Cochlear Implants as an Option for Children with Single-Sided Deafness, in partnership with American Cochlear Implant Alliance

Presenter: Lisa Park, AuD, CCC-A

Welcome, everyone. Thank you so much for joining us today. This is Donna Sorkin from the American Cochlear Implant alliance, and we will be talking today about cochlear implants as an option for children with single sided deafness. And we are thrilled to be doing this webinar with audiology online as part of the continuing ed programs. And you could go to the next slide.

And this is actually part of a two part series. We earlier recorded the series on single sided deafness for adults. So you can go back and look at that one if you didn't already see it. And it's intended to be a resource for people from across the care continuum working with adults and children. You could go to the next slide.

So you may wonder who we are and why. There's another organization in hearing health, and we are a membership organization. We're unique in that we're focused on cochlear implantation and access to care, and our members are from across the continuum, audiologists like Doctor park, as well as physicians and speech pathologists, educators, and others on CI teams. We also have consumer and parent members, and they often serve as our advocates and hearing aid specialists who are wanting to learn more about when to refer. We have a website that's very extensive, designed for people that are both in and out of CI, and we really work to be collaborative with other organizations, and that's portrayed by alliance in our name.

And we welcome your involvement regardless of where you are. And we've given you some sources there of how to find out more about what we're up to, and we could go to the next slide.

So our mission is to advance access to the gift of hearing provided by cochlear implantation through research, advocacy, and awareness. So we work across those three key aspects of our work, and we address factors contributing to underutilization

of cochlear implants, because in this country, we're still really only serving about 50% of children who could benefit from cochlear implants. And that percentage goes down even more if we think about children who have single sided hearing loss. The topic of today's talk, and we really try to improve awareness regarding candidacy and outcomes of cochlear implants, which, of course, is a key topic for today. And you could go to the next slide and why this topic is so critical right now.

Really, our perspectives about unilateral deafness have changed dramatically. I've been working in cochlear implantation for well over 20 years, and when I first got into this field, we never talked about providing cis for people with SST. It was always about people with bilateral, severe to profound hearing loss. And that has changed because we know that there are measurable impacts on access to sound and quality of life for people of all ages who are deaf on one side. And I think many hearing health professionals and others in health generally are unaware of when and whether to refer for a cochlear implant candidacy evaluation.

So a big change in not that long ago where we were still just focused on bilateral deafness. The other thing that's really important to know is that insurance coverage for CI and SSD expanding. I had written a paper a few years ago on availability, and it turns out that most insurers can be convinced to cover many more are including SSD in their indications in their policies. And this has all come about because of much greater knowledge of the impact on outcomes. And Doctor Park going to talk more about that, of course, and you could go to the next slide.

And we have developed a number of resources to support our community's knowledge about single sided deafness, both for adults and children. And two papers have been developed and published in ear and hearing, and the first one on adults, and we go to the next one because that's a topic today. And we developed guidelines for clinical assessment of cochlear implants and children, and that one was actually developed by

a task force that was led by doctor Lisa park. And so I've just put some of those key findings there. But you can actually look at the full paper, which is open access, and we'll give you some additional support after the webinar today.

So take a look at that and other materials that we have on our website. You can go to the next slide, Doctor park. So today's talk is on CI as an option for children with single sided deafness. And our esteemed speaker is Doctor Lisa park. She is an associate professor and division chief of the Children's cochlear implant program at the University of North Carolina at Chapel Hill, and she has a doctorate in audiology from the University of Florida.

Her clinical research focuses on expansion of CI indications for children to include SSD and other issues related to this. And she's also very focused on trying to ensure that we provide the best possible outcomes for children who have non traditional indications. She is really a world renowned first individual, both for her research and her clinical care. So we're thrilled to have Doctor Lisa park with us today for this talk. Thank you so much.

Thank you so much, Donna, for that kind introduction. I'm not sure I deserve all that, but thank you very much. My name is Doctor Lisa park. I'm here today to talk about single sided deafness and how it can be an option for kids. So here are my disclosures, our learning outcomes.

We're going to talk about identifying children with SSD who should be referred for an implant evaluation. We're also going to talk about the benefits that can be expected from cochlear implantation in kids with single sided deafness. And we're also going to talk about strategies for requesting insurance approval for cochlear implantation in kids with SSD. So let's do a little background first back to some of this physiology of bilateral hearing. There are really three types of listening.

We have our monaural hearing. That's when the signal is just going to be coming to one ear, as in the case of SSD, or let's say you're listening with just one earbud in.

We have bilateral hearing, so that's when you're going to have the same signal to both ears, but you're not really integrating them together. There's no need to. So you're getting the exact same signal to the left ear and the right ear. So maybe you have both of your ear pods in, but there's no real stereo setting or anything like that. And binaural hearing is when we're combining information from both ears and using the processing in our brains to really be able to use those binaural cues to be able to know intensity differences, timing differences, and spectral differences between ears.

