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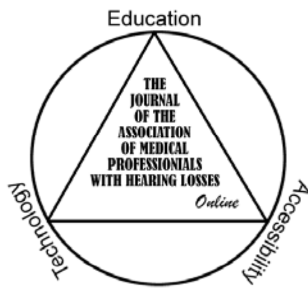


# Cochlear Implantation: Is It For You?

Samuel R. Atcherson, M.Ed.
Danielle N. Rastetter, D.V.M.
Stacey M. Cordwell Carroll, RN, BC, Ph.D. (c)
Mike McKee, M.D.

Today, it is estimated that there are 25,000 people in the United States with cochlear implants and 60,000 people worldwide (Self Help for Hard of Hearing People, 2003). Included in these figures are healthcare professionals who have opted for cochlear implantation when hearing aids provided little to no benefit and when difficulties arose in clinical or academic settings. The purpose of this communication is to describe some aspects of the cochlear implant decision-making process. Following this description, we have provided our own personal perspectives on the process, decisions made, and outcomes with specific emphasis regarding our vocations as an audiologist, veterinarian, nurse practitioner, and physician. Each of us has a hearing loss. Three of us currently wear cochlear implants; one of us has recently been granted cochlear implant candidacy and is currently awaiting cochlear implant surgery. Although our hearing loss, academic, and clinical experiences are idiosyncratic, there are common thought processes in determining whether or not cochlear implantation was right for us.

## Cochlear Implants Are Successful Prostheses

Cochlear implants are considered the most successful of all neural prosthetics (Møller, 2001). Modern multi-channel cochlear implants have the potential to provide more than 90% word recognition (Dorman, Loizou, Kemp, & Kirk, 2000) and they also provide correct identification of many environmental sounds. These are major leaps from 1977 when Bilger reported that patients using a single-channel implant could only report 56.9% of twenty-seven environmental sounds correctly, and only a 7.9% difference on a lip reading test with the implant switched off (79.4%) versus the implant switched on (87.2%). Today's most successful cochlear implant users have the potential to regain use of the telephone, to communicate better in the presence of some competing background noise, to communicate without lip reading, to decipher some messages from speakers (e.g., PA systems and car radios), and to take their own notes in class or conference lectures. At the very least, cochlear implant users will be able to detect sounds both simple and complex, at a greater range of intensity levels (e.g., ≥ 20-30 dB), and across a broader range of frequencies than is possible by even the most technologically advanced hearing aids. By no means, however, do cochlear implants restore normal hearing. Cochlear implants provide awareness of sound. Much research is being undertaken in a variety of fields to understand better the coding mechanisms of the auditory system (see Klinke & Hartmann, 1997; Møller, 2001), and the cochlear implant devices and speech processing strategies are evolving as a result (Zwolan, 2002).

## Decision to Obtain a Cochlear Implant Can Evoke Anxiety

There are several potential sources of anxiety involved while deciding whether to obtain a cochlear implant. Perhaps the greatest source of anxiety comes from the fact that following surgery, any residual hearing that the individual has in the implanted ear will be virtually lost. Unlike hearing aids, there is no trial period. Once the surgery is performed, there is no turning back, unless one desires to have the cochlear implant removed completely. Should this decision be made, a hearing aid will do very little for that ear. Other important anxieties arise from deciding when to obtain the implant and choosing a specific cochlear implant device.

## No Good Time to Obtain a Cochlear Implant

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The decision to obtain a cochlear implant is not one that is made without serious contemplation. The surgery is invasive, requiring two to six weeks of healing time before the activation of the device. Upon activation, it may take up to several weeks or months before the cochlear implant user can use it well enough to communicate using their hearing alone, if that performance is achieved at all. Finally, auditory rehabilitation sessions and program re-mapping sessions can be in inconvenience to a busy schedule. These events can put a cochlear implant recipient out of commission for some time until they are able to resume their duties. In other words, there is no good time to obtain a cochlear implant.

## The Process of Making the Decision

### *Are hearing aids adequate?*

The first step in the process is determining whether or not hearing aids are sufficient for communication and/or for performing certain job functions. This may come about either from sudden changes in hearing abilities or realization that hearing aids will not provide what is necessary to be fully competent in a healthcare field either as a student or professional.

