Strategies for Fitting Complex Hearing Losses

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Presenter: Amanda Greenwell, AuD

- [Amanda] Hi there, my name is Amanda Greenwell and I am the education and training specialist for the southeast region of Oticon. I am so excited to be here with you today as we talk about strategies for fitting complex hearing losses. In our presentation today, we're gonna discuss some of the challenges you may encounter when a patient walks in your door that doesn't necessarily fit that general, easy to fit, mild to moderate, gently sloping, hearing loss that you probably see on a regular basis. Some of you may be in settings that you actually see more of these complex fittings on a regular basis, but regardless of where you are and where you practice, there are some important considerations that may contribute to a more successful experience with amplification for these patients and for you as their hearing care professional.

You know, during our time together, we are going to be talking about so much that I'm hoping is going to be so helpful for you. I'm excited about our time together, I hope you are as well, but after this course, it's our hope that you're going to be able to list at least three assumptions that hearing care providers make when fitting typical patient audiograms, I'm gonna tell you what that means here in just a few minutes, hopefully be able to recognize the processing limitations imposed by complex hearing loss, and be able to develop alternative fitting strategies for patients with atypical hearing loss. So here is our roadmap for our time together today. Before we start talking about this, I have a quick kind of poll that I would like to see what you have to think here.

So let me pull this up for you. Which type of patient do you find the most difficult to fit? Reverse slope, medically complex, asymmetric, severe. We're getting a real mix, and I'll show you this in just a minute, it's really interesting to see, because what we're going to be talking about today is very much reflecting what we're seeing in this poll right now. So I'm gonna go ahead and stop it just to make sure we have time for everything today. There's a little bit, we're kind of divided throughout all four. We have people who are reporting, there's no right or wrong answer here. What we're gonna talk about today is we're going to be talking about specific types of complex hearing loss,

and, let me get this off of my screen, we're going to be talking about specific types of complex hearing loss and how you can address them and make them as successful as possible of a hearing aid fitting in your clinic.

But before we get there, we're going to be talking about some other important considerations involving variability and etiology and history and context. So there's a lot of things that we have on our agenda for today. So with that being said, let's get started. So, evidence-based practice is something you hear about a lot, not just in audiology, but in general in medicine. It's been getting a lot more talk in audiology as well, but in general, we hear about evidence-based practice. So what does that have to do and how does that apply to our discussion we're going to have today, and how might it apply specifically to recommending and fitting amplification to patients with more complex losses?

You know, evidence-based practice is not just what the research says, or it's not just only peer reviewed publications, because you actually have to marry that to your clinical experience and to what patients' values are. We know that what the patient believes in values is important, but we also know that our clinical experience informs some of that scientific evidence. You know, complex hearing loss offers some examples of this where, and you can probably think of some of these in your mind as I'm talking, but where some physicians believed a condition existed and others did not, some questioned their colleague's treatment decisions, but their clinical experience fueled those decisions. And then as imaging improved, so did the scientific evidence for what clinical experience was telling them.

Now of course, there's better scientific evidence, but we would've never gotten there if it hadn't been for the clinical experience of some pushing convention and really understanding that we don't know everything. You know, we have to put those things together, we have to put our experience, we have to put peer reviewed research, we

have to put evidence together to make these decisions. The thing is, is that we don't always have the evidence that we need to answer some questions. You know, when you get into these complex and difficult fittings, the vast majority of the evidence is based on mild to moderate, gently sloping, age related, sensorineural hearing loss. You heard me correct, most research is based off of that mild to moderate, gently sloping hearing loss.

Now think for a moment of those four groups that we're going to be talking about, think how far we are from that mild to moderate sloping hearing loss. When you vary from the group that was included in the research, the evidence becomes very sparse, particularly when we're talking about treatment. We know more about diagnosis now, obviously, over, you know, advancements in technology, but not as much when it comes to audiological treatment, so we have to rely on the patient's experience and our clinical experience when we don't necessarily have everything we need. And this, my friends, is when you see the art and the science of hearing aid fitting coming together. You know, even when we have evidence, what does that evidence, you know, what does that base look like?