So right now, when we have kids with single sided deafness or a unilateral hearing loss that's too severe to be treated with a hearing aid, we have very few options. A lot of the times it's watch and wait. So we're not doing anything until they get older. But one of the options is a cross rerouting of the signal, contralateral rerouting of the signal. So here we have our young lady who has her cross on.

In this case, it's going to take sound from her poorer ear over to her better ear, hearing ear, which is great. We like that. We want to be able to have more access to sound on the poorer ear. The problem is that also brings noise into the poorer ear that into the better ear from the poorer ear that we do not like. That's going to interfere with our overall speech understanding.

So for these reasons, we often want to wait till a child is older before we give an option of a cross. We want them to be able to survey their environment and know when they need to use their cross and when maybe they have to turn it off. It's a lot to ask for a young child. They say around seven, you can start thinking about it. I think that's a really big responsibility for a seven year old.

The other problem is that when you put that receiver on the better hearing ear, you're occluding that ear, and we don't want that to happen. So their ears have to be physically big enough so that when that receiver goes in the better ear, it's not closing everything off. Our other option is a bone conduction device, which is going to be very similar to across. It's going to be taking signals from the better hearing ear over from the poor hearing ear over to the better hearing ear. But it's using bone conduction, it's taking advantage of that very low intraoral attenuation.

But you're going to run into a lot of the same problems with the noise, also going to the better hearing ear, which we do not want.

So we need two auditory signals. We need one from each ear to reach the brainstem, and that's where the signals are combined in the superior olivary complex, and then they're sent higher along the auditory pathway, and eventually the brain is using those differences in information to form auditory perceptions. So let's talk about what having two ears can do for us. And then like a refresher on binaural hearing. Binaural summation, that's the practical benefit of hearing with two ears.

It's an additive effect. It's from the signal being heard by two ears. Typically it's going to give about a three decibels boost in perceived loudness. For higher input levels, that boost is even greater. But for most of the time it's about three decibels.

It's a psychophysical effect that sound being presented to both ears is perceived as being louder than just a monorail signal. When children have unilateral deafness, they aren't able to take advantage of binaural summation, which may not seem like a huge impact on its own. But that's not the only difficulty that SSD brings. We have an additive effect here. Now, head shadow.

Head shadow is a physical effect, can work for and against kids with single sided deafness. The head is actually providing a barrier. So here's how it works for hearing a noise. We have a young lady sitting in class. Her teacher is in front of the room giving a lesson.

So let's say that her voice reaches our students ears at about 50 decibels. Since she is in front of the classroom, we'll say she's directly in front. The same level is going to be presented at both ears. Now, unfortunately, the air conditioner is at our student's right ear making a bunch of noise, which gives her a zero decibels signal to noise ratio on that right side. Now, she isn't just going to hear that sound on the right.

The sound is going to travel around her head, high frequencies more so than low frequencies. But when the noise reaches the left ear, the amplitude will be reduced on average by about 6.4 decibels. The left ear, there's going to be a 6.4 decibels signal to noise ratio, a positive signal to noise ratio, and that's going to help her be able to access information from her teacher. This is part of that spatial release from masking. Let's say the air conditioner was in the front of the room.

Signal and noise are going to be co located and the same. You're going to have a zero decibels signal to noise ratio presented to each ear. If we move that noise, the head shadow is going to create a beneficial situation with a more advantageous signal to noise ratio on one side. This is great when you have two ears that are hearing well on each side. But let's say our student is deaf on the left side.

She's not able to access that higher signal to noise ratio, and she's stuck with the poor signal to noise ratio on the right. She's not going to be able to have that spatial release from masking that children with typical hearing have.

So in this instance, the listener's relying heavily on interaural level differences, or ILDS. That's when sound comes from one direction, encounters the head as a barrier, and then the sound is softer on the other side. But we also use cues about timing and pitch differences between ears.

So intraoral timing differences are exactly what they sound like. When the teacher moves a bit to the right, sound is going to reach her right ear before her left ear. It's very subtle, but that's what happens. If she moves to the other side, sounds going to reach her left ear before her right ear. So the student's able to use the timing differences between ears for spatial hearing cues.

But there are no timing cues to weigh against each other when only one ear is stimulated.

Pitch also ends up being different between ears. These are those spectral differences. So your ILDS are going to vary based on frequency. For low frequencies, little to no difference exists because low frequency sounds have longer wavelengths and they can bend around the head. Higher pitched tones.

The level arriving at both both ears is going to be different because high frequencies are diffracted and the amplitude is reduced at the contralateral ear. The higher the frequency, the greater that effect. Here's a visual. We'll let our teacher sit down here, bring her closer to our student. Our teacher's speech is made up of a number of harmonics.

