Rehabilitation
Research & Training Center for
Persons who are Deaf or Hard of Hearing
University of Arkansas
Arkansas Rehabilitation Services

ADVANCED BIONICS

Presenter: JARED SCHNACHENBERG

JARED SCHNACHENBERG: My name is Jared Schnachenberg. I'm a clinical specialist. I will spend some time talking about the High Resolution Bionic Ear System from Advanced Bionics. We have several other products as well. We are not just a cochlear implant company, but we have a couple of other divisions within Advanced Bionics that really helps us mutually with different technologies. All of these technologies are neural stimulation devices.

One of the products we have is called the Bion, with a small, low invasive surgical procedure to put it in. Some of the uses being investigated for this device include migraine headaches and tinnitus. It's not yet FDA approved.

We have the Precision, a spinal cord stimulator for those who have chronic back pain. The Precision is actually where some of the cochlear implant technologies that I'm going to be talking about today originated.

So just real briefly, what is a cochlear implant? Basically it's an electronic device that we use to help provide hearing. By putting an implant in the skin and putting an electrode into the cochlea, we can provide functional hearing to those with profound hearing loss. There are several pieces of the cochlear implant system that allow it to function. First, you have to have a micro, something that captures the environmental sounds. We take those sounds and manipulate it, put it into digital form and transmit that signal across the skin through a head-piece to the internal implant.

Once that internal implant gets that signal, it converts it into electrical pulses. Through an electrode array inserted into the cochlea, we then stimulate not the neural hair cells, but the neural elements in the ear. We are able to get sound that way. I'm going to talk about some of these different components within the system. Then, I'm also going to talk about some of the things yet to come in the future.

First, we are going to talk about the internal implant.

At Advanced Bionics our goal is to make things easier not only for you, but also for the audiologist and for the surgeon. Our goal is to make things faster, to make it simpler for you to use and to make it smarter. By smarter, we mean once technology changes, we don't want you to have to get a different implant or not be able to take advantage of the new technologies. I'm going to talk about how we made the system faster, simpler and smarter.

I don't know what each of your personal experiences have been once you've gone in for programming, but fitting a cochlear implant used to be a very long and drawn-out process. Now, we made our software more automated and it is a lot easier for your audiologist to fit you. We wanted to make sure we could make it faster, but the quality was also better.

A lot of the features we put into Sound Wave are automated. Through studies, we verified that the changes we made didn't decrease performance or create a poorer map just because we're trying to make programming faster.

With the implant we put a lot of the features into one screen. The audiologists said that didn’t want to have to jump back and forth from screen to screen and go a bunch of different places to change parameters. We made one screen where they are able to do the vast majority of the programming. This made a big change in how long it takes an audiologist to program you. We reduced a two to three hour fitting to an average of 30 minutes.

We also have the ability to measure neural responses. This is especially nice for infants and people who can't perceive pitch or tone differences. For example, an infant wouldn't be able to tell us how loud to set the device. With a neural response we can measure the response from the nerves directly and use this measurement in setting program loudness levels.

Now, I'm going to talk about how we made things simpler. One of the lessons Advanced Bionics learned, when we came out with the first behind the ear, BTE processor, was that it was cumbersome. It was difficult for patients to use. We heard a lot of complaints on how hard it was to use. Also we heard the battery life was poor.

We wanted to design a processor that was simple to use, easy to operate on ear level, and have an adequate battery life. We addressed each of these technologies and things.

There's a prestigious award not just for medical devices but also for all sorts of devices called Industrial Design Excellence award. Our Cochlear Implant, the Auria received such an award. One of the things judged in awarding different levels, is the capability and functionality of the electronic instrument. How easy is it for each individual to use and modify? They also judge durability. How well does it stand up? The BTE processors really go through quite a rigorous life span, especially with kids throwing them. The

Auria had to be a product that could withstand these rigorous things, and the Auria was awarded the silver medal for capability, functionality, and durability.

