Cochlear Implant Assessment of Adults

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- [Ellen] Okay, can everyone hear me okay? Okay so my name is Ellen Deres, I'm one of the cochlear implant audiologists at UNC hospital. English and I are gonna be presenting to you on cochlear implant assessment of adult patients. So these are just the learning objectives that Anna was talking about a couple of minutes ago. Knowing how to identify three audiologic assessments that may be conducted pre-operatively. Being able to list two medical assessments that are conducted during the cochlear implant process. Having the ability to describe the suggested audiological course of follow-up after cochlear implant surgery, and then naming two sentence materials in the revised Minimum Speech Test Battery. Okay so initially the first thing we're gonna talk about today is we're gonna break the talk into two sections, the pre-operative evaluation and the post-operative evaluation. The pre-operative evaluation is gonna consist of the case history on audiologic testing, speech perception testing and medical assessment. The post-op evaluation section is going to consist of the medical follow-up, audiologic follow-up care, audiologic testing, speech perception testing and then a little bit about the Minimum Speech Test Battery and we have some case history, case studies to go through at the end.

The first thing that English and I wanted to do is just gauge your experience, kind of get to know our audience a little bit, engage your experience with cochlear implant testing. So if you are, depending on what your experience is, are you a novice, have you done some cochlear implant testing before? If you guys could just type a little bit about what experiences you have. Have you done it before or is this completely new to you? Okay so we have someone's done some assessments, "only in graduate school." "I've seen many adult MPCI assessment and programing." "New to me, observed during CFY." Okay so this is designed to be an introductory talk. So if you've done a lot assessments or maybe some of this material you've probably seen before, anything for people who are new to this, that this will be hopefully a good talk for you. The first thing we're gonna start with is the case history. So when a person comes in for a cochlear implant evaluation, we like to start with the case history. This is really

important because it's the framework into which you can put the rest of the cochlear implant evaluation. So in some cases you can even predict cochlear implant candidacy a little bit from your case history. The entire case history is really useful and important but I think the first, maybe the first four questions tell you, can potentially tell you which ear and possible outcomes that the patient may actually have with a cochlear implant. So the first question is the age of onset of hearing loss. And then the age of diagnosis of a profound hearing loss. Sometimes when you ask a patient how long their hearing loss has been profound, they don't really know how to answer you. So another way to phrase it is just how long has your hearing been the way that it is right now? Has this been progressive over many years? Was it sudden? And then the next question is have they been aided in one ear or in both ears? The piece that's really important here and if you look at our case history, we have it broken down into the left and the right ears.

The reason this is so critical is because you may have a patient who comes in who's had a profound hearing loss in the right ear for like maybe 40 years. And a progressive hearing loss in the left ear maybe for 10 and they've worn a hearing aid in the left ear. So all of this, everything that you're asking during the case history is leading back into counseling once you finish with your assessment. So you, it really give you sort of a head started, or an idea of which ear you might be thinking of. And it may be different from the ear the patient is thinking of. So you may be looking at someone who again, back to that person, dead ear in the right ear for 35 years, progressive hearing loss in the left ear for 10 with hearing aids. You may be thinking, well we're probably gonna need to the left ear whereas the patient may be coming in thinking, I'm gonna do my right ear because that's the ear that I haven't heard out of for a very long time.

Again if that's the ear that the patient really feels strongly about and the surgeon and the patient decide on that ear, the right ear that is, you may not, you may be thinking about what possible outcomes is the patient gonna have in an ear that's been dead for so long versus doing it in the left ear where they've had a hearing aid and some

acoustic stimulation? Moving down from there, what type of hearing aids they have? This is just looking at is the patient appropriately fit with hearing aids? Do they have a better ear or a worse ear? Can they talk on the telephone? The majority of patients when you ask that question will say, "Well I can talk on the telephone, but I can't hear on the telephone." But of course if you have a patient who says, "Yes, I can definitely talk on the telephone." Then you know, potentially they may or may not actually qualify. Etiology of hearing loss, family history of hearing loss, these are just question to give you as the audiologist a little bit more background of, kind of what to be expecting when you actually go in to start doing the testing.

Tinnitus and vertigo, these are things you would ask during prior to any audiologic assessment and the nice thing about the way that our appointments are set up is that the patient is scheduled to see audiology first, but then they see the physician after and they're all ready scheduled to have usually some sort of imaging. When we're looking at noise exposure, OME, let's see, medications and allergies to medications. These are things that historically, we as the audiologists used to ask more of. I remember writing down all of the medications that patients were taking, but more recently we've just been, I usually just say, "Do you take medications? "Do you have allergies to medications? "Did you bring the list with you today to share with the doctor?" And most of the time they do. The second page is looking at a little bit more medical questions, heart disease, diabetes, high blood pressure, ear surgeries, other surgeries on their body.

