Connect and Protect: Benefits of Perimodiolar

Presenters: Neil Patel, MD, Kate Johnson, AuD, Zach Pollack

And hello everyone. Welcome to today's course presented to you by Cochlear. I am so pleased to welcome with us Dr. KateJohnson, Dr. Neil Patel and Zach Pollack, who is who are going to be your presenters today at this time. Zach, I'll hand things over to you. Awesome.

Thank you so much, Kimberly. It is very awesome to be here today. So thank you all for both the opportunity to present some of the benefits of perimodiolar and really the core goals of an electrode from Cochlear's perspective, which are to connect to the hearing nerve and to protect the health of the cochlea. I'm very excited to be joined by doctors Neil Patel and KateJohnson and give us just a minute to get going.

Now, we do have a few limitations and risks to share as well as some learning objectives for this course. So hopefully by the end of this hour, the participants will be able to list the two main goals for an electrode and a cochlear implant survey surgery. Hopefully you'll be able to describe the difference between modern and legacy perimodiolar electrodes. We hope that you will be able to discuss and understand One center's research with lateral wall and perimodiolar. And we also hope that you would be able to highlight the value of good team communication between a surgeon and an audiologist.

There is a reason why we have both Dr. Patel and Dr. Johnson on the call today because we do believe that the best thing for your patient will happen when you are communicating as a team for cochlear implant care. So as Kimberly mentioned, my name is Zach Pollack. I do work for Cochlear North America and I am the senior product manager of our cochlear implant system. I am joined today by Dr. Neil Patel, who is the associate professor of otolaryngology, head and neck surgery and adjunct professor of neurosurgery at University of Utah Health, and Dr. KateJohnson, who is an audiologist at the University of Utah. Thank you both for joining us and I will call you back up in a few minutes.

So here are some disclosures from our University of Utah health partners. And I also do again want to reinforce that I am an employee of Cochlear Americas.

Now we have an hour long session, very jam packed with a lot of content that we're excited to talk about. I will spend the first 20 minutes really sharing Cochlear's philosophy on electrode array design, why we believe in perimodiolar electrodes, and we're going to review a few different sets of Evidence to talk to the benefit that perimidiolar electrodes offer cochlear implant recipients. Next, we'll spend about 20 minutes with the University of Utah, who will be talking about an intra patient comparison study that they recently published. I won't share too many of the details. I'll save that for Dr. Patel and Johnson later on.

But this is a very unique study that I think is very interesting that really accounts for some of the patient variability that we see in cochlear implant data. And lastly, the 20 minutes, the closing 20 minutes will be a question and answer period. So we do have some questions prepared in case we don't get any questions submitted. But we would love for you to engage in this webinar and please do submit questions through that Q and A button that is built into the Zoom feature set. And we will be trying to answer and take any questions from the audience as this presentation goes on.

So please feel free to use that feature for the last 20 minutes of a Q and A.

Okay, now, when it comes to cochlear implantation, we're going to spend the rest of this next 20 minutes talking about both the nucleus nexus system and how that can help patients keep advancing on their on their hearing journey and how slimodiolar electrode helps provide patients with the strongest start. We really do think that the nucleus nexa implant with the slimodiolar electrode will help patients reach their full potential. And hopefully by the end of the next 20 minutes, you will understand why cochlear believes that to be true.

Now, if I can really start as a foundation. There are two main goals for an electrode during cochlear implantation. And that's first to connect to the hearing nerve. This electrode is really the interface to the

hearing nerve and the and the brain. And so in order to provide amazing stimulation, we want to try to optimize that electroneuron interface.

By getting that electrode close to the modiolus. We can enhance the spectral resolution through reducing spread of excitation. That can lead to more efficient and precise stimulation. That can lead to more sound detail than lateral wall electrodes. And we can also cover excellent portions of our spiral ganglion cells.

But that's not the only goal of a cochlear implant electrode. And one of the main reasons that we redesigned our perimodiolar electrode and introduced the slimodioler was to also protect the health of the cochlea. We want an atraumatic insertion. We always want to preserve structures, but if there are low frequency thresholds to preserve we also want to preserve hearing. We also want to avoid the damage associated with overly deep lateral wall insertions.

And we'll talk through that in a few slides on why that's really critical for protecting the health of the cochlea. As a company, we really do believe that slimodioler is the only electrode on the market that can best achieve both of these goals.

Now, before we start digging into some of the data, I do just want to orient us to the anatomical structures in scala tympani and the cochlea that we might be talking about today. So the first is that we have a cochlear basal term here. This bottom scala is scala tympani. The top is scala vestibuli. And this orange highlighted structure is really the, the organ of chordi and scala media.

This black dot is our lateral wall electrode that uses that lateral wall as a tract and sits very close to the basilar membrane, that functional structure that is really important for hearing. This yellow dot represents where a perimodiolar electrode would sit. And that has the two main goals of both sitting close to our spiral ganglion cell population, which is the target of electrical stimulation, and avoiding that

delicate structure of the cochlea, that basilar membrane. We are further away from the structures we'd want to avoid damaging and closer to the structures that we want to stimulate. So this is really the core philosophy behind perimodiolar electrodes.

Get that array as close to the structures that you want it to be close to and avoid what we don't want to cause trauma to.

