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Case Studies in Real Ear Measurement (REM)

Presenter: Clayton Fisher, M.Cl.Sc

- Welcome everybody and thank you very much for being with us today. It is a real pleasure to have you here today for this last appointment of the year with Inventis Academia Webinars. We will be discussing real-ear measurements with a clinician you already know, Clayton Fisher. Clayton is a clinical audiologist and audiology consultant. Hello Clayton, and thank you very much for being with us today.

- You're welcome.

- Clayton will review and interpret hearing aid fitting results using the real-ear aided response screen for all different types of tricky-to-fit hearing losses. Clayton will describe a series of clinical cases, and so you are invited to ask your questions regarding each individual clinical case during the webinar. After the event, you will receive a survey that I kindly ask you to fill out. The survey will help us to understand your needs and to get your ideas in order to provide the best educational support ever. But Clayton, it's your turn now. Enjoy the webinar and see you later.

- Thanks, Anna. And I just wanted to mention that as you can hear, my voice is pretty rough today. I've been getting over a sickness. I've got three kids at home and we're always in some state of sickness, so if I have to cough or clear my throat, I apologize. Okay, so I just wanted to tell you a little bit about myself before we get started. It's funny, Anna often introduces me as a real-ear guru, which I love. I'll take that title, but no, the truth is I don't have a PhD, I don't even have an AUD, but I have fit a whole lot of hearing aids and I do it every day and I have a strong background in amplification.

And so I'm hoping I can share some insights with you today 'cause for me, despite my clinical experience, I still find fitting hearing aids challenging. You know, don't you? It's not always easy. I mean, sometimes it is, sometimes it isn't. But I do like teaching and I've mentored or supervised at least a dozen students over the years and I've helped dozens more of my colleagues with real-ear measurements. And because I had

identified through doing this that there was definitely a need for support with hearing aid fittings, I created a YouTube channel to support clinicians around that. So feel free to check out my YouTube channel, if you like, what you see today, because there's a bunch of videos on there about fitting hearing aids and a couple gear related videos as well as some other webinars.

Okay, our learning objectives today are just to give you a bit of history around the real-ear aided response and hearing aid fitting protocols. I'm also hoping that you learn some tips and tricks to facilitate workflow around hearing aid fittings and ensure accurate real-ear measurements. I'm also hoping that you learn some techniques for fitting. Yes, those tricky-to-fit hearing losses, specifically slight and mild hearing losses, which we're gonna get into today, which I'm kind of excited about. Our outline today, part one, I'm just gonna tell you why and how I fit hearing aids the way I do. Again, some background on the aided response. Gonna give you some background on my fitting philosophy and protocol, and again, workflow tips and tricks for fast and accurate fittings.

Part two is all about the case studies, which should be fun. I don't know if there's ever been a webinar done exclusively on real-ear case studies. So it was hard to choose the studies for today and I could have chosen a whole bunch of different cases. But we're gonna look at some sensorineural hearing loss, various degrees, configurations, symmetries, asymmetries. We're gonna look at some mixed and conductive hearing losses. Both cases of otosclerosis, just kind of by chance. And then we're gonna look at, again, some more trickier fittings, the mild hearing losses, and an upward sloping hearing loss. I know everyone's going, "Ooh, okay, great." The real-ear aided response. Pretty much every single screenshot that we look at today will be the aided screen on the Trumpet.

This is our EAR screen, this is also known as the SPLoGRAM or SpeechMap, SpeechMapping. But basically what we're looking at is the measured frequency response of the hearing aid in the ear canal. So we're looking at the db SPL recorded across frequencies in relation to the patient's hearing thresholds, that's here. Their prescriptive targets, that's the dotted line that you're gonna be seeing, and their loudness discomfort levels, which are up here. Okay, so some history. I went to Western University. Western University is where Richard Seewald was working on and developed the Desired Sensation Level with, well, I think they started at the University of Connecticut with Mark Ross, that was his supervisor. Richard Seewald then went on to mentor Susan Scully, who I'm sure a bunch of you know, and down here, so at Boystown, Patricia Stelmachowicz also mentored Ryan McCreery.

So there's quite an impressive lineage there. Anyway, I just bring up this figure from a 1987 article because as I understand it, the figure on the right here is the first aided response screen ever that is showing because DSL or Desired Sensation Level has targets for ear canal hearing instrument output. Okay, so here's your targets up here. So we're looking at output and not gain, and not insertion gain. The S's are the threshold. Back then it was sound field. Here is the long-term average speech spectrum, the unaided spectrum right here. This is a reference to normal hearing and of course we're looking at db SPL going up the vertical axis, and then frequency across the bottom axis here.

And again, as I understand it, these curves in this study were actually obtained using an old phonics system and then actually hand drawn. So anyway, pretty cool. You can check out the full article here. Okay. For infants, for young children, we have very high standards for fitting hearing aids. At Western, like I said, where I studied, they helped develop the Infant Hearing Program in Ontario, Canada, which defines very specific criteria for what is considered to be a high-quality hearing aid fitting. So this is taken from their protocol for the provision of amplification, which as you can see was just

revised. And one of the things that they ask all clinicians to document is the hearing aid fitting details.