### *Personal Research*

The second step is taking the time to learn about cochlear implant technology. This step can proceed with personal research on cochlear implants or with direct consultation with a cochlear implant surgeon or audiologist. Often times, people interested in cochlear implants will first browse manufacturer websites, read published scientific and commercial materials, and ask current cochlear implant users about their own personal experiences. This step becomes a difficult because a candidate must choose one of several available cochlear implant devices, all of which may differ their technological features (e.g., electrode array design, MRI-compatibility, battery type, etc.). Current research does not provide substantial evidence that any one of the FDA-approved devices is superior to another. In other words, each of the different devices has both successful and poor users of its product. The differences in performance between users of both the same device and different manufacturer devices may relate more to other factors such as age at onset of deafness, duration of hearing loss, duration of hearing aid use, status of the cochlea, amount of residual hearing, presence of concomitant disabilities, rehabilitation opportunities, speech and language abilities, and status of the brain.

### *Preoperative Evaluation for Determining Cochlear Implant Candidacy*

The third step is having a complete preoperative evaluation to determine whether an individual is a candidate for a cochlear implant. The preoperative evaluation includes several test procedures. A surgeon conducts a medical evaluation in attempt to identify the cause of hearing loss and to assess the general health of the patient. An audiologist performs an audiologic evaluation that includes a standard pure tone and speech test battery. The audiologist may conduct otoacoustic emissions (OAEs) testing and auditory brainstem response (ABR) testing to validate audiologic results. In addition, the audiologist conducts a hearing aid and speech perception evaluation. The purpose of the hearing aid and speech perception evaluation is first to determine if the current hearing aids are appropriately fitted and then to evaluate the speech perception abilities of the patient using the hearing aids. This evaluation determines aided benefit. Depending on the test that is used, when performance falls below a certain cutoff (e.g., ≤ 40% on open-set Lexical Neighborhood Test; Kirk, Pisoni, & Osberger, 1995), initial cochlear implant candidacy is granted. Cochlear imaging is performed either with computed tomography (CT) or magnetic resonance imaging (MRI) to evaluate the status of the cochlea. The imaging test may identify non-candidate cochleae that may assist the patient in deciding which ear to have implanted. Also, the surgeon uses the imaging information to decide how to proceed with the surgery. Finally, a psychologist may evaluate a patient's cognitive, social, and emotional status and adaptive behavior. Psychological evaluations are given primarily to pediatric patients and sometimes to prelingually and postlingually deafened adults. Table 1 delineates the current candidacy requirements for adults.

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**Table 1.**

| Candidacy Requirements for Adults |
|---|
| • Moderate hearing loss in the low frequencies and profound hearing loss in the middle to high speech frequencies bilaterally<br>• Little or no benefit from hearing aids. This is defined by a score of 60% or less in the best-aided listening condition and 50% or less correct in the ear to be implanted on open-set sentence recognition when using hearing alone<br>• No medical or radiological contraindications to surgery<br>• Motivated patient<br>• Appropriate expectations |

*Which Cochlear Implant Device is Desired?*

The audiologist often presents product demonstrations to the patient of the various devices are available to that clinic. In some clinics, all possible devices are available; in others, the surgeon and/ or audiologist may feel competent with only one or two different devices. Following the demonstration, the patient will ultimately have to decide which device to choose, and if the option is available, which ear to have implanted. The patient must decide which of the various features offered by the different devices are desirable. To name a few, for example, the devices may differ in weight, style, color, battery type (rechargeable or disposable), battery life, assistive listening device connections, perceived durability, types of speech processing strategies offered, and future of the device and company. For healthcare professionals, the assistive listening device features of cochlear implant may become very important with stethoscope use, for example.

*Which Ear to Implant?*

In the event that one has to choose an ear, there unfortunately is no solid evidence for choosing one over the other. A decade or more ago, the poorer of the two ears was chosen because the long-term effects of cochlear implants was not known. As our knowledge expanded and the long-term effects became known , the better ear was usually chosen. Friedland, Venick, and Niparko (2003), in a study correlating ear choice and speech recognition performance, found only correlation between performance and duration of deafness, which may be not ear specific. They believe that performance may relate more to total auditory receptivity of the patient. This means that if the brain is wired for speech and language, it may matter very little which ear is chosen. Although there has been some concern about the survival of auditory nerve fibers following long periods of deafness or lack of acoustic stimulation, the number of auditory nerve fibers is not correlated well with performance (Blamey, 1997). In support, Blamey explained that auditory nerve fiber count declines with age and with lack of auditory stimulation, yet cochlear implant users have shown increases in speech perception performance over time.