Now, you may have heard about the percutaneous cochlear implants, but I do want to spend a few minutes talking about this because we didn't really start talking about the percutaneous study until we launched the nucleus nexa implant system. So cochlear does a lot of research behind the scenes, some of which is public and some of which is not. And for 17 years, we actually had, I believe, the longest running investigational device exemption in FDA history with this percutaneous cochlear implant study. Now, if you see on the far left, we essentially have a very long contour advance with a percutaneous plug. This would actually go through the patient's skin and the implant electronics would sit on the outside of the skin.

This essentially allowed us to study all sorts of things while being unlimited by the hardware of that time. Because this was a 17 year investigational device exemption. We actually did span three different implant generations across this study. These patients would come into the Denver cochlear office. Once a month, they would get hooked up to this benchtop system that you see in the middle, which was essentially a very large implant that was unlimited by any kind of hardware or technology that we could make changes to.

And so we would bring them in once a month for 18 months. And we would do a very rigorous programming session looking at electrode neuron interface, looking at novel objective measures, looking at new stimulation methodologies, trying to continue to drive outcomes forward. So after those 18 months, these patients would be reimplanted with whatever technology was commercially available

at the time. And this is really what landed us on the Nucleus Nexa implant system. We knew we needed a smart implant that could be upgraded and updated over time.

Because technology is advancing at an incredibly fast rate, we knew we need to deliver more sophisticated stimulation methods. And because of this foundational research, we've landed on the Nucleus Nexus smart implant that is an incredibly capable implant system. I'm very excited to say that KateJohnson is actually one of the investigators on this percutaneous research study, and we are going to be asking her a few questions about her experience with these patients later on at the end of this presentation.

Now, in order to really understand the electrode journey that cochlear has been on, I really want to start with the concept of spread of excitation, because this is foundational for perimodiolar electrodes and why they provide excellent speech perception outcomes. You've probably heard cochlear talk about a flashlight example, and I'm going to bring that back for this for this next couple of minutes. So if you take a flashlight and you hold it up against a wall, you get a really tight cone beam of light. But as you pull that flashlight further and further away from the wall, you see that cone beam of light start to expand and expand and get larger. That same concept can be applied to the spread of excitation and how current spreads through paralymph in a cochlear implant patient.

If you look at the slide, if you look at the imagery on the left here, we see a lateral wall electrode. We've got our spiral ganglion neurons closer to the modiolus on that inner wall. But the electrode is sitting on the outside wall of the cochlea because it's further away from those spiral ganglion cells. We have a very large spread of excitation patterns. And what actually happens when you have that large spread of excitation pattern is that adjacent electrode arrays will stimulate overlapping portions of spiral ganglion cells.

Now, we call that cross channel overlap and this has essentially poor electrode discrimination. As a result, over on the right, you actually see a perimodiolar electrode. So by getting that flashlight very close up to our spiral ganglion cell population, we have a lower current level required to stimulate these spiral ganglion cells. We see more focused stimulation and a more distinct portion of spiral ganglion cells being stimulated. And that is really critical to improve and enhance spectral resolution of sound encoding.

Now, that's our concept. But how does an individual patient actually experience that? This data that you see at the top of my slide is from a Ramos study, essentially looking at pitch ranking. So what these researchers did was stimulate either the same electrode array or adjacent electrode arrays and ask these patients to do a pitch ranking exercise. Did that sound the same?

Did you detect a pitch difference between those tones? The lateral wall group was only able to accurately distinguish pitch differences in those tones 47% of the time. However, the perimediolar group was accurately able to distinguish those tones 77% of the time. Now, if you bring that back to the foundational theory, the hypothesis behind that is because the lateral wall electrodes are stimulating overlapping portions of spiral ganglion cells, stimulating either of those electrodes is going to sound more similar to that patient in a perimodiolar electrode. Because we focused in that spread of excitation, we're stimulating a more distinct portion of spiral ganglion cells, which improves the resolution of stimulation and therefore the tones that that patient can hear.

Now, that's wonderful. That kind of shows the foundational concept of spread of excitation and how an individual patient might be experiencing those different stimulation modes. But let's look at that as a function of speech perception. Now, this is a study out of Columbia University that was published last year in 2025, and Columbia actually looked at all manufacturers. So all three manufacturers were included in this study, and they looked at speech perception as a function of electrode array design

type.

They ran a multivariate regression model looking at all sorts of things that would be statistically significantly impacting performance outcomes. And they found electrode array design to be a very significant predictor of performance. Meaning when you look at a multivariate regression model, implanting a perimodiolar electrode over a lateral wall would expect to see an average increase of 16.88% CNC ward scores. So I'll back up and rephrase that. By implanting a perimodiolar electrode, you can expect that patient to, on average, outperform a lateral wall by about 16.88% CNC word scores.

Now, in this study, they also looked at all of these patients out to 24 months and the perimodiolar group was the only group to statistically significantly continue improving out to 24 months. Now, in that same multivariate regression model, Columbia found that on average a perimodiolar electrode would outperform a lateral wall by 19.85% CNC word scores at the 24 month time point. So simply by choosing a perimodiolar electrode in this category, patients were achieving about 20% improvement on CNC scores, which is incredibly meaningful. This multivariate regression model also did comment that there was an inverse correlation between insertion depth and CNC scores, meaning those electrodes that were inserted deeper did exhibit poor CNC scores. That's really interesting because it's a cross manufacturer study looking at all electrodes on the market comparing perimodiolar to lateral wall and there are significant speech perception results in this study that were exhibited.