The engineers built an electronic chip in the Auria processor that enables it to do everything that our body, pager-style processor was able to do. This was easy for our clients because if they had a program they liked on their BTE, it could be interchanged with the body processor. If they had a program they liked on their body processor, they could put the same program on to the BTE without having to manipulate the programs.

The Auria has a dual action, which really reduces the number of manual adjustments a user has to make to program different environments. The processor really changes itself in different environments. The Auria has the ability to capture more of the sound environment. This allows us to capture a wide range of the sound levels in the environment, process the information, and send it through the processor. That's what the 80 dB IDR is. It provides a wide range of information that we are able to process.

Auria has flexibility with power cells and power options. It also has a lot of different options with the ear hook. There are different varieties of ear hooks that you are able to use with the Auria as you go into different environments and different listening situations.

From the very beginning, the Auria was designed to be durable, to withstand a wide range of rough possibilities. It needed to withstand a lot of the impact, the child’s falls, or when the child takes the processor off and throws it. It does very well with that, but also does very well with moisture. Recently we looked at all the company returns of the BTE or the Auria processor. We found overall we have a return rate of about 12 percent, which is significantly lower than other BTEs in the industry. When we looked at those 12 percent, we wanted to see how many returns were for moisture. We found that less than 2 percent of the 12 percent were returned due to moisture.

Another Auria feature is its sleek design. People had said the previous BTE was ugly. They wanted something nice, something which they could change colors on. Now, a user can create different color combinations and personalize it. It has easy controls. It's an intuitive device. It's lightweight and small. The headpiece is also very small. It has user-friendly controls. We have a volume wheel that is rotated to increase the volume, and we have a program switch for three different programs.

We have different ways to power the Auria device. We have a lightweight battery that lasts between eight and nine hours. We have a power cell plus batteries that the adults like. It's larger and has more weight to it, but you are able to get a full day’s use out of the processor. We have a power pack that a lot of the kids like. If for some reason a person has difficulty with the Auria processor staying on, they can attach the power source to this power pack that is charged by an AA rechargeable or alkaline battery

Different ear hooks can be applied to the Auria. We have the Direct Connect that allows you to plug into different kinds of audio input sources. We have a Fire Fly, diagnostic ear hook, a T-mic, and also the standard ear hook

The Direct Connect system to the Auria makes it very easy to put on different ear hooks. All you have to do is push and it snaps into place. To turn it off, you turn it a quarter turn and pop it off. We learned from the previous BTE that at schools with F.M. systems, teachers were having to screw different pieces on and off. Direct Connect makes it more flexible and easier for you to change to different ear hooks.

T-Mic: a lot of people hear about T-Mic and they think it's a T coil. T-Mic is an earphone. When it's plugged into the Auria, it allows the microphone to sit in the bowl of the ear. Some of the advantages to doing this is you get high frequency emphasis from the shape of the ear. You also get some background noise reduction. If noise is coming from the back, the shape of the ear helps block it. We learned users liked the T-Mic in all situations although it was developed for use with the telephone. We wanted you to be able to put the telephone in a natural position rather than holding it up to your head post or to the microphone.

AUDIENCE MEMBER: You mentioned something about blocking out sound around you. I don't find that with my T-Mic. When I'm talking on the telephone with background noise, my T-Mic picks it up. It’s not a T coil like the Nucleus or hearing aids have.

JARED SCHNACHENBERG: Some users notice the background noise more than others do. That little benefit you are able to get with the high frequency will add decibels, but it's not a drastic impact. I mentioned the Fire Fly. This is a pediatric ear hook. It enables us to have an LED status indicator on the top of the processor instead of along the side. In this position a caregiver or teacher can see that there may be something wrong with the processor, that the child is not getting communication between the internal device and the external processor. For example, if the headpiece falls off, the light will blink, notifying the teacher that the child is not hearing.

