Bridging the Gap: Bimodal Fitting Considerations for Government Services Hearing Aid Clinicians

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- - [Neil] Good afternoon, everyone. Thank you for joining this afternoon. My name is Neil Wright. And we're gonna go ahead and talk today about Bridging the Gap: Bimodal Fitting Considerations for Government Services Hearing Aid Clinicians. Just to prep you as we go into the presentation, there will be some time at the end for any questions. So if you do have a question throughout the presentation, please go ahead and hold those until the end. Those can be typed into the questions window, and I can answer those at the end. So just the quick disclosure slide. I am an employee of GN ReSound, but I have no non financial relationships to disclose. A quick overview of our learning outcomes for today, the first one is after this course, participants will 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 our last learning outcome is participants will be able to program an optimal streaming program and system for bimodal streaming.

This is just a quick outline of where we're going to be going today. We'll start with a quick introduction to bimodal processing. We will go over the bimodal fitting flow and then we will look at four different fitting considerations for hearing aid of a bimodal patient. So we'll look at hearing aid verification, directionality, music perception, tinnitus, and then we will wrap up with conclusions and like I said before any questions that you all may have. So let's jump right in, we'll start with overview of the bimodal fitting flow. So for those of you who may have limited experience with bimodal patients, this is going to be a very generalized introductory couple of slides. For those of you with a little bit more experience, this may be a little bit of review. But just to kind of give everybody a general starting point, bimodal patients have been a relatively new patient base for audiologists. This has come well after the introduction of cochlear implants as cochlear implant fitting criteria has expanded. This is ultimately resulted in some cochlear implant patients having residual hearing in the opposite ear. Now initially when cochlear implant candidacy was expanding, there were questions as to

whether or not these patients would derive any benefit from the hearing aid or whether these patients would be able to combine the input of the cochlear implant and the hearing aid together ultimately, for benefit, and that is shown to be with time and with research that there is substantial bimodal benefit of adding that hearing aid to the non implanted side. So, where there once was just cochlear implants of severely severe to hearing profound hearing impaired patients that has now changed to candidates, they can actually use a hearing aid on that opposite side. So as I just mentioned, the cochlear implant candidacy criteria has expanded from where it used to be to include patients with moderate hearing loss in the lower frequencies. Now, most of you are likely going to be working with adult patients. So that candidacy criteria is the most inclusive, including those with, like I said, moderate to profound bilateral sensory neural hearing loss, and then limited amplification benefit, as defined here on the slide. Now, for those of you who do see children or infants, those have a more restrictive, candidacy criteria with children, it allows for severe profound sensory neural hearing loss, while infants is strictly profound sensory neural hearing loss and limited benefit from binaural amplification. So as we've talked about just kind of a very general introduction to bimodal patients, what is the current practice in the US?

So, back in 2015, research done by Siburt and Holmes heads, surveyed different bimodal audiologists, and looked at their fitting practices. So, one thing that was found is that there's actually a high degree of variability in terms of the overall protocol. And this related to when hearing aids were reprogrammed, if they were reprogrammed at all, who provided the care for the cochlear implant and the hearing aid. And what was found was that obviously, there was some variability in care, as to who provided the care. And one key finding was that bimodal patients were often treated by two separate audiologists, one being the cochlear implant audiologist and the other being the hearing aid audiologist. So, how do we take patients that are seen by their providers as either a unilateral hearing a patient or a unilateral Cochlear implant patient and really change that view to being a bimodal patient. So, this slide is just kind of

giving you a very generic bimodal fitting flow that provides five key steps to the total bimodal fitting. So depending upon the services that you provide, whether you are a hearing aid audiologist, a cochlear implant audiologist or if you happen to work with both, your role might start or stop at different steps along this process. So as I mentioned, this is broken down into five key steps the first one being programming the cochlear implant and before we move on to step two, which is programming the hearing aid, we wanna make sure that that cochlear implant map is stable. So, the key here is that if you're going to be looking at fine tuning the hearing aid, verifying loudness balance. If the cochlear implant map is still changing how the patient perceives loudness on a cochlear implants side will vary. So we don't wanna try to set up for a moving target on the hearing aid side. Now for the purposes of today's talk, we're going to primarily focus on the steps two through five on this fitting flow.