*Postoperative Outcome*

Unfortunately, it is very difficult to determine preoperatively how a cochlear implant user will perform following activation. No two experiences are ever described exactly alike. At the very least, cochlear implants that are activated for the first time may evoke only a sensation of feeling and may not even appear acoustic. However, over time, the sounds will take on an acoustic quality. The first few months of cochlear implant activation has been likened to learning a language for the first time, and this is the period of time for which the new cochlear implant user must make connections between sounds that they have heard and actually put a

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mental/ lexical name to the sound. Sounds that occur frequently in one's daily routine will be easier to identify than sounds that occur less frequently. With time, most cochlear implant users become satisfied with their devices and the cochlear implant is often better than the benefit provided by hearing aids.

### Cochlear Implant Personal Perspectives

*Atcherson*

I have a syndrome called large (or enlarged) vestibular aqueducts (LVAS) that is likely the cause of my hearing loss. LVAS results in hearing that slowly deteriorates over time, particularly from childhood to adulthood. I did very well with hearing aids throughout my childhood until I was a graduate student in audiology. My decision to get implanted came after two events. The first event came when I was an intern at the Kennedy-Krieger Institute in Baltimore MD. Speech began to be noticeably muffled in my ears. Fear struck and I worry for the first time that I would not be able to depend on my hearing aids much longer. I knew that cochlear implants were available, but I was unsure if I was ready for such procedure, if I even wanted it at all. With such drastic change in hearing, I began to think about whether I wanted to graduate and get a job as a clinical audiologist or enroll in a PhD program to pursue teaching and research endeavors. I decided to pursue the latter. I felt at the time that I did not want to have to depend on my hearing, not knowing if cochlear implants would work for me. I would find alternative ways to be involved in my field. The second event came the summer after my first year as a PhD student. My hearing dropped again, this time in just my right ear. I became extremely tired at the end of classes from straining to speech read, and I began to think about how I would survive in the field without the ability to hear. After all, is not audiology an auditory-dependent field? Following the second event, I actively pursued the cochlear implant and I was implanted in July 2001.

Today, I am a fourth year PhD student in audiology and I feel that the cochlear implant is one of the best things to have happened to me. Two years before, I worried about my survival in the field of audiology. Today, my horizons have broadened and more doors have opened to me. For sure, I am not afraid of the possibility of clinical audiology. I can hear the feedback of client/patients' hearing aids. I can conduct speech discrimination tests without great anxiety. I can troubleshoot diagnostic equipment using acoustic signals that once were not audible to me. I teach classes and can confidently engage my students in discussion. I can easily take my own notes in class and during conference lectures. And most importantly, with sufficient and acoustically-challenging aural rehabilitation sessions, I can use a telephone in some of the most acoustically harsh (noisy) situations. I can't imagine where I would be today as an audiologist without my cochlear implant.

*Rastetter*

People have a common misconception that certain breeds of dogs are inherently dangerous. I never did agree with that, despite the fact that a violent episode with a Rottwieller dramatically changed my life.

Since I was three years old, I coped with a bilateral progressive sensorineural hearing loss due to enlarged vestibular aqueducts. My coping skills grew to encompass utilizing hearing aids and assistive listening devices, strategically placing myself relevant to the speaker, asking for repeats, training teachers how to best communicate with me, speech reading, and using closed captioning. The year 2002 found me as a veterinarian who managed her hearing loss okay, or so I thought. I had been looking into a cochlear implant for my left ear, which received absolutely nothing on any test the audiologist gave me. There was no urgency though since I was functioning with a hearing aid in my right ear. I looked at the surgery with a rather nonchalant eye: "if it's meant to happen, it will happen."