The Direct Connect ear hook has a prong on the back. That enables us to plug into a variety of audio devices, CD players or computers. However, if you plug into anything directly connected with the wall as the power source, you need an isolator. Word of caution: You don't want to use this and plug directly into the wall in case there's a surge of power. You are able to plug into battery sources without worries. If you use wall power source, you need a special isolator between yourself and the power source.

This is a quick and easy system that I'm going to show you. We developed a wireless F.M. system that also snaps right on to the back of this. Along with that we have a T coil that you are able to snap directly onto the back of the ear hook. That allows you to access looped rooms or hearing aid compatible telephones.

Among the power cell options, there are different options to choose from. The batteries are very easy to put on. They are large enough that it's easy to slide them on and off. A lot of the users are able to do slide the batteries on and off while the processor is still on their ear. You are off line for just a matter of seconds.

The rechargeable batteries are also cost effective. We've changed the chemistry that goes into the batteries. Not only are we getting more day-to-day life with the batteries, but also we are getting more life for the whole life of the batteries. Rather than lasting a year or two, we're getting closer to three years. Another nice thing with rechargeable batteries is most insurance companies typically cover 80 to 100 percent of rechargeable batteries.

The headpiece is very small. It's lightweight and has a very low profile compared to a competitor's headpiece.

The program switch, as I mentioned, has three different programs, the same number of programs as you have in the body-worn processor. You are able to have the same programs on your BTE as you have with the body-worn processor.

The body processor is the size of a pager with the three program slots, LED, a microphone test position to test the quality of the microphone, and a programmable alarm. If something falls off a child user, you hear a beep or alert for the teacher. It has audio capability, all the things that the Auria does as well.

It also has a program dial, a volume and then a sensitivity switch and a LED indicator.

We made the software faster for you and for your audiologist in the programming clinic. We made it simpler to use. We learned from the previous BTE, which was confusing and hard to switch back and forth in different environments. We made that a lot simpler.

Now I want to focus on the most important piece, the piece you all are most committed to. Something that is surgically implanted isn't something that you can change in and out as technology changes or as you want something different. So from the very beginning, our engineers wanted to develop a design that allowed a lot of flexibility. We have come out with better ways to process sound and to make hearing better so you don't have to get a new implant to take advantage of the changes. Our design clear back to 2001 has had a lot of upgrade ability.

When we look at overall performance, the question is how well are you going to deal with a cochlear implant? That's impossible for one of us to predict; however, certain indicators will lead us to say generally how well someone will do. These are features that are unique to you when you walk into the surgeon’s office. That's why we can't just say you'll do just as well as your neighbor. Because of these variables, we can't predict how you’re going to turn out with a cochlear implant. Some of these variables are duration of deafness, the amount of the hearing loss, your age when you acquired the hearing loss, neural survival and some other variables we have no control over.

What we can control are the technology limitations. We are trying to remove all of the technology limitations so the only limitations holding you back are those things that you walked in the door with.

Our Hi Res 90K implant is composed of several major parts. The electronic package is housed within a titanium portion. The design is low profile, good for young kids whose heads aren't very big. The low profile in the housing is also M.R.I. safe with the magnet removed.

We have an induction coil, which transmits the natural, analog sound from the headpiece to the implant. The electrode lead and the electrode array are at the tip of the wire in the cochlear where the electrical current stimulates the hearing nerves.

One of the unique aspects to our design is that each electrode contact on that electrode array has its own power source. The electronic platform has 16 independent output circuits. That means each electrode on the array has its own power source. That enables us to use certain technologies as we deliver stimulation, which really sets this device apart from its competition.

We also have the fastest stimulation rates. We can stimulate and sample the incoming signal at 90,000 pulses per second. We can stimulate slightly below that. We can take a lot of information and convey that information to your hearing nerves just like it would happen for a hearing individual. These signals come in at super high rates. This is really the closest any device has been able to come to replicating normal hearing.

