weakest, that compression ratio was 1.5 versus SoundRecover2 at its weakest is about 1.1 now with the original SoundRecover, the strongest that we could it or the lowest that we could compress that frequency down to was 1500 Hertz. And whenever we lowered down to 1500 Hertz, we had this whopping compression ratio of 4.0 versus now with SoundRecover2, we're actually able to lower all the way down to 800 Hertz. And even if we do that, we're only getting a maximum of 1.5 of a compression ratio. So that means that we're able to lower down significantly more, but keep those compression ratios low so that we are providing less distortion for the sound quality for that patient.

Now looking at the adaptability, looking at the less distortion in a slightly different way. We can look at it on a spectrogram. So if it's been awhile since you have looked at a spectrogram what we're looking here kinda as you go across that time, so we see the different words and sounds that this person is saying and then as we go up that's frequency. So we have low frequencies towards the bottom and then as we go up we

have higher frequencies. In those little bars of colors really correlates to the amount of energy that there is at that frequency for that sound on the top we have original SoundRecover on the bottom we have SoundRecover2. So these areas that are circled here are those S sounds. So it's that Z sound in the is and then it's this S sound in Asa. So we see that with them both original SoundRecover and SoundRecover2. Those were shifted down. So we see that shift there. But we also can see that with the M as well as the I in the A sound with original SoundRecover, we see less clarity there are those colors are the frequencies, the energy at those frequencies are a little bit more muddied compared to what SoundRecover2 shows us. And really what that demonstrates is the fact that with SoundRecover2, we're able to compress down those high-frequency consonant sounds, but we're also able to maintain the natural spectral properties of vowel sounds and nasal consonants.

Question came through with whether or not the studies that we were looking at were performed with nHL prescriptive targets or Phonek proprietary one. And they were done with Adaptive Phonak Digital. So proprietary Phonak. Now SoundRecover2 can also be independent. And what I mean by that is that you can go into the programming software and have the different years calculated independently. However, that's not something that's done by default. So even if the hearing loss is asymmetric, whenever the software is creating defaults, it takes the information from the better ear and then would apply it to both. But if you want to, and if you need to, if you go into your global tuning tab and then under SoundRecover, you can check the box that says, "Calculate the sides independently." And by doing that, you will get these two different prescriptions based on the hearing loss specific to the ears.

So the bottom line with SoundRecover2 is that because we have these lower cutoff frequencies that are available to us, it allows us to utilize frequency lowering technology for more precipitous losses as also with more coroner audiograms or those people that are really completely profound in the mid and high frequencies. The

ultimate goal of frequency lowering technology and SoundRecover2 is to provide more audibility for high frequency sounds. And because SoundRecover2 does have lower compression ratios, there's this improvement that's able to be seen and definitely noticed from patients. In terms of the sound quality of sounds, even whenever frequency lowering technology is being used. And I would say that the biggest difference that's noticeable for patients is that naturalness of the sound quality for vowel sounds in particular.

So now that we know the what it is and how it works, let's talk about how you fit it, how you verify it, and then how you validate it. So step one, look at the ears or sorry, look at the hearing loss, Is it symmetrical or is it not? If you do notice a significant asymmetry in the hearing loss, that's whenever I would absolutely recommend that you go into that global tunning tab and calculate the sides independently. If there is a worst ear, we want to utilize SoundRecover2 as much as we can. And if we don't calculate the sides independently, that worst ear may not be benefiting from amplification as much as what we would like compared to the better ear. So the next step then is to manipulate those SoundRecover2 settings if you need to. And as I said, you have that top slider of audibility towards distinction and then the bottom one of clarity and comfort. And we'll talk more about that in a little bit and exactly what those are when you manipulate those. Exactly what are you doing? We'll talk about that soon.

