

Breakthrough: A Resounding Remedy

ALLYSON SISLER DINWIDDIE: I never thought in a million years I would ever end up deaf-- completely deaf. June 4 of 2004, I got in a motor vehicle accident that ultimately ended up causing a progression of my hearing loss over the course of about six months. I'll never forget this day because it was a Saturday. I had a little dog. She went to the door like someone was there. I couldn't hear her bark at all. And at that point I realized, there's no more hearing left. This is it.

I'm a pediatric audiologist here at Vanderbilt. Being an audiologist, it'll send me from the schools to the clinic back to OR. During cochlear implant surgery, my job is to check the integrity of that cochlear implant before the surgeon implants the device. When I was young, my hearing was tested for the very first time. And we walked away with hearing aids. I had hearing loss growing up, but the car accident made it so much worse.

I remember my father saying to me, Ally, promise me that you will never, ever let your hearing loss get in the way of anything you want to do. In 2003, I started my first year of graduate school with my hearing aids. But between my first and second year, I got in the car accident, and there was no more sound. That's when I realized I want to try to find a way to keep on keeping on. I want to be an audiologist, and there's got to be a way.

RENE GIFFORD: Ally had basically almost no sound detection whatsoever. We're talking about the most severe types of hearing loss. My name's Rene Gifford. I run a large research program. I teach in the graduate school program here. I also direct a large portion of the clinic. I see patients.

I was actually raised by my grandparents. My grandfather incurred very severe hearing loss during World War II, and so you had to speak loudly. You had to speak clearly. You had to get his attention. It absolutely shaped sort of my desire and my interest that would come into play many years later. Like Tim said, you want to look straight until the noise is played.

SPEAKER 1: Ready bearing go to white five now.

RENE GIFFORD: Helping people who have hearing loss is pretty complex. We've got the outer ear, of course, that everybody is familiar with. You've got the ear canal. At the very edge of the ear canal is the tympanic membrane-- or as we call it, the ear drum. Connected to the tympanic membrane are the three smallest bones in the body. The very smallest bone in the body is then connected into the inner ear.

The inner ear is the cochlea. Within this cochlea, it's three small chambers that are filled with highly conductive fluids. And then you have a number of hair cells and their

vibration creates this electrochemical reaction through the auditory nerve and then ultimately up to the brain.

SPEAKER 2: When I was 25, I started losing my hearing for no reason at all, pretty much.

RENE GIFFORD: The most common type of hearing loss that we see is the deficit of the cochlea. It's a deficit of those hair cells that are dysfunctional or are completely destroyed.

ALLYSON SISLER-DINWIDDIE: As hearing loss gets worse, you lose the ability to piece things together. There's just not enough information. A cochlear implant definitely has the ability to provide sound. A very different kind of sound. It's an electronic device, but it's in the brain where all of the magic really happens.

RENE GIFFORD: Cochlear implants bypass the outer and the middle ear entirely. The actual implant itself is placed beneath the skin. And then the electrode array enters the cochlea or through the middle ear. Each of those individual tiny electrodes are actually stimulating auditory nerve fibers from within the cochlea itself. That device receives input from the external processor that's worn on the outside of the ear. This is connected through a magnet.

ALLYSON SISLER-DINWIDDIE: When I got my first cochlear implant, I went from nothing to a world that's so far beyond what my hearing aids were able to provide. And I had no idea how much I missed growing up. No idea.

RENE GIFFORD: Cochlear implants are a miraculous technology, but when you stimulate an electrode, even though you're wanting to stimulate just a narrow population of cells, what happens is it spreads.

SPEAKER 3: It's got kind of a background noise I hear when I'm talking.

RENE GIFFORD: We know that's one of the biggest culprits for why our patients struggle for communication and noise. Why they struggle with music perception.

SPEAKER 2: So a piano would sound a little different or like a violin would sound different.

RENE GIFFORD: If you think of electrical spread of activity causing a smearing of the incoming frequencies and pitches, more could potentially be less. Now with a cochlear implant, you can see the electrode array as you're inserting it, but beyond the first turn of the cochlea, you're basically blind.

The engineering group was looking at 3D reconstruction of the internal ear. And we just kind of said, we know the distance between each one of those electrodes in those

neuron targets that we're trying to stimulate. Now let's selectively deactivate some of those electrodes.

SPEAKER 4: What we have suggested is turning off 6, 9, and 10.

RENE GIFFORD: Fewer number of electrodes, but the right ones. It was sort of like one of those literally "aha" moments that you get a handful of times in a career. We'll take everybody's individual anatomy and function and really develop a cochlear implant program that can maximize their hearing capabilities.

ALLYSON SISLER-DINWIDDIE: I had heard this research was going on. I was here on staff. But as a patient, to hear that we're going to turn stuff off. Even though I know-- even though I knew it was going to be for the best. I was very nervous.

RENE GIFFORD: Ally was the first or second participant.

ALLYSON SISLER-DINWIDDIE: I kept thinking we are all here to make this experience better for everyone else. If we don't do this, we'll never know.

RENE GIFFORD: With her, I recall it was just two electrodes we deactivated. I turned off those two electrodes and she said, it's like you took a pillow off my head.

ALLYSON SISLER-DINWIDDIE: That program ended up being so far beyond my other program that I had before.

RENE GIFFORD: I am very much a skeptic. You know, I just-- unless I see data, I don't believe it. So she came into the lab. At her baseline, she was getting about 38% word recognition. And we just ran that test again. She was at 88% overnight by just turning off two electrodes. We were just so excited.

ALLYSON SISLER-DINWIDDIE: So it's been four years. The number of patients that have been able to take part in this, it has gone on and on. And so they're not going to stop here.

RENE GIFFORD: So you ready?

Morgan Yeah.

RENE GIFFORD: Yeah? OK. Activation can be a very emotional experience. This is something they've been waiting for. They've had surgery and now they want to know how well it's going to work. So I'm going to have you just turn around and talk to your parents and just kind of see what their voices sound like and kind of get used to the sound.

Morgan Hi.

SPEAKER 6: Hi, Morgan.

Morgan You sound the same.

SPEAKER 6: I sound the same? You remember my voice?

SPEAKER 7: Can you hear me? [INAUDIBLE]? Pretty cool.

SPEAKER 6: Is it better?

Morgan It's a good thing.

RENE GIFFORD: I love it. I mean, that's the moment. One of the goals is to try to get this technology into the hands of people who need it. The Mama Lere Hearing School at Vanderbilt-- we've enrolled about 30 children. And the children actually show even greater outcomes than the adults.

SPEAKER 8: Boom. Boom.

SPEAKER 9: Beautiful, Laura.

RENE GIFFORD: And we're really hopeful that, in the future, we'll really develop a cochlear implant program that can maximize their hearing capabilities.

ALLYSON SISLER-DINWIDDIE: Yeah! The patients that I have the opportunity to see every day help me just as much as I am hopefully able to help them.

RENE GIFFORD: What a role model for these little patients of ours who see that gosh, look, Dr. Ally's got implants just like I do. And I can grow up and I can help other people too. I mean, we couldn't ask for a better job.

ALLYSON SISLER DINWIDDIE: Everybody's got challenges. Everybody's got things that they want to overcome. It's just all about your perspective.

SPEAKER 10: Bye, Miss Ally.

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