We have the 120-plus channel capability. It's called “plus” because we are just limiting it in the software. Actually, the device can do whatever we want it to do. We could have as many channels as we want.

We have designed something that is able to incorporate upgrades. The Hi Res 90K and its predecessor, the C2 device, can already incorporate the first generation of upgrades. When we came out with High Resolution, those who had the C2 or the 90K were able to go to their audiologist and be programmed for new software. Because it's an upgradeable platform, clients received a new way of processing sound. However, the High Resolution, which we are using now, only uses a small fraction of the capability of the internal implant. We have a long way to go before we truly realize what this device can do.

There are three degrees or three dimensions to sound. Hi Res 90K accounts for these three dimensions. The better we can replicate the three dimensions, the higher fidelity or resolution that sound will have. One dimension is the intensity domain that has to account for how loud the incoming signal is. Another dimension, the timing domain, accounts for the signal change as it occurs in time. The third dimension is the frequency domain that accounts for what the signal includes. The better we are able to represent each of these domains, the better signal you have will be.

In the frequency domain, we went from eight to 16 channels. When I talk about channels, think about it as pitches or frequencies. We went from eight pitches to 16, doubling the frequency or our pitch spectrum. The big change with High Resolution was how well we were able to deal with the timing component of the signal. When the signal changes in time, we have to be able to replicate what that signal is doing. With High Resolution we went from using 400-Hertz filter, the industry standard, up to 5200. The higher rates captured the vast majority of the environment at 80-decibels. High Resolution changed the way these are the three domains of sound replicated. That's why we saw patients do better with High Res.

The philosophy of Advanced Bionics is to replicate the signal as accurately as we can, to take all of the information that we can possibly capture from that signal and deliver all that information. The data has shown that clients are able to use the vast majority of that information. If they can't, we have the flexibility to change rates. We can change fast rates to slower rates. We have the ability to go faster, too, for most of the clients indeed are able to use all of that information.

Historically, when these speech-processing strategies were developed, we only took small parts of the signal. It was called feature extraction where we took the most important parts of the signal and left out all the parts that the technology wasn't able to process. In doing this, only a few aspects of that signal were included. Performance was relatively pretty poor. As we added more and more information to the signal that we are trying to recreate, the performance went up.

In theory, the more information we were able to add, the better the performance was going to be. The more signal we are able to provide you, the more possibilities you are going to have to perform better with the implant. That is, the better we can recreate or represent each of those three dimensions of sound, the higher fidelity the signal is going to be. When we look at our leading competitor, we can look at how it does in each of these three domains. In comparing high resolution, we are able to capture a wider range of the environment. We can stimulate the electrodes at much faster speeds.

The number of channels is also different. We have 16 electrodes. The number of electrodes varies from device to device. How we deliver stimulation on those contacts also varies. Our philosophy was: deliver as much as we can collect. We look at the different pitches and frequencies coming in. What happens is the electrode number one fires first, then two fires, then three, then four. We deliver each of the 16.

Some of the other devices extract certain components, or the most important or prominent components in that signal and they deliver just those. These devices look at the amplitudes in the different filter bands and depending on how high the amplitude is, they will deliver the ones with the highest or most important energies. Some of the other frequencies are actually not delivered through to the user.

Our processor, once the signal comes in and we break the signal down into 16 filter banks, we have to be able to recreate how that signal changes in time. This is where High Resolution made the big difference. Formerly, we used a fairly average envelope detector where we were able to get a gross analysis of how this signal changed in time. We were missing a lot of the fast moving, changing aspects of that signal. That was a gross estimation of what that signal does in time. On the other hand, High Resolution, going from a 400-Hertz filter to a 5200-Hertz filter, allowed us to precisely track the changes in a signal in time. We were able to figure out exactly how this signal changes in time.