There are a lot of frequencies represented in one utterance. Lower frequencies, with their long wavelengths, can bend around the head and are represented pretty much the same way on each side. The higher frequencies have shorter wavelengths, though, and

that head is a barrier. So the high frequency signal on the other side is going to be reduced. In that way, we end up with very different spectral content at each ear.

The signal on the right is going to look much different than the signal on the left, and our brain can use that information to help focus on the signal that we are interested in.

So, binaural squelch. When we have two ears to listen with, there's this combine effect of the differences in spectral content level and timing. Head shadow is a physical effect. When binaural squelch, we're using those two sounds integrated in the central nervous system. We're using that neural process.

Here. We have a bunch of noise and speech presented to one ear. For a monorail listener, there's no signals to compare between the two ears because the ears aren't receiving signals. So everything gets kind of jumbled up together. When we're listening with two ears, we have differences to compare and sort out between speech and noise at the level of the brain stem.

So for this effect to take place, we need neural integration from both sides. The squelch effect is what happens when we're tuning out a noise. So you're using both ears to sort out the speech and the noise. And monorail listeners aren't able to tune out noise because there aren't two ears receiving signals for the brain to compare that information. So if you're fitting them with a cross or a bone conduction aid, we're also not taking advantage of any of these binaural listening effects because we're still only stimulating one ear.

We also use two ears to figure out where sounds coming from. It's common to see localization and lateralization used interchangeably, and there's competing definitions of which is which. But clinically, in audiology, we're typically using the phrase lateralization when we're discussing the perception of sound coming from the left

versus the right. This is a rather simple task. So this is just saying, is the sound coming from the left side or is it coming from the right side?

Localization, on the other hand, is identifying where the sound's coming from in a free space. So the brain is using all of those spatial cues, time, distance, differences in spectral content, to find out where that sound is coming from. And again, this is a task you need two ears for. So, yes, two ears are better than one. For children with single sided deafness, the only way that you're going to be able to stimulate both neural pathways so that sound from each ear can be weighed and compared is with a cochlear implant.

I'm going to guide you through some of these difficulties that we know kids with SSD face and how a cochlear implant can provide benefit, and we're going to use a case study to do that. We're going to talk about our friends Simon.

So Simon comes to our clinic presenting this way. A six year old male, he has a history of otitis media and tubes. He passed his newborn hearing screening at age four. They documented normal hearing on both sides, but then he had this persistent Perf and they tried a myringoplasty, and that didn't work so well. So then they tried a tympanoplasty.

At that point, his post op testing showed a severe profound hearing loss in that right ear and poor unaided word recognition. So he was only really able to understand about 12% of speech. They fit him with a ponto on the soft headband, so, bone conduction device, and he was using an FM system at school. So this is a typical situation, and this is when you as a provider may be asking, is this someone that we want to refer for a cochlear implant evaluation?

So let's talk about referral versus candidacy. When you refer a child for a cochlear implant evaluation, it doesn't mean that they're signing up for surgery date. It doesn't mean that the diagnostic audiologist or the physician needs to be sure they're going to be a candidate first. We often hear that clinicians are hesitant to do any referrals because they don't know what the latest criteria are. They don't know what insurance will cover, or they make assumptions about what insurance will cover.

The job of the CI team, that's what we do. It changes so, so quickly, and we're here day in and day out, seeing what these differences are, how they're changing who's a candidate who may not benefit quite as well. So it's important for clinicians to recognize that a cochlear implant is another tool in your toolbox for hearing care. It's all on a continuum, in a spectrum. Even if a parent just asks about a cochlear implant, we are happy to see them.

Audio. We are. In the case of SSD, we argue that being a unilateral listener is worth a referral. So it's worth at least talking about for most kids.

So one of the questions people may ask is, is Simon too old because he's six? But his hearing loss only happened two years ago, so we're still learning a lot about outcomes. There are clinics who are only implanting kids who are perhaps under five years of age, under four years of age, because they believe that the outcomes are better for us, benefit is benefit. It may not be 80% word recognition, but it could be that that's not the goal. It could be that all they want is better lateral, better localization.

We might be able to get them that with a cochlear implant. So we need to look at each individual and decide from there if this is something that's worth at least talking about.

So Simon does fall in the age range of candidacy, but that doesn't mean that anyone under five is not a candidate. The number five was pretty arbitrary when the FDA set

their candidacy. So there's the FDA candidacy, and then there's the care that's given to children. So in some of our bigger centers, including ours, we do a lot of off label cochlear implantation. So that's when we know that this cochlear implant is going to be beneficial for this child.

And so you can go ahead, the surgeon can go ahead and recommend that intervention for them. So refer, refer, refer. We love referrals. We'll always talk to a family about cochlear implants. It could be that they're not a candidate now, but they might be down the road, and then they're prepared for that.

So Simon comes in for his evaluations. This is what his audiogram looks like. No big surprises, but we want to make sure that we gather all the data that we can, especially the subjective and quality of life data. Insurance really likes to see those data. It's really meaningful for them for everyday function.