You know, typically strategies provided are based on the mean or the average, but what is the average person? That's the question? What is the average person? A good example is fitting targets. Think about fitting targets for just a moment. Targets are based on the average of what was required to have the best outcome for a population. Now, you can have all sorts of normal distributions, you can have a group with a narrow distribution like you see here where everyone is close to the mean, or you can have a broader distribution where people are further away. You know, you can even have a broader distribution even in a relatively normal group. For example, people with severe hearing loss have a broad distribution because their word recognition can vary so greatly, and we'll be talking about that here in a few minutes.

Whereas if you were to have a mild to moderate, you know, gently sloping, age related, sensorineural hearing loss, you very well may be looking more of that narrow distribution closer to the mean. The point is, if you're going to look at research, which is important, don't get me wrong, you need to look at who was included and who was excluded. Because what you've probably already noticed is a lot of the people who were excluded from these studies are the exact people who are sitting in front of you and the people we're talking about today. So when learning to fit hearing aids, we learn or we adopt some assumptions of what our goals are. Some of those assumptions are probably things that you could rattle off before I even pull them up, but in the interest of time, if you will, I'm gonna pull some of them up for you.

We learned, or some of those assumptions that we adopted are, all speech is valuable, or we want to restore audibility as much as possible. We definitely want to hold true to that prescriptive approach and make sure that we correct for any threshold loss. And this one is so interesting, measurable hearing is usable hearing. We know that's not the case at this point, but these are assumptions that we make, making sure that we can put the full range of inputs within their dynamic range, and use as much bandwidth as possible. And lastly, both ears contribute equally. Remember, these assumptions are based on average data that was mostly collected on people with mild to moderate sensorineural hearing loss or otherwise called simple hearing loss.

But another kind of consideration here is variability. There can be high variability and even a "normal population." And some, of course, some populations are more variable than others. Diversity in a population naturally introduces variability. There can also be diversity of population characteristics, and of course, with complex hearing loss, we have diversity of etiologies. Now, thinking back to those assumptions we just talked about on the previous page, think about variability and those assumptions. The higher the variability, the less applicable those assumptions. So there is also when we're talking about "normal," and knowing so much about evidence-based practice and it

being based on the mean, let's look at what normal means. There's a so called normal hearing loss graph, you've probably seen it maybe in a textbook.

It shows the typical age related hearing loss. Now, there's a separate graph for men and women. The one you see here is for men, it's from the Bob Dobie book on medical and legal audiology. If you look at the graph, you probably can relate to the patients you see every day in each of these age groups, but what I really want you to be thinking about here is, and just to kind of give you an idea of what this graph looks like if you can't see it well, each of those five lines are audiograms, starting with 40 years old at that top line, with 80 years old being the bottom line. If you think about a 40 year old patient you've seen recently, you probably can think of one that does not have hearing thresholds as good as this, or you could see an 80 year old patient who maybe has better hearing than that, or worse or different, the idea being is that this is a normal hearing loss graph that there is great variability from.

And fitting rationales are really a great way to understand this idea of being based on averages. Fitting rationales were based on averages, it meant that half of the people would want more gain and half would want less, and that's where we ended up with, with the algorithm. They're based on that so called, excuse me, "normal populations" within that hearing loss group, they're also each based on those assumptions that we talked about that may or may not be true for all. The point is you should understand your options and know that, especially for these complex hearing loss patients, you may vary and even significantly from target, and you may need to incorporate your clinical judgment and the patient's feedback versus adhering strictly to a fitting algorithm.

So I've mentioned a couple of times this idea of simple sensorineural hearing loss. Now, simple sensorineural hearing loss can, yes, be defined by the audiogram, but I want to give you a little bit more insight into what is simple versus what is complex.

Because if we have it labeled simple, there has to be a complex, that's how it works, right? So, before we talk about what makes something complex, let's see what's defined as simple. You know, simple sensorineural hearing loss is of course, a reduction of that sound intensity due to cochlear damage or cochlear mechanisms. The biggest piece of information here that really sets it apart is that most of the damage, and I would say a majority of our sensorineural hearing loss that is classified as simple, that damage is going to be limited to outer hair cell function.