Do you wanna point out though here that one tool that can be beneficial in the software is actually playing those speech sounds through the software itself. So if you have target media and sounds downloaded oftentimes people don't just because they can be quite a large file to download, but if you do have them downloaded, you're actually able to play speech components like an /sh/ in an /s/ sound right through the software so that patient can be listening to it. And then you can make these adjustments as appropriate. Now let's talk about some ways that you can figure out whether or not you need to make adjustments. And then if you do, which ones are you gonna do? So a

good way of testing this could be to use live voice. And obviously you would want to most likely cover your face somehow. But saying some words with those /s/ and /sh/ sounds or even just saying those sounds by themselves. We want to make sure, can people hear it? So can they hear me saying /s/ and /sh/ but we also want to make sure that they can tell the difference between those two sounds also. So when I say /s/, /sh/ do they sound the same are they different? Am I lisping? Those are all things that we're trying to tease out from the patient. But besides just focusing on high frequencies, we also wanna focus on some of those lower frequency sounds as well. So say words that have vowels and nasal consonants in them because we wanna make sure that our voice still sounds natural to that person as well. So live voice is the good way.

A better way to determine whether or not adjustments are needed to SoundRecover2 could be to use the Phoneme Perception Tests that was developed by Phonak and can be used through target. So there are three sections to this test and we're gonna look at this in more detail in a little bit. But the three sections are detection, recognition, and then distinction. So the patient will go through those three things within the Phoneme Perception Test, and then the results would show up in target and then would give you some tips on adjustments that you would make to SoundRecover2 based on those results. And then the gold standard of course, is to do your real ear. So most real ear systems do have a specific /s/ and /sh/ sound that you can verify. So you would do that. And we'll go through the exact steps on what's recommended for real ear verification of frequency lowering here. Another test that you can do is the UWO Plurals Test also. So this is a way to determine whether or not the patient is able to detect word final consonants like /s/ or the /z/ sound, because that's generally how in the English language we show pluralization. So this is just another test that you could use because it is focusing specifically on those high-frequency speech sounds that we are trying to make audible thanks to SoundRecover.

So let's take a look a little bit in closer detail at the Phonak Phoneme Perception Test. So this is something that you can download from us if you don't have already. You can reach out to honestly anyone at Phonek and we can get this to you. But it will live actually in Noah if you wanted to. So whenever you open up the Phoneme Perception Test, like I said, there are three sections of this test starts with detection, then we have distinction and then recognition. So with detection, we see here we have two types of /sh/ sounds, so male and female, and then two types of /s/ sounds, male and female. And it's quite interactive for the patient to just do it with you. You could play it yourself or you could have the patient kind of control it on the computer, but essentially you're just kinda Houston Westlaking it So you're going up and down in volume playing that signal and then determining what is the lowest threshold that they can actually hear the sounds. And then you would check that says save as audible and then that would save it as the threshold for that sound. Now for distinction, the patient will listen to four different sound samples and then they would pick the one that's different from all of the other ones. And then with recognition, the patient would hear a sound and then they would choose from all of these options what sound that they heard. And after they go through all of those things, when you open up target there will be the section up at the top here in fitting for specifically your Phoneme Perception Test results. So you'll be able to see all of the results right on here as well as the recommendations. And then you can choose to apply or unapply those. and the question came up about with this, does the sound play through the hearing aids or the speakers? And it would play through the speakers themselves. So that would go through the environmental mics.

Now within target there is also another section that can be quite beneficial for you. Whenever it comes to making sure that the verification process for SoundRecover is as efficient as possible. And that tool is the verification assistant. And I talk about verification assistant a lot with kiddos in the pediatric world of amplification. But if you are choosing to use frequency lowering technology, I would also recommend that you get in the habit of using verification assistant to do real ear also. Whenever you press

verification assistant, what it's doing is it's putting the hearing aids into this. it essentially turns off all advanced features so there won't be any noise reduction. The microphones will be an omnidirectional, SoundRecover2 will be off. Things like whistle block will be off. All of those things will be turned off. So then when you click it, you're going to see your acoustic coupling. Pause here for a second. Just make sure that everything matches here compared to what's actually in the patient's ear. And then as you click through you'll be able to see average RECD measurements, or if you had actually input measurements for RECD, those would be right there. And then as you continue through, it's going to ask you, do you want the program to be the active program right now to be the startup program or any of the other ones? And then as you're looking at those gain curves on your real ear equipment and everything like that, do you want the changes that you're making, do you want those to be applied to all programs or only the one that you're working in right now?