As you can see, this is going to be all of the programming that's more related to the hearing aid. So step two being your general programming fitting to targets, three being fine tuning the hearing aid, and then verifying bimodal loudness balance between the cochlear implant and the hearing aid, and then any auto relate to any additional programs, setup in the hearing aid and setting up any streaming programs. So, let's just go right into our first bimodal fitting consideration and this is hearing aid verification. If we look at the research that has been done, surrounding bimodal hearing bimodal fittings hearing aid verification is one of the most critical steps and is routinely utilized in research as part of methodology to analyze the benefits of bimodal fitting and bimodal fitting practices. If we look to the right side of your slide, you'll see there's another chart or another graph from Siburt and Holmes. And this was the US bimodal fitting practices survey. And this is just looking at the percentage of bimodal audiologists that were completing, real-ear measurements. So the good news here is that just over 50% of those audiologist surveyed were completing real-ear measurements, most if not all of the time. The concerning part of this pie chart is going to be that almost 20% of those audiologists never completed real-ear measurements.

This is gonna be troubling for us as we look at the data, but it's also concerning for the patient outcomes as real-ear measurements are going to be one of the key pieces to ensuring bimodal patient benefit. Now when we looked at that same survey data, there was a widespread of the actual fitting roles that were used. If we look at the bimodal fitting flow that I had shown you in a few slides back, it was recommended to use NAL-NL2 as sort of your default fitting rule. That is not to say that other fitting rules can't be used and also can't provide benefit. If we look through bimodal research, there have been depending upon the researcher themselves, there have been different fitting rules used throughout the research surveyed. Now prior to the implementation of NAL-NL2 older versions of the NAL fitting roles such as NAL-RP, which is revised profound, or NAL-NL1 were used and found benefits to bimodal fittings. The same can be said for DSL, this has been used in additional prior research studies and these have all shown benefit.

One thing to kind of keep in mind is that there has not yet been shown to be one fitting rule that is more beneficial than another in the sense that there has not been any direct comparisons for bimodal fittings between the different fitting rules. Now, there have been studies that have shown that experience with different fitting rules of a patient had previous experience with DSL, they were more likely to prefer DSL fittings for bimodal fitting. But, when it comes to direct comparisons, those have not been completed to suggest any one fitting rule being better than the other. So our key takeaway here is gonna be that the most critical part of a bimodal fitting is to ensure that you are setting the gains to a fitting world targets using real-ear measurement verification. One thing that I will also note here is on the slide, you can see where you can find the different fitting rules within the Smart Fit software. So you can see, as I pull up the drawing arrow here, that there's just a fitting menu at the top of your Smart Fit software, you select that you can pull up your target rule. And then there are different options here to set different targets within the Smart Fit software. Beyond just real-ear measurements, and fitting rule targets, there are other considerations to make when

we're thinking about setting gains in the hearing aids for bimodal patients, one of those is whether or not we should be restricting bandwidth or providing wideband amplification. To put it simply, the idea of restricted bandwidth would be to try to only amplify the low and mid frequencies and allow the cochlear implant to provide more of the high frequency input. The ultimate goal being to reduce the gains in the high frequencies in the hearing aid. So if we look at the research that's been done for bimodal users, there has been some research that has shown restricting the hearing aid bandwidth above 2000 hertz can provide some potential bimodal benefit. But the caveat to this was that it was the presence of cochlear dead regions seem to align more with that benefits. So the presence of their being cochlear dead regions in the hearing aid here indicated the need for restricted bandwidth particularly if those dead regions were within those higher frequencies.

So if you're really not seeing any, if you're getting no response on the audiogram, this and applying the TEN test or the threshold equalizing noise test and identifying those dead regions restricted bandwidth may be helpful. If we look to wideband amplification, so just amplifying across all aidable frequencies. There's more research out there to suggest in terms of just overall number of research articles that have applied wideband amplification and shown the significant bimodal benefit over either the hearing aid or the cochlear implant alone. So in general wideband amplification has shown to be beneficial for bimodal users. That said most of these articles, most of this research that was completed had not tested for cochlear dead regions within those different research projects. So, our key takeaway when we're looking at whether we need to restrict bandwidth or just apply wideband amplification is that wideband amplification is going to provide bimodal benefit for most bimodal users. However, the presence of cochlear dead regions may indicate the need for restricted bandwidth. Now once we've gotten through our hearing aid programming and our fine tuning, we get to step four in our bimodal fitting flow and that is Loudness Balancing. Again if we look to the research done for bimodal users. Loudness balancing is commonly applied