Now to look at another study. I go around the country often and talk to quite a few different clinics and most of the data that looks at electrode array design as a function of speech perception is performed in the adult population, and rightfully so. Whenever I speak with a pediatric clinic, they always ask me, well this data is great, I'm so excited to see this, but does this apply to the pediatric population? Do you have any pediatric specific data that looks at the same electrode array design? Question.

And I'm very excited to say that we now do have some data looking specifically at electrode array design as a function of pediatric speech and language development. This is a two set article out of France and these researchers found that the perimodiolar electrodes consistently achieved closer mediolar proximity, which led to lower impedances and neural thresholds, which leads to reduced energy consumption and therefore better battery life, as well as more consistent early auditory thresholds. I think the crux of this, the conclusion of the paper was that when implanted at three years or younger, that is very important. We need to find these kiddos young. But when implanted at three years or younger, perimodiolar electrodes translated to significantly improved speech and language outcomes in children.

I am very excited to say that a lot of the data that we do see in the adult population can also be translated to the pediatric population. We do have some data sets looking at electrode array design type in that pediatric population and the results are very compelling.

So I'm now going to shift gears slightly into the protect section of my 20 minutes because we can provide amazing electric stimulation with a perimodiolar array that can provide awesome speech perception outcomes. But the other side of this equation is how do we reduce trauma? How do we keep the cochlea healthy? How do we preserve hearing if there are thresholds to preserve? And I do want to share that.

When we move from the contour advance, which is the electrode you see on the left, this was a large stylet based electrode. So there was a metal wire holding this electrode straight until the time of implantation. And then when you insert that electrode, you remove the stylet. But this is a very large and robust electrode array. And you can even see just how much of the cross sectional area of scala tympani that this array takes up.

Now, on both of these cochleas, the basilar membrane is highlighted. And this is really that functional structure of the cochlea that we don't want to damage. If we translocate, you're going through that structure. And so we want to avoid damaging the basilar membrane. And one of the ways that we can do that is by reducing the volume of that electrode.

So by removing that stylet, we actually reduce the volume of the Contour advance by 60%. So the Slim Medio is 60% smaller than the contour advance. And because of that fact, it can be atraumatic. It takes up a very small cross sectional area of scala tympani. It can avoid structures and stay very far away from that functional structure in the cochlea while still optimizing how close it sits to the hearing nerve.

I mentioned that scala tympani changes size and shape as I was introducing Connect and Protect. This is an ABSC study looking at the height of scala tympani as we move deeper towards the apex of the cochlea. So just to orient you to these lines right here, this black line is the average height of scala tympani along the medial wall or along the mediolar wall. This red line is the average height of scala tympani along the lateral wall. And you'll notice that in the basal turn we have this really nice ovoid shape with our scala tympani.

And as you move towards the apex, it kind of changes to this more triangular shape where that lateral wall height is decreasing faster than the perimediolar height. And so that's something that we need to consider if we're taking into account hearing preservation or cochlear health. We don't want to be pushing up against the str. The cochlea that we want to be functional. So at about 360 degrees, this phenomenon starts where that lateral wall decreases at a significantly faster rate than that perimodiolar height.

And if we think about inserting an electrode to 720 degrees, we're putting an electrode into a space that's not tall enough to accommodate it. So we can avoid that trauma or that damage to the basilar membrane two ways. Either implanting a slim lateral wall electrode to about 450 degrees when the

space of that scala is still tall enough, accommodate it, or we can put a perimodiolar electrode in where we still have plenty of height before we're actually contacting any of the structures or that ceiling of scala tympani.

But the electrode array and abutting scale and abutting the basilar membrane is not the only thing that we do need to consider. So this is a SOMDAS study that I've got a screenshot of, and it's a postmortem study of cochlear implant patients. This black dot right here is the electrode array. The purple color, burgundy color that we see here is osteogenesis. It's new bone growth.

The yellow is fibrosis, and this blue is parallim. And what Sombass discovered was that this foreign body reaction is going to happen in cochlear implantation. The position of that fibrosis is strongest in the basal turn of the cochlea, because those cytokines can actually get in there and really increase the inflammatory reaction. But the inflammatory reaction is also the strongest at the position of the foreign body, which is the electrode array. You notice over here towards the modiolus, we see a lot of space that still has a parallel left.

It's not necessarily tissue filled anymore, not anymore. Sorry. It's not necessarily tissue filled. The electrode array pushing up against the basilar membrane is something that we need to consider. The fibrotic reaction further attaching to that basilar membrane is also something that we need to consider.

When you think about stimulation with this electrode, you also now have to fight a less conductive tissue to get that current to where our spiral ganglion cells live. If you ever wondered, why do lateral wall electrodes have higher impedances? Why do they need more current to reach the spiral ganglion cell population? It's because it has a further distance to travel, and it might have to fight this fibrosis. And with a perimodiolar electrode, that fibrosis primarily forms on the backside of that electrode array.