Another question came up about the Phoneme Perception Test I just wanna answer before we move on here. But the question was, can those results be applied to fitting software regardless of technology level? And yes, it can. So SoundRecover2 isn't a feature that is specific to certain technology levels. So regardless of 30, all the way through a 90, that can still be used. And then depending on the platform a little bit that might be dependent. If you're using anything from a belong or above, then it would be making those recommendations based on changes to SoundRecover2. But if you're using anything before belong, then it would be for the original SoundRecover method. But let me know if there's more to that that you would like to know. So once you figure out what program you wanna be working in, as well as any changes that you make, what programs those will be applied to, you'll click through and then come to this screen. So here you'll be looking at your real ear equipment and then you'll be able to make any gain adjustments right here. And like I said, SoundRecover2 is off whenever we do this. So once you're done making all of your gain and MPO adjustments, you can choose to click to the tab called SoundRecover2 at which point SoundRecover will

become active. And you can choose to adjust it so you have access to your audibility and distinction as well as your clarity and comfort sliders. So this is the perfect way to just go through it and see do I even need it in the first place. And if you are doing you're real ear through verification assistant and you find that no, actually with the hearing aid set the way it is and with me increasing gain, I can actually make that /s/ sound audible for the patient. And if so then keep it off. You don't need to use it. But if you can't, then move over to SoundRecover2 and verify using it that way with SoundRecover active.

So we talked about kinda at the beginning towards the beginning of the presentation we talked about how we would walk through what is recommended as best practice for verification of frequency lowering technology in pediatrics. And so that's exactly what we're gonna go through right now. And the cool thing is that you, if you are using verification assistant and target, you're gonna follow these steps exactly. So it makes it really easy for you because the first step is to verify the curves with SoundRecover2 off. So the role always is, is that if you don't need it, don't use it. But we need to determine first whether or not we need it. So you would verify your curves with SoundRecover2 off first. So go ahead, do your soft, medium, loud speech samples. And then I would definitely recommend going a little bit deeper than that and also verifying your specific /s/ and /sh/ sounds. So here we did that. So we verified our soft, medium, loud curves with SoundRecover2 off. We then kept SoundRecover2 off and played just that /s/ sound. Very clearly here we see that /s/ is not audible at all because the entire energy for that sound is falling below the line for the patient's hearing. So then we turned SoundRecover2 on. And when we do that, we now see that that upper shoulder for that /s/ sound is completely audible and falling in a range that is usable for that patient. So let's talk a little bit more about some fine tuning tips and tricks. So once you've determined that you need to activate it, what are we doing based on what we're getting back from the patient or based on what we're seeing on our real ear equipment.

So let's go back to that good way of checking it. So with our live voice, so if the patient is saying that the /s/ or /sh/ sound muddy, then what you would do there is move that top slider, that audibility in distinction slider more towards distinction. Now if you get this sound quality complaint of vowel sounds are sounding strange or that /s/ sound is sounding really lispy, then that's when you would go to that bottom one and move that bottom slider more towards comfort. Question came through. So let me read it. So just to be clear, is the verification assistant in place of REM and they said that I usually use REM plus adjusting targets, main gain adjustment screen. And if I do this I would not need to use the verification assistant, correct? That's correct. So verification assistant is definitely not in place of real ear. It's just a way to make the process of verification a little bit more organized I think. So really the reason for that is because it does shut off all advanced features and really we want to determine whether or not we need to use things like SoundRecover. And the best way to do that is to just turn it off and then verify it first with it off. And you can definitely do that within the target software. So just go to like global tuning on check SoundRecover, go back to your gain and NPO and then adjust there. But I think a slightly, what can be more efficient process of doing that is to just click on that verification assistant button. It turns SoundRecover off and then if you need it, you can turn it on right from that screen without kinda jumping back and forth between things in target. So it sounds like you're doing it the right way. So you're not doing anything wrong. It's just a different way of doing it through verification system.