Again these are things that the physician will go into with much greater detail with the patient. But it's something where if we go to talk to the physician about a patient who we just finished doing the CI evaluation, they may say to us, "Well what kind of shape is this patient in?" Just so they can get a feel before they see the patient and it's nice to be able to have an answer to that, like "oh the patient has had several open heart surgeries." Or "the patient didn't report any previous surgeries." Depression and

alcohol, it may seem odd to ask about these during a cochlear implant evaluation, but these are really trying to get a patients social history. So you may have, looking at depression, you may have a patient who for 20 years their spouse made all the phone calls. Their spouse called the insurance company. Their spouse did everything for them and maybe their spouse has just passed away. And so that right there gives you patient motivation. How motivated are they? Are they living alone? And it helps you to know how to counsel that patient the best.

When we look at education. So education is another really important thing to ask about. Because most patients who come into your clinic are fairly well educated. Potentially they we have lots of patients who have a lot of advanced degrees. But then you also have patients who come in and maybe they went to school through third or fourth grade and then they had to stop working, stop going to school so they could start working maybe on their family's farm. That does happen and I have been in a situation where I've brought them into my office and been really glad that I knew that they were unable to read before I started typing out the information. So if you have a patient with a profound hearing loss, a lot of times I'll do some typing when I'm you know do the typing counseling. But it's really nice to know. I'm not gonna start doing that because then the patient will feel really embarrassed if they then have to say "no, I can't read."

So the case history really gives you a really good look at the patient as a whole. Why are they in your office? And hopefully will be able to tell you potentially which ear you might be sort of thinking of ahead of time as far as counseling. The other thing that the case history can sometimes do is set up realistic outcomes in counseling. So knowing what a patient wants out of the cochlear implant will help you best direct your counseling in the end of the appointment. The audiologic testing that we're doing pre-operatively is tymps and reflexes, Air Conduction, Bone Conduction, SRT, word rec, we are doing Recorded Word Recognition, we're using CNC words rather than

W-22 words. W-22's are a lot easier than CNC words, so we prefer to use the CNC. Also then post-operatively if we're using CNC words, we can compare. OAEs and ABR again the goal would be to do all of these types of testing, tymps, reflexes, everything. Sometimes that's not necessarily feasible, certainly if you had a patient who's hearing loss indicated or warranted doing reflexes, asymmetric word recognition, vertigo, tinnitus, any of those things you would of course do reflexes. So the goal would be to do all of the above, but sometimes you really don't have time.

We don't necessarily do an ABR before every patient, but if you had any sort of concerns that they might be malingering, then you would wanna do an ABR prior to cochlear implantation. When we look at the aided testing that we do, we're doing an SRT and sound field thresholds to assess the functional gain of the hearing aids. Then we'll do some speech perception testing, this is gonna be in quiet and in noise, we're gonna do the right ear and the left ear and again the goal would be to do all of these conditions. Sometimes there is not time to do bilateral or bimodal testing. But the goal would be to do all of it. The other thing to note is that we will run hearing aids, the patients hearing aids in the test box to ensure that they're being appropriately fit. So that's something that is important to check because especially if you're not the client that's actually fitting the patient with the hearing aids. It's nice to know where they're hearing aids are set. So the speech perception testing that we're doing is, the goal of this is to see how patients preform when they are appropriately fit at a conversational level. So how are they preforming with their hearing aids?

When you're looking at booth set-up, the patient should be seated in front of the speaker. So zero degrees azimuth and they should be about a meter from the speaker. The presentation level is 60 dB SPL, so remember you're gonna be calibrating. For those of you who have never done cochlear implant testing and maybe are starting it in your clinic, you're gonna need to do calibration using a sound level meter. So you'll adjust the HL dial, see this works best of course if you have two people. So one person

behind the audiometer, one person in the booth holding the sound level meter. The audiologist behind the audiometer will adjust the HL dial until the calibration microphone measures 60 dBA, so it's A weighted noise, so 60 dBA and then make note of the hearing level dial setting because this is the level that you're gonna use to present your speech. So for example in our clinic, we use 62 dB HL for the head testing and 52 dB HL for the AzBio. We are using recorded speech and the speech and the noise for the noise conditions are presented from the same speaker.

And another note about when you're doing the setup and the calibration, you're gonna have to calibrate each booth that you're doing testing in and you're also gonna need to calibrate each CD. So the HINT CD and the AzBio CD, those are two different CDs, and so they both need to calibrated. We have a little cheat sheet on our CD player that will tell us what level we need to use for what tests in each specific booth. When we look at speech testing, we're looking at closed-set verses open-set speech testing. In closed-set testing there's a limited number of choices that are available to the listener. An example of a closed-set task would be ESP or 4-Choice. Another example would be just saying the days of the week. So you know, I'm gonna say one of the days of the week, if I say Wednesday, you know that you only have seven choices and one of them was potentially Wednesday. Open-set testing you have an unlimited number of choices. These are sentence tests or single word tests. So the CUNY testing, HINT testing, AzBio testing, and then the BKB-SIN, and CNC word testing. A little note about the triangle to the right, this can be a pretty useful counseling tool because sometimes patients have, sometimes they have a little bit unrealistic expectations as far as what they can expect from their cochlear implant and when.