As many people with enlarged vestibular aqueducts know, sudden losses of hearing can occur at any time, and have been associated with head trauma. That day in May dawned as any other. Animal restraint takes many forms, one of them sometimes being using the weight of your own body to restrain. Not a smart idea with a 120 pound muscular Rottwieller who did not want to be restrained. Our wrestling match led to a violent head butting that left me with a split lip and a dramatic drop in my right ear's capabilities—from 24% discrimination to 14%. Now I struggled. I became depressed for the first time in my life about my hearing loss. I could not use the telephone anymore. I could barely hear people. I was not auscultating well. I was dependent completely on

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speech reading and TDD. I was asking others to double check sounds such as breathing or auscultation. The cochlear implant surgery on my left ear was moved from early 2003 to September 2002, as early as possible.

I was not able to find dramatic scientific evidence to choose either the Clarion or the Nucleus. My final decision was based on two pieces of information—the jack for the assistive listening devices was at the bottom of the Nucleus BTE (ease of attaching my direct audio input from my stethoscope) and the fact that my surgeon was most familiar with the Nucleus.

The surgery was rough. I had significant nausea and vomiting after a previous ear surgery, this surgery was no exception. The pain surprised me. After having my son via natural childbirth and just taking over-the-counter pain medications then, my need for prescription strength pain killers for the next nine days was unusual in my mind.

Six weeks later, I was activated. It sounded like extremely loud noise and it was just someone shifting in his seat! Speech was unbearable. I had a headache within thirty minutes of activation. On the drive home, I was able to pinpoint a noise that turned out to be papers ruffling. I couldn't remember the last time I had ever heard that. The next day at work, I was going around making noises while my co-workers watched me with enjoyment. Turning the water on and off, tapping different objects, moving things, asking "what's that noise?" a million times. I could separate noises and pick different voices apart from others. I could tell that my son was singing along with the radio in the back seat of the car. I could hear the wind blowing and people talking from across the room. It was a miraculous world of sound that I had forgotten about and never in my wildest dreams thought I would ever regain. Five months after activation, I had 94% speech discrimination in a sentence, 54% individual word discrimination, and a moderate hearing loss when only utilizing my cochlear implant. My audiologist also told me I'd get even better with time. When I got those test results, a weight just felt lifted from my shoulders and I cried. My clients, friends, and family have commented on how much easier it is to communicate with me. I'm much more confident and comfortable which allows me to enjoy myself more in the exam room and bond with my clients. I rarely need to speech read. I still utilize my FM system at lectures so I can relax and take notes but if the group is small and room acoustics good, I don't absolutely need it. I've started trying to understand the words spoken on TV rather than relying on closed captioning. I am awaiting a dual HATIS so I can start practicing on the phone, which I think I should be able to comfortably utilize eventually. I am also working with Bob Mendoza to create a stethoscope patch cord that works for me. My hope is that I'll be able to auscultate better, especially the respiratory system.

I still wear my hearing aid in my right ear though I can understand why some people stop doing that. What the implant brings in is phenomenal. When my hearing aid battery dies, I don't notice it right away. I like how my hearing aid just fills in a few gaps of the cochlear implant. I can't put my finger on those gaps but, to me, it's most prominent with music. The hearing aid smoothes over the rough spots and blends the melodies. When my implant batteries die, I am amazed that I functioned from May to November with only that residual hearing. I know, though, that one day in the future, I will have my right ear implanted also—maybe when the implants become fully implantable!

I'm lucky that I've gained so much, especially in light of two things I did that could have caused the implant to be less successful. One was choosing to implant my deaf ear—that one that had not had any appreciable stimulation for over eleven years versus my ear that still had residual hearing. The second was not doing any real rehabilitation. I just didn't have time to sit down and watch TV without the captions or have people read to me. My son, fiancé, and work kept me too busy. Real life became my rehabilitation.

Over a year ago, a Rottwieller set a chain of events in action that gave me my life back in ways I never allowed myself to dream possible. I think one day, I'll return the favor and give a Rottwieller a home.

*Carroll*

While working as a nursing instructor a few years ago, I was quizzing a student about the side effects of beta-blockers. The student's response was initially clear, but then her voice suddenly dropped to an inaudible level. My hearing aid battery always died gradually, unlike this. In my heart, I knew there was something really wrong and my suspicions were confirmed when I was told that I had lost my tiny bit of residual hearing. Even though I have had a profound sensorineural hearing loss since birth and rely totally on lip reading, my residual hearing helped me tremendously. In a way, losing that last bit of hearing ended up being a blessing in disguise because

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the cochlear implant I received just a couple months later has provided me with so much more sound than I ever had with my hearing aid. If I had not lost my residual hearing, I don't know if I would have been brave enough to get a cochlear implant. However, if I knew then what I know now I would have gotten the cochlear implant in a heartbeat.

