Bridging the Gap: Bimodal Fitting Considerations for Hearing Aid Clinicians

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- - [Neil] Good afternoon everyone. Thank you for attending this afternoon's talk. Today we're gonna be talking about bridging the gap, bimodal fitting considerations for hearing aid clinicians. My name is Neil Wright, here to lead you through our computer side chat. So let's go ahead and get started. First, this is just my disclosure slide. Just let you all know that I am employee of GN ReSound. I don't have any non-financial relationships to disclose. So here are three main learning outcomes for today's presentation. So after this course, participants should be able to identify three benefits of bimodal fittings, compared to unilateral Cochlear Implant fittings. Participants will be able to complete an optimal bimodal fitting of a hearing aid. And after this course, participants will be able to program an optimal streaming program and system for bimodal streaming. So this is just a quick outline of what we're going to be covering throughout this next hour. So we do have our overview of the bimodal fitting flow. Just a kind of general introduction to bimodal fittings in general. And then we're gonna look at four distinct fitting considerations for hearing aid for a bimodal patient. We'll start with hearing aid verification, move on to directionality settings, and then look at some specific settings for both music perception and for patients that are bimodal, and also experience tinnitus. And at the end we'll have our conclusions, wrap up and any questions that anybody has at the end of the presentation.

So, let's start where everything starts. We'll start with the introduction and the overview of the bimodal fitting, and bimodal fitting flows. So, for those of you who are either fairly new to bimodal patients, or have worked in either specifically working with hearing aids, or Cochlear Implants and are trying to get a better understanding of the other side of the equation. Bimodal patients are gonna be those who utilize electrical and acoustic stimulation for hearing. So while this is something that, you know, in the early days of Cochlear Implantation was fairly uncommon, this patient base has grown substantially as the Cochlear Implant fitting range has expanded. So more CI patients have usable, residual hearing than ever before, and this has led to the increased

utilization of bimodal stimulation. For those of you who just want a quick refresher on current candidacy criteria for Cochlear Implant in the US, there are different candidacy criteria for the standard electrode array based on the age of the patient. So for adults, you'll see here with the line in red just kind of giving you the threshold outline for your audiogram, you need to have moderate to profound bilateral sensorineural hearing loss, and limited amplification benefit. So in the base aided condition, there needs to still be this limited performance with amplification. Now as we go and look at younger patients, the implant candidacy criteria do get stricter. So as you can see here, with children, two to 17 years, that's more of a severe to profound sensorineural hearing loss, and for infants, it's profound sensorineural hearing loss. And for both of those again, it's limited benefit from binaural amplifications, so that best aided condition. Now if we look at current fitting practice, so we look at, so this is data taken from a survey that was completed by Siburt and Holmes. Granted this is from 2015, but this is some of the most recent survey data available, looking across fitting practices across the US. And what we can find is that because this is a fairly recently patient base, this bimodal fitting protocol across different sites is highly variable.

So if we look at the chart here on the right of the screen, this is going to show you the amount of time waited to reprogram the hearing aid after the Cochlear Implant fitting. And what you can see, while there is a large portion of those surveyed that said they waited, but eventually did reprogram the hearing aid at or over two months, some never reprogrammed the hearing aid, and some programed it very quickly, and there were others that, you know, had reported at different practices. So, a couple of things to keep in mind here is both that the fitting practice has been highly variable, and we kind of like to get something a little bit more standardized for these patients. But another thing to keep in mind when we're thinking about bimodal patients is often times, and at least in 50% of those surveyed back in 2015, is that most of these patients, or near majority of these patients are seen by two different audiologists for their Cochlear Implant and hearing aid health care. So they are often times treated as

unilateral Cochlear Implant or unilateral hearing aid patients by their audiologists, and what we have seen from research into these patients is that they're a very unique subset of patients. So we need to kind of think about that accordingly as we move forward with the modal patient care, and this patient base becomes even more common. So here we're looking at a basic binaural fitting flow. So this is showing that there are five key steps to a successful bimodal fitting. So the first one is making sure that the Cochlear Implant has been programmed and mapped. So this is going to be taken care of by the bimodal patient's Cochlear Implant audiologist, whether that is you or another provider. And one key step here, and one piece to this that we want to make sure we focus on before we move on to steps two through five, is that the map is stable. Very early in the process, the map will change quite substantially, particularly right after activation and in the first month after activation. So map stability is going to be key for us to complete the following steps after step one.