The majority of patients, we want them to get to that open-set and hearing in noise relatively quickly. But, I was testing a patient, well I did a cochlear implant avowals once on a patient and she was pretty young, her mom came with her and the patient signed. Her primary method of communication was signing. And the mom asked me,

"When can we expect that she's gonna talk on the phone?" And at that point, I just though we need to back up, let's talk about expectations for the cochlear implant and you start from the bottom. We need to initially know that sound is present, as in I'm hearing a sound in my environment, identification, oh that sound is the door bell and then moving into closed-set tasks. I'm gonna say one of the months of the year and you repeat back or one of the days of the week, and then finally open-set and hearing in noise. So it's a simple icon, but it's something that can be useful. Especially if patients maybe have unrealistic expectations. So we're gonna talk a little bit about the ESP. Have any of you administered any of these tests? I know that for some of you who have done some assessments or people who have done a lot of assessments, you certainly have. But for people who are new, have you ever administered the ESP or the 4-Choice?

Okay so someone's done the ESP. We have a no, okay. The page of the ESP that you give to the patient is what you're seeing right now. And then there are pictures, a shoe, cookie, airplane. This second page is the audiologist is using for scoring. So the ESP was designed, there's a standard version and a low verbal version. We are using this lower verbal version because the goal is to estimate speech perception abilities in either very young children who have limited verbal abilities, or in patients who have limited experience with listening. So in this scenario we have this page right here where the audiologist will, and I do this monitored by voice. So I'll say ready? Baby. So let's see, get this arrow here. So if I say baby and they say baby, I put a little hatch mark right here. If I say baby and they say toothbrush, a little hatch mark goes right here. And so at the end of the test, you've administered, I've said each of them twice. So I'll say ball twice, shoe twice, fish twice, and then however many are in these shaded, these little boxed regions are considered correct. So if I say cookie and they say baby, we count that as correct because it's the pattern perception that you're looking for, not necessarily that they've said the word correctly. On the other hand if you say ice cream cone and they say ball, then that does not count as, that would not be scored as

correct. This is administered at 60 dB HL or SPL. So when I'm saying it, I'm setting my dial to 60 dB HL. 4-Choice is another closed-set task. In this scenario, the patient is getting, here we go the patient is getting this form. I just usually put it in the booth with them and then I'm keeping this one in front of me and this is, says list one here at the top, randomization one and so I know these are the words I'm gonna read from. The patient is sitting in the booth, ours are laminated so they just have a little marker that they can circle what word I'm saying. So again 60 dB HL, I'm saying, "ready?" Practice version I'd say, "ready?" Daylight and then here are your practice items and they would say, they would circle daylight if that's what they heard.

A piece of advice in administering this if you haven't before, sometimes no matter how hard you try, you end up getting off by just one because the patient that you have in the booth may not, sometimes what'll happen is they'll do one, two, three, and then somehow end up starting here or maybe they don't hear one of them and they skip it and they go to the next one. This test is easiest to administer actually when you have somebody else in the booth with the patient. And maybe that's just me, I don't know what English's experience has been, but it can be challenging. So just, sometimes if I have a fourth ear with us, I'll just ask that they sit in there and make sure that we're going through each number and that nothing is getting skipped. So again they're just looking at, they're given the option of four spandy words and they're asked to circle what they hear. CUNY testing is using, oh here we go. The CUNY test is looking at the patients ability to repeat back a sentence. The person will say "ready?" And then they'll say the sentence. So this is a recorded, these are recorded materials and they sound like this.

- [Man] Ready? They looked up at the blue sky. Ready? I enjoy TV. Ready? Would you like to eat dinner now? Ready? Make sure you go to the dentist and have him look at that tooth.

- [Ellen] Okay so as you can hear, those go pretty quickly. So a lot of times I actually will pause between sentences, which I try not to do during like the AzBio testing which we'll get to. But sometimes if you're using these test materials, these are the easiest open-set test materials that we do. So the patient may need a little bit more time to try to process what they heard and then repeat it back. The HINT sentences, these were actually originally developed as an adaptive noise test, but in the clinic we do it in quiet and then we do it at a +10 Signal to Noise Ratio. So we're doing it with a fixed noise. Each list has 10 recorded sentences, but this time the man does not say ready first. And so the HINT sentences sound like this.

- [Man] The house.

- [Ellen] And a word about this, I could not separate the static from the person saying the sentence. So you're hearing it with the background static, the patient would also hear it in quiet.

- [Man] And nine bedrooms. They're shopping for school clothes. They're playing in the park.

- [Ellen] So the HINT sentences are a little bit harder because they don't have the ready indicator, but they actually have a nice long pause between sentences which is a little bit nicer than the CUNY sentences which kind of go kind of fast. The AzBio sentences we're developed at Arizona State. They're the ones that we're using most of the time now. It's four talkers, two male and two female. Each of them are saying five sentences. So you have 10 sentences by the women speaking, with two women speaking and 10 male talkers. Again, 10 talker babbles recorded on channel two. And let's see, we can have a listen to this. And again the babble is, you're hearing the babble as well.