So Simon's family reports that he can't localize, and they're very concerned that that's a safety issue for him. He's also really overwhelmed by noise. He actually has this safe room at his school that he goes to when he's really overwhelmed. They have these assemblies that he stopped going to because it was just too loud and overwhelming for him. He takes naps during the school day in the principal's office.

So these kids, a lot of times when they'll come in, their families don't even really realize that they're struggling as much as they are. They will tell us, oh, yeah, they take Naps after school. Well, that's not a typical six year old behavior. So sometimes it's just a matter of talking to families about what is a typical level of fatigue. Some of the tests that we like to use are the SSQ.

There's a version for children, parents, and teachers. The Vanderbilt fatigue scales are really nice, telling you about how tired they are from listening. The peach has been

found to be sensitive to single sided deafness, as has the flip, the functional listening index, pediatric. So we use all of those tools.

We also want to make sure that we get imaging. We want to make sure that these kids have a normal cochlear nerve. If they have a hypoplasia cochlear nerve or a missing cochlear nerve, we don't. We don't want them referred for a cochlear implant. That's probably the only case where we're really like, those cases are not going to be candidates.

At least in our clinic, we're not going there. The outcomes for cochlear nerve deficiency in kids with bilateral hearing loss are not that great, but that's sometimes a child's only chance to hear sound at all. In cases of single sided deafness, our concern is that if we add a cochlear implant to that ear with a hypoplasia or aplastic cochlear nerve, it's going to really interfere with their overall understanding. When we're doing an evaluation, we want to look at aided word recognition. We often do that just because of insurance.

If there is a child who we know is not going to benefit from a hearing aid, and of course, we wouldn't recommend one clinically, I don't feel that it's right to put a hearing aid on that child for three months just for the sake of insurance purposes. So if we're going to do a hearing aid trial, I will fit a hearing aid in the office, test them with it, and there is. Their hearing aid trial is about 20 minutes. Yes. Something else to remember is when we're doing this aided word recognition, we have to mask the contralateral ear.

We don't really have a choice that sounds going to be really loud and be able to transfer to the better hearing ear.

Since Simon was part of our clinical trial, we were able to get some localization data from him. The way that we do this, we have a big arc in our lab, there are eleven speakers, each one is 18 degrees apart. The kids hear a 200 millisecond speech burst from a speaker, and then each of our speakers has an animal on top. So they tell us which animal they think made the sound based on where it was coming from. So for Simon, he actually stopped in the middle of it and said, doctor Lisa, I'm just going to say cat every time, because, I don't know.

He really, really struggled with localization before he got his cochlear implant. You can also see here that his spatial release from masking, he did not have any. In fact, it was a little bit poorer when noise went to his good ear. His snr 50, his ability to hear a noise got poor, but he did get it when get spatial release from masking, when the noise was to his poorer ear. So when he was able to rely on his better hearing ear, that's where that better signal to noise ratio was.

He could understand the sentence better.

So at first, insurance denied. They said that it was experimental. We hear that often, and we kind of knew that this was going to happen, that this is something that happens with his plan. They're known to deny. A lot of times it's just someone sitting at a desk reading the words, say, well, nope, we don't cover this.

And then they say, no. So we got to fight back. Often we send just kind of a generic request that our insurance people will send for a letter of medical necessity. But insurance doesn't make decisions for us in terms of who's going to be a cochlear implant candidate, who's going to be referred. We want to see any child with SSD who could potentially be a candidate.

And if they are potentially a candidate, we're going to evaluate them and recommend a cochlear implant if we think that that's something that's going to be beneficial for them.

So things that we want to make sure that we throw at that insurance company is data, data, data, lots of information. Their word recognition, their subjective scores, speech and language. If you can get that, if you have speech pathologists on your team, that can be really, really helpful, because some of these kids are already showing delays. Speech and noise testing, localization, if you can do it also send tons of references. Insurance companies actually want to see those references.

A peer to peer review is something that is usually our first line of defense. Unfortunately, they don't like to talk to audiologists, they want to talk to the surgeon. So it has to be something that your surgeons are willing to do, is to call that, call that insurance company and talk about the benefits for the specific child.

Last case resort. You can go to your state ombudsman. We have had some families who have done that. They have like a, I don't want to say a trial, but they have a way of looking at the case and then the insurance ombudsman will decide if that's something that should be covered or not. So we do have some families who have done that.

In your materials for this course, there is a template with the PDF's. It's a letter of medical necessity template that you can use in your own practice and change based on the situation that you're in.

So we got Simon approved. He went ahead and got surgery. He received a med l flex 28 device in his right ear. And surprise, there was some ossification at the round window. So at this point we believe that he had some inflammation from the infections that caused some damage of his cochlea.