So if you are not the CI audiologist, making sure that you're on the same page with that provider prior to making any hearing aid changes is going to be critical for the patient. So steps two through five is what we're going to focus on for the majority of this talk. As this is a talk specifically looking at the hearing aid side of the bimodal patient, we're gonna first look at step two which is programming the hearing aid so this is going to be talking about, you know, hearing aid verification, making sure that we're setting to targets. Moving on to step three, we'll be looking at fine tuning the hearing aid, so making any gain adjustments, making advanced feature adjustments to the initial program, and maybe different environmental programs for these patients to use. And then we're going to discuss verifying bimodal loudness balance. And then finally discussing, you know, and looking at auto-relate which is in smart fit. This is taking the game changes you've made in one program, and applying them across the board to make sure that fine tuning and really your measurements are applied to all programs. As well as looking at streaming set up. So is this going to be for accessories, for mobile phone or smartphone use so that the patient is able to stream those bimodally.

All right. So we're into our first fitting consideration. So bimodal fitting consideration number one is going to be your hearing aid verification. Now if we look at the background on bimodal hearing aid verification, one thing we need to look at, first and foremost, is current practice. So here we've got a graphic, and this is from Siburt and Holmes. This is showing if and when, or how often, really our measures were completed for bimodal users. And what we can see here is while the majority of bimodal audiologists were completing really our measures the majority of the time, there is still a substantial subset that wasn't, including nearly 20% of those that never performed, really, our measurements when completing a bimodal fitting. So this is something that we do want to make sure changes, so that we are practicing our best practices. Another question, when we think about hearing and verification as, well, not just are we setting really your targets, but which targets should we be setting them towards. Should we be looking at NAL, DSL, proprietary fitting roles? What's the best option here? So the fitting flow that we just referenced has suggested, and we've recommended that we use NAL NL2 targets for bimodal Real Ear Measurement targets. That's not to say that this is the only fitting rule to use, because if we look at prior research, there has been research into different fitting rules as well. One thing to note, and this is very critical, when we talk about hearing aid verification is that prior research typically has utilized really our measurements in methodology by default. So this, basically, is saying that as part of best practices, setting to Real Ear targets is critical for success. If we're going to look for bimodal benefit, we need to be setting to Real Ear targets, and if we're not, this can actually have a negative impact on bimodal benefits. So your first line of optimizing your bimodal fitting is going to be using verification. Now which rule do we wanna use?

So as I mentioned in the last slide, you know, our standard fitting protocol recommends using NAL NL2, but prior research has shown bimodal benefit with both DSL, older and kind of the newest version of DSL which is version five, but also previous versions of the NAL fitting rule. The studies that have shown these benefits

may have been older studies, but they did show binaural benefit, even using NAL RP or NAL NL1. There are some articles that have been released and some research that has been done that's shown some benefits for proprietary fitting rules that have been developed by manufacturers, but obviously, you know, when we look at the larger subset of research that's been completed, mostly you're going to see those third party fitting rules utilized. So either NAL or DSL fitting rules. If we look at research, there is very limited research looking at direct comparisons between fitting rules. So trying to set one bimodal patient into DSL, or NAL, and then comparing the results. But if we look at some of the more, some of the research that has looked at preferences, really it does come down a lot to patient preference, or patient experience, excuse me, which indicates and can provide some insight into patient preference. So here on the right of the slide, just wanted to highlight in the Smart Fit fitting software, you do have the opportunity to change your fitting rule. So if you go into the fitting menu at the top of the screen, you'll be able to choose your target fitting rule for each patient. So here we have NAL NL2 selected, but you can see DSL is an option, NAL NL1, RP and then audiogram plus which is the resound proprietary fitting rule. So our key take away here is that the most critical part of a bimodal fitting is going to be setting those fitting rule targets using REM verification. So make sure you're doing your verification. Another area where there has been some substantial research and some investigation for hearing aid verification is looking at whether or not the hearing aid should have the bandwidth that is amplified restricted, or if it should be amplified across all able frequencies.

And so if we look at the research that has been done, there is some evidence to suggest that restricted bandwidth can be helpful, however most research is done by providing wide band amplifications. So fitting to every able frequency that the patient has. Now if we look at the research that has suggested benefits to restricted bandwidth, there is some compelling evidence to suggest that the subjects that are going to benefit from restricted bandwidth the most are going to be those that have the

presence of a cochlear dead region. So if the cochlear, the bimodal user has some cochlear dead regions, this could indicate that that wide band amplification might be introducing additional distortion. So restricting that bandwidth can actually provide some benefit for those patients, however with candidacy for CIs expanding, this is going to indicate that there is going to be more usable hearing for the opposite ear. So our key takeaway when we're thinking about either restricted or wide band bandwidth of amplification, is the side band amplification is providing bimodal benefit in most bimodal research, so it'll be, you should be able to see this benefit in most bimodal cases. However, if there is the presence of a cochlear dead region, this might be a good opportunity to utilize restricted bandwidth. Now the, another step in our bimodal fitting process is loudness balancing. So what this is basically going to be talking about is looking at the amplification in the hearing aid compared to the loudness in the Cochlear Implant. Now this is, as I said, this is completed as part of the bimodal fitting protocol, and this is completed after Real Ear Measurements and initial gain adjustments.