as part of a general bimodal fitting protocol. However, there is limited research specifically investigating the impact of loudness balancing on bimodal benefit. So, what this means is there's not been direct comparisons between patients that have had the loudness balancing completed and those who have not. If we look at patient preferences within the research that's been completed, some patients show a tendency for preference for more gain, than typical fitting rules prescribe. And the same time other patients have preferred less gain than the fitting rule prescribes. If we look at how loudness growth works, between cochlear implants and hearing aids, so the difference between soft sound and as it gets louder, what ultimately is determined as a louder sound. These fundamentally work differently within the cochlear implant ear and within the hearing aid ear. So trying to get a better understanding of just how that loudness growth is going to work and how that relates to loudness balancing within the devices, is gonna be a key area of research moving forward. What we don't want to see particularly for bimodal patients, is to have the hearing aid being too loud and having it adversely impact the performance of the cochlear implant.

So we don't wanna have one ear sort of masking the other or causing an imbalance for the patient. So our key takeaway here is gonna be that we want to start with our real-ear measurements setting the target, you're gonna hear me talking about getting those real-ear measurements done a lot today, as you already have so far. But when it comes to loudness balancing, we wanna start from those earlier measurements and then adjust the gains as needed. So this might be to include patient comfort, or for patient performance. Now for those patients who may be seeing a cochlear implant audiologist and a hearing aid audiologist separately, it may not be very easy for that patient to complete the loudness balancing in the cochlear implant office. One way for the patient to do this before seeing the hearing aid audiologist and having the gains adjusted, would actually be to use the Smart 3D app and connecting their hearing aids to that. So, how this could be done is if the patient utilizes the app, they could actually go ahead and set up a favorite using the sound enhancer within the Smart 3D app.

Whether the hearing aid needs to be turned up or down. They could open up that sound enhancer, turn up the base middle, in treble or turn them down depending upon the patient's needs, and then add this as a favorite, so that they can access these settings easily from the app every day. They could be saved as a favorite, set to something that's an easy to remember name, something as simple as a balance. And then when the patient is actually able to go in and see the hearing aid audiologist, these settings can then be applied to the main programs. So the way that this would happen is if we look at our bass, middle and treble sliders, those numbers are going to translate directly to the change in dB across those different frequency bands. So it may just be a need for a couple of dB increased in base in the middle and then leaving the treble alone. One thing to note is that when changes are made and saved, the master volume and the hearing aid will be saved to those favorite settings. So if they switch from their program one that's at their default volume level and switch to their favorite if they've adjusted the master volume that will be saved to the favorite.

And again, as I had said, those settings can then be applied at the next hearing aid follow up appointment. Another piece of the bimodal hearing aid verification that I wanna touch on is gonna be frequency lowering. So whether it be composition, compression, or transposition, there have been studies that have looked at different aspects of frequency lowering and whether or not those can show any additional bimodal benefit over conventional wideband amplification. So if we look at research that has been done, it's really only looked at transposition and compression. And the research that's been done really hasn't shown any significant benefit or detriment over conventional amplification benefits when we look at frequency lowering. So, bimodal benefit can be achieved without frequency lowering. The caveat here is obviously that if there's no detriment if the patient prefers the sound quality with frequency lowering applied, if this is going to ensure that they're wearing the devices more frequently or for longer periods of time to achieve that benefit, it can be something to consider for that patient. Now what we'll do is we'll go ahead and we'll move on to fitting consideration

number two, and that is hearing a directionality. So, bimodal patients in particular, really do benefit from directionality for both the cochlear implant and the hearing aid alone. And this is through the improvement of the speech to noise ratio for those patients. If we look at research that's been specifically focused on hearing aid directionality settings, for bimodal users, there's actually relatively limited research that has been done that has shown these benefits. And this is more of the fact that the research hasn't been done rather than the research is there and hasn't shown any benefit. So we've still got a little bit of a gap in the literature here, when it comes to defining strictly the benefits of directionality in bimodal users. One thing we need to keep in mind when we are discussing directionality of the hearing aid for these bimodal users is that the benefits of hearing aid directionality might be limited due to just simply just due to the degree and configuration of the hearing loss for these patients losing out on high frequency input for the hearing aid negatively impact the overall benefits of directionality settings for these patients.

