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Sound Beginnings

Supporting Families of Young Deaf Children With Cochlear Implants

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For many families of young children who are deaf, a cochlear implant may be the most viable option for promoting spoken language development. Children may qualify for a cochlear implant as young as 12 months if they have demonstrated minimal benefit from conventional amplification. In order for oral language to occur, however, parents need to be fully involved in their children's early-intervention program. This article presents 2 family constructs that are associated with language learning in young children with cochlear implants: parental involvement and maternal self-efficacy. After reviewing the theoretical and clinical applications of these family constructs, we provide practical suggestions for professionals working with families who have young children with cochlear implants. **Key words:** *cochlear implant*, *early intervention*, *self-efficacy*, *parental involvement*, *parent-facilitative language strategies*, *natural learning environment*

OF THE 4 MILLION American children born every year, approximately 4000 are born with a profound hearing loss and may be a candidate for a cochlear implant. A cochlear implant is an auditory prosthetic device surgically placed in a child's inner ear that electronically stimulates the auditory nerve to provide the child with awareness of sounds. In order for a child to learn how to derive meaning from those first sounds, however, it is essential that families not only be knowledgeable about their child's cochlear implant, but also be actively involved in an early-intervention program. Collaboratively, early-intervention professionals can support families during this critical period.

Recent research has greatly expanded our knowledge of children's language learning during the toddler and preschool years. We now know that, compared to deaf children with hearing aids, the majority of children with cochlear implants show significantly better outcomes in speech perception, speech production, and spoken language skills (Kirk, 2000). In fact, compared to young hearing children, children with cochlear implants exhibit language-learning rates similar to hearing peers (Svirsky, Robbins, Kirk, Pisoni, & Miyamoto, 2000).

It is also the case, however, that some children demonstrate much better communication abilities than others (Govaerts, Schauwers, & Gillis, 2002; Kirk, Miyamoto, Ying, Perdew, & Zuganelis, 2002; Kirk, Miyamoto, Lento et al., 2002). Variability in language development seems due to several factors. First, several aspects of children themselves may help or hinder the child's communication. Both the age at which a child receives a cochlear implant and the length of implant use seem important (Kirk, Miyamoto,

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Ying et al., 2002; Kirk, Miyamoto, Lento et al., 2002; Svirsky, Teoh, & Neuburger, 2004).

But 2 family factors also seem essential. The first of these relates to parental involvement, which has long been considered to play a role in children's early learning. Parental involvement can be defined as the amount a parent is involved in his or her child's program (ie, number of hours) or how a parent is involved (ie, facilitative language strategies used during caregiver-child interaction). Either way, parental involvement has been shown to directly relate to better developmental outcomes for their children.

Historically, parental involvement has been based on the theory that parents can be effective teachers for their children. More recently, early interventionists have modified the parental involvement concept into the empowerment model. This model focuses on collaborating with families to enhance their parenting skills—which in turn improve children's learning (McCormick, Loeb, & Schiefelbusch, 2003; Turnbull, Turbiville, & Turnbull, 2000).

The second family factor relates to parents' own self-efficacy (Bandura, 1991). Parental self-efficacy—a belief that a parent has knowledge and competence as a parent—may translate into parental practices to enhance their child's ability to function more effectively (Brody, Flor, & Gibson, 1999; DesJardin, 2004; Teti & Gelfand, 1991). Indeed, recent findings suggest that a mother's sense of competence is associated with specific language strategies that appear to enhance language learning in young preschool children with cochlear implants (DesJardin, 2004).

In this article, we first describe the cochlear implant before presenting 2 family constructs, parental involvement and maternal self-efficacy, that are associated with improved spoken language development in young children. After reviewing the theoretical and clinical applications of these constructs, we provide practical suggestions for early interventionists collaborating with families of young children with severe to profound hearing loss who use cochlear implants.

YOUNG CHILDREN WITH COCHLEAR IMPLANTS

For many children with severe to profound hearing loss, a hearing aid may not adequately amplify sound to audible levels necessary for oral language to develop. In this case, a cochlear implant may be the only viable option. In contrast to conventional hearing aids, which deliver an amplified acoustic signal to the damaged inner ear, a cochlear implant transduces the acoustic sound wave into an electrical stimulus. That stimulus bypasses the damaged hair cells in the inner ear and directly stimulates auditory neural tissue, sending the signal to the brain (McKinley & Warren, 2000; Waltzman & Cohen, 2000). But in order to understand how cochlear implants work, and why parental input is necessary for optimal development, we first provide a more detailed discussion of the nature of cochlear implants and their effects on children's communicative development.