So moving on to that Phoneme Perception Test. So very simple and the nice thing about the PPT is that it gives you the recommendations right there very clearly. But if the /s/ and /sh/ sounds are not detected or if they're not measured in an audible range then obviously we would move that audibility distinction slider more towards audibility because we need that patient to hear it more. Now, if we're looking at our real ear, there are a few things that we need to consider here. So one, we need to make sure

that that /s/ and /sh/ sound, that upper shoulder up that sound are audible. Now we also need to determine that those sounds are at least 1/3 octave apart in the way that we can kinda increase that separation if they are too close to each other, is to move that top slider more towards distinction. So kinda going back. So the good, so when we were doing our live voice, the patient said that /sh/ sound sounded muddy. So how did we solve that? We moved that top slider more towards distinction. Another way of thinking about that is that those sounds are just too close to each other spectrally and they need to be at least that 1/3 octave apart from each other in order to prevent that muddiness or that that muddy sound quality from happening.

So I talked a lot about moving it towards audibility, moving it towards distinction, clarity versus comfort, all of those things. So let's dig in a little bit deeper into what it's actually doing. So whenever I change these things, what is it actually changing? So anytime that we move that top slider more towards audibility, we are lowering everything down further. So another way to think of that is we are just making the frequency lowering stronger. So it will adjust that CT1, that CT2 and that max frequency down more into a lower frequency range. Now if we increase that top slider and move it more towards distinction however it's making the frequency lowering weaker. Or it's moving that CT1, CT2 and that max frequency higher and shifting it more towards the higher frequencies. Now what happens then when we move that bottom slider more towards comfort, so essentially what that's doing it's having the greatest effect on that CT2 or that middle cutoff frequency and it's going to shift that CT2 closer to the max output frequency. It has a somewhat of a change on the CT1 as well, but it's less significant. So this is what our B looks like. As we move towards C we see again that area between CT2 and that max frequency is getting smaller and then this area between our CT1 in our CT2 is getting larger, but for the most part the overall size of that area, the overall size of the SoundRecover2 areas staying the same. It's just shifting the size of that adaptive area. So as we move all the way towards that D we really are only experiencing adaptive compression at that point. So we don't have this

area between CT2 and the max frequency where there will always be frequency compression occurring. So that's one way of looking at it.

Let's take a look at what those shifts from A through D look like on our real ear equipment. So here we're looking again, we're keeping audibility and distinction exactly the same here, we're only manipulating that bottom clarity and comfort slider. So here we see when we are comparing A and B, we see the slight difference here. right around one in 1.5K. But besides that, everything is pretty spot on above that. So then if we move it towards C, again some difference here, it's about the same in this area. And then again, we start to see a little bit more difference in the frequency of that sound as we move higher up really beyond five K and then with the highest that D, again, everything's about the same here, not a huge difference. But then we see this pretty significant shift in those high frequencies. But really in this case, it's beyond the audible range. So what happens if by changing that A, B, C and D, if everything's audible for the patient, what do we choose? And ultimately that's gonna come down to the preference of the patient. So if we've determined that we've made it audible for them, and then by shifting that clarity and comfort slider, it's still audible, ultimately what is more, what's the preferred sound quality? And then that's what we would choose with the A, B, C and D and then kinda the same thing. So with this E sound, A, B, C and D almost had absolutely no change in those frequencies where it really mattered in the mid frequency range. Really any difference that we see is in the high frequencies where with this patient it's really not in that usable range anyway.

All right, and then when we were talking about making sure that there's that proper space between the /s/ and /sh/ sound, we will achieve that by shifting that top one more towards distinction. So on the left hand side. So this is the same ear, same hearing losses. We just have our audibility and distinction set at different numbers. On the left hand side, we're at a 19 so we have actually this huge separation of over one octave between those sounds. But the tricky thing is that because of where it's set,

there's some of that sound that that /s/ sound really isn't audible for the patient. So we see that upper shoulder slightly over the thresholds, but not very much, probably not enough to the point where it would be usable for the patient. So because of that, we do need to shift it more down towards audibility so that more of that sound is falling in the audible range. So we moved it to 17 on the right hand side here. And when we did that, we're definitely seeing that that sound is more audible. But the good thing is that we're also seeing this at least 1/3 octave separation. So we've determined that they can hear both sounds. So that's good. But we've also determined that there's this separation there. So we should not run into this instance where we're getting these complaints of muddiness for consonant sounds from the patient.