Now, this is not to say that there's no research to suggest improving the speech to noise ratio has a positive impact, it's actually quite the opposite when you can improve your signal to noise ratio for bimodal users, this has a significant impact, a positive impact on patient success and patient speech understanding. So if we can provide a higher speech to noise ratio in different environments, this is ultimately going to lead to better success for those bimodal patients. This slide is just gonna be a very quick and very kind of simple rundown of different hearing aid directionality programming options and the rationale to use them for bimodal patients. So as I said, it's pretty simple. In terms of what options we're going to have here, as this is going to be a monorail hearing aid fitting, there's not going to necessarily be as much in terms of bilateral directionality settings for bimodal user. So, you still have your very classic omni directional response. And this is going to amplify all sounds from all directions as equally as possible. And this is going to provide the patient with environmental awareness. Depending upon the speech understanding the word recognition scores in

that hearing aid, ear, sound and environmental awareness may be the the best benefit that you can provide for that hearing aid ear, and this is going to be something that is going to vary patient to patient as you may know depending upon the bimodal patients that you have seen thus far, they can be highly variable in terms of the performance of the hearing aid ear. So if we are looking for the best outcomes, sometimes environmental awareness is the best outcome for certain patients. So utilizing an omni directional microphone response is going to give you that. We look at a fixed directional response, so this is something that is obviously going to provide more of a focus on sounds that are to the front and maybe just slightly off to the sides of the front, while still reducing noise from behind the patient. This setup is going to provide some speech to noise level improvement, and can provide sort of a consistent performance across environments. So the patient will know what to expect from a fixed directional programming.

Particularly if we then compare it to our last setup here, which is your automatic directional, which is gonna be something that adjusts more based on the environment that the hearing aid is in. So listening for that noise and the location of the noise, the loudness of the noise in the background and adjusting the width of the directional response based on that environment. So if it's a noisy environment, the directional response gets more narrow. Whereas if it's not as loud, that's gonna widen that response a little bit to provide more input to the patient. So this is going to be something that is helpful for users that are in changing environments that may not want to be constantly fiddling with their hearing aids. If we look at the ReSound Smart Fit, directionality options, we look at what we can program into the hearing aid. There's a couple things that we wanna keep in mind. The first is, depending upon the environmental programs selected, you're gonna have different options in terms of directional response choices. So for your all around program, that's your default program one, you're going to have Soft Wwitching, which is gonna be more of an automatic directional response that includes an omni directional polar plot option

within it or just a conventional omni directional response. We look at the other environmental programs such as restaurant, music or outdoor programs. You're gonna have a few additional options for these programs. So that's gonna be your Soft Switching, which is still there in the all around program. Then you'll also have AutoScope, adaptive directionality, fixed directionality, and then your classic omni directional response. So you'll see that here in your different directional options. Now what I do want to note and can discuss here for a second is just what's the difference between Soft Switching and AutoScope Adaptive directionality? So the key difference here is that the Soft Switching option is going to have an omni directional response option, whereas AutoScope Adaptive directionality will always be in a directional response of some kind. Now, the width of that responsible vary based on the background noise and that is the same with Soft Switching. However, in a quieter environment, AutoScope Adaptive will stay in a directional response whereas a Soft Switching program will actually revert to an omni directional response.