Now, a little bit further with this. So we're looking at reduced air and bone-conduction scores or thresholds with speech perception or speech discrimination or word recognition, however you would describe that, is generally going to be reduced in proportion to those audiometric thresholds. You see the asterisk there, for the most part, until we get to older adults, those older adults, normally 80 years old and older, we have a higher likelihood of having that disproportionate relationship with those thresholds in regards to their speech discrimination scores, but for simple sensorineural hearing loss, for the most part, it's going to be in proportion to those thresholds, it's going to have reduced air and bone-conduction thresholds with no significant differences between the two.

Now, what may cause a simple sensorineural hearing loss? You probably have some ideas. Again, these are etiologies that generally only affect outer hair cell function. The first is age. But in addition to that maybe, it could be some levels of noise exposure, absolutely, some levels of ototoxicity, possibly oxygen deprivation, or even some genetic disorders. So now, my friends, let's talk complex. So when we think about a complex hearing loss, we know we're not going to be talking about what we saw with simple sensorineural hearing loss. This is going to be something that causes the reduction of sound intensity due to damage to the cochlear mechanisms, the auditory nerve, or the central auditory nervous system. This results in reduced sensitivity to

sound, it may result in severely impaired fine tuning of the signal, and some aspects of the signal that cannot be represented to the brain at all.

The thing to really keep in mind here, what's really important to consider with these patients is that the physical change or damage that happens does not necessarily correlate to what is perceived by the patient, okay? So, that's where that patient experience is extremely important. So for these types of audiograms, these patients, you probably already know that the audiograms are going to vary greatly. So we can have reduced air and bone-conduction thresholds with an air-bone gap that may or may not exist. Remember, any bone-conduction threshold that's greater than around 40 dB begins to be complex because that inner hair cell function becomes involved. Damage to those inner hair cells is generally around 40 dB or greater.

And lastly, one of the things we've already mentioned is that in complex sensorineural hearing loss, speech perception, speech discrimination, may be reduced disproportionately to what those audiometric thresholds indicate. So, let's talk etiologies, and you know that this list is not comprehensive, there are definitely things missing from this. So it's important to know the the etiology of the hearing loss, if at all possible, so that you can understand where that damage may have occurred and try to work with your best experience and knowledge that you have with the current function of that patient's auditory system. We know that counseling is important all the time, but it's extremely important with this group of patients to really help them understand that they have a unique situation, and success with amplification may take time to find that sweet spot for function and comfort.

And the more information you can get about their diagnosis and history will contribute to you being able to make decisions during that fitting process that can have a positive impact on the outcome. This is really where we start to see the art of hearing aid fitting come into play. So finally, before we get into those specific types of complex hearing

loss, I wanna talk to you about the importance of where this patient has been on their journey before they appeared in your office. The more information we have about the patient's hearing loss, and any experience they may have had with amplification in the past, becomes even more important with these patients. Have they worn hearing aids for the last 30 years?

Have they tried hearing aids in the past without success? If it's a asymmetric, have they tried a CROS, have they had binaural amplification? There are so many questions, we want to get all the information out of them as we can. And here's a great reminder of why that history and context is so important. Case and point right here, this is a 30 year old female who came into an audiology practice stating she felt that she had hearing loss after a concert. We know the reverse slope hearing loss was not caused by the noise exposure, however, it is absolutely possible the high-frequency hearing loss was. The reverse slope could have been missed, it's possible that she wasn't screened as a child, or even if she was, it could have been missed because the purpose of screening is to ensure normal speech and language development.

So based off of this, if we were thinking about those assumptions and treating this the way that maybe a prescriptive target would, or based off of those assumptions that we want to correct thresholds at all frequencies, we may end up in a little bit, we may have some difficulties with this patient if we applied those assumptions to this particular case. Imagine a scenario where the audiogram on the left was before the noise exposure and the audiogram on the right was after. The point is, you have to assume what you are seeing today is not the whole story, so now, how I would treat this disorder is going to be largely influenced by her history. You can put this hearing loss in and you can fit it to target, but we don't have target specifically for reverse slope hearing loss, but the computer will absolutely calculate something.