What is the purpose of that? They want to know the quality of the hearing aid fitting 'cause if the hearing aids aren't fit properly, then if the kid's not doing well with the outcomes, well then we know why. So I just wanna draw two things to your attention today. They document the Speech Intelligibility Index, that's the Aided Speech Intelligibility Index, and they document data login. And these are two things that I have started to do with all of my fittings. Just continuing on, the Aided Speech Intelligibility Index needs to fall into the expected normative range, okay? Speech Intelligibility Index, for those who need a review, it's a proportion or percentage of speech that is audible to the patient.

You can have the unaided SSI shown here without hearing aids, and then the aided SII with hearing aids. So this is showing a screen from Verifit where these norms, the upper and lower limits, are actually built into the device now. Before, in the Infant Hearing Program, you used to have to plot it out on like a paper chart based on their PTA. This is incredibly convenient and it should be mentioned that the norms, which we only had for DSL for children, are now available for adults, which is very cool. This is the article to the reference for that. Those norms are available on the Verifit, not yet on the Trumpet, but I believe they're working on that.

Okay. So my fitting philosophy is that adults deserve the very same level of care as infants and children. So you can look at the achieved aided audibility or SII and being within the expected range, as I just mentioned. Or what I like to do is actually look at the improvement in audibility. So what is the change in the SII, that's the aided SII minus the unaided, and what is that difference? And you can see that the Trumpet does give you that, and that's automatically, and that is actually unique to the Trumpet.

And then next, our outcomes for our hearing aid fittings need to be documented. So we need to validate the success of the fitting. How well are we doing?

So that means that after they've been fit, they come back for a two-week follow up. You are assessing the degree of perceived improvement on something like the COSI, which of course you got their listening needs early on when you're doing your hearing aid evaluation. And then of course we wanna know the data log, how much are they actually wearing the hearing aids? So my goals for a fitting are, there's basically just two goals. Number one is to maximize audibility. That's trying to get the largest change in SII, the largest improvement in SII that I can get, while, number two, maintaining loudness comfort. Okay, so having the patient feel that it is not uncomfortably loud for an average level speech.

Because these two goals are essentially the same goals as the Desired Sensation Level using prescriptive targets are really the blueprint to help you to get there and to achieve this. By the way, I think I see a question come through and what we'll do is just answer the questions at the end, if that is okay. Okay. So in relation to that first goal, maximizing audibility, again, my focus is not the ultimate aided SII value, but rather how much change or improvement is observed. Again, the Trumpet automatically calculates the aided SII value, it automatically predicts the unaided SII value and then unique to the Trumpet, it automatically gives you that improvement, which is fabulous. It just makes your life that much easier.

So what do you do with that improvement value? How do you interpret it? Well, I have created a tool to help clinicians interpret the change in SII values. It's called the expected benefits with amplification or EBA. And it's really trying to help you understand, okay, with that value that you get, how much expected benefit do you expect the patient to get? So for example, 43 high here, a change of 43 is extremely high improvement. So that would sort of be off the charts. We're expecting that patient

to you know, that's like night and day with their hearing aids. But just going through here, starting at the bottom, if your change in SII 65, or for average speech is zero or negative, that's obviously a big rag flag.

You need to reexamine the fitting. If it's very low, that might be a bit concerning. You might wanna reexamine the fitting unless, as we'll see today, you're fitting a slight hearing loss, for example. If the change in SII aided minus unaided is between five and nine, that's considered to be low single digits, we probably expect there to be a slight improvement with the hearing aids, unless again, the loss is mild, or if it's like precipitously sloping or just a high frequency loss, something like that. If your SI change value is between 10 and 14, that's considered to be a fair improvement and we're expecting there to be a noticeable improvement from the patient. Average is 15 to 19, we're expecting to see a good improvement there.

High is 20 to 25, we're expecting to see a very good improvement, they're noticing a big difference with their hearing aids. And then very high is anything above 25. On the loudness comfort side, so what I do is I give the patients in their hands the Cox loudness scale, and I have them rate the loudness or volume by pointing to the appropriate rating while the actual speech passage is running, of course, they can't talk or that will contaminate the measurement. So I'm giving that to them as it's running. And what I'm hoping is, and what I'm working for with my adjustments is making sure that average speech at 65 db should be number five, comfortable but slightly loud. That's for new users or comfortable for experienced users.

By the way, a note here, if they're saying it is number six loud but okay, that is not okay, that's a patient who's probably gonna not wear their hearing aids for the week or two and say they were too loud or call you a few days later and say they're too loud. So you really wanna hone in on number five or like four and a half there. By the way, I started, as I was doing this presentation, I started thinking, where did I even get this

from? And I started like the idea of this comfortable slightly loud for average speech. so I started digging around and it turns out there's a 2009 20Q article with Gus Mueller featuring Robin Cox that talks about this.