So, depending upon your patients needs, you can make that choice. One thing that I also wanna point out here on the slide is your AutoScope, choices here this is whether or not the directional program you're in is going to utilize that automatic directional response or if it's when it goes into a directional response. You can set that to a specific setting whether it be narrow, wide, or kind of a medium width. The last thing I wanna point out here when we're talking about directional programming considerations is the directional mix. So this is something that is utilized across ReSound devices. And this is how we define our band split directionality, anything in those lower frequencies that is below the directional mix, split band frequency is going to remain in an omni directional response regardless of the directional setting that you are in. So that means your lowest frequencies are going to stay in an omni directional response. This is to ensure that we're not getting any directional distortions to those lower frequencies. It's also going to ensure the patient is still provided some level of sound and environmental awareness, regardless of where the sound is coming from, so they can kind of stay in

the environment without being completely isolated. Now the directional mix will set what frequency that is. So, if the setting is high, that's going to mean that more frequencies are going to have directionality applied to them. Whereas if it's set to very low, so we bring the arrow back here. So if it's set too high, that means more the frequencies are going to be setting in the directional response. Whereas if we set it to very low, that is going to put fewer of the frequencies in a directional response. The software is going to give you a, have a default recommended setting in bold. And if the patient does come in stating that they're having trouble in noisier environments, maybe it's time to turn that directional mix, setting up a little bit. Now one thing that I did wanna point out here at this point is just the different options in terms of directional settings in the ReSound software and how that would relate to settings within the cochlear implants. So if you want to use a automatic directionality setting that kind of matches up with the cochlear settings, that's going to be your Soft Switching, which is the default near all around program that will match up fairly well with cochlear SCAN programs.

For automatic directionality, the default for the Restaurant program is gonna be that AutoScope Adaptive Directionality, and that's gonna be most similar to the Beam program in the cochlear. Lastly, if we're looking for fixed directionality, that's going to be an option in those different environmental programs for ReSound. But that's not set as a default in any programs, but it is an option in the different environmental programs and that will most similarly wind up with the Zoom settings, on the cochlear device. Now, having said all that the application of these automatic settings may differ between the cochlear implant and the hearing aid based on the environment. These are not synced up programs, these are just going to be settings that are gonna be most similar to one another. So different noise levels may trigger slightly different responses in those automatic directional settings. So looking at a few key takeaways here, from the directionality portion of these fitting considerations is bimodal fittings can still provide bilateral cues and these bilateral cues do improve localization within noisy

environments. So this is gonna be a key takeaway here. Now, having said that, research is limited in terms of directional benefit on speech understanding, but we do know that improves signal to noise ratio shows benefits for bimodal users Specifically thinking about ReSound and Smart Fit software, different environmental programs are gonna offer different directional options. And we need to think about that and consider that based on patient needs and where those patients are going to be. And the last takeaway here is going to be considering communication between both the cochlear implant and the hearing aid audiologist. It is gonna be key to providing similar directional input across the ears. So making sure that there is some communication between the two audiologist providing care for these patients so that the patient can get the most out of both devices. So that they're not just considered unilateral hearing aid or cochlear implant patient rather being considered a bimodal patient. Moving on to bimodal fitting consideration number three and that is music perception.

Now a little bit of background here. If we think about the input that cochlear implants provide, they can provide very good timing cues very quick, very sharp. But there are still some limitations in terms of music perception and enjoyment. Post cochlear implant surgery. If you look at prior research, music enjoyment, music perception is routinely rated lower than normal hearing users as you might expect. But if we think about hearing aids on their own, they're also gonna have some limitations in this particular population, just given the amount of amplification limitations and speech understanding limitations for this population. Now, if we can combine the input from the cochlear implant and the hearing aid, we can actually kind of see the best of both devices, you're hearing aid providing some of those fundamental frequencies and the lower frequencies and the cochlear implants providing a little bit more in terms of speech understanding. And we can see that in results from research like this one on the slide. And this is research from Jace Wofe, showing the benefits of bimodal simulation for both sound quality and ease of listening but also lyric recognition for music in this patient population. So kind of being able to provide more benefit together

than either one can necessarily on their own when it comes to music, enjoyment. So what do we need to think about when we are looking at music programs? So, specifically in Smart Fit fitting software, we do have the music environmental program option and this does provide a few key differences from other environmental programs. So the first thing that you will notice if you look at the gain chart which actually isn't on this slide is that it's going to provide a more linear response. So that's to, try to stay true to the music itself by providing that dynamic range from very soft to very loud, that is kind of part of music. If we look through different aspects and different advanced features one thing that you will notice also changes is the time constants for your compression speed. So for our All Around program, our Restaurant program, the default is typically gonna be syllabic, so it's gonna be a very fast compression response. But for our music program, it's gonna default to slow, this again is to help to preserve that dynamic range, that dynamic response of the musical input.