Changing that filter made a big difference, but even going to 16 pitches still presents a limitation. Imagine how many pitches in a song, and then imagine reducing that song to 16 pitches. You can imagine why a lot of cochlear implant users say that they didn't really like music. It didn't sound natural because we were mashing those frequencies all together. If you look at where we started from, we've really come a long way in how we have been able to recreate and represent the speech signal.

Current Steering is the name for what we are doing with some of the capabilities of the internal implant. Rather than firing each electrode sequentially, one, then two, then three, then four, current steering allows us to fire two electrodes adjacent to each other at once. This actually steers the current between the electrodes to elicit individual pitch perceptions.

Before, we had the 16 filter banks. If a signal came in around 487 Hertz, it would be assigned to one filter. It would come down and be processed and stimulate the neural elements or the nerves right by that electrode contact. If another signal came in on the other end of the range for that filter bank, say it was 697 Hertz, it still would fall into the same filter bank and stimulate the same set of nerves. All of the frequencies between 487 and 697 would be reduced to one pitch when actually there are several different pitches within these ranges. To the cochlear implant user it sounds like one pitch. This filtering process really degrades the pitch domain of the signal.

Research has shown us that even if with a severely impaired auditory system, most users are able to detect far more pitches than what we are currently delivering. So there's potential to give users additional pitch perceptions. The key to this current steering is having independent output circuits. The ability to fire multiple contacts simultaneously is unique in our implant. Now we can fire two at once. We could fire all of them at once. We can do whatever we want, but right now we are looking at firing just two simultaneously.

Current steering is possible only because we have power sources for each electrode. A way to think of this is if you had two different lights with a dimmer switch. To be able to turn both lights on at once you need two outlets. If you have two outlets, you are able to turn one light all the way on and have one off. That is the way we traditionally did stimulation, one on at a time. Or you could turn one light on a little more than the other but still have the other one on. You'll notice that the focal point of that light energy will shift to somewhere between the lights. This is what we do with electrical current. We are able to turn on two electrode contacts because they each have their own power source and we are able to steer the current between the two electrode contacts. We can do it in any degree and we can do it very precisely.

Depending on what we want to do, we just alter how much current we put on one, and thus we change where that current is exciting the nerves. If there were two electrode contacts, we could send all of our current off of one and stimulate these nerves, or we could alter how much we are putting on each one simultaneously. Then, we can steer the focal point of that energy anywhere in between the two that we want. To repeat, we give a certain amount of current simultaneously to each electrode contact, but weighting how much current we put on each electrode. By doing that, we can change the focal point of that electrical field between the two. When we do this, we can elicit different pitch perceptions to different individuals between these two.

We wanted to see how many different pitches people could differentiate from one another. We have some data from 61 different patients. With this current steering, we found that on average each user is able to differentiate about six to seven different pitches between just two contacts. If you take seven pitches just between contact one and contact two, you can see that we've added another seven channels effectively for that patient to use. If you use current steering in each of the intermediate positions between all of the electrode contacts, you come up with a different map that has more channels. The average that we have found for pitches that an individual would be able to utilize is around 93.

We gave the subjects two different beeps using the current steering and asked them which pitch was higher and lower. Statistically they had to get a certain number right which this told us how many pitches that individual was able to perceive.

About a third of the subjects did really well. Some of the people weren't able to tell the difference between one contact and the second contact. That was very rare. We found that over 80 percent of the patients had at least two pitch perceptions between just two contacts. One experimenter tested an individual who had 55 pitch perceptions between two contacts. If that remained constant across the array, and if we provided a map across 50 different channels, he could use all that information. This implant has all that capability.

We are looking at a strategy that involves 120 different pitches or channels. Michael Chorost, one of the individuals we strategize with, wrote a book, *Rebuilt*. He talked about the differences in regular speech and said really wasn't different from the High Resolution, but when he listened to music, he said, “It's working great, music sounds much, much better. It almost knocked me out of the chair because the bassoons and oboes sounded richer and warmer. The flutes and piccolos sounded brighter and clearer.”