Interestingly, they're talking about it in the context of how could you possibly verify hearing aids if you don't have a probe mic system or if you're waiting for your probe mic system to arrive. And so I just kind of incorporate, rated that, it made a lot of sense to me and I've just started using that with probe mic measures, with real-ear measures. Okay, so just back to the fitting protocol, I'm a big fan of AutoREM or automated, automatic real-ear measurements, okay. If the hearing loss is fairly standard, mild, moderate sloping to moderately severe, I always do AutoREM if it is available for the manufacturer that I'm fitting and for the REM system that I'm using.

So the Trumpet in my case, and in case you're curious, the Trumpet has Starkey set up, they've got the Demant brands, Oticon, Bernafon, et cetera. And I believe ReSound is coming soon, which is exciting. But basically what that does doing automated real-ear measurements, AutoREM, is it creates a really good starting point. It gets you pretty much, pretty darn close to target, right? Very, very quickly. I always like to check that, however, with manual measurements to obtain those SII values that I was talking about, which often are not available for the manufacturer's software. And often with AutoREM you can't actually run MPO from the manufacturer's module, which is where you're triggering it from. And then of course you can probably always make a few more other manual adjustments.

So it's really a hybrid approach. Why do I use AutoREM? It's really fast, it's objective, which I love. It doesn't rely on me. It's extremely convenient. However, it's important to note that it's not always appropriate, okay? So these slight hearing losses we're gonna talk about if we ever get there, it would not be appropriate and you'll see why. Very quickly, here's just a couple examples of me having run AutoREM and here's the

simulated gain curves here. That's what they look like. These are the offsets that were made. And then I just ran this manually. This is the unaided response, this is aided response. And you can see that aided response is pretty darn close to target.

Same thing with this slightly more significant loss. These are the offsets here in the software. This is the fit to target. Like that's pretty good for having just clicked a button, just saying. Okay, but if the loss is not straightforward or the patient is an experienced user and I wanna see what their old hearing aid is doing 'cause you can't do that with AutoREM, I use a fully manual approach. So first thing I do is measure the real-ear unaided response, which is a 70 dB pink noise. This is like the unaided screen. And basically it just gives you an idea of what the ear canal resonance is. It can also give you an idea, if there's a problem with your probe tube insertion.

Then the next thing I do is measure MPO and adjust as needed. It's good to try and remember to get MPO out the way and it's nice that you can do it first when you're doing this manually because adjustments to the MPO can sometimes affect your soft, average, loud gain. So it's good to get that out of the road right away. Then I manually run unaided speech at 65. Okay, so that's no hearing aid in or if they have old hearing aids, I run the old hearing aids to get to see where they were set at before. And that's the reference point there. And I'm doing this in the aided screen, the real-ear aided response screen.

Then I run aided speech at 65 to see sort of like what the best fit is and then make adjustments as needed. We're gonna be assessing the loudness as we do this, make further adjustments. And then of course you can run your additional levels like soft speech, which is very important. And then loud speech, which is important for comfort. Today we're almost exclusively gonna be looking at average speech to try to keep it simple. Although as you'll see, some of the curves are not completely straightforward. So in all of the upcoming case examples, I have used average RECDs, but measuring

your RECDs is definitely better. I do not have the drum presently, which I'm working on. So I actually don't have the ability to measure an RECD, so I need to use the average.

But if you're using an average ear, that should be fine. I'm also using predicted uncomfortably loud levels, or LDLs I should have put there. But of course measuring LDLs are better. And the prescriptive target for all of these cases, the DSL version five adult. On the assessment side for the hearing test, the AI that you'll see referred to as the Audibility Index, which is essentially the SII, but based on the HL audiogram and I believe they're actually using 60 dB speech instead of 65, which is why you'll often see the AI is lower than the SII, but it's also related to the conversion to SPL. So for the first case, what we're gonna do is really just use it to go through all those steps I just talked about.

This was a 33-year-old woman, she's a special needs teacher. She felt like she had a blockage in her ear. She came in for wax removal and guess what? There was no wax. So of course we went ahead and did a hearing test. Those are the results. Over on the right side, you basically have a moderate notched hearing loss right in the most important speech range. That gives her an AI or Audibility Index of 61 and 62 right and left. That's not very good. So after she got over the shock of the hearing test, we started talking about it and talking about it, and of course she has a lot of listening effort. That's really the big one for her, low talkers in her life like her partner who's soft spoken, she can't hear them and she cannot hear at staff meetings where she's at the back of the room and the people are speaking to the front.

There's like 15 people there. So the hearing aid fitting, we used some RICs with medium gain receivers and some open domes. This is sort of where we ended up. We ended up with an improvement of about 11 in terms of the SII on both sides, which is quite nice for this hearing loss. Because I was just using this as a quick example, I've actually haven't seen her back yet. I'm seeing her on Friday, so I don't have her

outcomes yet. But let's use this and see how we got there. Okay, so first step, quickly measure the REUR for pink noise. And again, this gives you the ear canal resonance. You'll be able to see if something funny is going on here.