Although outwardly I probably appear to function much the same as I did with my hearing aid, inwardly I know that communication is easier for me as a nurse practitioner. In geriatric settings, edentulous old men and women are easier to understand. In psychiatric settings, patients with tardive dyskinesia no longer present the challenge they once did for me because I can use my hearing to help me determine which mouth movements are words and which are medication-induced. And in all settings, patients and students with accents are less problematic for me to understand. In addition to less strenuous lip reading, my cochlear implant has enabled me to hear many more environmental noises. Thus I am generally able to hear the call buzzer system, pump alarms, and people calling me. This awareness of what is going on around me has increased my feeling of comfort. Aural rehabilitation has been invaluable in helping me identify sounds and speech. When I returned to school to pursue a doctorate in nursing, I found that I was less tired after three-hour lectures than I would have been with my hearing aid.

Because I am prelinguistically deafened and got the cochlear implant as an adult, I will never function as a hearing person. However, I definitely notice an improvement in the amount and quality of what I am hearing and this is extraordinarily helpful in my work as a nurse.

*McKee*

During my medical training, I had been approached by two ENT surgeons who have asked me if I would consider becoming a cochlear implant recipient. Both times I politely refused. I was too proud of my accomplishments of becoming a family practice resident physician despite being born with a severe-profound sensorineural deafness (genetic deafness). In some odd way, I perceived the cochlear implant as a way in which I would be rejecting who I really am as well as my participation in the deaf culture. I also felt that the implant would minimize my success achieved so far as a deaf person. I was also concerned about setting an example to other deaf children and people my age that cochlear implant was the answer for their hearing loss. Besides, I felt satisfied that with my speech reading along with my clear speech and usage of hearing aids, I was still communicating better than those who were implanted. Obviously, pride was a big barrier for me to overcome in a step towards my plan to receive the cochlear implant.

However, the sense of "defeat" and "burn out" came upon me during the latter part of my second year of residency. The feeling made me realize that I expended lots of energy to keep up my career and life as a deaf physician. Shortly after, I felt waves of frustration that caused me to behave apart from my normal enthusiastic and excited self. With each struggle and difficulty I encountered, I would scream to myself "why me or why does it have to be this way?"

My ear molds caused the first wave of frustration when my hearing aids started "cutting off" or giving feedback due to poorly fitting molds. Since I cause a lot of wear and tear on my ear molds by habit of taking them out frequently to place the DAI boot that connected to my stethoscope, I knew it was time yet again to get a new set made. Unlike the previous new sets, obtaining those new sets of ear molds proved to be no easy task since it took several rounds of mold impressions and weeks to finally find the fit that allowed me to use my hearing aids again. I felt upset to be struggling with such a simple yet essential object that really only gave me limited advantages in hearing and communicating. Another situation occurred when I got the privilege to visit my fiancée's family in Kauai, Hawaii. This exotic locale proved to be my second wave of frustration for me. Her family speaks pidgin, which is a combination of Hawaiian/Filipino/English language. Even though her family was patient and easygoing with me, I had great difficulty comprehending them since lip reading proved to be useless for me. My residual hearing is helpful with my speech reading but by itself, it proves to be useless as well. I depended on my fiancée to translate for me and I felt upset that I couldn't even communicate well with them one on one. Despite the wonderful time visiting Kauai, I came to the conclusion that I need to bravely make the next step in which I had so proudly declined for several years. Just like how I think in medicine, I started evaluating the benefits and risks of the cochlear implant for myself. I also started noting the daily struggles and difficulties I had not only as a deaf physician but also as a deaf adult. Even though I am well

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educated and bold in my work, I realized my timidness in accepting my need for other people's help. Fortunately, I have been blessed by a wonderful group of deaf friends (professional and non-professional) along with a supportive and caring family and fiancée who helped me grapple with my decision. I still find it odd to be perceived as the "patient" rather than the health care provider yet I am eagerly taking my next step on August 5th when I get implanted.

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