Now this is commonly a part of bimodal research protocol, and this is largely done in an effort to make sure the patient feels balanced across the ears. Now again, because this is something where it would, there's some ethical questions about whether you're taking benefit away from a patient when trying to look at these two different conditions directly within one patient, there is very limited research specifically investigating whether or not loudness balancing has a critical impact, or a measurable impact on bimodal benefit within the subjects. But again, if we look at patient preferences in these research studies, you know, you might, you do see some patients do prefer more gain, and or less gain than the fitting rules generally describe. And this is partially due, or could be due to the fact that loudness growth in Cochlear Implant and hearing aids are perceptually different. If we think about both the input signal that's going to be coming in and how the devices processes that sound, how that loudness is going to grow from soft to loud in each ear is going to be perceptually a little different. But we

do wanna make sure that the ears don't seem to unbalanced, or overwhelming that the patient isn't perceiving any benefit from one ear or the other. So our key takeaway when we think about loudness balancing, again, and it's gonna be something that I reiterate multiple times today, is that we really want to start off with our Real Ear Measurements, and our real ear verification, because that's going to be our key step to ensuring that we get the best results for these patients. And then we'll wanna adjust gains as needed for patient comfort. Now when we talk about loudness balancing, and as I mentioned earlier in the talk, a lot of bimodal patients are seeing two providers, one for the Cochlear Implant and one for the hearing aid. And if we use the ReSound Smart Fit software, we actually have a good way of getting that loudness balancing programmed to the patient's ears, specifically the hearing aid ear, even when they're not in the office with the hearing aid audiologist. So the way we can do that is by using ReSound assist's remote fine tuning feature.

So what I'm gonna show you here is just a standard gain screen, looking at the output of a hearing aid in a remote fine tuning session. So let's say, the patient has gone to see the Cochlear Implant audiologist. There has been some mapping changes, and now they're trying to balance the hearing aid's loudness to that new Cochlear Implant map. A good way to do this is to actually go into the sound enhancer of, here we are, in the Smart 3D app and make adjustments directly to the base, middle and treble settings underneath the sound enhancer menu in Smart 3D app. If you make these changes, and then make a request through the remote fine tuning through ReSound Assist, you actually can then see those changes in Smart Fit once the request arrives. So, let's say the patient makes those adjustments, sends the request over to the audiologist, and then the audiologist turns on the settings in the app, and you can see here now in green, so I do realize we've got a bit of an overlap here in these gain settings. This will show those changes. So the additional base, middle and treble are now able to be shown on the gain screen and the fitting screen in Smart Fit, and so this allows the audiologist to program in some setting changes to give that loudness

balancing to the patient without them having to come back and to see the hearing audiologist right after seeing the Cochlear Implant audiologist. And one thing that I do wanna note here as part of this is that if they do make changes to the master volume in the hearing aid, in the app, that's not going to show up in Smart Fit as user settings. So it's critical, if we wanna go and make these changes based off user settings, it has to be done in the sound enhancer using the base, middle and treble. Once those settings are made, you can auto relate to other programs, save the settings and them send them to the patient. The last thing I wanna talk about, specifically related to hearing and verification is just going to be frequency lowering for bimodal users. So what has been done in this area has looked at both frequency transposition and frequency compression, to look to see if there is a positive impact on bimodal benefit. And the reality right now is that these settings, whether them being on or off really didn't seem to show a significant benefit or really a detriment over the conventional amplification. So again, this might be something that comes down to patient preference or patient experience, but our key takeaway here is that bimodal benefit can be achieved without frequency lowering.