Imagine reducing a song with 2000 different pitches to 16. That’s pretty bad. If we can reduce those thousands to 120, or in the future we go higher than that, you can understand the difference in music that is going to be made available to different users.

Some of the volunteers that we have here today are using this 120-channel map. I invite you to ask them for their comments on what differences it makes adding this new spectrum of information. Overwhelmingly we have been seeing there's a big difference in music. There's a difference in noise. Speech is an environment where we don't have to tune in to a lot of the subtle pitch differences in pitch to understand. We are able to understand speech with a fewer different pitches.

AUDIENCE MEMBER: When you are talking about different pitches where you can enjoy more music, are you talking about the programming? Are you talking about the electrodes in the ear?

JARED SCHNACHENBERG: It's both. The electrodes in the ear have to have the capability.

AUDIENCE MEMBER: Do the electrodes in my ear have the capability?

JARED SCHNACHENBERG: The 90K and the C2 device have this capability. The Auria does not have this capability because it doesn't have the front end for it. The pager body-processor is able to do it. We have a BTE style device coming out, a lot like the Auria that is able to run this strategy. It's just an external equipment upgrade. You don't have to get a new surgery.

AUDIENCE MEMBER: I could change mine for that one?

JARED SCHNACHENBERG: Exactly. You can take advantage of all of this new technology that we are developing. Everyone back to 2001 is able to upgrade to this new technology once it becomes available. Some people may have to exchange their external processor for the new processor. Depending on how long you have had it, we will have an exchange policy for a new processor. At least it's just a processor and you don't have to have a whole new implant or be left out.

AUDIENCE MEMBER: When will that technology be available?

JARED SCHNACHENBERG: It will probably be available towards the end of the first quarter, probably around April of next year. 2006 is when it will be commercially available. For anybody who the surgeons are implanting now, it's going to be an easy upgrade. If you have an existing program, you can switch to this new strategy, and it's not going to take hours in the clinic to work this thing through.

AUDIENCE MEMBER: What about the implants done before 2001?

JARED SCHNACHENBERG: That electronic platform does not have the ability to run what we're doing now. Some inherent limitations in that electronics platform makes it not upgradeable to the point that the new one is. People with implants prior to 2001 aren't going to be able to benefit from this new technology. However, we are also working on better ways to do improve hearing for them as well.

As for other changes, we talked to the surgeons and got their feedback on what we provide them for the implant surgery. Based on that feedback, we changed a lot of the tools and some other things that we do for them. We've heard from you, the users, that you wanted more accessories. We added other accessories to your kit so you receive all of the things that you need to go into all the different environments. We made a new case for the Auria which has a dry and store kit inside. We also have a travel bag. The adult kits include additional ear hooks, the T-coil, and other cables.

For the pediatric kits we included a sensor that is a wand that functions a lot like that fire fly ear hook. A teacher or parent is able to hold the sensor up to a child's head and tell whether or not there's a problem somewhere.

We are getting ready to release the I-connect, a wireless F.M. receiver. It is an ear hook that attaches to the Auria. It is able to work with the Phonak MLXS receiver. This enables you to have a wireless phone system with the Auria BTE. It has its own power source, a size 10 hearing aid battery. This way it won't draw power from the processor battery. It won't change the day-to-day life of your processor.

Bluetooth capability is another thing we are looking at. Starky makes the Eli module where you plug in and have Bluetooth capabilities with computers and phones. If you have the capability to stream through Bluetooth, the capability might be there and with cell phones. Expected availability is sometime this month. We're just finishing field-testing it with a lot of kids. We want to make sure it is as durable as we can make it, and then it will be released.

AUDIENCE MEMBER: When you say Bluetooth, I wouldn't need a cable or anything?