But just keep in mind that targets are based off of averages, and this particular population was excluded from those studies, so we don't have a target that's going to specifically work with this type of hearing loss, and what about the etiology? There are so many things that could cause a reverse slope hearing loss, some of them you might want to treat and some of them you would not. If we gave this woman a lot of low-frequency gains, she may say that it's great, I would say based off of my experience that may not be the case, or she may say, "Oh my goodness, my brain has no idea what to do with this information," and now you've introduced an upward spread of masking so she can't hear those high frequencies regardless.

In this particular case, that's actually what happened. One option is to treat that high-frequency hearing loss and not the low-frequency hearing loss. We have to respect how the individual patient's brain will react to these situations. Where someone was before absolutely matters, and if they were in linear technology, if they were in a pediatric fitting rationale, if they came in from a different manufacturer, if they have been living with a hearing loss for 30 years, it's very important that we take into account where they have been and where they want to go on this journey with hearing loss. So the discussion of that patient's history brings up a really important piece to kind of discuss. When should you switch a patient from a pediatric to an adult fitting rationale if they were fit in early childhood?

I will tell you, as someone who works with hearing care providers every day, this question is one I get, not quite every day, but I will say every week generally. Think about children being diagnosed with hearing loss and being put in a DSL Pediatric fitting rationale, okay, algorithm, the goal of DSL Pediatric is audibility. If they've been living with that and being very successful with it, our answer is, we don't wanna switch them. If they have been very successful with DSL Pediatric and they simply need updated technology, there is nothing wrong with keeping them in DSL Pediatric if they

can handle that amount of audibility and that amount of gain, there's no reason to switch them.

Okay, so let's get into these complex patient profiles that I teased at the beginning. We have discussed kind of some of those important issues that impact people with complex hearing loss, so now let's talk about these four common types of complex fittings that you most likely encounter, some more regularly than others I'm sure. So we're gonna look at the main challenges for each group within the context of what we have already discussed and provide fitting suggestions for each group that may kind of challenge convention. They don't line up exactly what those assumptions that we were taught or adopted earlier on. These suggestions may seem counterintuitive to what most of us learned, they are based off of our collective experience at Oticon with the intention of providing you ideas to improve hearing aid outcomes for these patients.

So since our first case example was a reverse slope with our 30 year old patient with the noise exposure, let's continue our discussion of the challenges and potential opportunities for success with this group. So as you can see here on this slide, our patients with reverse slope hearing loss generally say, these are three of our big reports from those patients, difficulties hearing in noise, sounds may not be loud enough for them due to that low-frequency component, and the ears may feel plugged. So let's take a look at what we may recommend here. So one significant challenge with reverse slope hearing loss is what those prescriptive targets will calculate. Remember, we discussed a little bit earlier that these are based on averages and really take out those people, or exclude those patients who do not fit neatly in that population group.

So, no target was specifically designed for reverse slope. I'll let that sink in for a minute. There was no target specifically designed for reverse slope. The other consideration with the audiogram you see here would be the implications of that air-bone gap, right? We see some unmasked bone right and left. If you choose to add

bone-conduction scores and click within our software to have them taken into consideration for the prescription, our software will absolutely take them into consideration and compensate for them. However, depending on the patient and the etiology, it could absolutely be too much and can actually overcompensate for that particular patient's loss. So let's take a look now at how this audiogram would be impacted by the various fitting rationales you can choose from and whether or not you include bone-conduction scores when Genie 2 calculates or not.

So first we're going to look at not having air-bone gap consideration used. And really, why we're looking at this is really knowing what the software is doing when you take those air-bone gaps into consideration. Now, if you're talking about a straight conductive loss where they want that power, they want that volume, things may be a little bit different. But that's not exactly what we're talking about here, we're talking about someone with better high-frequency than low-frequency. And as you start thinking about what that means for speech understanding and the environments they encounter, we have to be really careful about what we apply in the software. So for our no air-bone gap consideration, for these three you see on the far left, our Oticon proprietary VAC+, followed by NAL NL2 in the middle, and lastly, on the far right, DSL Pediatric.