- [Man] I could hear another conversation through the cordless phone. She relied on him for transportation.

- [Woman] He was an ordinary person who did extraordinary things.

- [Man] How long has this been going on?

- [Ellen] So what makes these sentences hard even in quiet is that as opposed to the CUNY and the HINT, which are fairly deliberately spoken, these are supposed to be or intended to be a more conversational type approach. And so the talkers speak a little bit faster, it's a little bit less formal and a little bit harder to hear. They also have limited contextual cues, so that makes it difficult for the listener to fill in unintelligible words. So patients will often remark how odd the sentences are, but they're designed to be odd because they're no supposed to be able to guess what's coming next. The CNC words are list of, it's a list of monosyllabic words with equal phonemic distribution across lists. And so the goal is that each list is exhibiting approximately the same phonemic distribution of the English language. There are 10 lists and each list has 50 words, and the CNC lists sound like this.

- [Man] CNC list eight. Ready? Duck. Ready? Balm. Ready? June. Ready? Moss. Ready? Cough.

- [Ellen] So very similar to the CUNY sentences. There's the ready a head of time and they also go kind of quickly. So sometimes depending on the patient, I will pause between words. Again you are probably not supposed to pause between words, sometimes patients will get really frustrated and upset if they don't have enough time to think about, process the answer and then say it. And when we're administrating the CNC word test, we are counting the word correctly. We aren't administrating it looking at phonemes, but some clinics may use the phonemes to score it. So pediatric clinics

or maybe some adult clinics might score it in that way. The BKB-SIN was designed to assess speech understanding in noise in cochlear implant listeners and those who have hearing impairment. It's a male in four talker babble and the Signal to Noise ratio decrease in 3 dB steps. So it gets harder and harder the further along on the list you get to. I don't know if you guys have taken this test before or heard it before, but by the time you get to the bottom couple of lists, it's really hard. Even if you have normal hearing, it's really hard to repeat back those sentences. And the results and reported as the Signal to Noise ratio in decibels at which the subject understands 50% of the key words in the sentence. The next thing we wanna talk about is the medical assessment. Oh hold on just a second. Let me,

- [Man] List one A.

- [Man] Ready? They are looking at the clock. Ready? The car engine is running. Ready? Children like strawberries. Ready? They are buying some bread. Ready? The green tomatoes are small.

- [Ellen] Okay so that should be enough for you to kind of get a sense of the rising level of background noise in those sentences. Sorry, I forgot to play that. So the medical assessment is what we're gonna talk about next. So after they have gone through the case history with us and then we've done the unaided evaluation, then we've done the aided audiometric testing and the speech perception testing, we've gone through all of that. Once we've determined whether or not audiologically they are a cochlear implant candidate, we will also do counseling, and usually that takes a good probably, we should probably be able to do it in half an hour but realistically it takes closer to 45 minutes, sometimes an hour depending on the patient.

So once they've gone, it's been quite a long day all ready, but once they've done everything, we send them on to the physician for the medical assessment. And in this

appointment they are having their medical exam and history review. They're gonna talk again about previous surgeries that they've had, any medical conditions that may prohibit surgery. Again they are already scheduled for a CT scan most of the time. Occasionally patients will be scheduled for an MRI if they are referred specifically to a doctor from another physician because they're concerned about middle ear, well because they're concerned about some other like an acoustic neuroma or something like that. They may be settled for an MRI rather than a CT scan, but primarily they're scheduled for CT scans. That's looking to diagnose any sort of potential disease in the temporal bone and evaluate the tissues.

They are given a minimum medical work-up prior to surgery, which includes the EKG, a chest x-ray, and then some blood work. The CBC is the Complete Blood Count, and that's used to check for disorders like anemia, infection, other diseases. PTT is Partial Thromboplastin Time, this is a blood test looking for basically how long it takes blood to clot, and then chem 7 is looking at basically the chemical balance in the body and ensuring that all of the chemicals are within their normal reference intervals. So looking at things like carbon dioxide, creatine, glucose, serum potassium, serum sodium and then just making sure that those are within normal limits. They're also given the FTA ABS, that's a blood test that is used to detect antibodies for syphilis.

All right and then they are given a pre-op assessment by an anesthesiologist. Sometimes patients will have a chronic health condition, well actually quite often patients have diabetes, heart disease, high blood pressure, emphysema, and usually that won't preclude a patient from having surgery but it's definitely something the physician will wanna know about a head of time. A lot of our patients will have, maybe they'll need to be cleared, to have clearance by their cardiologist prior to undergoing surgery. So the surgery usually takes about an hour and a half to three hours. Usually an hour and a half to two, three would usually be if, something came up and it took longer than expected. The patient is put under general anesthesia, it is an outpatient

procedure, but usually patients end up spending the night in the hospital. So it's counted as maybe a 23 hour stay in the hospital rather than a full day. And then the patient wears their external bandages home. About a week after they have surgery, they are seen by the physician again to have the bandages removed, look at the residual swelling, and check if they have any abnormal middle ear status. Usually at the post-op day, there will still be blood behind the ear drum. If you look into their ear, you can sometimes see blood back there and it usually takes a couple of weeks for that to go away. Let's see, and occasionally we have done cochlear implant activations at the post-op date. That does happen sometimes. The tricky thing with that is if they are swollen, you may need to up the magnet strength to compensate for the swelling but then as the swelling goes down, you need to make sure that you're seeing them in a timely fashion to reduce the magnet strength, make sure it's not too tight. Okay the next thing that English is gonna talk about next is the Audiologic Follow-Up.