So how do I know what a one 1/3 octave is? So an octave. So think of it. An octave is essentially the doubling of that frequency. So if you have something at 1000 Hertz, an octave away from that would be at 2000 Hertz. And so if you're trying to figure out what's that 1/3 octave away from it, it would be about kinda that 1/3 distance away there. Little bit different though, if as the frequencies go up, like if you're one sound is at 2000 Hertz, one octave away from that would be then 4,000 Hertz and then split that into three. 1/3 octave would be the other away from it.

So we talked all for an almost a full hour about SoundRecover2 and let me just say for a second. My experience using frequency lowering technology when I was in the clinic actually the majority of my clinical experience was working with kids. In the nice thing about working with kids is that as long as you verify that you're providing the audibility that they need in matching targets, that child's going to do really well. And also things like frequency lowering aren't necessarily as much of an uphill battle with kids because you just put it on them and then their little brains are so plastic that they're going to get used to it over time. But then whenever I started working more with adults that's whenever I really kinda got into this battle about do I use frequency lowering? Do I not? I feel like every time I turn it on, people are complaining about it.

So ultimately what I did was by default went in and turned it off for every person. And that was with SoundRecover1. And then my Phonak trainer her name was Eliza at the time. She came in and said, "Listen Jon, SoundRecover2 has been out "for about a year right now. "Just use it please. "Like let's talk about how to change it, "what you're doing, "but for the next five patients that you have, "I want you to just keep it on "and use what we talked about today and see how it goes." And I did. So I liked Eliza. So I listened to her. And what I found was that I wasn't running into all of these complaints about the sound quality from patients. Actually what I was hearing from them was all of these new sounds that opened up for them in their world. And really we see that on testing as well.

So this right here was original SoundRecover and really CNC word recognition with original SoundRecover versus these two versions of adaptive frequency lowering technology. And we have this one area of you fit it and you tested it right away. And then also we tested them again about four to six weeks later. And we can see that from the original to now this adaptive way of doing things. There's definitely an improvement in speech discrimination for people. We saw that both on the CNC as well as the UWO plural test. So not only is it improving discrimination for people, but because of this adaptive nature, we're also again able to preserve a lot more of that naturalness of it. So some final thoughts here. The default settings that the target software comes up with are designed to kinda create this balance between access to the high frequency sounds and familiarity with those sounds, but then also the familiarity of those low and mid frequency sounds. Now, we also, we have to keep in mind if we change things, how that will affect all of these other areas.

So if we want to provide greater access to those high frequency sounds, we're gonna have a little bit of a give and take here because we're going to lose some of the familiarity of those high frequency sounds, but also lose some of the familiarity of those

low and mid frequency sounds. And then the opposite of that, if we make SoundRecover weaker, we may be preserving more of the familiarity of both high frequency and low and mid frequency sounds, but we're also losing some of that access to those high frequency sounds. So you have to weigh the pros and cons of each of these things. And really that's going to be based on that patient that's sitting in front of you and what they're looking for, but ultimately SoundRecover2 the purpose of it is to restore access to that high frequency information. And really because we have these different cutoff frequencies in this adaptive area, we're now able to maintain the familiarity for those low and mid frequency sounds, but also compress lower so that we can extend the benefit for frequency lowering to these people who have more of a profound loss or precipitous loss or these corner audiograms that we sometimes see.

So now hopefully rather than SoundRecovery just being this tab in the target software that you rarely looked at, and if you did it was to uncheck it so it wasn't being used. I hope you feel more comfortable with the how it was developed as well as the what it's doing and then based on what that patient is telling you, how you manipulate those settings to give that patient the most benefit. So thank you everyone. We are at the hour, so definitely appreciate you taking this time to listen to me and learn about SoundRecoveer 2. And I hope you're able to use this information to try to help your patients more, but hope everyone's staying healthy and safe out there. And if you have any questions about this you can reach out to me. If you don't know my contact information, reach out to the people you do know at Phonak and they will definitely be able to get you in touch with me. Thank you.