This is a little bit more expected, this is a little bit peaky here, but I think we reran this, that's the way it is. That's part of the reason why you're running this. You wanna know if they have a slightly different than average ear canal resonance. Then run MPO and make adjustments. Okay, and this is a really classic response right around the ear canal resonance. We are actually over target, well over target for the MPO. And so what we did is manually took that down pretty aggressively there. Okay. Then we're gonna measure unaided average speech. So this is the curve down here. And the gap is of course what we wanna close when we're fitting to the target.

The dotted lines is the target. Importantly, if you have an experienced user, you don't care about what the unaided speech is necessarily. What you care more about is what is that old hearing aid doing? So you run the old hearing aid instead of running this. Then we measure average speech again, but just with whatever the best fit is, okay? So you can see with this particular hearing aid and this particular loss, the best fit really wasn't all that great. We're significantly under target here, a little bit over target here and so on. So we got some work to do. So what do we do? We switch into on-top mode, which puts the Trumpet Maestro software on top of your fitting software, which is extremely convenient 'cause then you can go and make your adjustments and all you're looking at is your measured curve.

In fact, I make a point of putting it right on top of the simulated curves because I don't even, I don't wanna see them. All I care about is what is being measured and I don't want that to throw me off. And we'll see that in a second here. So and of course we're gonna rerun our average speech, make sure it is as close as we wanna get it. You can see we've got a fairly nice fit to target here in between two and 4,000 hertz, that's

looking really good. We're not too concerned about these sort of ultra-high frequencies here. And then you can run soft and loud speech as well. As I alluded to before, this is what the simulated curves look like.

And I know a lot of people are probably, they got their eyebrows raised here. They're going, "Oh my God, really? Like what is the problem here?" Don't freak out if your sim curves look wacky, okay? It's fine. What is important is the measured curves that are being measured in the ear. Everything is gonna be okay. You know, we tend to get, if we deviate from those simulated curves, we get really worried about it and worry that we're doing something wrong, it's okay, you're not. Okay, so just tips for workflow, the following three tools can make your life easier and speed things up. Again, I use AutoREM whenever I possibly can, but it's not appropriate for all degrees and configurations of hearing loss.

I use binaural, simultaneous binaural measurements wherever possible to cut down on time. But that may not make sense if you're fitting some very asymmetrical losses, which we'll get to. And I always use the on-top feature because you can do all your adjustments on one screen, you're not toggling back and forth. Some tips for accuracy 'cause obviously you want your measurements to be accurate and you have to be able to trust your measurements, right? It's a big problem if you can't. So just a couple tips here, you can calibrate for the room, that's the speaker equalization every time. It's not a big deal, if the room hasn't changed, if the position hasn't changed. But just do it.

Counter to a previous recommendation I made in a previous webinar, I'm gonna suggest that everyone just leave open fit deselected, okay? And so what that means is that it will calibrate for your level before each measurement. But what you have to do, and it's really easy if you're in on-top mode, is just mute the hearing aids right before that calibration and then unmute them, and then you know, record the measurement. Because if you're muting the hearing aids, you're not worried about anything leaking

into the reference microphones. And then you're getting that calibration before each measurement, which is really important because my previous recommendation was to leave it on open fit all the time and tell the hearing aid user to stay still, which of course they never do, right?

So I think that this might be a better way of doing it. And I got this idea from using AutoREM, which often automatically mutes the hearing aids for you. So it's super easy to do in on-top mode. Re-run curves, re-run curves as needed. Okay, if your curves are looking wacky, check the probe tube depth, check that the hearing aid hasn't moved out. Check that the patient hasn't moved. And this is a handy little button here on the Trumpet on the top left corner of the real-ear aided response screen. You can press that and just re-run one measurement on one side 'cause the Trumpet doesn't let you kind of go from doing binaural to monaural and back and forth, but you can just re-run a single measurement.

So that's really handy. Also, if you want to be super accurate, you can also just run sequential monaural measurements because the way the Trumpet works is that if you're doing a binaural measurement and the difference between sides is more than five dB, it's gonna say, "Hey, stop, don't," it won't let you run the measurement unless you deselect that. But let's say it's four dB difference between sides, like that difference is just gonna be averaged out so that it does create a little bit of like a room for error in there. So you could also just run one side at a time. That's fine too if you got the time. So as we go into part two where we're gonna look at a whole bunch of case studies, I just wanna give you a quick curve tour because the Trumpet does not let you yet, there's a new version of my show coming out on Friday, by the way.