So if at all possible, getting that wide van amplification, amplifying all aidable targets is going to give the patient the most that they can use in that hearing aid ear. Now, moving on to bimodal fitting consideration number two, we're going to look at hearing aid directionality. So if we look at some of the more basic research for both Cochlear Implant patients and hearing aid patients, directionality does provide substantial benefits, particularly improving signal to noise ratio, and providing benefits in noisy environments. However, if we are looking specifically at bimodal patients, this research is a little bit more limited in terms of overall speech, speech benefit looking across different directional settings. Now if we do have the bimodal stimulation, this does provide binaural cues that can improve localisation. So that is key, it does give this opportunity to improve localisation over just a Cochlear Implant alone. Now bimodal stimulation has been shown to provide benefits in noisy environments, improving that

speech to noise ratio, but if we're talking about specific research looking at different set ups in directionality, that research is a little bit more limited. And you can kind of understand why there might be a substantial amount of variability in terms of performance between different bimodal users, and a lot of this comes down to what defines a Cochlear Implant candidate in the first place, and that is substantial, severe to profound, high frequency hearing loss. So the question becomes whether or not there will be any benefit from directionality in that hearing aid ear with the residual hearing that's still there. And if we are looking at these patients, we have to also think about how research is completed in the lab, and how it's implemented in real life. So often times it's a question of whether or not the speech and the noise are separated within the lab environment. That's not always the case when we go out into the real world. If a patient goes out into a restaurant, the person that they're talking to might have somebody sitting right behind them that's going to be loud, or presenting a lot more noise. So when we look at bimodal patients, we do really need to think about this as trying to provide a high signal to noise ratio. So really getting that signal above the noise. So anything that we can do to improve that is going to provide these patients with benefit.

Now when we're talking about directionality for bimodal hearing aid programming, we're gonna talk about three different types of directionality. We're gonna talk about omnidirectional settings, which is no directionality, but this is really going to provide environmental awareness. So this is something that you wanna think about for bimodal patients that still have some residual hearing in the hearing aid ear, but are really only looking for either those binaural cues, or more of that sound awareness on the hearing aid side. For those patients that may have a little bit more residual hearing, we can start to think about how much of an impact directionality will have on their signal to noise ratio in those noisier environments. So we want to think about both fixed directional and automatic directional. Now some patients do seem to have, particularly if you think about your more severe to profound patients, often times these patients

may have a strong preference for a reliable, consistent performance, and that is something you can typically get with your fixed directional. So something that the patient knows is going to behave in a certain way, that they can rely on consistently. Other patients are going to be much more keen on something that does a lot of the work for them, and wants that automatic directionality. So this is something where you see the focus and the nulls move around based on the level and location of the noise around the patient, whether it be off to the sides or behind, changing the width of that fixed directionality in the front. If we look specifically in Smart Fit, when we think about bimodal users, we're going to see very specific options. Now these are going to be in the Smart Fit software, they're going to be seen as mono-role fittings. So you won't see the directionality options for bilateral directionality, but you will see your mono-role options. So if we look at specific environmental programs, they will have specific directionality options. The key that I wanna point out here is the all around program is kind of your most limited in terms of options, but this is because it's also your most automatic program. So it's trying to give you the settings that make the most sense there.

So all around, you'll have soft switching and omni as your directionality options, but in your restaurant, music and outdoor programs, you are going to have the full selection of options here. So you'll have your soft switching, but you'll also have autoscope adaptive directionality, fixed directionality and then you'll have your omni option. One thing I want to point out here, for those of you who may not be familiar with Smart Fit, is the different between soft switching and autoscope adaptive. So why soft switching is used as your default in your all around program is that this is going to give you an automatic directionality option with an omni response possible. So if the patient is in a quiet environment, it's going to default into more of an omni response, and as the noise level goes up, it's going to go into a directional response, and that will then vary based on the background noise and the location of the speech. Whereas autoscope adaptive directionality is going to specifically be an automatic directionality program,

but it won't have that omni response option. So if this is a patient that really needs to cut down on background noise, and really doesn't need that omni as an option, you can just switch over to this automatic adaptive, and your restaurant, music or outdoor programs. Another thing that can be sometimes, can throw off fitters and audiologists who don't have a lot of experience with Smart Fit is that we use that autoscope name twice. And so just to point this out here is that underneath your directionality option in advanced features is your autoscope. What this is going to do, is this basically is whether or not you want to set your directional setting to a automatic setting, where the whip of the directional response will vary based on the noise, or whether or not you want it to set specifically to either wide, normal or narrow, as your different directional options. Last thing I do wanna point out here in Smart Fit is your directional mix. So this is how you control the ReSound band-split directionality feature. So what this means is that the frequencies that are below the band-split frequency are going to stay in omni no matter what. Even if the hearing aid is set to a directional mode, those frequencies, to avoid distortion and to avoid any need for artificial base boost, stay in an omni directional response. This is to give the patient sound awareness, even in a noisy environment.