JARED SCHNACHENBERG: This is wireless, just like the Bluetooth headsets. You will be able to plug this little unit into the back of the processor and use it wirelessly. It allows wireless communication from one device to another. One of the nice things about Bluetooth is you don’t have to have line of sight. Infrared connects you, but you have to have a line of sight between the two components. The signal is sent through a light ray.

AUDIENCE MEMBER: Is it like my wireless Internet connection in the house?

JARED SCHNACHENBERG: That's not what it is, but that's a way to think of it. It's a wireless way to link two devices to each other. You might have seen people using a mouse with their laptop. It has no wire. That's Bluetooth.

AUDIENCE MEMBER: What is the range for Bluetooth?

JARED SCHNACHENBERG: About 30-meters. We also have new electrodes positioning the electrode contacts closer to the middle wall of the cochlea, which in theory puts them closer to the hearing nerves. This idea was developed from surgeons' preference. We haven't shown that this electrode performs better than the ones out there right now. Patients don't perform differently.

A lot of the new hype right now is with bilateral cochlear implants. Is two better than one? Are two hearing aids better than one? High Resolution demonstrates that two are better than one for a lot of people.

Earlier, I said we are able to capture a wide range of the sound environment. With that wide range we are able to make very fine loudness adjustments. This allows us to take advantage of the two ears and the benefit you get with two ears. You have to have certain timing differences that you are able to differentiate between the ears. You also have to have intensity differences. We are able to capture the intensity differences because we can make fine adjustments between the ears.

Timing, the ability to stimulate very fast rates, allows us to get a lot of the timing differences between ears. When we look at what Hi Res does for performance, we find there are significant advantages with two ears implanted rather than just one.

AUDIENCE MEMBER: I have never had any type of stimulation in my left ear my entire life. I'm completely deaf there. If someone like myself should get implanted on the left side, is there a chance of being able to use both implants?

JARED SCHNACHENBERG: There are things that we have no control over, but just looking at others who have had no hearing and been implanted, the performance has been very limited. I don't think you would be one of those individuals who would be able to take full advantage of the two differences made by two implants. The timing and intensity cues are really important to the binaural benefits. High Resolution is able to deliver the differences.

At the University of Iowa, Rich Tyler and Bruce Gans did a study of having two cochlear implants. They compared two implants programmed in conventional strategy, CIS, and transferred them over to High Resolution with two ears. They wanted to see if there were differences in test performance between those two conditions. The vast majority of these subjects did overwhelmingly better with two High Resolution implants as compared with only one. Bruce Gans commented that they had not seen anything else developed for speech processing that made such a dramatic impact.

To show a difference in speech processing performance, the researches had to change how much noise they were tested in with High Resolution. With the CIS they had plus ten, there was a little bit noise. When they went to High Resolution, the noise was much louder. In a more difficult situation, it still showed a significant difference between those two conditions. We are now undergoing a lot of other research studies across the country to see if High Resolution is truly doing something better than our old CIS strategies.

With the new 120 channels, we are also able to get more intensity. We are going to go from 80 to 96-decibels. The temporal will be at 83,000 pulses per second but the spectral or the frequency information is now going to be 120. Initially, but this implant has the capability of really going up to whatever the individual is able to perceive. So ... are there any questions?

AUDIENCE MEMBER: That's only with the newer implants?

JARED SCHNACHENBERG: With the C2 and Hi Res 90K. If you were implanted 2001 forward you will be able to use the 120 channels.

AUDIENCE MEMBER: What is the C2?

JARED SCHNACHENBERG: That's the name of the implant. We have a C1 implant, our first implant and C2 our second. We went to a C2 implant. The C2 has the same outside as the C1, but the electronic package is much more powerful than the C1.

AUDIENCE MEMBER: All of the studies I'm aware of show the performance levels of the users are equal all the way along. Each company makes progress and has technology improvements and they seem to be keeping pace pretty well.
Are you noticing that your users are performing better on speech now with these new technologies than users of the other systems?

