Coming Soon to a School of Yours! Pediatric Cochlear Implants

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At least 33 states nationwide have passed laws requiring hearing screening of newborns in the past five years. It is predicted that the number of neonates screened for hearing loss will continue to increase. Utilizing technologic advances, objective hearing tests for use in screening infants and newborns are becoming widely available. Initial screening helps identify neonates with possible hearing loss, and a referral for further evaluation can be made within hours of birth. Early detection of hearing loss dramatically increases the number of children receiving prompt and appropriate intervention, while at the same time decreasing the amount of special services the child will need over the life span. For a number of babies, the initial screening failure is due to fluid in the ears or other debris from the birth process. However, for other newborns further testing will demonstrate a significant hearing impairment. For the child with severe or profound hearing loss intervention options may include cochlear implantation. This article will provide background information on pediatric cochlear implants and address issues unique to the school setting in which the school nurse may be involved.

What is a Cochlear Implant?

Early interventions for children with diagnosed severe and profound hearing loss and advances in cochlear implant technology increase the chances you will encounter a student with a cochlear implant (CI). Cochlear implant was first performed on children in the early 1980s. To date, approximately 30,000 individuals worldwide have received cochlear implants. In the U.S. some 4,000 people have had cochlear implants; approximately half of these individuals were adults and half were children (NIDCD, 2001). In 1999 alone over 3,000 cochlear implants were performed worldwide.

In normal hearing, the fluid-filled inner ear, or cochlea, has ultrasensitve hair cells that are stimulated by vibrations from the middle ear. The hair cells transform sound energy into electrical nerve impulses. A cochlear implant is a multi-component electronic device that bypasses the damaged tissues in the inner ear. One component is the electrode array, which is placed directly in the cochlea and delivers electrical signals directly to the acoustic nerve (cranial nerve VIII).

The cochlear implant does not work by amplifying sound, like a hearing aid, but rather by electronically sorting out sounds and changing them into electrical impulses. The application of electrical current at the various points on the electrode array results in direct stimulation of remaining neural elements (Alpiner, McCarthy, 1993). The speech processor is initially programmed about three to four weeks after surgery by a specially trained audiologist. During the first six to twelve months after surgery the child will return to the audiologist approximately eight times for fine-tuning of the processor.

Cochlear implants do not restore normal hearing; however, they can help the user understand speech and perceive sounds from the environment. Hearing and speech outcomes can vary between individuals depending on a myriad of factors, including age at implantation; duration of deafness; type of early intervention and auditory environment of the child; whether the child was post- or pre-linguistically deafened; motivation of the user; and whether the child has other health problems. Making certain the family understands the long-term commitment to post-implant habilitation is a large part of the pre-implant counseling process. When determining if a child is a candidate for a cochlear implant, a cochlear implant team assesses all the factors that may impact upon a child's success using one. In pediatric implantation, both the child and the family are evaluated in determining candidacy for implantation.

Why is Early Intervention Important?

At birth, the neonate begins the neurological organization work that fosters the sensorimotor development required before he or she can make sense of or produce spoken language. It is the early and continuous exposure to sound that allows the neural networks of the auditory system to develop. Through the interplay of the maturation and myelination of the nervous system and sound stimulus humans, develop the ability to decode language (Freiburg, 1992; Hall, 2000). While a 1-month-old child cannot speak, the neurological processing of sound has been taking place since birth. Research has shown a dramatic difference in language acquisition between children identified and treated for hearing loss before six months of age versus those identified and treated after six-months of age (Yoshinaga-Itano, 2000).

Prior to the current trend in hearing screening for all newborns, hearing loss would not have been detected until months or even years after birth for many children considered low risk for hearing loss (Stein, 1983). By the time a diagnosis was made, critical developmental periods in language

processing and sensorimotor development would already have been missed. Before age two the foundations of language development have been laid. After two years of age the development and use of our language system accelerates dramatically. If the pathways and contexts have not been established, the neural system continues to evolve in ways not compatible with the use of language (Sanders, 1993). In turn, delayed diagnosis of a profound or severe hearing loss can lessen how effective hearing aids or a cochlear implant will be in facilitating spoken language and communication development.