The directional mix control here is going to actually allow you to set where that frequency is, where the frequencies above that are gonna go to your directional response. So as you slide across the directional mix, it's going to, from high to very low, it's basically saying, you know, the high setting here means that more of the frequencies are going to go into a directional response. As you slide to very low, less of those frequencies are going to go into a directional response. This is just a quick reference chart to kind of give you an idea if you are wanting to get the hearing aid and the Cochlear Implant on a similar directional pattern. There are different directionality options for both cochlear and for ReSound, and here this is just to kind of give you some comparable settings. So if you want something that's going to be more of an automatic directionality with an omni option, you have soft switching in ReSound or

you have the SCAN program for Cochlear. For something that's automatic directionality that's not going to have an omni response, you have Beam in Cochlear, and then AutoScope in ReSound. Lastly, you do also have a fixed directionality option. For Cochlear, that's gonna be Zoom, and for ReSound, that's just the fixed directionality option. Now I did also wanna put those default programs on there for ReSound, but you can make changes to those in the advanced features once you've set them up. And one thing that I will just note here is that while we can try to set similar directional settings, how those are gonna apply may differ between Cochlear Implant and hearing aid, based on the environment the patient is in, and the sound input that each device is getting at any given time. So some key takeaways here when we're thinking about hearing aid directionality, is that the bimodal fittings, one, when you have those bimodal fittings, they are going to be able to provide bilateral cues that can improve localisation for these patients. While the research here is limited for specifically directional benefit on speech understanding for bimodal users, improved SNR does show benefits for this patient base, so providing them with the best signal to noise ratio is going to be key for their success.

Specifically thinking about Smart Fit and ReSound fitting software, remember that different environment programs are gonna offer different directional options. And our final key point here is that communication between the Cochlear Implant and the hearing aid audiologist. Making sure that your on the same page in terms of patient care, and making sure that the patient is getting what you expect from the opposite ear when you are making your own programming decisions. So that communication is going to be key for patient success. Our next fitting consideration is music perception, so we'll get right into this one. So if we're thinking about hearing aid programming and music perception, just a little bit of background here for bimodal users. Cochlear Implants do a very good job of coding in time. The responses are very fast, and it's great at picking up changes that are very quick, however one thing that is, Cochlear Implants can still sometimes struggle with is coding for more of those, that perception

of melody, the perception of lyrics within music. Whereas hearing aids actually do a very good job of detecting these things, however when we look at this patient base, again we're looking at a patient base that has a pretty severe to profound hearing loss. So added distortions can sometimes come into play. Now if we look at the bimodal, bimodal users, we look at prior research that has been done, utilizing bimodal stimulation can provide substantial benefit for these patients when it comes to music perception, music enjoyment, music understanding. So if we look at some data from 2015, from Jace Wolfe, this data shows, you know, the bimodal stimulation provides improved sound quality, improved ease of listening and better lyrics recognition, when we think about it in comparison to either the hearing aid or Cochlear Implant alone. So we're really getting the best of both of these devices. Now if we wanna look at this in Smart Fit, and how we would program the hearing aids to provide some optimal benefit for these patients. There's a couple of different options, and it's really going to depend on how the patient is listening to music, as to how you want to make these programming changes. So Smart Fit does provide an environmental program that is specific to music. The default gains are set to slightly more linear environmental gain offset, relative to your conventional audiogram plus, or conventional targets. This also does change the time constants of our compression speed, so typically ReSound is going to default to a syllabic compression speed, but for the music program, this is going to default to a slow time constant. So this is going to allow, it's going to take a slower approach to compression so that that dynamic range of the audio input music allows the patient to still perceive those dynamic changes. Another key difference to the music program is actually it provides a different feedback suppression option. It is specifically called music.

This is a less aggressive setting in an attempt to prevent feedback suppression or distortion that can be introduced when a patient is listening to high pitched musical instruments. When you think about musical instruments, they are typically providing input at a specific frequency over time, and sometimes that can be a very long held out

note, which the hearing aid can misidentify as feedback. If that gets clamped down, then that really starts to cause some issues in terms of music enjoyment. So what we've done here is provided a music option that will, won't be so aggressive at clamping down on misidentified musical notes. One last thing I will point out here, and now this is something that is, it's called low frequency boost. This is something that is only available for your UP receivers and super power devices, but this gives the opportunity to kind of provide added base for those patients. They really do, they need that low frequency boost. Now another way for users to listen to music is going to be using it through either streaming accessories, or through their phone. So this is going to be unique and also independent of the music program itself. Now if we look at ReSound and we also look at cochlear devices, you're able to stream not only phone call audio, but also music, you know, audiobooks, the audio in, you know, YouTube videos or other videos, as well as stimulating they can come through other apps, such as tinnitus stimuli from tinnitus apps. So if we look at some of the research that has been done in terms of looking at quality of life, having access to this bimodal streaming can actually show improvements in, excuse me, the social activities subsection of the quality of life questionnaires.