I don't think it's included, but I'm sure it'll happen eventually. It doesn't let you just select specific curves. You can either choose all the curves or you can choose one curve, but not A and C for example. So some of the diagrams that I have here are

showing a whole heck of a lot of curves. And so I wanna help you try and interpret them and I'm gonna do my best, but I admit that it is a bit messy. Most of the time, the turquoise curve on the top is the unaided response that I've run. Most of the time, the second curve down is the purple aided curve at the best fit or their demo settings or with the old hearing aid if they're an experienced user.

Okay, so that's this curve here. You can see this is someone's old hearing aid and man, it was was not a very good job done with that. Orange, this is with the aided after making some adjustments. And you can see that in this case this isn't a full case that we're doing, but we more than doubled their SII audibility here and tripled it here. So you gotta run real-ear, you gotta make adjustments. And then finally green, it's either the final aided after making a few more adjustments or for a bunch of these, you're gonna see that I've also run soft speech here. Okay, let's give this a shot. Okay, so our first real case study, so case study number two is a mild to moderate sloping to moderately severe sensorineural hearing loss.

This is a 71-year-old woman, she's a university professor, she's about to retire. First time hearing aid user, has known about her hearing loss for a long time. She's been putting off treatment and by the time she got to me, she's seen multiple providers but she is actively ready to go. She wants to do something about it. Okay, great, that makes sense because her audibility is 36 in the right ear and 26 in the left, which is not good enough. So where is she having difficulties? Seminar rooms when she's doing her classes at universities, she's having big problems there, at conferences, of course, she can't hear what people are saying in the audience when they ask questions afterwards.

And she gave the example of women whispering, she just doesn't have a chance, right? Okay, so let's look at the fitting. We use RIC's with closed domes for her. So let's take a look at these curves here. So I sent her out with some demos before I got

her actual hearing aids because I was just like, you gotta be hearing well right away, just use these. And she was really happy to have those. So the purple curve is the demos, really not bad and she did okay with the demos. Little bit over target here, definitely under target in the low frequencies. Again, so the orange curve here was we just ran and that's right, we had used some larger domes 'cause with the demos, her domes are coming out of her ears.

And as soon as we put those larger domes on, things started to look a little weird. Boom. Of course the low frequencies came up. And then especially on the left side, we really got rid of any ear canal resonance that we might have had there. So we had to do some adjustments, and that's here, this is aided post-adjustments, we've boosted the low frequencies up a little bit higher, sorry, got the low frequencies down a little bit lower, closer to target. Boosted the high frequencies up closer to target. And so what we can see here is with the demos, she had a really nice improvement. And with this loss it's pretty easy but 22 and 23 points in the SII.

But just by making a few adjustments we can get that a few points higher pretty easily, which we can feel good about. Of course on the COSI, she was just doing much better across the board. This makes a world of difference for her. And her data log was showing 10 hours average daily use, that's a pretty successful fitting. But as we'll see, these fittings kind of go not exactly, but they kind of get harder and harder as we go here. Okay, so we're gonna look, the next case is a significantly asymmetrical hearing loss. By the way, as I was looking at these slides this morning, I noticed that in almost all of these, the left ear is a little bit worse.

It's funny how that works. Sometimes there's one guy where it's the opposite, thankfully, but don't worry, my gear's not broken, it's just the way that the case has worked out. This is a 73-year-old man, he's a handyman. You know, he's still working, doing handy work, never worn hearing aids before. He's known about this hearing loss

in his left ear for a long time. He thinks he got it during the '80s due to a noise trauma. He was like a sound tech for bands. And I think something happened where his left ear was just right at the speaker and then boom, he was done. We can also see of course in his right ear, he's got a bit of a, what looks like probably a noise component there from that same work.

His AI is 67 on the right and only five on the left. So this is a huge asymmetry. Because of this asymmetry, he can't hear in a noisy environment. He can't hear the servers at his favorite restaurant that he goes to regularly. He's, as a result, constantly turning his head to the right. He told me that he's gotta get the server's mouth like right in his right ear. And then his cell phone calls, excuse me, for work are a really big issue for him. Okay, so let's look at the fitting. He was fit with another set of RICs with the power receiver and power dome on the left side and a medium receiver and open dome on the right side.

Just gonna, so here's unaided. We checked out how he was doing with his demos. Just wanted to mention with his demos, like when we were getting the setup, we didn't run real-ear 'cause finances were, you know, it was a big cost to this guy. He wanted to make sure these things were working. So I set him up with demos for a couple weeks and we initially set him up. He felt like he was hearing better out of his left ear just 'cause we're giving him more gain on that side, which of course wasn't true. So he really wanted me to increase the gain on his right ear to give him that perception of balance, which we did.

And then when he was going ahead with his hearing aids, we measured that, we could see we had him significantly over target on the right side and he was under target on the left side to keep him comfortable. So we made some adjustments, we took down the gain a little bit on the right side, but still left them significantly over target for the perception of balance. And then on the left side, really what we're doing, this is in

orange here. You know, we boosted him up closer to target but we still, as you can see, have a ways to go and he's getting close to a 30-point improvement in audibility as it is and he's noticing a huge difference.