So based off of this, I would like you to think, what concerns come to mind when you think about this? You notice the differences between those rationales and what they're going to calculate. How do the issues impact complex sensorineural hearing loss affect what you see here? So now, you've seen this, right? You've seen what it calculates with sensorineural hearing loss, now, let's look at having those air-bone gaps calculated. Look at what happens to those calculations when that air-bone gap is taken into consideration. Since the reverse slope hearing loss could be from several different etiologies, there may or may not be a significant air-bone gap. Notice how the low-frequency gain is impacted in all three fitting rationales.

This is an important consideration. Do you include any air-bone gap? And if so, at what point is it going to be beneficial or at what point will overcompensate, especially for a reverse slope hearing loss? Keep in mind here, or what we have seen here, is it's going to impact what we're talking about in the next several, I guess three that we have left, three patient that we're still going to talk about. So before we move on, let's talk about our suggestions for this particular group. Remember, keeping in mind, the whole idea here is that, for each of these complex patients, you're going back to your experience, your knowledge, and looking at patient experience, and if there is any, scientific data, putting all of that together to come up with a plan for this patient.

So for this group, our recommendations for that reverse slope, focus on where that patient really struggles the most, what did they walk in telling you they were struggling with? That's where we wanna start, you know, move away from that idea of the hearing loss correction, right? Meaning, that was the assumption we had at the beginning, and that hearing loss correction is that we need to correct every threshold that has a diagnosed hearing loss. Enhance audibility and the important speech regions, consider the limitations of those prescriptive fitting targets and how they were not necessarily crafted for this particular type of patient, and then lastly, I cannot stress this one enough, choose a more open fitting. As someone who actually has a low-frequency loss herself, I can tell you that choosing more open fitting allows some of those low frequencies, even if you do provide some low-frequency gain, it does allow for some of those low frequencies to naturally pass out of the ear canal and not feel as plugged and overwhelming-

- Sorry, could you say...

- [Amanda] Plugged and overwhelming as you would otherwise. So now let's move on to our medically complex hearing loss. So medically complex hearing loss can be

challenging, not only for the patient, but for you as well. While good diagnostic information is important, a complete picture isn't always available, no matter how hard you try, you may still be missing important information. Because most of these patients have some loudness tolerance problems, understanding if an air-bone gap truly indicates that there's a conductive and, excuse me, a conductive component, will be extremely important. So let's take a look. So what may cause a medically complex hearing loss? Again, this is not a comprehensive list, but this is a great starting point.

So, Meniere's Disease, sudden hearing loss, mechanical or metabolic disruptions, unknown progressive hearing loss or an unknown etiology, and those Third-Window syndromes. You know, diagnosis and treatment for all of these is going to be complex. At the point that amplification can be attempted, many assumptions that we talked about earlier and fitting practices are not necessarily going to be successful for this patient. Each person's residual capabilities have to be explored because they're all going to be very different. And thinking outside the box, using that art of hearing aid fitting is going to be very important in order to have that positive outcome with amplification. So this, as I mentioned, is not an exhaustive list, but it is giving you an idea of some of those patients who may not be so straightforward as you've probably already encountered in practice already.

So I want to, as mentioned, I wanna address the question of air-bone gaps. So because most of these patients will have tolerance problems, it's important to understand if an air-bone gap indicates conductive hearing loss or if the air-bone gap is because of something completely different related to the etiology. So the question is, are these audiograms examples of conductive hearing loss and would you treat them as such? So, let's take it a little bit further, because even if you said, yes, my question back to you would be, are you sure? Because additional diagnostics can be important with medically complex hearing loss. For example, with Third-Window syndromes, the

audiogram and tympanogram look like otosclerosis, however, reflexes help determine the diagnosis along with proper high resolution imaging.