And this is really, this is understandable given how connected everybody is to their smart phones, and to their, you know, their devices nowadays, and being able to be a part of that is a way to be more inclusive for not only hearing aid patients, or Cochlear Implant patients, but bimodal patients as well. Now one thing that you do want to take into consideration when we are programming hearing aids for streaming music is that the different audio routing options that are available also have different defaults, and they have different programming sections within Smart Fit. But streaming does give us this opportunity to optimize these things for music perception, but also speech perception on the phone, and for using different apps for auditory rehab. But as we, I'm sure, have all seen in the clinic is patient technology literacy is going to be a key factor in implementation here. So how well they know how to use their smart phone or

their cell phone, if they're still using a non-smart phone. Getting that Bluetooth connection, or understanding how the Bluetooth will work with their phone and with their devices is something that we're all starting to really take as part of our counseling process. So knowing how much to provide the patient, or what they can work with, is still critical here. That being said, every year that goes by, if you look at Pew Research Center, they're always looking at smart phone uptake, and if you look specifically at those aged 65 and older, the adoption rate of smart phones is increasing. So more and more often we're going to see patients coming in with smart phones looking to be connected, and looking to be able to utilize these special features. So this is something that, particularly for this population is going to open up a lot of new opportunities for them. So when I talk about streaming accessories and phone streaming accessories, we're going to be talking about slightly different things, and it's really just about how their audio is routed through the hearing aid. So I wanted to separate them out just so that we could look at how that audio is handled. So first we're going to look at the accessory program settings. So this is your multi-mic, your micro-mic and your TV streamer. So as it is it's own program, it is going to have it's own independent gain settings and advanced feature set, compared to the environmental programs. So you will have the options for a streamer based boost, so that is going to be unique for the streaming accessories program.

You will also notice that that default's on. We also, in the streaming accessories program, the music option for your feedback suppression is there. That's not going to be the case in your all around, or your restaurant or your outdoor programs, but since streaming can be utilized with specifically looking for music to come in, we wanted to make sure that that was an option. The other thing we want to point out here was that you do have control over the mics on the hearing aid, relative to the streamers. So this gives the patient the opportunity, and you the option to kind of reduce that environmental background noise so that they can focus on what they are streaming specifically. There are two different settings, one for the TV streamer and then one for

the micro or multi-mic accessory. The multi-mic accessory is going to default to negative six, and this is going to give the patient, it is going to be your optimal setting for the multi-mic so they're still, or the micro-mic. So they're getting that improved speech to noise benefit, but also still able to hear the environment around them, so they're not completely isolated. Now if we look in the smart 3D app, there's also the possibility for the patient to make some changes to the background sound, so the surrounding sounds, but also the streaming volume. Now this slide is just to highlight the benefits of streaming bimodally for these patients relative to using the hearing aid or the Cochlear Implant in just a normal way with a conventional phone. So as you can see here on both in a quiet and in noise, streaming provides improved speech recognition for these patients compared to using a conventional phone. Now when we think about phone programming, it is going to be slightly different depending upon what device you are programing the patient to use.

So if we look at LiNX 3D, ENZO 3D, and legacy devices, they are going to utilize a specific phone accessories program. This is going to have it's own gain settings very similar to the streaming accessories and will have a lot of the same defaults that the streaming accessories program did. The key difference here is that you'll see that you've got your mic balance, instead of being for the TV streamer and the multi-mic, it's the mobile device, so if they're using MFI, versus if they're using a phone clip. So that's going to be your major difference, the defaults are slightly different. It's a little less aggressive than the multi-mic balances, but these are going to be your key differences. So you've still got that phone volume is going to be controlled on the side of the phone, but you also, if the patient does require a phone clip, there's additional volume controls on that device itself. When working with a patient that has LiNX Quattro, now this, the LiNX Quattro line introduced what's called mix-in. So what this does is it allows the hearing aids to switch into that phone audio quicker by utilizing the gain settings of the program the patient is currently in. So you'll see the phone accessories balance options underneath each of the environmental programs advance