One other thing that I wanna note here is going to be a new setting in your digital feedback suppression and that is gonna be this music setting. That's just right there. In your other environmental programs this won't be an option, but this is here so that particularly if you have any patients that play instruments, that the sound of their instrument isn't miss identified as feedback. So particularly if you're thinking about anybody who plays the flute, or anything that's in that upper register, sometimes that can be miss identified by the hearing aid. As feedback in some of the conventional feedback settings, so this was introduced to help to reduce those miss identifications. So if you've got a patient that's having trouble with that, this is a good option adding a music program. Lastly, this is another piece that is low frequency boost is another advanced feature that really only shows up for your ultra power receiver users and super power devices, which are going to be fairly common in this patient population, just given the hearing loss that occurs with this patient base. So you'll wanna keep an eye out for this if they are having some trouble in terms of sound quality. If you need to give a little bit of a low frequency boost, that option is here. Now what about streaming

music and streaming phone calls? So this is something that it's much more commonplace now, but this is still very recent in terms of tech development for hearing aids. So nowadays, with most smartphones, music and audio can be streamed through the hearing aid and the cochlear implant, whether it be directly from the phone, or through an intermediate can Bluetooth bridge, such as the Phone Clip+ We look at prior research. It's looked at streaming audio for bimodal patients, it shows that it can improve quality of life in social activities for these patients. And what we'll look at here is there's going to be a few differences in how we provide that input based on whether it's through Wireless Accessories or if it's directly streaming through either a smartphone or with a Bluetooth accessory. So, how we make adjustments and changes to the patient settings will vary based on that input. And one thing to keep in mind as we talk about this is gonna be patient technology literacy, whether or not they can successfully utilize that technology and is gonna be critical for whether or not they can get benefit from it or if it becomes more of a hassle for them rather than beneficial.

So when I was talking about those different audio streaming routes, whether it be streaming accessories or phone streaming accessories, this is the divide that I'm talking about. So when I talk about streaming accessories, we're looking at either the micro or the multi mic or the TV Streamer, and when talking about phone streaming and phone streaming accessories, that's your Phone Clip+ or direct smartphone streaming, whether it be from an iPhone or from Android. So if we're talking about streaming accessory settings now this has its own distinct program, and this is going to have its own separate advanced feature settings. Now the gain settings are going to be initially based off of those same settings in an all around program but those gains settings can be changed based on patient needs from that streamed input. But it will also have some additional advanced feature settings that are unique to the streaming accessory program. So one of those is gonna be or is your streamer base boost that is going to default on it'll default to mild, this is gonna give about three DB worth of additional oomph to the base, those bass frequencies. But you have additional settings

if the patient is struggling with getting some of that low frequency input. Another point to make here is much like the music program the streaming accessories will also have the option of the music setting for your digital feedback suppression. So if they are someone who is routinely using these streaming accessories to listen to music, and they're having their reporting trouble or any artifacts this might be something to look at, to see if this can kind of reduce those artifacts. One other piece to look at here is that you will have a mic relative to the streamer accessory balance. Now the default settings are slightly different between the TV Streamer and the microphone accessories, in terms of how much it attenuates the environmental mic So that's the microphones on the hearing aid. And so that attenuation is a little stronger for the microphone accessories, which would be expected given the microphone is going to typically be used in a noisier environment and is used to, provide that extra signal to noise ratio benefit in those noisy environments.

When you are using the accessory, when the patient is using the accessories, they will have additional function in the Smart 3D app. So, you'll see both the surroundings volume and you'll see the mic or the TV Streamer input. So those are gonna be different volume settings here that's gonna be your surroundings. And again, here that is going to be your streaming volume. So those are going to be two different volume settings that the patient can adjust while they're using their streaming accessories. Now when we look at the phone, we look at some previous research that has been done in terms of looking at the benefits of streaming phone audio through the Phone Clip. And you can see for bimodal patients as compared to conventional. Using the phone and unconventional matter, there is a significant improvement in both quiet and in noise for word recognition when streaming that phone audio in comparison to conventional phone input. So, this is gonna be critical for those patients who might be struggling on the phone, might find it difficult to get that phone in just that right sweet spot over the microphone to provide that benefit. So streaming is ultimately gonna give them a better quality input signal. Now for phone accessories and for phone streaming,