JARED SCHNACHENBERG: With each system range of performance differ. Some don't perform well, some perform medium and some perform quite well. The limitation is in our ability to detect the differences in some of the hard situations. We are currently developing new tests. We need to find a way to draw out differences in the hard situations.

Michael Dorman at Arizona State University as done exactly that. He added noise to different situations and changed and manipulated the environment to tax the system to make it as tough as possible. In a hard situation, are we then going to see differences? Yes, there are significant differences between the devices. Michael Dorman's study showed that.

In house we can study these things, but it means more when it comes from the clinics. The clinics investigate new ways to test how one strategy may or may not be beneficial over a different strategy.

AUDIENCE MEMBER: That's your old system versus the new system and you would hope the new system is better. Do you have studies that show that your new system is better than the competitor’s?

JARED SCHNACHENBERG: They just brought theirs out. There are inherent differences in how the companies do processing. Advanced Bionics right now is only one capable of doing current steering. If pitch differences make a difference, the new tests we are doing will reveal those differences.

AUDIENCE MEMBER: I thought 120 channels wouldn't help.

JARED SCHNACHENBERG: Yes, in speech. That's why I talked about music. We are having to develop new ones that differ from speech tests. We show the tests are too easy. How do you test music appreciation? That's what we have to really, we have to think in a new domain we are in areas where we never knew cochlear implants could be. How do we make it harder, how do we make this person perform poorer. With music appreciation and hearing and noise is what Michael Dorman did, music and noise. Music appreciation, we have to come up with some test. How do you ask one individual how much do you like it versus how much do you like it here? We have to do music tests to show a lot of these things. I think we will see that coming out.

Some of our volunteers are here to give their own perspective on the differences. What were the subjective differences that wouldn't be shown in tests?

AUDIENCE MEMBER: No matter what I do, I score 100 percent on the tests. I started out with CIS. I scored 100 percent with it. That does not mean I hear perfectly. But any word, any sentence you give me, I'm 100 percent. Going to Hi Res, I heard the same thing. But I heard an absolute quality difference from CIS to Hi Res. It sounded better to me. Now with 120 channels, I'm hearing like CD quality, okay? I started out A.M. quality. I went to FM quality and now I'm on CD quality. Does that make sense?

JARED SCHNACHENBERG: Yes. Michael Chorost said the same thing. He heard speech about the same. He felt he performed the same but the sound had fuller substance to it. It was richer.

When we brought out High Resolution, 96 percent of the people who transferred over to High Resolution wanted it.
What did that? We changed the pitch, and we changed our temporal domain, our ability to track the timing of the signal, and we also changed our ability to map amplitude differences better.

AUDIENCE MEMBER: Everybody has their own preference, especially if they have an implant. Those without an implant are trying to decide which company is better. If I had my choice instead of doing to a workshop by Cochlea Americas and now Advanced Bionics, I would like each of you tell me why should I pick your product. Is that possible?

JARED SCHNACHENBERG: It's possible, possible.

AUDIENCE MEMBER: Maybe next year instead of having two separate presentations we can have a formal debate.

JARED SCHNACHENBERG: Choosing which implant is specific to the individual. Ask yourself what is most important to you? Investigate your choice. First step: just get information. Then you can ask what the differences are.

Different people choose different devices for different reasons. Some people like the rechargeable batteries. Regardless of technology, they want rechargeable batteries; that's why they get this one. Or like to have a color choice, something as simple as that. Then there are engineers who want every specific piece of information on what is going inside the processor and implant. So what is important to you? That's a tough question.

Jared Schnackenberg, M.A., CCC-A is an audiologist and clinical specialist with Advanced Bionics Corporation. Prior to Advanced Bionics, Jared was at the House Ear Clinic in Los Angeles. Jared received both his Bachelors and Masters degrees in Communication Disorders: Audiology from the University of Northern Colorado. Jared will present, "Advanced Bionics: The HiResolution Bionic Ear System.