- [English] So this is English, and I just want to ensure before I start that everyone can hear me. If you have issues, please just send me a little note here on the side and I'll readjust. Also want to give forewarning I'm at home with the winter weather with my three children. So if you hear screaming in the background, just ignore it, they're fine. Before I start talking about some of the post-op procedures and audiologic follow-up, wanted to just get a gauge of from the audience for those that do have experience with cochlear implant evaluations pre and post-operatively, ask a question or poll the audience in terms of what current test condition or test measures that Ellen went over a moment ago are you using to determine cochlear implant candidacy? So in looking at your Medicare population and scoring less than 40% on, and I'll give you options and you can just respond back with the A, B, C, D or E. So A, are you utilizing AzBio in Quiet to determine candidacy? B, are you using AzBio in Noise to determine candidacy? C, are you using HINT in Quiet? D, are you using HINT in Noise? or E, other and if it's other, what measures are you using? And I'll give a moment just to get those responses from our audience. So I'm seeing an answer B, which is AzBio in

Noise. What level Signal to Noise Ratio are you using Kevin with AzBio in noise? Are you using +10, are you using +5 or that varies? "Can vary," okay. Okay thank you, that's the only response I'm seeing thus far and again I'm assuming most of, that's because most of you are, we have another response this is, "depends on the patient," which test. So that's a little bit about what I'm probably gonna talk about, or touch on a little bit today but in addition we've got a second webinar that we're hosting here in a couple of weeks that will go into more specifics about candidacy and so on. But thank you for those answers.

Gonna move on to again, so at this point the patient has undergone surgery, and as Ellen mentioned they do typically return to see the physician five to seven days post-surgery for their follow-up with the physician or the surgeon. And as Ellen indicated, it is not unusual to have the request of the surgeon that we activate the patient at post-op. That is something we are continually counseling and reminding the physicians the reason why we don't like to do that. It's certainly, when you have a patient that's coming from a distance, whether that's out of state or whether that's from multiple hours away, even the state that up North Carolina, it's understandable that patients may wanna try and combine those appointments. And in that case, they may postpone or push that post-op a little bit further than that five day window. They may schedule it at a week or week and a half and pushing that back a little bit to give them more time to heal.

And then on that same day, thus accomplishing the initial activation. But for most patients, we typically do perform initial activation and I would say it's probably closer to the two week mark. Our goal is to have them back in two to three weeks, depending on schedules, that may be a little bit farther out than that. And as she mentioned, we do wanna ensure we get the patient opportunity to heal from surgery, that the incision sight itself is not infected, is healing up and that they don't have a lot of swelling or fluid as that does impact the strength of magnet use at initial activation and in having

to keep an eye on that down the road. We do work, Ellen and I as you may have realized and some of our discussion do not work with children with cochlear implants, we work only with adult recipients. And when you're working with, 85-year-old patient where they may have thin skin anyway, it's just really important that they're healed and in addition to feeling good on that day, there's a lot that we go through. It's a lot of information, it can be a life-changing event for them and wanna ensure that they're feeling good. At this point up to post-op, most patients have not washed their hair. So just washing their hair can make them feel like a new person. So ideally we do accomplish that down the road.

When they return from surgery, they typically get a call from the audiology scheduler to schedule that initial activation. We absolutely encourage the patient bringing a family, their spouse and/or other family members to that visit. And then again, we are reviewing a lot of information and equipment and having someone else there who's familiar and can help the patient with any questions or practicing manipulating the equipment itself is helpful. And we want the patient as much as the spouse is gonna be involved in this process and want them to have some ownership and at the activation as well. We do at that evaluation as Ellen mentioned, do a lot of counseling on a variety of topics and one of those topics is talking about a cochlear implant can certainly do wonderful things for a patient but it is not an overnight process and is a process that very much takes time and requires commitment and returning back for follow-up visits.

And we typically counsel patients, those visits can be an average of about six to eight visits in the first year and those visits are typically two hours in duration. So it is a commitment in time and resource and getting resources in terms of traveling to and from our clinic for testing and programing. After initial activation, ideally we see patients two weeks after initial activation, and some of that we've become a little bit more flexible on, but we really do like to see them soon after that initial activation to get a gauge of what they're hearing, how they're hearing, and then it's a really good

opportunity to review any equipment that we may not have gone over at that initial activation or need to review at that time. We see patients then about two weeks later at the one month mark. So one month post-initial activation, at three months, six months, and then depending on how the patient's doing at six months, we may need them in the interim between the six month and one year mark. At each of those visits, we are starting in the booth with testing.