We do have to slightly different ways that this is going to be handled. So this is handled a little differently for the LiNX 3D, ENZO 3D and then any legacy devices. These devices don't have a phone accessories program which I've highlighted here. And the advanced features are going to be very similar to those of the streaming accessory program. You still have your streaming base boost, you still have your music setting in DFS ultra but then you also will see your microphone attenuation relative to either the mobile device or to the Phone Clip. So the mobile device is your direct audio streaming from the smartphone. So those are gonna be your key differences here. And one thing to note is your phone call volume for these patients is gonna be controlled by their handset, the phones actual volume itself so they will have that control that won't be something that's radically different. from conventional phone use. Now when we look at the LiNX Quattro devices, the way that this has fundamentally changed is there's now no longer a specific independent phone streaming program, rather, the LiNX Quattro utilizes the Mix-in phone streaming.

So this allows the audio to switch over just a little bit faster but it also utilizes the program that the patient is currently in. So if the patient answers the phone and they're in their All Around program or their Restaurant program, it's going to apply those same gain settings to that phone streamed input. And as you can see the phone accessory settings these advanced features are now instead of being set aside as a different program, they are now listed at the bottom of the advanced features for your different programs. So these phone settings will be the same if you're in your all around program, your restaurant program or your music program, so those will apply across all the environmental programs. As you can see here in the app, when the patient is streaming audio or taking a phone call the app will identify which program the hearing aid is currently set in. And the quick buttons will ultimately change their functionality as well. So this is going to give the patient the option to either focus on the streamed audio or the phone call. But then the volume slider will ultimately change it's label to say surroundings, so that's going to be controlling the volume of the hearing aid

microphones, controlling that input compared to. Again, when they're taking phone calls using a LiNX Quattro device, the phone volume is gonna control that audio, and the phone call audio volume. Now this slide is just to highlight the differences in what devices can work directly with made for iPhone streaming with the Nucleus 7 which is a Cochlear device, and those that would still require a phone clip and, would be able to provide bimodal streaming with the Nucleus 6. So this is just to delineate between the Nucleus 6 device which doesn't have access or to the MFi functionality and Nucleus 7 which does. So the hearing aids that are listed here in each column are gonna be those that are compatible with both the Nucleus 7 for the MFi and with the Phone Clip+ and the Nucleus 6. So as you can see here, the LiNX quattro, LiNX 3D and the ENZO 3D devices, the RIEs and BTEs, all function with the MFi with Nucleus 7 and then all of the devices all the way back all families back to ReSound Alera will actually pair up with the Phone Clip+ and work to provide bimodal streaming with the Nucleus 6.

Now moving on to our last bimodal fitting consideration and that is tinnitus. Now when we look at the impact of tinnitus on the cochlear implant population and these candidates is if you look at the research is tinnitus can reportedly impact somewhere between 67 to 86% of all cochlear implant candidates. And a lot of this research reports that cochlear implant users who report tinnitus pre implantation do report a reduction in that same tinnitus post implantation. Having said that it's not necessarily true in all cases. But it is rare that some users may report an increase or new tinnitus, but again, that's relatively rare. Now when we think about the perception of tinnitus during CI mapping, it has been shown that this can sometimes complicate CI mapping, making it more difficult for the patient to identify when those t levels are being set during the mapping process, which can ultimately have a negative impact on the mapping itself. So we obviously wanna try to find ways to mitigate that impact of the tinnitus on both the CI side and on the hearing aid side. So, as those of you who work with tinnitus, like we know, tinnitus can be highly variable between patients, so providing them options is going to be critical for success. So if we look here in the

ReSound Smart Fit software, the tinnitus sound generator is going to be located in the hamburger menu in the top right corner of the fitting window. We go into those settings. There are different options and can be programmed specific, whether it be setting any different type of noise or a custom noise range with different levels of amplitude modulation. But we've also got, we have different nature sound options for these patients. So if that's something that they would prefer to have programmed into each program, you can program different tinnitus sounds into different programs, giving the patient a few different options. Now one thing to keep in mind is that if you have set the tinnitus sound generator to being on, this will provide the patients with additional controls within the Smart 3D app. So they will have some additional amplitude modulation options in terms of the white noise variations, they can also adjust that frequency response so maybe they can make that noise stimulus a little bit more narrow. They can also adjust that that volume level there. Now they can also switch over to nature sounds which, again, they can make these adjustments within the app so it's not something that necessarily has to be done in office.