So we can take our time getting there if we need to. So you can see we actually lost a point in audibility taking this resonance down with the adjusted settings. And then we gained six points on the left side as we adjusted up to target. Again, you know, this was really making the world of difference for this person much better, almost across the board on the COSI. This guy is wearing his hearing aids 11 hours a day and is very happy with them. So moving on and we'll have to go quickly here. This is a moderate conductive hearing loss on the left side. 39-year-old woman works at an office job, never worn hearing aids before. She does have known otosclerosis though, and she had a stapedectomy on the right side.

Her hearing improved but she got tinnitus as a result. She doesn't wanna do surgery on the left side. ENT recommended hearing aids, makes a lot of sense to me. Audibility is 72 on the right and only 20 on the left. Okay, so we got some work to do. She's having difficulties in group situations, work meetings, hearing her partner at home, TV at home and environmental sounds like the kitchen timer going off. So getting into the fitting, again, another RIC fitting, she had M receivers on both sides and small closed domes on both sides. You can see that this was the best fit in purple here and this was adjusted. We are under target in the low frequencies and particularly on the right side.

And I think what's happening here, there's really no change with the unaided. That's just venting out. Fast forward at the two-week follow-up, we did switch to a larger dome, she was comfortable with these and we could go to a larger dome and so this would've jumped up a whole heck of a lot. But anyway, after boosting the high frequencies a little bit, boosting the low frequencies, really no change in the right ear, but we're buying an extra four points just for making a few adjustments on the left here.

This is another patient, just so happy to be hearing in a balanced fashion again. She's a younger patient. She's working, starts to see a theme here.

Even for these sort of milder losses, this makes a big difference for these people who are still working, she's wearing hearing aids 14 hours a day. Love streaming to them, by the way, and same with that last guy. You know, the streaming to the hearing aids can be a huge motivator for some of these folks. Okay, next, very quickly, another otosclerosis case. This is a longstanding client of mine, longtime custom hearing aid user. He followed me from another clinic to my private practice. He's 53 years old. He is a successful business person. Used to wear IICs, had a set of CICs as a backup. But his otosclerosis, which he never had surgery for, is progressive. And I hadn't seen him for a couple years when he came back to me and I just realized, wow, his hearing had gotten a lot worse.

Audibility is nil in both ears without hearing aids. You know, presently, his listening needs with his current hearing aids, his hearing his girlfriend, he's bluffing, trying to hear her like in the kitchen or when any noise is going on or if they go out for dinner and then phone calls on his cell, none of these previous options had direct streaming. So looking here, we'll just go one at a time. So we ended up fitting him with custom rechargeable ITCs, get a little bit more power. He was comfortable with that now, you know, looking more like a Bluetooth headset. As we go through here, the first curve is his very old IICs. This is almost irrelevant 'cause these hearing aids are so weak.

And they were for an older hearing loss. Similarly with the sort of backup set of CICs that he had in purple here, definitely better in audibility than the previous ones. But definitely not very good. So we ran the new ITCs with these settings. You know, we're getting way better audibility just with the best fit settings, but you know, we're a little bit over target here, a little bit under target here and so on. And fairly significantly off target on the left side. So we go in, we make some adjustments and here in green is

the new adjusted. So we took down the low frequencies here, boosted up the highs, really brought up the left side heck of a lot closer to target, big improvement, seven point improvement on the left side after adjustments.

And yeah, he's hearing either better or much better across the board. 12 hours average use, which we would expect to see with a guy like this. Okay, so great. So we do have time to get to some of these more interesting, more challenging, not that that last one wasn't challenging, but challenging in a different way. Here is a slight in the right ear and mild in the left hearing loss that I think a lot of people would just tell this guy to take a hike. Say, look man, there's nothing we can do for you. Hopefully there's a bunch of people on here who would feel comfortable fitting this type of hearing loss. This guy was 27 years old, he works in politics, never worn hearing aids before, but really feeling like his left ear is down, really high audibility, 89 on the right side, lower 71 on the left side.

He's the note taker in his meetings at work and he is constantly having to ask for clarification and his boss has a soft voice. He feels like he's mumbling all the time. He goes to political events, there's people talking all over the place, cocktail parties, he can't pick out the voices. So he is got a ton of listening effort. He is leaning to his right side. So work is a huge part of his life and he's having a lot of hearing difficulties. He wants a solution. So I'm not gonna tell him 'em to take a hike. So lot going on on this screen here. We fit him with some RICs with M receivers, medium-sized closed domes.

Definitely need to try and close off this fitting. So if we look at the best fit, and I threw this in up here, okay, the best fit, is not too too bad, improvement of one and six. But if you look at it, there's really no low frequency gain here and we're especially on the right side, we're destroying his ear canal resonance that he has in his open ear. So even though there is a small improvement here, he's gonna feel like he's wearing an earplug overall. Down here are our adjusted settings, and look at that, with a closed ear

you can see we've got him right on target and this is the unaided. You can see I'm working really hard to stay at least meeting or being above the unaided response 'cause I don't want him to be wearing an earplug.