With the syndromes, these are defects in the integrity of the bony structure of the inner ear. Reports from the patient will be valuable in these cases. You know, what symptoms are they having? What diagnostics have already been done? What else do we need to do? Now, with a true conductive component, a true conductive hearing loss, we are looking at much what you see here, simply a difference between bone-conduction and air-conduction, with speech perception generally not reduced. We know and you've probably learned at some point in schooling that the maximum conductive hearing loss may be up to 60 dB, but for the most part, unless this is something that has been chronic, it's normally much less than that.

However, the idea with the conductive component is once you bypass that conductive hearing loss, wherever that hangup is within the system, once you bypass that conductive hearing loss, the signal can get to the brain and be processed normally. So, let's talk about what makes the medically complex etiology different from this. So there are several indications of a more medically complex hearing loss. While an air-bone gap may actually be present like you see here, there will be signs that this isn't your simple conductive hearing loss. Word recognition could absolutely reduced and rollover could be present where you increase the presentation level, I lost my word there for a minute, presentation level for speech discrimination. And when you increase the presentation level of your speech discrimination, their scores get worse, that's our rollover.

So it could be, word discrimination could be reduced and, or rollover could be present. Understanding their history is going to be beneficial because you will know what has been done, especially if they have had any unsuccessful ear surgeries. Because an unsuccessful ear surgery could absolutely leave them with a conductive loss that they

didn't have previously that could be complicated by the etiology. Okay, so you could have a lot of things going on. So if you enter the bone-conduction scores in Genie 2, as mentioned, and check the box on our audiogram screen to include those scores within the prescription, the software is going to compensate for that conductive hearing loss. But since these patients typically have loudness tolerance problems, that could definitely result in some amplification.

And we know that this also means that we need to take a closer look and may have to be creative in how we fit these patients in order to, let's see, in order to handle those tolerance problems without over amplifying. So here are some suggestions for this particular group. You know, both tympanogram and reflexes are going to be extremely important. As always, but even more so, the history is going to be really, really necessary part of identifying where this problem lies. So asking about any history of ear surgery, you know, especially if it wasn't successful. Look, of course, then for word recognition scores, reduction of those word recognition scores and any rollover, I would highly recommend rollover, quick test of rollover just to see if that could be a problem.

And then to address those problems, you know, best practices for these patients include doing frequency specific LDLs, and then using verification to ensure that you are not exceeding those levels. We really need to be conscious of those loudness sensitivities that this group has in order to give them audibility without overwhelming them. And then make sure you're entering those LDLs into Genie 2. Another suggestion would be to keep that your canal more open and reduce that low-frequency gain below what your chosen fitting rationale is going to recommend. So let's get onto our third group, that asymmetric hearing loss group. And before we do this one, I have a quick poll for you, because I've encountered this several times in the last week or two.

So, a patient comes in with a mild hearing loss in one ear and a severe to profound loss in the other, what do you fit them with? Okay. All right, I love it, I love it. Okay, I'm gonna share the results. So what is so interesting here is variability. So we're going to be talking about, we are going to be talking about this group of asymmetry now. So you've probably seen these a lot. Another complex fitting population are these patients that have that asymmetry. It could be due to so many different reasons, but you have to be prepared for that variability, not just in the symptoms, but also in the same person over time. They may or may not have been previously successful with amplification and in some instances may have only been aided in the better ear.

Like the previous two groups we've talked about, history and context, where they've been, where they wanna go is also very important with this group. We also wanna understand what they value and what is going to be important to them. So let's take a look here. I'm so sorry, my computer, there we go. So let's take a look at a typical example of asymmetric hearing loss. So there's a significant asymmetry in this example, he has a good word recognition score in the left ear, however, nothing measurable in the right ear, he has a history of noise exposure, and his loss has been stable for many years. He has no middle ear pathology, no vestibular symptoms and has a clear MRI.