features. Now these settings are going to apply across all environmental programs. So you won't have individual phone accessory settings for each environmental program, they will be the same across all of those programs, but they will utilize the gain settings of the program you're in. So if you're in a restaurant and would like to keep the settings in the restaurant program, they'll still be able to do that without any needed changes on their own. And this is just a way to highlight what that looks like in the Smart 3D app. So you'll see up in the top right corner, what we just highlighted with that white square is the program that the hearing aid was in before starting to stream the audio. So this is going to show both on the left, this is if they decided they were going to stream some music, and on the right you've got the phone call. So there was both in the all around program to start with, and you'll see the difference here is that now they've got some different quick button options, so more of a streaming focus or a call focus, and the volume slider has now gone to a surroundings volume slider. So that's going to be controlling that environmental noise of the hearing aid microphones.

Again, here you are going to see the phone volume controlled based off of the phone volume itself. So if they need to turn the volume up, or if they've having trouble hearing on the phone, it may sound really simple but you'd be surprised how often it happens, just checking the phone volume and how loud that is for them. This is kind of a quick guide to MFi streaming or the need for a phone clip if we're looking for bimodal patients. So as you may know, the Cochlear Nucleus 7 introduced made for iPhone direct streaming, and that can work with ReSound devices. So that is going to work specifically with the LiNX Quattro chargeable hearing aids, and the receiver in the ear hearing aids that still use conventional batteries. It's also going to work with your LiNX 3D BTEs as well as the RIEs, as well as the ReSound ENZO 3D devices. So those super power BTEs. Four devices for the Nuclear 6. So the Cochlear devices that are working with the Phone Clip Plus. That's going to actually work with all of the devices I just mentioned, but also our legacy devices that utilize that 2.4 gigahertz wireless. So that includes your LiNX squared, your ENZO squared, the original LiNX and ENZO, all

the way back to your Alera devices. All right. Now we are coming close to the end. I'm sure you've all really enjoyed listening to me talk for the last 50 minutes, but we've got one last fitting consideration to go through, and we're gonna move through this one so that I don't keep you over time. But basically we're gonna be talking a little bit about tinnitus in bimodal patients. Now if you look at some of the research, the range for, of percentage of patients that are Cochlear Implant candidates that are affected by tinnitus can range anywhere from 67% to 86%. So that's a pretty high impact rate in terms of this particular patient base. Now a lot of users that do end up getting a Cochlear Implant ultimately, that also have tinnitus, can report that having the Cochlear Implant has reduced the impact of the tinnitus on their day to day life. They've reduced the level of perception of that tinnitus. But there's a few cases, and while they are rare, they do exist, that sometimes it has no impact on that perception of tinnitus, and sometimes they can actually report new tinnitus. Again, that is rare but this is something where if we look at this total patient base, again thinking about the severity of their hearing loss, tinnitus is going to be quite common with this patient base.

The other question is going to be where are they perceiving the tinnitus? Is it a central tinnitus? Is it in the Cochlear Implant ear? Is it the ear with the residual hearing? And any perception of tinnitus can complicate Cochlear Implant mapping. So this is gonna make this more difficult for both patients and for the audiologists. So because of the variety in tinnitus perception, we really need to think about what our options are in terms of providing tinnitus relief for this patient base. So if we look in the Smart Fit fitting software, this is just a quick screen grab to show you where to find the tinnitus sound generator within Smart Fit. Now once you've decided to activate this, you do have a couple of different options. You have a white noise or a custom noise options where you can customize the frequency range. The loudness is going to be this slider over here on the right. Let me see if I can just pull up my arrow here, you'll see that there. You can also change the amplitude modulation, and your frequency ranges here and here. And also the environmental mics relative to that tinnitus sound generation.

Now if we switch over, you'll see here, there's the option to turn on nature sounds instead of just a static noise. So you have six different options of nature sounds. And these can be program specific. So you can have a nature sound program, and also a white noise program. One tricky thing that we do need to keep in mind, however, for this patient base is the output level required for some of these tinnitus stimulating might be pretty high. So if there's still a tinnitus perception, maybe giving some, doing some tinnitus screen testing to kind of get a better idea of how and when they perceive that tinnitus. Now if we look at the Smart 3D app, there are actually some specific tinnitus controls that the patient will have if they have a tinnitus program installed. So you'll see this tinnitus stimuli symbol there, and any time that the patient sees that, if they go into the sound enhancer down here, they'll have this option to switch over from your sound enhancer settings to your tinnitus manager settings. So they'll be able to change the variation, the frequency range, the loudness of the tinnitus sound generator, or they'll be able to switch over to some nature sounds, if they'd like. One last option I'd like to go over is actually the ReSound relief app. So this is a smart phone app that provides the patient the opportunity to design their own soundscapes based on multitude of different sounds that they could choose from. So here we've got a few different options.