So you can see again, the black is where the perimodiolar electrode would sit. That fibrosis would be growing along the backside of that electrode. So you wouldn't necessarily have to fight as much fibrosis to stimulate those spiral ganglion cells. We also are inherently further away from that basilar membrane, and that fibrosis has a further distance to grow before it would negatively impact that structure. So we're putting the electrode in the foreign body on the appropriate side to reduce that trauma and to reduce the impact of that fibrosis.

And we do believe that that has a significant impact on hearing preservation. So the left study that we see is a Sackman et al study looking at hearing preservation across limited electrodes. And they found that in the short term, these patients can preserve hearing at about a 70% rate, and in the long term, that drops to about a 61% hearing preservation rate. Now, the study on the right was a Gang et al study comparing slim straight electrodes to slim mediolar electrodes. And they found very similar things, that both electrodes were able to preserve hearing in both the short and the long term.

However, Gang et al also commented that with the straight electrodes, they saw a decline in hearing preservation over time. And we think that that's likely because that fibrotic reaction is further attaching to basilar membrane, negatively impeding its function. However, in the perimodiolar group in this meta analysis, they saw a more stable hearing preservation rate over time. Our theory is that the fibrosis just has further to grow before it starts to negatively impede that structure. And that's why we saw incredibly stable hearing preservation rates with a SlimBodyler array over time.

We do think that slimodilar can both connect to the hearing nerve to optimize speech perception outcomes and protect the health of the cochlea in a meaningful way to hopefully preserve structures and therefore hearing if the patient does have it. And with that, I'm actually going to invite Dr. Neil Patel and KateJohnson back to back on camera because we're going to hand it over to them for the next 20 minutes to talk about their very interesting intra patient comparison paper. So, Drs. Patel and Johnson,

I'll turn it over to you.

Thanks so much, Zach. That's really helpful background and I really appreciate the opportunity to speak with you all. You know, at most of our neurotology meetings, Sometimes there's only 15 or 20 people in the audience. So to have an audience like this is really special opportunity. So I really appreciate it.

So before I get into this study that we did, I just wanted to give you a little bit of background about kind of my journey to understanding cochlear implant electrodes.

This debate has been around for a long time, and I was kind of brought up in the lateral wall generation. The goal was structure and hearing preservation. There was a lot of data coming out about the benefit of hearing preservation and sort of as a surrogate structural preservation of the basilar membrane and the residual hearing for even electric only outcomes. So not just eas. And so, you know, we were try.

Everybody was trying to figure out, well, what's the special sauce to be able to save all that? Is it steroids? Is it slow insertion? Is it lateral wall electrode, short electrode? You know, all these questions kind of came up and the sort of, the, maybe the consensus or what a lot of surgeons were doing were placing lateral wall electrodes of kind of short to medium length.

And over time, that hypothesis or that theory, for a lot of the points that Zach mentioned about the position of the electrode relative to the basilar membrane over time, that hasn't really proven to be true. And what we find based on emerging electrocochleography data, which is essentially a marker of basilar membrane function, is that longer lateral wall arrays, as you insert them further into the cochlea to try to cover the same population of spiral ganglion neurons, they ride up along the basilar membrane and can dampen the function of the organ of corti. The other thing that's changed over time that's led to the questions in the study are what we all know in our practices and what you all know in your

audiology practices, which is the amount of hearing that people are coming in with when they're seeking an implant. And, you know, there once was a time where it wasn't that hard to make somebody happy when they had 0% CNC scores. And you could call 20% or 30% a good outcome because it's better than nothing.

And nowadays that delta has to be significant. And what we were noticing is kind of a little bit of a glass ceiling when it came to what we could achieve with typical length lateral wall electrodes. So getting to the study, a lot of the literature out there, actually all the literature out there is comparing perimodiolar and lateral wall outcomes between large groups of subjects. And as we all know, there are so many things that we don't totally understand about why an individual does well with a cochlear implant and why an individual does poorly. And Kate would probably attest to the fact that there are so many times that we say, oh, this person's going to do fantastic with their implant.

And then every now and then they come back and they're not doing fantastic. And we wonder, well, why? What went wrong? And we look at the CT scan and the electrode and think about what the device is doing and everything seems okay. And so it's some sort of patient factor.

And conversely, somebody who's scoring zeros across the board with a corner audiogram every now and then a month after surgery starts scoring 70, 80% on CNC words. And we say, well, how is that possible? So there's something about the patient in there. And that's why the study design that we adopted for this retrospective series was an intra patient comparison. So in theory, with the slight exception of duration of deafness, an intra patient study design essentially controls by itself for all of those patient factors, cochlear health, brain health, etiology of hearing loss, and allows you to really try to isolate, well, what differences do we see with the electrode so we can move on to the.

There we go. So I'm not going to go over too much of this, but just to summarize, because Zach has already done a great job talking about this, I really like the flashlight analogy. I sometimes tell patients

about a Christmas tree analogy. So to if you're hanging lights on a Christmas tree and you stay really close to the trunk of the Christmas tree, you don't have to travel as very as far around it. And so one string of lights might get you to the top of the tree, but if you go on the very periphery of the tree, you gotta travel ways.

Probably gonna use two or three strings of lights. And that's kind of the analogy between the length of the electrode and how far around the cochlea you actually have to travel. So the trauma of the electrode comes from where it lies relative to the basilar membrane, if it is translocating from one scale to the other. And then anything that is surgically determined, blood entering the cochlea, things like that.