So what do you think about the left ear? I feel like the left ear is pretty obvious, we would all say, "Yes, let's aid the left ear, let's give him some audibility and those high frequencies, absolutely." The question is, would you do any additional testing? Would you do anything with the right ear? And then my last question to you is this, what about binaural speech? Because what we see is that, yes, none of these patients are predictable and even more so is you don't know. I guess the only predictable parts of this group is that we don't know what we're going to get, that's the predictable part. So when we do binaural speech testing for this patient, look at the scores, my friends, look at the scores.

So in the left ear, in quiet, the left ear only 76%. But when that right ear, even though it can't carry the load on its own, when it works binaurally with the left ear, they get 92% in quiet. With the plus 10 signal-to-noise ratio, that 56% that the left ear can do on its own goes up to an 88%. There is no way that, probably any of us would've predicted that, that's why I say there's nothing predictable about this other than knowing that it's unpredictable. Here is that case of aiding, that unusable ear may give a substantial result, and I will tell you, it's one of the reasons, anytime I talk to someone about an asymmetry, I'm always so hesitant to ever label someone as a CROS patient.

I want to try everything in my power, and that's really our goal at Oticon as well, to really make sure that if that poor ear, if there is anything left to aid in that binaural, like binaural performance, that's what we wanna do. We want to stimulate that ear if at all possible. And as soon as we tell a patient or a patient is fit with a CROS or a BiCROS, they will be that way forever probably. Unless someone were to go out of their way and say, "Let's just try, let's try binaural speech discrim," otherwise they will stay in a CROS forever. Now, of course, this is not going to happen in every case, but it's worth a try, we just don't know how the brain is going to put together information from both ears.

You never know if an ear is truly unusable unless you try to use it, right? The only thing that could be lost, if anything, is just the time that it takes for you to do this, but it's so worth it. That bad ear may only provide a small amount of benefit, but what if that tiny bit of usable information added to the results from the good ear and made the whole process work better? It's really, really amazing, binaural speech discrim. So here are suggestions for this population. You know, binaural testing is very valuable, the results as we just saw may absolutely surprise you. We also recommend what you, we call them serial monaural fittings. What this really means is that you focus on the better ear first, you're gonna fit the better ear first, you're going to allow the patient to adjust the

amplification on that ear, fine tune it for audibility and comfort and sound quality, then add the second device and adjust the gain in that poor ear based on patient reports.

Most likely it will be less gained than any of the fitting rationales would calculate. The goal is to achieve that fused auditory image so that the patient can evaluate whether amplification on that poor ear provides additional benefit. It may only be awareness of sound on that side and minimal speech understanding, however, for many of these patients, that will be an improvement that they appreciate. So our last group we're gonna talk about today is our severe hearing loss group, we wanna discuss the challenges that they face. I'm sure that many of you have seen this patient population. This could be for various etiologies, it could be something that's been progressive over their lifetime, and they very well may have been wearing hearing aids for decades at this point, right?

They know how they like to hear, they know what they want to hear. So if you've seen many of these patients, you know that it can be very rewarding to work with them, but frustrating for both you and the patient at times as well. There's a lot of variability in this group, many different hearing loss configurations are a part of this severe hearing loss group, and they can definitely be time consuming when it comes time for that demo or that fitting appointment, definitely. So let's take a look at just a few examples of severe hearing loss, so some of the common configurations you might see. As you know, it can be progressive and it comes from tons of different etiologies, some of these patients may have been aided from a very young age, there can absolutely be distortion, many times it's really just about addressing their desires regarding what amplification can and cannot do for them.

They're usually going to ask about new technology and of course, if possible, they also want things smaller, if you have a smaller option. History and context, their amplification history, when they were diagnosed, the etiology, all of those are going to

impact success greatly. So these are three typical audiograms. The thought is, not only is it important to discuss what to do for these patients where gain and compression are concerned, we also need to consider what advanced technologies may or may not be beneficial, and when to recommend a superpower product. So we know there's greater variability in word recognition scores as hearing loss increases. At least for those patients under 80 years old, which is what we're looking at on this chart, again, remember once we get to 80 and older, variability, even with more mild losses, that variability is greater.