On the left ear, it's easier to get him sort of a nice improvement. Stay above the unaided response here and get him to target here. Four points extra on the left side, an extra point on the right side. These are actually significant improvements considering how high his aided SLLs are or sorry, unaided SLLs are. By the way, these are the simulated gain curves up here. You can see that I really, really, really had to work and boost to get this guy to where he is here. So if you were just doing a best fit and sending this guy out, yeah, he's gonna come back and say nah, these things didn't really help. You know, they're more annoying than anything.

But if you make the careful adjustments, this guy came back and said it is much better. He's hearing significant, he used the word significant, significantly less effort at work and he's wearing them average of six hours a day and he's not really wearing 'em at home 'cause he is really just using them for work. Anyway, pretty successful fitting with a mild loss. Let's look at another tricky fitting. And again, I know people are looking at this and going, oh man, like do I even really wanna try and get this guy hearing better? Well I did, I guess I don't know if it warrants mentioning, but both the last guy and this guy did have coverage through a certain third party and so they really didn't have to pay anything for the hearing aids at the end of the day, which maybe factors into it.

But this is tough, right? You got moderate hearing loss rising to sort of slight mild, borderline normal and then mild high frequency loss. This is a tricky hearing loss to fit. This guy was 67 years old, he's a new immigrant to Canada and he's known about this hearing loss. He was tested outside of Canada. I saw him for an ENT assessment. Again, really high audibility, again, I don't know what it is with the left side being lower, but 89 on the right, 71 on the left. So that's a significant difference and significantly

high. Okay, so hearing difficulties, sorry, I think this must have been carried over from the last slide, my apologies with that, 'cause obviously he did not have old hearing aids.

I'll fix that on the printout. But these are his hearing difficulties. He has a difficulty with official communication because English is his second language. This is both in person and on the phone and so he is taking these calls based on his citizenship and all this stuff and he's gotta bring someone with him if he goes in to do anything like that. He's got some friends here, social, if they're sitting in a cafeteria, he said he can't hear the person beside him. Okay, and then repetition with his family and his daughters at home. So the hearing aid fitting, again, using some RIC hearing aids M receivers we're using actually a small but a power dome to really try and close off his ear 'cause we gotta get those low frequencies or otherwise what's the point, right?

Really interesting. If you look here, this shows both unaided responses for soft and average. Okay, and what you can see is that with the best fit, there's zero improvement on the right side and then negative one on the left side. So these hearing aids, if you just best fit them with a power dome like that, you're blocking off the ear canal resonance, you give the guy earplugs, that's not gonna work. So you really, really have to work to restore the ear canal resonance and match it or beat it. And then work to get those low frequencies up. Again, showing the simulated fitting targets, here you can see I'm well over the simulated target but looking down here, I'm actually right on target and I'm matching the unaided response here, which is in purple for average speech and which is in green or turquoise for the soft speech.

So you can see that we're getting really nice, you know, double digits, single digit improvements, and when he came back two weeks later, he really was noticing that a lot of situations were better and a couple situations were much better like his family at home. Data log, somewhat surprisingly, 11 hours a day, which is fantastic. It shows

that he's really getting benefit and improvement. So a big win there. In summary, and we have a few minutes for questions, some hearing loss configurations and degrees are harder to fit than others, obviously, but all fittings require careful measurement and adjustment using real-ear measurements. I think that you'll find that, as I have, SII change values are a very convenient and useful means of assessing the potential benefit you might expect your patients to get from their fittings.

And we need to document the quality and success of our fittings. And we do that by measuring the improvement in audibility and documenting that SII change by assessing the perceived improvement, for example, like on the COSI, the degree of change and then by documenting and looking at the hearing aid usage data log hours per day in the same way that they would for a kid or an infant. Okay, I just wanted to mention really quickly if you like these case studies, if you like looking at case studies, I recently recorded a video for the Pacific Audiology Group, they've got this new learn on program, it's free and I've got five or six case studies there, which are kind of interesting.

It's not my own, it was when I was working at a clinic where the clinician I was filling in for had never done real-ear and I was doing real-ear on her patients. So it was really showing why we need to do that. So you can check that out. So we got a little bit of time for questions, which is great. I am just gonna take a quick sip of water here and thank you for bearing with my voice. I'm barely getting through here. What is considered a good improvement in audibility when using the difference of the aided versus unaided? So that was what the EBA tool is for. I think what I consider to be a good is sort of 15 to 20, but fair, where you're really looking at like 10 to 14 is also a really great answer.

Why do you use DSL as a prescriptive target? So you can use NAL, use NAL or DSL, honestly for adult fittings, the differences are a lot smaller. I use DSL just because, like,

again, maximizing audibility across the broadest frequency range makes sense to me whereas NAL is more about sort of intelligibility but either/or is good. I went to Western, so I'm using DSL. Good question. How do I measure the AI? You can count the dots on the audiogram or you can just use a modern audiometer that's gonna, like I used the Cello from Inventis and it automatically calculates it for you. Thank you so much, you're welcome. So are there any particular manufacturers that are closer to target before REM, if you're allowed to mention this?