Early diagnosis and prompt intervention are essential in improving outcomes for children with hearing loss. Parents must be the final judges in selecting options for their child.

How Can Cochlear Implants Help?

Cochlear implantation at an early age can give the child exposure to the combination of sounds we call language. Children receiving a cochlear implant prior to age two have been shown to have at-age-level skills in language development by the time they enter kindergarten. Older children whose hearing loss has been progressive, and whose hearing aids are no longer effective, may be candidates for CI. Also, children who have lost their hearing postlingually due to illness or injury may be candidates for CI (NIDCD, 1998).

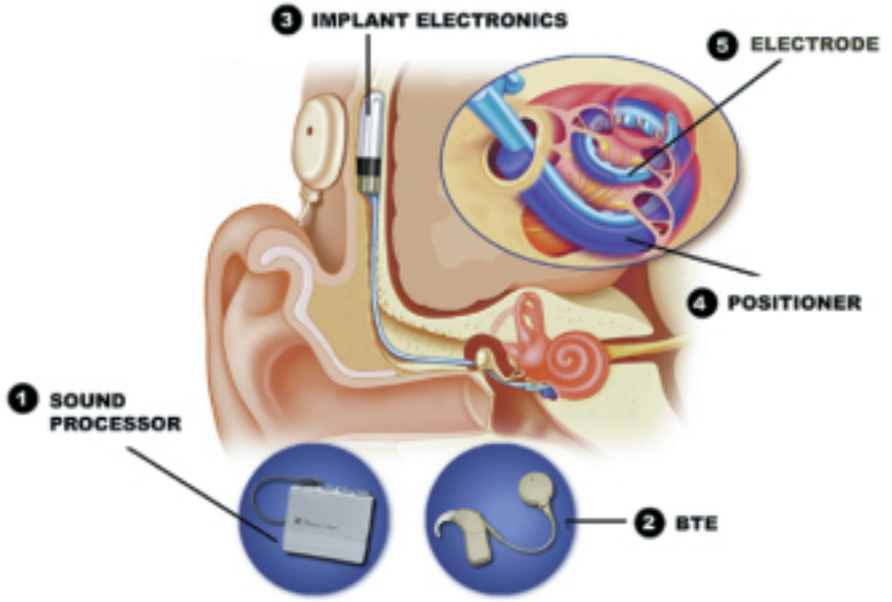
What Will It Mean For the School Nurse?

The age of the child and the age at time of implant are factors that will affect what interventions are needed in the school setting. The situation and specific needs of both the child and the family will differ between an older child who receives a cochlear implant and those of a child entering school with an implant already in place. The individualized education plan (IEP) for a kindergartner who had a cochlear implant at age 18 months may be very different from that of an 8-year-old postlingually deafened child who received the implant this spring. However, there are also commonalities between the two cases.

In caring for the "whole child," the school nurse must realize that cochlear implants do not restore hearing equal to that of a child with normal hearing. For this reason the school nurse, in conjunction with the audiologist, speech therapist and classroom teacher, should examine classroom acoustics and make recommendations for any needed modifications (Pepi, 2001). While some modifications can be costly, there are others that can be made by simply rearranging the classroom. Any needed modifications fall under the federal law mandates requiring schools to provide appropriate services and modifications just like those providing for wheelchair access. These modifications will not only will help the hearing-impaired child but more than likely help create a learning environment more conducive to achievement for all the children in the classroom. Noting the differences in acoustics between the cafeteria (tile floor, high ceiling, laminate tables) and the school library (carpeted floor, partitions, book stacks) demonstrates how materials and floor plan can affect the environment and "feel" of a room.