So I know some clinics actually perform mapping first and then do just testing after. We start in the booth to get a gauge of what they're hearing on the map that they present with and how they're hearing before we actually do any reprogramming or remapping. And then after that one year mark, we do counsel patients that performance tends to improve pretty quickly in the beginning, but every patient's different in terms of when you start to see that plateau. So a lot of patients by six months are doing pretty well and there may be patients that are a little bit slower to progress, hence why we may see them at the nine month mark. And some patience it really takes them a full year but most patience by one year are doing well and are utilizing their device consistently, can appreciate the improvement they receive from their device, and that's considered their quote unquote graduation and we typically see them annually thereafter for maintenance of external equipment, to ensure the internal device is stable as well as performing.

In terms of audiologic testing that we perform post-operatively are very similar to pre-op testing. We do measure sound field thresholds with their cochlear implant on and all the frequencies from low pitch to high pitch using an FM tone, engage the threshold for speech using spondee words and then perform speech perception testing to assess their performance with their cochlear implant and just keeping in mind that there're more and more patients are coming in and being implanted that may have residual hearing in the implanted ear and/or the contralateral ear. So you may need to plug and mask that contralateral ear, even in presenting tests and measuring

the thresholds. But certainly in presenting speech perception testing. And then I wanted to make note in terms of unaided testing. We do typically make all efforts to test post-op hearing thresholds in the implanted ear to asses whether electrode insertion was atraumatic and the inner ear structures were preserved just to get a gauge of what that post-operative residual hearing is in the implanted ear. Obviously if a patient comes in with a profound hearing loss to begin with, we may skip that, but if they had any degree of low frequency residual hearing, we're trying to do that and that's usually done at the one month mark.

At initial activation or even soon after you may still have some middle ear issues. So assessing middle ear status and doing your tympanometry and then measuring thresholds, to get an idea of what that ear looks like. We also will typically do unaided thresholds in the contralateral ear through that first year. In particular if a patient is reporting something's different or they feel like they're hearing differently. That may come into play not only based on what they're hearing with their cochlear implant, but what they're hearing or what may have changed in the contralateral ear. In terms of speech perception testing, again similar to what you were doing pre-operatively. We are trying to assess how the patient's performing with their cochlear implant specifically and we are doing that using recorded speech at normal conversational level.

Our booth setup is the same as what it was pre-operatively with the speakers one meter, with their head directed at that speaker, presenting at 60 dB SPL and as Ellen described the process of making sure that you have calibrated that booth for the stimulus that you're using. And then I do wanna make note in terms of our speech and our noise signals are coming from the same speaker. So on the audiometer if in for the noise conditions you are using channel A and channel B. Channel A may be for the sentence and the channel B may be the noise, whatever task you're using. You then aren't able to mask the contralateral ear. So quiet conditions you can mask with the

second channel, but when you are presenting noise, you're not able to mask that contralateral ear. So ensuring that you have that plugged and masked so that ear isn't contributing as, in terms of help if applicable. And then going back to some of the speech reception testing, your closed-set versus your open-set. The ideal certainly would be to perform open-set tasks and doing that with recorded speech. But there are some patients that may not be at that level. So you do have your closed-set test, but even administering open-set sentences via monitored by voice is kind of an in between where they, they're obviously gonna do better with a live voice than a recording.

A recording is certainly the gold standard but if they're not able to achieve that, then looking, just getting engaged with conversational speech, what are they're abilities. And you need them doing that, in some cases certainly without visual cues, but then with visual cues and that's another side note I'll make pre-operatively. There are still patients that I'm surprised that come in not recognizing the significance of their hearing loss and how much they do rely on visual cues and not recognizing how good of a lip reader he or she may be. And so from a counseling perspective, presenting those sentences whether if monitored by voice or recording without visual cues and then suddenly giving them visual cues and seeing the difference, and using that as a counseling tool even pre-operatively but post-operatively to show them this, you rely of visual cues and have for many, many years in some cases, and that suddenly is not gonna go away. You are gonna need to use some of that and not make it easier, make it better, you may understand more and more without visual cues but that's not gonna happen over night or usually within the first period of time with their implant.

So again talked a little bit about this in terms of your administration of these tests is gonna be very dependent on the abilities of the cochlear implant recipient and what they're understanding ability is. Which is... I'm a big proponent of HINT, and we'll talk a little bit about the Minimum Speech Test Battery here in a few minutes, but it just gives

you a good gauge pre-operatively to see what is our patient's abilities with their hearing aids, and then you can certainly make it more challenging or make it easier. And then if you have that HINT testing pre-operatively, it gives you a good starting point post-operatively. Whether you're testing this at the two week mark or the one month mark better, those early stages with their cochlear implant. Giving them a task that's achievable and there may be patients that blow HINT in Quiet out of the water. And if that's the case, you may never administer that condition again. But they may not be able to do that test very well and giving them kind of a starting point and then knowing where do I need to go from there. And then also having an easier task that can give them encouragement of look you are doing better on this task then what you were pre-operatively and doing pretty well that we're probably not gonna do this again, but that gives them encouragement, versus turning out with something that's really, really hard that they're gonna struggle to do while they're on with their implant can sometimes be pretty discouraging.