Definitely, you gotta figure that out. But it obviously it depends on the manufacturer, depends on the hearing aid and it depends on the hearing loss. But some manufacturers are a lot better than others. But I'll let you figure that out for yourself. You gotta be running the real-ear anyway, so. How do you deal with reduced dynamic range patients for those who suffer from hyperacusis or tinnitus? Is this where predicted levels are more useful? Definitely, but they're also better to have or, well they're very useful in a regular hearing aid fitting as well. But that's honestly the hyperacusis and tinnitus, that's a whole webinar in itself. But good question. Case study number four, is the target prescription taking into account the air-bone gap?

Yes, it is. And you need to make sure that when you do that, that you go in and you manually, you have to, at least in the Maestro software, you have to manually tell it to take into consideration the bone conduction thresholds 'cause that is going to change, at least with DSL, it'll change your target. Do you always run real-ear aided response after changing the dome size? No, you should, but you can, if you've run enough real-ear, change the dome size, you can imagine what's gonna happen to it. But really anytime you change the coupling, you should do that. For case number five, have you ever considered referring this patient for a CI? Cosmetics may be an issue.

So okay, so that must be, right, the mixed hearing loss. Yeah, so I would totally be into that. So that's quite a hearing loss otosclerosis. Exactly. So yeah, I would consider

referring him to the CI team if that was something he was interested in. Those SII, and obviously this person is talking about, Sarah is talking about the aided SII. They're not great but they are probably within or close to the expected range. But I would fully refer him for a SII. That's something I can talk to him about. Knowing him, he probably would not be into that at least at this point. But that's a great future consideration as well. Case study number six, what about the MPO?

Will it be easier to boost the aided response when the MPO is better or higher? Yeah, I didn't show the MPO there, but yeah, the first thing you would do, the first thing you would do is run the MPO and look at the MPO and get it to where you want and then run all your aided curves. Okay, so just looking here, there's a fair, okay, hopefully I'll try and answer all these questions. There's a few more. Do you ever measure S, and the answer is yes, especially when we're doing frequency lowering and that's a whole webinar on its own. Where do you get your AI values? We already answered that. Amanda says, you mentioned AutoREM is not always appropriate for all degrees and configurations of hearing loss.

So yeah, so I answered this in the talk, I think, like super mild losses, you can't run AutoREM because you have to be looking at those measured unaided responses for speech and trying to match S. And for mild and slight losses, you're typically over target. So if you fit to target, which is what AutoREM does, that's not gonna help you. And then yeah, like you know, just high frequency losses, precipitously dropping losses, you're gonna run into feedback. There's a bunch of reasons why you wouldn't do AutoREM for those or at least why I don't. Okay, I'm really interested in the SII improvement chart. Has it been published? Email me and I'll send that to you. No problem.

You can also just grab it from the slides if they become available. What is the best REM device in your opinion? Try out as many as you can, hopefully working at various clinics

and make your decision for yourself 'cause it really depends on your needs and different devices are better for different clinical situations and setups. And then finally, what is your rationale for closed domes on a slight mild loss? Well, because if there's a low frequency component, then we need to be able to try and get them those little frequencies or they're not gonna see a benefit. But if there's a high frequency component, and I really wanted to include that in this webinar. If you're looking at a slight or mild high frequency loss, obviously that's gonna be an open dome and that's a tricky fitting all in itself.

And if your closed fitting is really looking like you're totally destroying the ear canal resonance and there's nothing you can do about it, then you look at opening it up if appropriate, if there's no low frequency component. Good question. How do you run unaided response in the Verifit? It's the same thing. You just run unaided response for speech without the hearing instruments in. Oh, but you're probably talking about for pink noise and you can definitely do that. You probably could do it in the insertion gain screen. It's been a while since I've used Verifit, but there's, I think they actually might even have a screen for the real-ear unaided response. Basically just a blast of pink noise is all you really need to do that.

You can do it in a variety of screens on the Verifit. Okay, great question. My voice is shot. Thank you for attending. And Anna, I think I'm going to hand it back to you.

- Yes, you strongly need to take a rest, Clayton, for sure.

- And I need a cough drop.

- It's always a pleasure to listen to Clayton, isn't it? Well, you have attended so many. Thank you very much, Clayton, for this session. It was truly informative as usual. Keep in mind that we will see Clayton again next year as he's now a fixed and valuable

member of Inventis Academic. So this is the last fitting webinar for this year. We will start again the educational season in mid-January, 2024 with the first vestibology session. However, we'll be back to discuss fitting on February 15th with a seminar titled "Optimizing Accuracy in Fitting Pediatric Hearing Aids Using a Real-Ear Measurement." Thanks again, Clayton. Thanks to the entire audience and we will see you next year. Bye.