The thought with older generation, especially pyramidiolar electrodes, being larger and being stylet driven, was that the chance of keeping it in the scale of tympani was lower than with a slim lateral wall electrode. So that led to everybody inserting electrodes through round window in an attempt to kind of keep the entire electrode in the scale of timpani and optimizing those outcomes. The other thing that came up early on with the slimidyler electrode that I think turned a lot of people, including many of my colleagues, off to the design was the idea of a tip fold over. And so lateral wall electrodes have lower rates of that. But I can tell you that, you know, it doesn't.

The learning curve is not that steep. It's pretty short. And the other factor is that we've seen tip foldovers with lateral wall electrodes too. So nobody is immune. It's all about good technique.

And there are some surgical tips and tricks that I often share with my surgeon colleagues about how to kind of keep that tip fold over rate to very close to zero.

We can move on from there. Zach, thanks. So the objective, like we talked about, was to compare paramodiolar and lateral wall electrodes within the same patient in individuals who are bilaterally

implanted.

This, like I said, was a retrospective review with one perimodiol or one lateral wall electrode. You might say, well, why did they have two different ones? And again, it comes down to the generation. So 20 or 30 years ago, or 20 years ago, roughly a lot of people were getting pre curved styletted electrodes. And then there was the 2000s-2010s that everybody was getting lateral wall electrodes.

And so we could see this sort of temporal difference between when each electrode was placed. And we had some patients who were sequentially implanted a relatively short period of time. But as we all know, our field is evolving so quickly that they might have gone from having a a slim straight electrode cochlear or slim J advanced bionics and then going to a pre curved array from one of those manufacturers. We looked at a lot of other data to see whether there were any confounding factors and we can present those later on. So we had 32 patients, not a massive number, but you can imagine that there aren't that many people walking around with two different electrode arrays.

Of course this was restricted to cochlear and advanced bionics because med el doesn't have a pre curved array and the study population was fairly typical for our center.

These pie charts kind of just demonstrate the distribution of electrode arrays and before your eyes start glazing over with all the different names of them. Just suffice it to say not all of these pyramidiolar arrays. In fact only the very minority of five of them were the slimmedioler configuration. So we had a lot of older generation styleted arrays, including even one nucleus contour. So not even pre contour advanced many 512s or the 500 series magnet with contour array and then a portion of advanced bionics devices in the lateral wall population.

Again, these were. The length of the array was fairly constant among those because of the manufacturer.

So this table Kind of summarizes our demographics for each of the groups and just descriptive statistics about the two groups. There was a little bit of a follow up duration difference between the perimodiolar and lateral wall groups, which I think again lends itself to the fact that a lot of people were implanted earlier on with styletted arrays and therefore had longer follow up compared to those who were implanted in the late 2010s or early 2020s with a lateral wall array. The big take home here, which I think sort of echoes what Zach presented from the, I believe the Columbia group was about a 20, 24% difference in CNC word score. And that remains significant. After we controlled for a number of factors, one of the questions that we knew that a reviewer would ask when publishing this study was, well, if somebody had their implant for longer, they're going to do better with that no matter what.

And there was a modest difference in AZ biosentence scores in quiet, but p value of 0.047. So not a huge difference. And the CNC word score was slightly different if you just look at the numbers. But it didn't prove to be statistically significantly different. And so we concluded that while there is, while all of us would attest to the fact that a lot of patients like their first implant more than they like their second implant, there wasn't a massive difference.

And so that difference between pyramid isler and conventional length lateral wall remained true.

This kind of summarizes what I've talked about. And just to reiterate a bit, we're focused here on speech understanding and CNC word testing. And so I've now kind of taken that number of 60 some odd percent home with me when I counsel patients. And knowing that that's an average, when I see somebody who has had their cochlear implant evaluation with Kate or one of our other audiologists and they're scoring 40 some odd percent. I know that I've got to eke out a delta with something so that they're happy and obviously lots of other things that define happiness with a cochlear implant, but that's a big one and that's one that we often will show patients and say, look how well you're doing.

And so that having a score, an average score in just that population with a lot of legacy devices of 66% is really meaningful. And I would venture to say, though I don't have the data to show it yet, that if we did the same study in 10 years with a whole lot of slim mediol ers compared to conventional length lateral wall arrays that we would probably see an even larger delta because we'd be leveraging things like hearing preservation and structure preservation, not having any scalar translocations and things that happen with the larger arrays.

As I mentioned, it's a relatively small study just given how unique this patient population is to have one of each. And we're a center that does all three manufacturers and does a fair number of med el devices. And this did not include longer lateral wall electrodes because of the study design. So you couldn't do an intra patient comparison unless they had two different manufacturers, which of course is very rare.

And these just are some references for this. And we'll move on from there.

I am going to jump in and talk a little bit, even though I am not a surgeon about what wrapping factor is. And Dr. Patel, please feel free to jump in if I misspeak or misstep on anything. So we've all, you know, Zach did a great job, Dr. Patel did a great job of talking about this kind of where in the cochlea this, these electrodes are sitting. And so Dr. Patel's example of that Christmas tree, we're talking about getting closer into the mediolus. And just because a device is pre curved does not mean it's always going to land tightly against the modiolus.