In evaluating the school environment you, as the school nurse, need to take note if your school has a checking or metal detecting system, like those found in airports or public libraries. These systems may cause a loud sound in the implanted ear. Though not harmful, the sound may be uncomfortable or startling. If possible, implement a plan that allows the child to walk around it or simply remove the external device.

It is important to work with the child's parents and explore their feelings about having a presentation for the child's class explaining what a cochlear implant is and how it works. With the parents' approval, contact the implant center to see if the center can provide a classroom presenta-



The implants' multi-channel electrodes are implanted unilaterally into the cochlea. An external microphone/headpiece (circular object in #2) is worn outside the body behind the ear – a magnet in the microphone is attracted to a companion magnet in the implant. The microphone picks up external stimuli and transmits the information via a cable (seen in #2) to a belt-worn model sound processor (1) or a behind-the-ear processor (BTE). The sound processor acts as a personal mini-computer. It is programmed and modified by a specially trained audiologist. It stores patient-specific information for activation of the electrode array. The processor receives electrical signals sent from the microphone and decodes the sound into the digital pulses. The electrical current pulses travel back up the cable to the head piece (2) to the implant electronics. The receiver/stimulator implant electronics (3) are seated under the skin in a surgically made depression behind the ear in the mastoid bone and transmit the digital pulses to selected electrodes along the multi-channel array (5) positioned in the cochlea. The electrode positioning system (4) ensures consistent positioning of the electrode array near the interior wall of the cochlea where hearing fibers are located. Drawing courtesy of Advanced Bionics Corporation/Clarion®.

tion and/or in-service training for teachers. As with any child, the child with a cochlear implant doesn't want to feel too different from everyone else. However, with education about the external components of the cochlear implant, teachers and students can feel more at ease. (Alpiner, McCarthy, 1993).

Preoperative Considerations

Initially the process for a child receiving an implant during the school year will differ from that of the child who has had the implant for some time. The extensive preoperative evaluation and therapy, in addition to the location of the implant center, might mean the child will be absent from school at times. Obtaining a schedule of future appointments from the parents and providing this information to the teacher might allow for classwork to be done before the absence occurs. This could help minimize the impact of these absences and facilitate the child's feeling of inclusion in the classroom.

The implant surgery lasts three to four hours with the child usually being discharged the following day. The child is encouraged to restrict activity until the follow-up appointment, which is usually scheduled one week after surgery. At that time the dressing is removed, the incision examined for any signs or symptoms of infection. An audiologist then may check the functioning of the implant's internal components. The child is usually allowed to return to school after this appointment. The device is not programmed at the initial post-operative visit. Once the incision has completely healed, usually in 4 to 6 weeks, the child will begin the process of having the external sound processor fitted and programmed at the implant center.

After cochlear implantation the child usually continues to work with a speech therapist and an audiologist. These services may be provided in the child's community or at the implant center.

The child's ear and/or the skin around the incision may protrude for the first few weeks after the surgery. It will gradually return to its normal position. After the swelling has subsided you will be able to feel the implant under the skin behind the ear. The child may say the ear feels numb, report a taste disturbance, or describe a metallic taste. These sensations are usually temporary and will typically improve over time. Depending on the child's perceptions of how noticeable the incision is, or the size of the area shaved, he or she may want to wear a loose-fitting hat or other head covering after surgery. You may need to advocate for the child and tell classmates why an exception is being made if your school's dress code prohibits hats.

Safety in the School Setting

The natural activity level of children in a school presents special challenges in injury prevention. The school-age child with an implant is urged to take precautions regarding physical education classes and recreational activities to minimize the risk of damaging the external and internal components of the device. Children are encouraged to avoid any sports where blows to the head are possible (volleyball, football, wrestling or boxing). A blow directly on the internal components or near the area of the receiver stimulator may result in damage or breakage of the internal device. However, bicycle riding, track, basketball and roller-skating are all suitable activities for children with cochlear implants in conjunction with the use of proper safety equipment. Coordinate with the physical education instructor to ensure that helmet use is required for all children in the class when they participate in these sports at school. Enforcing this policy will foster safety habits for all students. In addition, the child with the implant will feel less conspicuous than if he or she is the only one required to wear a helmet.