So there was some bone growth around his round window. The surgeon had to place the device in the scala vestibule, which we really like it to go in the Scala tympani. That makes us a little bit nervous because there's more of a chance of damage to the cochlea array can go through that basilar membrane and really damage those spiral ganglion cells. So we weren't too thrilled about that, but we were still hopeful he did receive therapy. So we do recommend therapy for our kids.

We're not, to be Perfectly honest, the data are not there yet to say if this is something we need or something we don't need. We know that it helps for betterment of understanding of single words. Whether that transfers over to localization and those binaural hearing skills, we don't know yet. But it's not going to hurt to have therapy. So we do recommend therapy.

The way that we get that done is through using a direct connect system of some sort. So we have to stream sound or send sound directly to that cochlear implant. And then the parents need to be able to hear what's going on too, because when we're doing auditory therapy, right, a lot of it is based on training the family to be able to do this. So we use a splitter. We have the family use their own headset.

Here we have a bone conduction headset, but they have to turn it down really, really softly so that the kid next to them can't hear, because they do still have good hearing in one ear and they really know how to rely on it. So a lot of the times we're doing this as distance therapy, we're doing remote therapy. Even if you came into our clinic, we're going to send you to the other room, too, to do the listening so that you don't hear us on the one side. So it can be tricky. But there are some ways to get that therapy done with these splitters.

With this one here, they have two independent volume controls, which is really nice. So the child can set theirs to the level that they think is comfortable, and then the parent can set theirs as well, hopefully to a level that the child cannot hear.

So when we did his evaluation, his C and C word scores were 0% with a. With a hearing aid, right. And he was only able to get some pattern perception on the ESP, so he could tell the difference between a three syllable word and a one syllable word, but that was about it.

So here's what happened over time. So CNC word scores higher is better here. So it's a percent correct. He got zero with a hearing aid. By three months, he's all the way up to 32%, continues to grow at six months, nine months.

He had another jump here at twelve and 18 months, all the way to 24 months, where he's understanding 78% of words in his cochlear implant year alone. This is really typical of what we saw in our clinical trial here, is at three months a postdoc, preoperatively, everybody was at zero. So it's not on this graph. But no one was understanding any words. By three months, we had a significant increase, and that continued all the way to nine months post implantation.

And then it stayed. We were able to keep that benefit for the two years of the study.

And that's all fine and dandy. We love to use those CI alone scores. That's what we do. As CI audiologists. That's our marker of progress and success.

But it's important to note that in our study and others have seen the same. There's really no significant correlation between single word scores and hearing and noise localization, lateralization, speech spatial release from masking, or any of the subjective report measures. So these results would suggest that isolated CNC word scores aren't

able to predict spatial hearing abilities or any of the subjective benefits that children might experience with SSD when they have a CI. So while they're nice to have, and you should do that to monitor progress, look for any signs of potential device issues, it shouldn't be relied upon as the sole measure of success for kids with unilateral hearing loss who receive a cochlear implant.

So let's talk some about localization challenges. For safety reasons, it's important for children, such as these kids walking to school. They need to know where are cars coming from, where their friend is in relation to them, and if any dangers come near. They need to know where they are coming from and so that they can alert quickly. But we also need to localize to hear a noise.

When we know where the sound is coming from, it's easier to attend to, but we need two ears to be able to do that. Our brains are relying heavily on the difference in timing and loudness between two ears to find that sound source. So here's Simon's localization. And just a reminder, when we do this task and we have our arc, each of our speakers are 18 degrees apart. So if an error on this lower is better, excuse me, his errors are lower.

That's better. Closer to 18 degrees. 18 degrees would mean that he was off by one speaker. So we can see over time. At three months, his RM's error, his errors were about 60 degrees.

So he was off by several, about half the array. And we got better and better and better over time. Till at the two month mark, he was really only off by about one speaker. What's interesting in his case and many of the others is even with his CI off, he got better over time, but that stabilized. That didn't get better or as good as his hearing with his cochlear implant on.

So we think they were able to learn some cues once they had that binaural hearing that they could carry over to when their implant is off. Probably some level differences, those are still going to be there, but really having the cochlear implant gave that extra boost.

That's very similar to what we saw in our study. Over here we have our scores with the normal hearing ear alone. These are our localization scores. Here's what the normal hearing ear and the CI. So you can see, over time, things did get better for most of the kids.

But also with the cochlear implant on, they got a lot better. Some of these kids were approximating kids with normal hearing in both ears, so that was exciting to see. But most kids were not as good as kids with normal hearing in both ears. So it's important to remember that a cochlear implant will be a tool in these cases. But they still are children with hearing loss.

They are still children who are going to need supports in school. They're still going to need to use that FM system. It's not Perfect, but it helps a lot.

So we have communication challenges that we're dealing with. Also understanding speech and noise. Here is some spatial release from masking for our friend Simon. So this is the BKB syn. So this is.

It tells you what signal to noise ratio is needed to understand about half of what is being said. So a lower score is better here. Our scores with the CI on are red. Our scores with the CI off are in the gray. So what we want to see here is this, you know, speech front, noise front is more difficult.