So this is what I, what identifies the typical protocol for a typical patient. So it's saying that patient is post-lingually deafened or required normal speech and normal language. We do again see patients and test patients at the two week mark. They may to do the fore gemmative testing that we do. Pop them in the booth and measure sound field thresholds and then we'll do some recorded speech testing and as I mentioned, I at least at the two week mark will start with HINT to get a gauge, and then I may be going into AzBio and even AzBio with noise at that two week mark. Just depends on where that patient is. At one month we are measuring unaided thresholds in the implanted ear. And then may or may not be starting with HINT and then working our way to doing AzBio, and then obviously the longer the patient has had their implant, typically you see their scores improve where you are maybe introducing more and more challenging conditions. And we but not a lot, but are more and more seeing the patients that have improved outcomes where we're administrating AzBio to +0 Signal to Noise Ratio. Which is impressive. I as a normal hearing individual struggle in that condition, and that

I would say is probably more so in addition to testing their abilities with their cochlear implant. We often will test their bilateral users. Testing them with both implants, or if they're bimodal, using a cochlear implant in one ear and a hearing aid in the other, testing them in that best aided condition. And that's more typical of a condition that we will test you know AzBio at +0 and even +5. BKB-SIN, I ideally you would be administrating that and that's the recommendation now under the Minimum Speech Test Battery.

It is not a condition I test as much as I used to, you think it's translating that decibel score to a patient. It's just hard for them to relate and grasp what does that mean. Well today you scored 3 dB versus last time you scored 6 dB. Oh yes while, we're at the score the better explaining that and counseling its just easier for a patient to understand percentage. Well this is what you got cracked they can relate to that. So, time is often a factor where I may nor administer BKB-SIN at every interval. And then by one year we are kind of again wanting to monitor and make sure performance is stable most patients are platued at that point and then recommending patients come in annually and we do administer this typically the same testing at the one year mark annually there after just to monitor performance and ensure things are stable and if not, what is the reason. Is it due to mapping? Is it due to an internal issue? Is it due to external equipment? And figuring that out.

So most of you all may or may not be familiar with the Minimal Speech Test Battery. And so, in 1996, the committee which was comprised of representatives from AAA from the American Academy of Otolaryngology had an ex surgery who claimed that many factors all came together to try and identify a set of materials that could be used to kind of clinically and also for research to assess the performance of adults with cochlear implants. And up until this point there wasn't a protocol or there wasn't a good recommendation or standard. And at that time they recommended use of CNC, to assess open-set word recognition and then using materials from the Hearing in

Noise Test or HINT to assess open-set sentence recognition in quiet and in noise. And so that is going into implants many years ago. This was the protocol that I used. Then over time, as advances in technology have occurred there's been certain improvements in outcome and even changes and expansion and can I say criteria it resulted in patients reaching ceiling effects in particular with HINT sentences. So patients coming in scoring 100%, where you can't do any better. Well there's a number of research that I've looked at the number of percentage of implanted adults that scored 85% or higher on HINT sentences, get forwarded to one in particular And all of this reaching to the conclusion that we probably need to implement other practices or methods to assess outcomes for adult patients.

And so they therefore came up with a revised protocol in 2011 which was utilizing CNC words, AzBio and BKB-SIN. And that is now the new the new Minimum Speech Test Battery. Which is again an updated test battery utilizing AzBio in Quiet and in Noise, CNC words and BKB-SIN. It recommended a presentation score of 60 dB, and a Signal to Noise Ratio of +10 and +5 for AzBio in Noise depending on the abilities of the listener. It doesn't specify which Signal to Noise Ratio is most appropriate in determining candidacy and I found that there is fair ability among clinics in terms of what pre-op testing is being administered to determine candidacy, and they're not related to their ability among what your testing you're doing post-operratively. And I think as a clinic, we have tried to come up with a common standard of what method are we using to determine candidacy criteria and what common testing would we like to see all of us doing for all patients.

And that may vary between clinic and clinic to clinic to clinic but most of the testing that we're doing are standard. So I think we have a few minutes that I'd just like to review a couple of case studies, just take a testing and cochlear implant outcomes. And that patients can do really well with the cochlear implant. And this there's a couple

patients that have been implanted here more recently and I'll start with this first candidate.

So this person, 81-year-old gentleman, who actually is a four star General. So a very, educated, well-spoken gentleman, he was really struggling with his hearing aid. So he'd been a consistent hearing aid user in both ears for 20 plus years. His hearing loss was progressive in nature. Obviously being in the military, he did have a history of noise exposure. And you can see his unaided, oops sorry unaided thresholds there for the right and the left ear. So a PTA of 80 dB in the right and 70 dB in the left. And then performing word recognition using CNC words. We do typically use that for word rec 20% in the right and 36% in the left. And when you see his aided thresholds for the right and left ear on the audiogram as well. And as Ellen mentioned, we do look at aided threshold just to ensure that the hearing aid is working, looking at functional gained. And if we're assuming that patient's thresh aren't hearing better with their hearing aid in respect to threshold and speech perception then we definitely go run them in a test box and ensuring that they're meeting targets and if they're not, then we maybe actually fitting the patient with a clinic stock hearing aid to ensure that we're treating them appropriately for pre-op testing.