A permission form and course description detailing the components of the physical education program facilitate safety and communication and reduce the risk of liability. Parental guidelines for physical activity exceeding those of the child's physician or those mentioned here must be followed. Documentation of these restrictions needs to be on file. All appropriate staff should be made aware of any additional limitations. Collaboration between the classroom teacher, physical education teacher, parents and the school nurse is essential in developing a comprehensive, safe, educational program for any child with a health condition.

Emergency information should indicate that the child has a cochlear implant, including the type and manufacturer, which ear is implanted and the telephone number of the implant center and the ENT physician information. Depending on the age of the child, parents may want to purchase a medical alert bracelet or necklace for their child to wear. All cochlear implants are not currently considered compatible with the high magnetic fields of MRI scanners (CDC, 1995). Implant manufacturers are redesigning their devices to circumvent this problem, and lower MRI magnetic fields have been used on patients with cochlear implants in Europe.

The microphone contained in the headpiece is held in place with a magnet in the headpiece and another magnet in the implant. (Photograph courtesy of and used with the permission of the Carolina Children's Communicative Disorders Program, University of North Carolina Hospitals, Chapel Hill, NC)

What should you do in the event a child with a cochlear implant has an accidental head injury by falling or receives a blow to the head? Triage the child as you would any other child who has received a head injury. Contact the parents or guardians and, using your judgment, advise them to call or visit their pediatrician or other health care provider and follow recommendations. Document the incident, detailing the "who, what, when, and where." Children with cochlear implants are just as active and engaged in sports as are other children. If the child receives a direct blow on or near the CI site, the internal components can break. Whether or not the device is damaged may only be determined by its performance. A computerized tomography (CT scan) alone is not considered a definitive diagnostic tool in determining whether or not an implant has been damaged.

ADDITIONAL SAFETY TIPS

Electrostatic discharge (ESD) – plastic slides, TV and computer screens can all be sources of static electricity. Static electricity has been known to cause interference with the operation or programming of a cochlear implant.

Magnets – additional magnets, or magnets other than those from the cochlear implant manufacturer, should never be used with the implant headpiece. If there is a problem with the headpiece staying in place parents should contact the manufacturer or the implant center. Use of other magnets could cause skin breakdown between the headpiece and the internal magnet.

Battery Safety – the batteries in the sound processor are small and discarded ones must be kept out of the reach of young children. If batteries are accidentally swallowed call poison control immediately.

Monitoring – after cochlear implant surgery the school nurse should monitor the incision site. The classroom teacher and other staff should also watch for signs that a sound is too loud or painful for the child. While the programming is being fine-tuned be aware facial nerve stimulation might occur. This inadvertent electrical stimulation can be easily remedied by adjusting the programming.

Parents need to contact their implant center or ENT surgeon if their child receives a head injury. The ENT surgeon can recommend appropriate follow-up. There are cases in which an implant quits working immediately after a head injury. Other times, the child will need to be monitored over a few days. The internal components of the implant will need to be replaced if the internal device is damaged or broken.

Summary

The school nurse plays a vital role in addressing the emotional and physical concerns of the child with a cochlear implant in the classroom setting. As more children with cochlear implants are enrolled in the regular school setting the school nurse's role will include promoting injury prevention through appropriate classroom and playground behavior, addressing the safety concerns of teachers and staff who are inexperienced with cochlear implants, and collaborative evaluation of the physical environment to maximize efficacy of the implant and assure optimal learning conditions are provided. In caring for the child with a cochlear implant the school nurse serves in a multiplicity of roles, and through these roles can take part in helping one more child experience success in the educational setting.

ACKNOWLEDGEMENTS

The author is grateful to Christy McNeil for her editorial suggestions and insightful contributions and to David Perry for his assistance in accessing the CCCDP photographic archives.

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