So this provides these patients with a little bit more flexibility if their tinnitus is having more of an impact one day than the other One other option out there for tinnitus patients that ReSound provides is the ReSound Relief app. So this is a separate app, where the patient can actually set up and design their own soundscapes. Whether it be based on environmental sounds, it can also be based on its kind of typical noise sounds like white noise, brown noise. And this can provide patients with kind of their own opportunity to set up unique soundscapes that can be therapeutic and help to reduce the impact of that tinnitus. Now, if we look at some research that specifically investigated the ReSound relief app, it looked at using the ReSound relief app with CI patients and it showed that it actually did provide some tinnitus relief when the audio was streamed through the Nucleus 6 processor using either the smartphone or tablet and a multi mic. So as we can see here in the results, there's kind of pre and post kind of a tinnitus impact rating. So the pre impact ratings were all found to be higher than

the post impact ratings. Now, the one caveat here is that some users had a much more substantial reduction in terms of that tinnitus impact when using the app in comparison to others. So this is something where we still need to continue further research looking at just whether or not this can be a consistent, positive impact for these patients. And whether or not it can also translate for bimodal users. So this study looks specifically at CI users. And so it would be beneficial for our next step to be looking at bimodal users. But overall, seeing a very positive trend in that utilizing the Relief app provided some tinnitus relief for all of those participants. Now, there are a few other controls in the ReSound Relief app that patients can use, they can use some guided meditations under the Relax Tab, as well as breathing exercises. So kind of trying to take out some of that anxiety that can sometimes become coupled with tinnitus.

There's also a learning tab that allows patients to kind of get some more information on, not just their tinnitus, but different things that may impact it, such as sleep, and then helping them find their way around the app. But there's also the Lastly, there's the My Relief tab, they can kind of give the patient some usage statistics and get some different options for new sound files and kind of give them the opportunity to really customize it for their own use. One last thing I do wanna point out, that is underneath your My Relief tab is the settings section, and there's a balance option. So if the patient is really experiencing tinnitus in one ear, more than the other, they can go into their My Relief tab, go into the settings, which you can just find here, and then you'll have the balance option here, and they can actually slide either to the left or to the right, slide that balance to one ear that might be more impacted than the other, so it gives the patient more control over that output. So kind of wrap up talking about fitting considerations with tinnitus for bimodal users. These users are gonna be highly variable just by nature. And those that are experiencing tinnitus are going to be more variable in terms of what their needs are. So providing them options for tinnitus management is gonna be critical depending upon where they're perceiving the tinnitus and that degree of the tinnitus it's reported. Options can be provided through both

Smart Fit or through different streaming options. So using either the 3D app to where the patient can kind of customize the stimulus within a program or within the app or also using the ReSound Relief app, which has shown promise introducing tinnitus, loudness ratings for CI users. So hopefully, we'll be able to be doing some more research looking at bimodal users, hopefully see the same result. I know we're coming right up to the end of time here. So just to wrap up. Bimodal stimulation can provide, improved speech-in-noise perception, localization and music perception compared to either cochlear implants or hearing aids alone. That said bimodal patients are not just unilateral cochlear implant or unilateral hearing aid patients they require unique considerations.

For those hearing aid fittings, real-ear measurements are gonna be critical. And that verification of the hearing aid output is gonna be critical, like I said to the success of these patients. Directional settings provide options to improve that signal to noise ratio in real world environments for bimodal patients, which we've seen that providing a clear signal above the noise is going to have a positive impact on bimodal success. And this something that can also be provided using streaming options, streaming bimodally, to both the cochlear implants and the hearing aid. And lastly, bimodal users who experienced tinnitus do have a variety of options both in the fitting software in Smart Fit fitting software and the ReSound Relief app. Now we've hit right at three o'clock. So I do wanna provide the opportunity for everybody to ask any questions that you may have. If anything has come up through the talk, go ahead and type some questions into the box. Otherwise, that is the end of this presentation. So thank you for taking the time and thanks for listening.

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