Scores are higher, but then they improve when we move the noise to either side. So in all these conditions with the CI on, we see that spatial release from masking, we see that improvement happening. We don't see it as much with the cochlear implant off, and all scores altogether are better with the cochlear implant on versus off, very similar to what we saw in our clinical trial. So here we have gray again, is the CI off, red is the CI on. Speech front noise front is here.

This is going to be the most difficult speech front noise to the normal hearing ear and speech front noise to the CI side. We want to see that improve, and it does improve some with it off, but much more with the device. On quality of life challenges. So greater difficulties are reported on quality of life for children who have single sided deafness. And in Simon's case, like we talked about, he was really overwhelmed by noise.

He has a safe room at school. He's napping during the school day. So when we look at his SSQ scores, we can see that preoperatively he's doing pretty poorly on. On speech spatial and qualities of speech. He's not seeing as much benefit in listening, he's not able to use those cues.

But by the time we're three months out, we see a huge improvement and then we see that continue to grow to about the six month point, and then it stays stable for the rest of the study.

We saw similar results in our clinical trial here, so you can see that here. And on speech spatial inequalities, preoperatively, we have scores that are pretty low, particularly on spatial hearing, which isn't a big surprise. But they improve really quickly. We see improvement at three months, and, again, that is cover that continues through the first two years of the study.

When we look at fatigue, we chose to use a fatigue scale that wasn't quite what we were expecting. So. And also, we had this whole global pandemic thing happening during our clinical trial, so everybody was really tired. So it was really hard to interpret these scores, but this is what we got. So, preoperatively, he's pretty tired.

This is. In this scale, higher scores are better, so you're more energized, I guess, with your score. Higher score equals more energy, so he's pretty tired here. And then we see improvement for both general fatigue and sleep fatigue, but not so much for cognitive fatigue. That also is similar to what we saw in our study.

I think what we learned from this that we can say really happened, is that cognitive fatigue is the biggest challenge for kids with single sided deafness. We see that those scores are the lowest and that general fatigue is. Is an issue. But sleep fatigue, they're sleeping okay, but that cognitive fatigue, is that really the biggest issue that they're dealing with in the classroom? We also see poorer language outcomes in children with single sided deafness.

And in our study, when we look at. Let's talk about Simon's speech and language. So this is a higher score is better. These are standard scores. So zero is going to.

I mean, 100 is going to be your average. And then there's a 15 unit spread, a standard deviation each way. So, at first, his receptive language, his articulation skills, and his expressive language skills were all within the normal range. So you would think, this isn't a kiddo. You really need to be all that concerned about.

His expressive language was kind of low, but still within the normal range. He wouldn't qualify for services at school. At a year out, we see an improvement, a big improvement in that expressive language, receptive articulation. That all stayed about

the same. But by the time we get to two years post op, we see a big jump in that receptive language skills and stability in that expressive skills and the articulation.

So this lack of change in articulation tells us it's not hurting their speech understanding. They're still able to understand and use speech the way that they did before they got a cochlear implant. But it also tells us here, this big jump in language tells us that there are kids out there who are maybe doing fine. They're within the normal range, but they're not meeting their full potential. They could be even better communicators, and we need to make sure that those kids are getting the care that they need as well.

He wasn't typical, though. We really didn't see any change over the course of the study. Nothing. Overall, no significant changes in terms of expressive language or receptive language or articulation. But again, overall, it does show us that we didn't do any harm by giving them a cochlear implant.

When we look at these quality of life challenges, there's a lot we still don't know about cochlear implants and single sided deafness and whether or not it's really a therapeutic effect. So we know that there are some higher level functions that may be impacted by single sided deafness. Those may impact auditory attention, some executive function, some sensory motor control.

That tends to be a result of this imbalanced auditory input, we think, but we can't be sure. So these educational challenges that we see, about a third of children with unilateral hearing loss are going to repeat a grade, and between twelve and 50% of them are going to need additional educational support.

They also tend to fare more poorly on cognitive measures. Particularly, you'll see that in verbal IQ. If you do a cognitive test and you see a big difference between verbal IQ and

nonverbal IQ, that is a sign that they're not reaching their full potential. When you see that gap between scores, the greater the degree of unilateral hearing loss, the more predictive of those difficulties. And when Bess and Tharp did their research back in 84, they used behavioral rating scales completed by teachers, and they perceived that those children with unilateral hearing loss were having more difficulty learning and behaving than their peers with normal hearing.

But there's a lot we still don't know. We don't know if a cochlear implant is going to help with that educational Performance. Is it going to help with that IQ issue? Is it going to help with attention? Is it going to help with what we see, anecdotally, as these sensory seeking behaviors?

Or is it that the etiology of their single sided deafness is what's causing this issue? That very well could be. We see a lot of kids with congenital CMV who have single sided deafness, that cortical reorganization. Can we do something about that? There is some research that suggests that we can, but we need larger studies on a larger scale to see what a cochlear implant can really do.