So for these under 80 year olds, there is significant variability when we start to get in that more severe hearing loss range. One patient may have better than expected word recognition and the next with essentially the same audiogram, a very poor word recognition. So we all understand why we would use compression and hearing aids. The goal is to fit loud, moderate and soft sounds into their dynamic range and provide the most audibility possible. However, what happens when you try to do that for someone with severe hearing loss, when their dynamic range is so much smaller? Take a look at this. So this is from a study from back in 1986. It's one of my absolute favorites to look at because really, a picture does paint a thousand words.

What we're looking at here is the same patient in all four sections. The bottom section is a linear approach, then we move to slow, and then eventually fast compression at the top where 90% compression. And the top line of each of those boxes, that is the UCL, the lower dotted line in each of those boxes is the patient's threshold. Patient has a flat, severe loss, and those solid lines in between those are the input levels. So showing that the more compression we're getting, more of that speech signal, more of that dynamic range is filled with those input. So let's take a look at what happens here. If we were just about getting more information into the dynamic range, then you would expect the patient's word recognition scores would get better as we went up this graph, right?

The more compression, the more information within the dynamic range, we would think absolutely those word recognition scores would get better. But that's not what happens, there's not a huge difference, if anything, with less compression, they do slightly better. The reason being, if you think about this, the more compression, when we're talking about such a small dynamic range, all of that information is getting overly compressed to the point where it may actually be distorted, whereas with less compression, the information that is within their dynamic range is clear, therefore easier for the brain to put that information together for them to follow conversation or be aware of conversation or sounds in their environment. I absolutely love this, I think it's so telling and so important for this particular group of patients.

Another thing to keep in mind is, we have a few minutes left here, frequency lowering is a technology that's been on the market for a long time. But before we talk about Oticon strategy, let's look at the types of strategies that are on the market today. We have compression, we have transposition, translation and composition. The method of technology used is going to differ based off of manufacturers. You know, providing access to higher frequency speech without introducing unacceptable levels of low-frequency distortion is unfortunately a challenge reported in both research and clinical findings. While the aim of frequency lowering technology is to alleviate some of the speech perception deficits, in users with severe to profound hearing loss, this group of users also have a narrow audible bandwidth available.

So if the frequency lowering distorts that low-frequency speech information, the user may well lose more than what they can gain from this technology. So let's take a look at how Oticon approaches it. So Oticon Speech Rescue uses the composition technique, which transmits temporal features of high-frequency speech with minimal distortion of low-frequency spectral features. This method is unique because it uses a multi-layered lowering technique that overlaps copied segments from a wide region in

the high frequencies into a narrow region in the low frequencies. We call it the copy and keep method. High-frequency content is positioned with great care in the region where the user has hearing by taking advantage of opportunities offered by the natural dynamics of speech.

Where that high-frequency content is placed is dependent on the hearing loss or what Oticon calls the Maximum Audible Output Frequency, MAOF, defined as the highest frequency at which the user can hear conversation speech with amplification. When using frequency lowering, it's a best practice to do verification. It's important to determine what the technology is doing for your patient. The goal with verification is to make sure the S sound is just above the threshold. So the question is, how successful is frequency lowering for patients with severe loss? And I will tell you the evidence shows it works well for about one third of patients. There's about no difference for about the next third, and for the last third of patients, they consider it to be worse.

You won't know which group they fall into until you actually try and verify that technology. So what are our suggestions for this group? Here's our list of suggestions. It's, you really have to try use their history, use where they came from, their hearing aid amplification history to determine what's going to work best for them. Connectivity may be a benefit for some, but you won't know until you prove they can't benefit from using some of our connectivity options. Sometimes the results will really surprise you. And on that note, do we have any questions? I hope you found this course to be beneficial and I hope you enjoyed our hour together and that you can take away at least a few new ideas you might be able to implement when a patient with complex hearing loss walks into your office.

Remember, fitting these patients with complex losses, it's an art and a science, so much is going to come from knowledge, but also experience on your part and the patient's part. If you have any questions moving forward, please don't hesitate to reach

out to your Oticon account manager, trainer or regional audiologist. Thank you so much and have a great day.