You've got your environmental sounds, you've got some music sounds, therapeutic sounds, like white noise, and they can kind of design them to have different levels, and can put up to five different sounds into any soundscape. Now if we look at some research that's been recently done looking at specifically Cochlear Implant patients, we can actually see some promising results looking at the use of the relief app to reduce the tinnitus loudness rating for patients with tinnitus that have used this app. So they streamed the audio through their Nucleus 6 processors using a smartphone, tablet or iPod, and then the multi-mic. What we found was across the board, while there was some variability in the total benefit and the total reduction of that tinnitus loudness rating, all of the users did rate it lowered than their kind of pre-app usage. Now this

study was only looking at CI patients in particular, so we do still need to be doing more work specifically looking at bimodal users. A couple of other key features we can find in the app beyond just the soundscapes. There's other sections such as relax, which kind of can provide some guided meditations, go through some breathing exercises. You have learn, which is another tab here. So the patient can learn a little bit more about what causes tinnitus. Learn about, you know, the values of getting a good nights sleep, something I should probably take a lesson from. You also have a final section here that's called "My relief". So this is going to kind of give them the opportunity to track their usage, what they've used, when they've used it and how long. It highlights that there are new downloadable sounds that they could try. One other thing that I think is pretty helpful is actually the settings. If you pull the settings up, you can actually slide the audio balance from left to right. So if the patient is experiencing tinnitus in the Cochlear Implant side of the ear, or more in the hearing aid side of the ear, they can actually slide this balance slider out of the center, either to the left or to the right, or somewhere kind of in between. So this is going to give them a lot of personalization opportunity. Oop. I clicked too fast out of there. But just to wrap up, in terms of bimodal hearing aid fitting considerations and tinnitus. The big thing here is that these users are going to need options, because there's going to be such a variability in terms of residual hearing, the perception of the tinnitus. There's going to be a need for giving these patients options.

There are noise and environmental tinnitus stimuli options via Smart Fit, but there's also multiple options in terms of streaming via the Phone Clip or MFi, or streaming accessories to stream those tinnitus stimuli to both the Cochlear Implant and to the hearing aid. So if this is something that is more of a global tinnitus perception, using a tinnitus app might be more useful for these patients than just using the tinnitus stimuli based in the Smart Fit since that's not going to have any control over the Cochlear Implant. And as we've seen in some preliminary work, using the ReSound Relief app has shown some promise in reducing tinnitus loudness for CI users, and this will be

interesting to see if we can provide similar benefit to bimodal users as well. All right, so. We're at the final stage here, and not a moment too soon. We'll get everybody out for their holiday weekend. So to just wrap up here. Bimodal stimulation is going to be able to provide improved speech and noise speech perception, improved localization skills, and improved music perception compared to either your Cochlear Implant or your hearing aid alone. It is critical that we consider these unique aspects of bimodal patients when we compare them to a conventional monaural hearing aid fitting or a Cochlear Implant fitting. These patients are going to be, they are going to have unique needs relative to those other patient basis. As I've said earlier in the presentation, and kind of repeated throughout, your Real Ear verification of the hearing aid is going to be critical for the success of your bimodal patients. Directional options are gonna provide some improved signal to noise ratio in real world environments for these patients. And streaming is going to offer improved sound quality, both for music and phone calls for these bimodal patients. And lastly, we need to remember to consider providing a lot of options for bimodal users who experience tinnitus. And you can provide those options either via the Smart Fit fitting software, or through different tinnitus apps like the ReSound Relief app.

And with that, we're all done for the afternoon for this presentation, so if anybody has any questions, feel free to type them in now. So far we don't have any questions coming in, but if there are any questions after the presentation is over, my email is provided here. Just got one. So we do have a question about loudness balance for pediatrics. So the question is, "How about loudness balance for pediatrics? "Most of the time they won't be able "to ask for more or less gain." This is very true. In terms of pediatric fittings, your main weapon is going to be using Real Ear verification, or using your Real Ear Coupler Difference to set the targets. Now, if it is something where you may be able to provide a couple of different programs, you're likely going to be skipping this loudness balance step for pediatrics, as your main source of benefit is going to be setting to those Real Ear Measurement targets. Okay, well given that's the

only other question that has come in, we are going to go ahead and wrap the meeting up now. Thank you to everybody who has attended today. Hopefully you all have a pleasant weekend.

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