We need to know, are these things treatable with a cochlear implant. We want to make sure that we are doing this. If we are doing this because we want to prevent these educational issues down the line, we want to make sure that that's what we're doing. So we are beginning to look at cochlear implantation for kids who are very young to see if that helps with these educational issues and if cochlear implantation is really more of a treatment for all of these difficulties that we perceive.

I'd like to open it up for questions.

Please go ahead and type your questions into the chat box or Q and A. Lisa, tell us this. Dana Sorkin, have you seen an upswing in coverage issues from insurance for

children who are getting cochlear implants with SSD? It tends to come in waves. It seems like if one company decides that they're going to be more restrictive, another company will follow suit.

We're very lucky in North Carolina that single sided deafness is covered by Medicaid. So that helps us out a lot. If we can say, well, Medicaid covers this, you really should, too. But, yeah, it does seem to come in ways, and it seems to be one, one company, and then the next company will follow suit.

Lisa, someone just said no questions, but a really great presentation. And I agree with a terrific presentation. So here's another one from an attendee, and he or she says, if a child is diagnosed with SST at birth, do you recommend treatment with a baha device or is hearing aid, hearing aid needed for a neural stimulation? So what we would recommend is if they have a severe to profound hearing loss or a really significant hearing loss where amplification could really cause cross over to the other ear. So in those situations where it's so, so loud that bone conduction is going to make them hear on their better hearing ear, then we really don't want to introduce amplification in those cases.

It's going to do more harm than good when they're little. We're also not really suggesting to use a baha or anything like that because they're right here by mom. So we kind of wait on that as well. That's what we do. But we like to get that binaural hearing as early as we can through cochlear implantation.

Right. That's really important. We have another question here from Sally, and she says, how soon would you recommend a b therapy for SSD kids after CI implementation, and would you give a period of time for them to bond with their CI? That is a really, really great question. And the first clinical trial that we did with adults, we sent them to therapy on the very first day.

So they came over and got AV therapy here with our LISS providers the day that they were activated. The researchers in that study really felt that that was very helpful to them. To go from hearing beeps to be able to figure out, oh, those are words. I recognize that. And to be able to bond with their device that way.

With kids, we find that it can be more frustrating that they are not able to figure those cues out. It just sounds like beeps. And then they're angry. They're upset. They don't want to wear this thing.

It can be hard. So it's kind of a case by case basis, just based on that child's personality. We tend to start with having the families have them stream their favorite tv show to their cochlear implant side or record a bedtime story to have them listen to that on their cochlear implant side, things like that to start with. And then we go from there. That's great.

This audience is really picking up on the importance of therapy. So Jane is asking, is the rehab for SSD similar to what you do with new cis for bilaterally deaf kids? Yes and no. So our therapists are following the same auditory hierarchy, but they're focusing on just listening with the cochlear implant ear alone. So they're streaming that sound to the cochlear implant side and then following those same sorts of tasks and skills.

But we also like to add in some binaural hearing, once they get through that auditory hierarchy, to add in some localization tasks, some hearing and noise tasks. That is something that we are looking at doing perhaps earlier in our therapy journeys. But like I said, the data just isn't there yet. And so we're kind of guessing, to be totally honest. Right.

Here's someone who's asking, how long you would wait to introduce the baha? That's a good question, and I have to say I'm not entirely sure because I'm not a diagnostic audiologist. I'm a cochlear implant audiologist, that our team doesn't like to fit them as infants. They wait till the kids can kind of crawl away. At least they're getting away from their families, and there's a distance issue and a localization issue that needs to be dealt with.

Right. Okay. And here's a great question. Are children with unilateral ANSD a candidate for unilateral CI? When not showing a benefit from a hearing aid that is one of my favorite questions.

So we actually just finished up a study and hopefully it's going to be published soon. We looked at all of our kids who had single sided deafness and auditory neuropathy diagnoses, and we went back and we looked at all of their MRI scans, and 75% of them had cochlear nerve deficiency. The chances of your child with ANSD having either a hypoplasia or an aplastic nerve are very, very high. We actually don't have any kids here in the clinic who have ANSD and single sided deafness and have a cochlear implant because all of those cases have ended up having cochlear nerve deficiency. Those kids who did not have cochlear nerve deficiency weren't interested in an implant.

So it's not something we see here. We've implanted about 125 kids with single sided deafness. I do hear from other people, other clinics who are implanting kids with ANSD, and the questions that I'm often getting make me think that those kids have cochlear nerve deficiency and they received a cochlear implant.

Anybody have any more questions? Go ahead and type them in, please. We have a bit more time. Lisa, I have a question. At one time, we used to think that if we didn't

provide SCI for SSD within a certain period of time, then there would be minimal or limited benefit.