Cochlear implants: The basics

As shown in Figure 1, a cochlear implant includes both external and internal components. The external components consist of a microphone (typically worn behind the ear), a speech processor (typically worn on the child's body in a cloth holder), and a transmitter (attached with a magnet to the child's head behind the ear), which sends the signal via radio sound waves to the internal components. The internal components consist of an electrode array, which is surgically placed in the scala tympani of the cochlea, and a receiver or stimulator, which is attached to the electrode array and lies beneath the skin on the mastoid bone behind the ear.

The cochlear implant works by converting an acoustic signal to an electrical stimulus (via the microphone) and routing it to the speech processor. There the signal

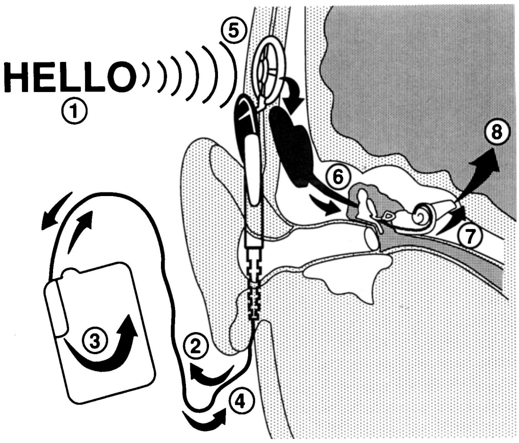

Figure 1. Sound transmission through the cochlear implant system: (1) Sound is received by the microphone and converted into an electrical signal, (2) signal travels down the cord (3) to the speech processor, which codes the information, (4) coded signal travels back up through the cord (5) to the transmitter coil, which is magnetically attached to the child's head. The signal passes through the child's skin via radio signal to the internal receiver, (6) electrical signals are sent to the electrodes in the cochlea, (7) where the hearing nerve endings are stimulated, (8) and the information is sent to the brain. Reprinted with permission from the Alexander Graham Bell Association for the Deaf and Hard of Hearing (www.agbell.org).

undergoes digital signal processing before being directed to the transmitter. The processed signal is then transmitted across the skin, where it stimulates the internal receiver and sends electrical current to select electrodes that correspond to the different frequencies of the stimulus.

For a young child receiving a cochlear implant, a 2- to 3-hour surgery is performed as an outpatient procedure. Approximately 4 weeks following surgery, the child returns to the implant center for the initial stimulation of the device. An audiologist assesses each of the implanted electrodes and determines the child's threshold levels (the minimum electrical current level required to produce a response). Once these levels have been obtained, maximal comfort levels of stimulation are established or estimated, and a "map" determined by this dynamic range is created and programmed into the child's speech processor (McKinley & Warren, 2000).

Effects of cochlear implants on children's hearing and communicative development

Although deaf children with cochlear implants can detect sounds in the mild to moderate range of hearing loss, these children function more like children with moderately severe hearing loss on word perception and language tasks (Boothroyd & Boothroyd-Turner, 2002; Eisenberg, Kirk, Martinez, Ying, & Miyamoto, 2004). Thus, a cochlear implant does not restore hearing to a normal range. Furthermore, when the implant is turned off or not in use (eg, while sleeping or bathing), the child is profoundly deaf.

While a cochlear implant can dramatically aid speech and language development for deaf children, using the device alone does not guarantee spoken communication. Families of a young child with a cochlear implant must make frequent visits to an audiologist to ensure that the device is optimally adjusted. For a toddler or preschooler with a cochlear implant, it may take many months for oral communication to develop.

In considering how cochlear implants affect communicative development, it is helpful to distinguish between speech perception (understanding sounds), speech production (using sounds to convey messages), and receptive and expressive language (understanding and using words for communication). In terms of speech perception, young children with cochlear implants (on average) make significant gains within the first 3 to 12 months of use on speech perception and speech production tasks (Cohen, Waltzman, Roland, Staller, & Hoffman, 1999; Fryauf-Bertschy, Tyler, Kelsay, Gantz & Woodworth, 1997; Hammes, Novak, Rotz, Willis, & Edmondson, 2002; Osberger & Fisher, 2000; Svirsky et al., 2004). Svirsky et al. (2004) compared 3 groups of prelingually implanted children (implantation before 2, 3, and 4 years) and examined their speech perception and language performance as a function of age at implantation. On average, children who received their cochlear implant prior to age 2 achieved higher speech perception and language scores than children implanted after 2 years of age.