So if you're re-up pre-operratively, and then post-op where did we have pre-op scores here for speech perception. So again I know I tested this patient 'cause HINT is the helm though HINT in Quiet for the right and left ear is indicated, then HINT at +10 Signal to Noise Ratio CNC words AzBio in Quiet and AzBio with a +10 Signal to Noise Ratio. And you can see this patient he did struggle so he's not scoring 0% across the board but sometimes he's in quiet even with the test with HINT he's struggling. So after counseling, and meeting with the physician, ensuring he was medically cleared, and healthy enough to undergo surgery at 81 And that's just a side note, I will say is the age does not determine candidacy and to some presented patients from being able to undergo cochlear implant surgery At least we wanna ensure that patients are

healthy. And then well you can see here one month, three months and six months. So this patient may not have actually come in at the two week mark. There's a time frame that we've We're kind of skipping that interval and having patients come in at one month just due to scheduling and not having the time to put patients on at two weeks. And a pretty big jump, again I did start with HINT and patient was extremely encouraged by his performance at the one month mark. But after after doing pretty decent on AzBio, and then knowing these patients early on are gonna struggle on these conditions and then you can see his three month and six month probably could have skipped HINT testing in Quiet at these intervals. But CNC word scores are obviously gonna be the most challenging task of all and that you'd with sentences even with AzBio there's some context there where you can take a guess if they say the word bee and there's bee they're getting credit for that. Also CNC words its any word in the English language And they may be close in terms of got one sounding correct versus the other but when looking at percent correct that was gonna be the most challenging condition and scoring 58% by the 6 month mark he is doing pretty well. And then I'll go mute myself and let Ellen get this case.

- [Ellen] So in looking at this candidate two she is a 70-year-old female, so she is Medicare age. Has been a consistent user of hearing aids in both ears for 46 years. She has a progressive hearing loss with a family history of hearing loss and a history of middle ear surgeries. So again you can see that we did the aided testing with both the right and the left ears And again using sound field left, sound field right, to indicate which hearing aid. Well actually this is aided right. So most likely we started talking about her using her hearing aid and then discontinue testing, and probably put one of our hearing aids on and then got these levels up here. So sometimes that's another thing to think about is if a patient comes in and you start doing the testing and their hearing aids really are not loud enough or maybe not powerful enough for them you can have clinic stock hearing aids that you can fit for them and then they can use your hearing aids as opposed to theirs. Her right ear PTA 95, left ear 80. So we're looking at

a profound hearing loss and word recs score of 12% in the right ear 36% in the left ear. And then pre-op testing, we did not do HINT or HINT+10 with this patient. CNC was 22% in the right ear 24% in the left. AzBio again less than 40%. If we're looking at Medicare aged patients and meeting that less than 40% candidacy criteria, this patient would qualify. And then at the one month, sometimes it's nice to start like English said starting with HINT sometimes at the one month just to give you an idea of how they're doing 'cause sometimes when you start with AzBio at their first appointment after you've done the activation it's a little bit disheartening sometimes.

So sometimes it's nice to start with HINT and just see how they do. Based on her HINT in Quiet and HINT +10 scores at the one month mark, I don't if it was necesary to do it at the three and the six month at all. It's nice when patients come in and you can they like to see that they're doing well and its nice for them to hear that they're getting 98%, 96%, 97%. But you don't necessarily have to do that, if they're doing that well. And then again looking at AzBio in Quiet going from the 30s to 68%, 98%, 89% oh sorry 91% and then 89%. So again doing pretty well with AzBio in Quiet. And then about 50% AzBio +10 at the six month mark. Interestingly, this patient is scoring 76% on CNC words at six moths which is like English said usually the hardest task. So 76% is pretty good. Let's see. Okay so does anyone have any questions for either English or myself?

- [English] This is English again. If there's any questions please ask away. And we just wanna thank you for taking the time to join us today. And just on a closing note, wanted to talk briefly make comment about newest expanded criteria that one of my patients that we are seeing that has some degree of benfit pre-operatively with hearing aids. So but they're still struggling in real life and that individualized testing is important but yet as you can imagine its time consuming. And that counseling, counseling and more counseling as regarding realistic expectations is extremely important. And that we would love for you to join us for our next audiology online webinar when we'll be

discissing in more detail about cochlear implant candidacy, considerations and counseling of adults in more detail. And that's on February 5th Thank you so much.

- [Ellen] I just wanna make sure that everybody has the opportunity to ask any questions. You can go right to the Ask a Question portal off to the left, and type in your field in the open box down below, and send in your question. If we don't get any questions within the next minute, I'll go ahead and end the meeting and thank everybody for attending. All right it doesn't look like anyone's typing anything in, so I'm gonna go ahead and end the meeting. And thank you all for coming.