And so there is variability between patients and more importantly between surgeons and surgical techniques on where that electrode is going to fall. And if it is closer to that inner wall or closer to the modiolus, then the wrapping factor is tighter if it is a lower number. So there is a number that we have that we're able to get what this rap factor is based on just how close we are to the modiolus. And that is a very important part into this, this aspect of we're talking about, you know, is this perimodiolar giving us

better speech outcomes? And the question isn't just is the perimodiolar doing that, it's also how is that perimodiolar sitting in the cochlea.

If it's not placed well, then it's kind of a moot point that we have this perimodiolar electrode. If it's poorly placed, it's poorly placed. And there actually is some research, I think the next slide, Zach has some of the research that some different groups have done looking at word recognition in comparison to this rap factor. So they are able, we are able to see that some speech scores are better when a electrode has a tighter Wrap factor. So you can see in some of those examples, over on the right side of the screen you can see sort of a tightly wrapped versus a loosely wrapped.

And it really looks that way. It looks like it is, you know, really spiraling versus just kind of curving and being more of a C shape. And there is a significant correlation between speech outcomes and how tightly wrapped the electrode is. This graph shows it really lovely that the tighter the wrap, the better the CNC outcomes are. And so it doesn't matter.

Like we're talking a lot about this perimodiolar versus lateral wall, but at the end of the day it actually matters how the device is placed. And obviously as an audiologist I have no control over that. But that is where communication with your surgeon kind of comes into play and being able to make sure that you are putting forth a recommendation to a patient that your surgeon is also comfortable with. Because if a surgeon does not feel comfortable placing a perimodiolar electrode, then they are better off with, with going to that lateral wall. Because a poorly fit perimodiolar electrode is probably going to have worse outcomes than a properly nicely fit lateral wall electrode.

Especially if we do start bringing in aspects of the, the length of the lateral wall electrode and if it is a longer lateral wall. So it's definitely not just a one and done sort of aspect of this electrode is better than lateral wall. It has to do with how it is placed in the patient. And like I said, I'm not a surgeon, but I do know that there are surgical techniques that the surgeons can employ to make sure that it is wrapped.

Well, this is a great picture of two different electrodes.

Both of them are perimodiolar electrodes and you can see just how different. This is just an X ray. It's not a CT scan, not anything fancy. This is just an intra op X ray, which is an important part of the kind of surgical protocol to make sure that you don't have a tip fold over. But it's not just about tip fold over, it's does this device look like it is placed where it is supposed to be?

There's some things a lot of research is coming out about. The surgeons can use what's called a pullback method, where basically the electrode gets placed in and then they just give it just a little tug and you can kind of imagine that that then hugs that a little bit closer to the modiolus that it's wrapped around. That is kind of the recommendation that cochlear has. They, they do train surgeons to use this pullback method, I will say from my experience, not all surgeons are doing that. A lot of surgeons are just placing the electrode, getting the X ray, saying there's no tip fold over.

We're, we're good to go. And there's a lot that is going to hopefully be coming in the future to help make this part of it, the placement part of it a little bit easier to see and to have maybe some objective measures that can confirm that wrapping factor without doing the, the crazy amounts of extra work to do that the some things are already, you know, in existence for this cochlear does have in their smart nav technology, which is the intra op measurements to be able to check for tip fold over. And there's a lot that hopefully could be developed in the future that will maybe integrate into some objective measures to be able to say it's not just looking at the tip fold over, it's also looking at some of these other factors. Because again, we now have the research to say that those other factors, the RAP factor in particular matters. But outside of that visual representation on an X ray, which is not always perfect, there's not currently an easy way to figure that out.

And that is again, an important thing that you need to know if you are going to be talking to your team about should we be implanting perimodiolar versus lateral wall?

So this is all to say, this is an audiologist and a surgeon decision. And when I first started working in the cochlear implant field, which was over 10 years, I did not feel comfortable talking to a surgeon, any of my surgeons, about, hey, there's this new research coming out. What do you guys think about this perimodiolar situation? I think I brought it to one of my surgeons once and they said, nope, I don't like that electrode. And I said, cool, you are going to put in the electrode that you feel confident and comfortable putting in.

And while I do still agree that that is the best course of action, because again, a poorly placed perimodiolar electrode is not going to work better just because it's perimodiolar, the placement matters. And so. But I think it's important to have these conversations with surgeons. And I think a lot of audiologists don't necessarily feel comfortable talking to their surgeons about this. Especially Dr. Patel kind of mentioned that a lot of the older training of cochlear implant surgeons, they learned on lateral wall electrodes.

That's what they're comfortable with. I'm going to kind of talk about one of our colleagues Dr. Richard Gergel, who is a fantastic neurotologist and a fantastic surgeon, and he did lateral wall electrodes for a very long time. And when the perimodiolar electrode came out, we brought it to him. Our audiology team brought it to him multiple times, saying, hey, can. Can we maybe try this?

And he was like, I don't like it. I don't. I don't feel. Nope, nope. And I was like, hey, that's your.

I would rather you do what you are comfortable with. You are doing the surgery. And it wasn't until he was kind of. He did a study that kind of forced him to use the. The perimedial or electrode.

And I think he did like three or four of them in a row and then was like, oh, never mind, this is fine. And it was just. He just had to kind of get over that little hurdle. And I don't know, Dr. Patel, if you want to add

in any. You.