And I've seen research that's showing that that's not the case. What do you think about that topic? I think it's important to remember that when we started, they had zero speech understanding. So maybe they only have 20% speech understanding, but that's still a benefit. So it might not be a huge benefit, but it's still a benefit.

And we need to think about what their goals are. Are their goals localization? Are their goals hearing and noise? They might not care what their single word recognition is in that ear, and it looks like that probably isn't a marker for anything. So it's just important to think about each child and what their goals are.

Something I did forget to mention that I want to make sure I slip in, is that there are cases where cochlear implantation and single sided deafness is urgent. Those are cases of meningitis. We have a very, very narrow window where we can still insert that device before the cochlea begins to ossify. So in cases of meningitis, we want to implant quickly. Also in cases of CMV or anything where there's potential for hearing loss on the contralateral ear.

We want to make sure that we are intervening in one ear and get that cochlear implant up and running before there's a chance of losing hearing on the other side. That's a, that's a really great point because we do have to look at the individual needs of each child. So thank you for that. Lisa. Here's a question.

Any suggestions to get parents to learn about CI when they're initially very opposed to the idea for their child who's single sided deaf, besides sharing their research data, which, of course, is something we can do, but how do you deal with a parent that thinks that he's got hearing on one side? Does he really need this intervention on the

other side? Yeah. We find our biggest tool is really other parents. So we like to, we have a whole bank of families who've agreed to talk to other families, and we kind of play matchmaker with other families and get them connected so they can talk about their experience.

We find that a lot of times, you know, those other families are able to quash some fears and some misunderstandings, and that helps a lot. We also say that our biggest, one of our biggest tools in the counseling toolbox is the waiting room. So other families looking at other kids and seeing what they're doing and comparing to their own child and asking questions. So really, the biggest thing that you can do is connect them with another family, in my opinion. Right.

That's really true. And honestly, it does sometimes take time for them to get used to the concept. So here's one from someone that says, besides using questionnaires, how do you evaluate very young children post CI who don't have spoken language yet? So that's a really great question. We have been super surprised at the differences that we're seeing in some of these kids.

So some of these kids are showing some mild delays when we do those questionnaires, especially those auditory skills questionnaires, they are below where we would expect them to be for their age. So those ones that are norm, like the flip the peach, we are seeing that they aren't meeting those auditory milestones as we would like them to. So far. When we look at our clinical trial kits, and there's only a couple of them thus far, they are shooting straight up as soon as they get that cochlear implant. So we're finding that that is something, those questionnaires are actually something we can really rely on a lot in the booth.

We are treating them just like we treat any other child with cochlear implant and single sided deafness. So we're plugging and muffing one ear. It's. Yes, that is way harder with an 18 month old. But we are trying.

We do some lateralization exercises. So we do see if they're able to tell us if something's coming from the left versus the right. Okay, we've got two more questions here that we, I think we'll try to deal with, and then we'll look at the last slide. This person, I think he's referencing something back that you said about it, says that maybe the case for temporal bone fracture as well. And we have a patient where an ossification in cochlear also occurred.

Yes, that's true. We have seen a little bit of that, too. Those can be really, really tricky just to see where the fracture occurred. Did it go through the otic capsule? Is that something that's going to be more difficult to treat?

One thing to think about in those temporal bone fracture cases, we have a couple of cases that have a little bit of dehiscence, and they're having some issues with balance and some tricky facial stimulation issues. So that's just something to think about in those temporal bone fracture cases.

Thank you. And then here's one really great question that's left. When and how to use hat systems hearing assistance technology for either the CI side or the normal hearing side. So something about our goal, cochlear implants and single sided deafness, is to have binaural hearing. Right.

So we don't want to, like, give a workout to one ear and not to the other ear all day long in class. So I'm a big advocate for using that. Those remote microphone systems in both ears. If you're just going to the cochlear implant side, that's their helper ear. That's not their ear for regular listening and communication.

It's there to help. Help. So putting an FM system just on the implant side isn't going to be all that helpful. It could be like a little bit therapeutic, perhaps, but we really want to make sure that we're getting that to both ears. So the tricky part with that is that their ear has to be big enough on the normal hearing side to be able to put the receiver on that ear.

So we're not occluding the ear. So that's a tricky thing. But I don't have a timeline. Other than that, I think that sooner is better. Get them used to the FM system as long as they can do some reporting.

And our kids with single sided deafness know what sound is. So they are better reporters. They can be better reporters. Let's say that they can be better reporters of trouble with their equipment.

Lisa, thank you. That was a really fantastic presentation and had a lot of people write in and say that. So thank you, everyone, for joining us today. If you just take a look at what you need to do to complete the exam to be able to get your CEUs. And please take a look if you haven't seen it.

For the other SSD talk, we do it on adults and stay in touch with us. We really appreciate you joining us today for Lisa Park talk on cochlear implants and single sided deafness in children. Thank you so much. Thanks, everybody.