You said it's a pretty easy learning curve, but it is a learning curve. There's something a little bit different about placing that perimodiolar than placing a lateral wall. Yeah, I agree, and I think you nailed it with just what people are comfortable with.

But I can tell you, having trained on both of these, I don't think it's measurably different to place a pyramidiolar array. I think it's quite a bit easier than older styletted electrodes.

And I think it's a wash between typical lateral wall array and slimmed dialer. And I think it is important, again, to this communication factor of bringing some of this research to. Especially if you are talking to a surgeon that, you know, if you are a practice that is only implanting cochlear, for example, there's no argument to say, well, the lateral wall is going to perform like this research is very clear that those shorter lateral wall arrays are not going to have as good or it's. It's. It's.

The outcomes could be a little bit less. It's not that it doesn't work. Of course lateral walls work. And of course, you know, Dr. Patel alluded to. There's this whole chunk of things that we don't know why some of these.

Some people do really well and some people don't do well, but that is definitely something that is part of an audiology and an audiologist perspective on all of this. And I think that we need to be involved in these decisions. It's not just a surgical decision. Yes, there's a big part of it that Surgical, but it is definitely not only the surgeon. Also, as audiologists, we all know that we're the ones stuck with these patients.

So, you know, the surgeons do their, tie it up in a neat bow and say, hi, I'll never see you again. And we're dealt with the patients that are complaining and unhappy with their outcomes. And so if we have

any way to get them better outcomes, if that involves influencing the surgeons a little bit, then I think it's well, well worth the time. On the not surgical side of things, from just as an audiologist that's worked with, I've done a lot of lateral wall and a lot of perimodiolar, and you can get, in general, overall lower stimulation levels to get the exact same loudness from a perimodiolar electrode. This is a great example of a, A, a patient that has a perimodiolar on one side and a lateral wall on the other side.

And you can see that there's a lot more headroom on the, the perimodiolar side. And so you can see that you just have a lot more movement and, and ways to, to adjust and change things when you have the closer proximity to the thing that you're actually wanting to stimulate. It's not a hard and fast rule. I, it actually took me a minute to find. I had a couple patients that have perimodiolar and lateral wall that I was like, that's actually pretty similar.

But in general, you are going to use lower stimulation levels with a perimodiolar electrode simply because it's closer.

Awesome. And I'm going to jump back in actually, because this kind of brings us to the Q and a portion of the webinar. That content took a little bit longer for us to present than we anticipated. So in the last 10 minutes, I'm going to quickly ask Kate a question and then break into the Q and A. But back to that percutaneous research that I mentioned in the very beginning of this study.

This has been something that we have been looking at for decades. And as a company, Cochlear really does believe in focusing our stimulation. You know, today we're doing that by getting the electrode close to our modiolus and reducing that spread of excitation, enhancing spectral resolution. But that percutaneous research was really foundational to push our understanding of cochlear implant stimulation forward. And so with that, I'm actually just going to ask Kate, as somebody who interacted with the patients in that percutaneous study that had some of the research maps for novel stimulation Methods.

Can you share a little bit of the experience about what patients were talking about with those maps and kind of their perspective on that stimulation method? Yeah, so I joined the percutaneous study at the very tail end of it. I, I did not have a huge amount of experience with these patients, but I did have a couple and one of them sticks out really in my mind because she brings it up a lot, to be honest. I have a patient who was actually bilaterally implanted in the percutaneous study. She had really horrible insurance and needed an implant on both sides.

And this was one of the ways to do it. Because after the percutaneous study was over, after that 18 month period that was taken out and a commercial device was put in, that was the trade off that that patient went through to participate in all of that. And I have a patient who's actually an educational audiologist and every time she comes in for just any of her follow up, she always says, I miss my study map. And she is always talking about, oh, I wish I could go back to my study map. Because as Zach was saying, when they were participating in this study, they were getting a mapping strategy that is not available commercially.

And so when that device was taken out, they lost that. And she always talks about how much better the sound quality is. Her scores didn't change at all. I should note that too. It was about sound quality.

Awesome. Thank you for sharing a little bit of that experience. It is very exciting. I think we are looking very much forward to the next phase of our research applications and you guys will likely start to see some things from cochlear in the future, in the near future about research opportunities. But yeah, we are very excited about what the Nucleus Nexa implant system can hold when it's paired with a perimodiolar electrode that already kind of hones in on our spectral resolution.

So because we only have a couple of minutes left, I am probably going to ask each of you just one question if that's okay. So, Dr. Patel, we'll start with you. My question is really around the study design

and I think you did touch on this a little bit in your presentation. But one of the things that I think this study does a really good job of is accounting for some of that patient variability and outcomes. Can you talk a little bit about why you guys came up with the study design in terms of accounting for cognition and I guess just the state of our industry and really where do we have gaps when it comes to variability and outcomes?

Yeah, absolutely, I can elaborate on that. You Know, a lot of people will bandy about the duration of deafness thing for predicting outcomes. It actually doesn't really predict outcomes. And there's more and more data showing that. And so once we kind of let that fall out of the equation, all we're left with are some things that we can test and some things that we can't test.

So you can test somebody's cognition, more or less. You can do screening tools, you can do a moca, you could do more involved neurocognitive testing. Most centers don't routinely do that because it's another barrier to somebody getting implanted. And we're really in the business of trying to reduce those barriers in a market that's already under penetrated. Then there's specifically the health of the cochlea, which there's a lot of emerging data from Craig Buchman and the group at Washu on electrocogliography and predicting outcomes.

And there's definitely something there. If you can't do that, because you can't do that in a retrospective study, there's really only one way to do it, and that's to try to control for all those factors within the same patient. And so these were all individuals where it wasn't like they had a Meniere's ear on one side and a presbycusis ear on the other side. It was all fairly garden variety hearing losses, or at least having symmetric etiologies. And given that the time difference between one array and the next wasn't dramatic, you know, 10, 20 years, we didn't think that that duration of deafness factor, which again is equivocally important, was going to play much of a role.

We didn't talk about children who got one implant when they were prelingual and then one implant later on. We're talking about sort of conventional adults. And I think that's where the strength was. And it was good to see also that it validated what other groups are reporting as well. So it wasn't.

It was kind of in line with the Columbia study and other literature.

Awesome. Thank you. Yeah. And I also think that cochlear, as a manufacturer, has kind of obligations to help push the industry forward. And I think some of what we didn't speak about in that percutaneous study was looking at novel objective measures to kind of help help us understand the impact of cognition and neural health and really what's going on inside of the cochlea.

And so that is an obligation that we take very seriously. And I think it's on us to continue delivering new tools to understand what's happening in the cochlea. So Kate, I'm going to ask you the next question and this will probably be our last question just because of time, but what advice would you give to a younger audiologist to start a conversation with their surgeon if they're not already comfortable having that discussion? In my opinion, all you need is data. And there is so much data that is out there and available to us.

And you know, most surgeons are going to be data driven people. Most physicians are data driven people. And so I think that as long as you can provide that data and not just say, you know, my cochlear rep told me that the perimodiolar array is better. Can you guys start doing that? But actually showing some of these research studies and the data that is coming along with it and especially knowing that there's some future things that, that could be coming down the pipeline that, that hinge on, on what we did in that percutaneous study, which we know you, you know, you guys have said our NEXA platform is kind of based on a lot of, a lot of that research.

And so if you can prove, I think that that is for me, I think that's, that's where I would start. I wouldn't start with someone told me to do this, I would start with hey, we've got some really compelling data to, to support this. And then going, I would say to your cochlear rep to talk to them about, you know, training and how do you bring, approach that, that subject. You know, cochlear definitely has had that conversation with many a surgeon. And so they're, they're going to know how to do that and how to support that conversation.

So if you have a big scary surgeon, which they're just people by the way, you can just talk to them. But if you've got a big scary one, then pulling in your resources from the manufacturer can be helpful too. Just make a quick comment on that. You know, I get calls from a lot of surgeons and I'm sure that the more, you know, senior ones in our field get a million more calls than I do. But from surgeons around the region who are trying something different or, or hey, I've never put in one of these before.

I've never used this device before. Yada yada yada. You got any tips and tricks? And, and the manufacturers, really all three manufacturers have been excellent about, about linking surgeons with other surgeons because there are some who don't want to hear it from the company. No matter how much expertise they have, that's a pride point.

But they're willing to talk to one of their colleagues, so that's another thing you know, to do. It might not be something that the audiologist suggests, but in that conversation that there's probably somebody not that far away who has had that experience. And I do the same of my colleagues when it's something I haven't done before.

Awesome. Well, thank you both. I couldn't agree more. I think leverage your manufacturer's representatives. I think our cochlear reps would be very happy to connect peer to peer.

If they want to hear from somebody in a surrounding area that has direct practice experience or if we can support a conversation with data or with any of the evidence here, or with bringing an electrode insertion model in to get some hands on experience, we are more than happy to do so. So thank you both, doctors Patel and Johnson. I really appreciate you both joining us today and sharing such an amazing perspective on cochlear implantation and electrode array design. And so to just wrap us up, really the key takeaways that we wanted you all to walk away from, we're just understanding some more data about slimodioler and that it's the only electrode that meets the design goals of both optimizing that electrode neuron interface and connecting to spiral ganglion cells for focused stimulation while also protecting the cochlea of the health. Protecting the health of the cochlea through an atraumatic insertion.

Perimedisler placement is important and manufacturer is working on novel objective measures to really understand placement and make sure that that's optimized. We will hopefully continue to release new tools to make sure that everything is placed as as optimized as possible. And then lastly, open communication with your surgeon can help guide electrode choice. Every patient has a different need and really opening up that team communication of what electrode is right for what patients is going to make sure that that patient gets the right device for them. So we encourage you guys to open lines of communication between the surgeon and audiology team to really discuss what's right for your patients.

So with that I will thank you all for joining today. This has been a very quick hour. I was really hoping that we would have some more time for a Q and A session. But thank you all for the time and attention. We are going to close it down here.

If you do need any information or if you would like more information from cochlear, please reach out to your local representative and we would be very happy to have conversations with you or your surgical team as well. Thank you all.

Wonderful. Well, thank you all so much for a wonderful presentation today. As Zach mentioned, please reach out with any questions. This will conclude today's course. So I just want to thank everyone for attending today.

We hope you have a great rest of your day. Take care.