Speech production can also be improved by cochlear implants. Many children demonstrate better speech production abilities depending on age of implantation (Conner, Hieber, Arts, & Zwolan, 2000; Tye-Murray, Spencer, & Woodworth, 1995) and length of implant use or "hearing age" (Serry & Blamey, 1997). In fact, many young children with cochlear implants demonstrate a pattern of phoneme acquisition at a similar rate to hearing children (Blamey, Barry, & Jacq, 2001; Svirsky, 2000).

Both speech perception and production outcomes therefore suggest promising potential for spoken language development in children with cochlear implants. Although understanding and producing sounds provide the necessary foundation for communication, these skills alone may not be sufficient to ensure communicative competence. Children must build on their speech perception and production abilities to further develop their spoken language skills (Stallings, Kirk, Chin, & Gao, 2002; Tomblin, Spencer, Flock, Tyler, & Gantz, 1999).

Typically, pediatric hearing aid users with severe to profound hearing loss have significant delays in spoken language development. For children with cochlear implants who are able to access sound across a broad frequency range, a positive relationship exists between speech perception and oral language development (Moog & Geers, 1999; Svirsky et al., 2000). In fact, language acquisition for children with cochlear implants follows a developmental progression similar to hearing children (Svirsky et al., 2000). Children who are implanted earlier, however, demonstrate better language skills (Hammes et al., 2002). Yet, within the Svirsky et al. (2000) sample, the language abilities of the children varied greatly even after accounting for both the child's age and length of implant use (hearing age). More specifically, the children's language quotients—language age divided by chronological age—ranged from 0.35 to 0.91. Most of the variability was not accounted for by child factors alone (Stallings et al., 2002).

FAMILY FACTORS INFLUENCING CHILDREN'S COMMUNICATIVE DEVELOPMENT

If the child's age at implant and other child factors alone cannot account for much of the variance, what else is influencing these children's communicative development? We suggest that 2 family factors—parental involvement and maternal self-efficacy—together partially explain why some children with cochlear implants develop better spoken language than others (Nikolopoulos, Gibbin, & Dyar, 2004).

Parental involvement in early intervention

In examinations of typically developing children, relationships with their parents or caregivers have been shown to profoundly affect what children learn on a daily basis. Similarly, parents involved in their child's early-intervention program have better communication with their child (Calderon, Bargones, & Sidman, 1998; Moeller, 2000). Parental involvement can even predict pre-reading skills in deaf children with hearing aids (Calderon, 2000; Calderon & Naidu, 2000).

Although most research focuses on the effects of parental involvement on speech-language outcomes of young children with hearing loss, broader ecological and family factors have recently begun to be examined. Calderon et al. (1998) analyzed characteristics of 28 families of early- and later-identified children who wear hearing aids and participated in the same early-intervention program. Children who had been identified with hearing loss at later ages (ie, generally after age 2) had families who spent limited time per week in early-intervention programs. These parents also demonstrated lower levels of confidence or independent knowledge related to the language needs of their children.

Parental involvement also contributes to language outcomes of kindergarten children with hearing aids (Moeller, 2000). In the Moeller (2000) study, parental involvement was defined as the "quality of family participation in early intervention." Using an overall rating scale, early interventionists rated each family retrospectively given specific descriptions of family characteristics, measuring both participation in program-related meetings and quality of communicative interactions with their child. The most successful children were those with high levels of family involvement and who were enrolled in an intervention program at an early age.

Parental involvement has also recently been investigated in families of young children with cochlear implants. Using a parental questionnaire specifically designed for the study, DesJardin (2005) showed that mothers of children with cochlear implants indicated greater involvement in their child's intervention program than did mothers of children with hearing aids. Even in the absence of an early interventionist, mothers who felt more competent in terms of having the knowledge to enhance their child's spoken language development felt more involved in their child's speech-language activities in their home.

Mothers' sense of involvement may also be related to how they interact with their children. In a sample of mothers of preschool children with cochlear implants, DesJardin (2004) found that mothers who felt more involved in their children's language learning at the first testing (Time 1) provided their young children with a greater number of higher-level facilitative language strategies (eg, parallel talk and open-ended questions) 1 year later. Even after controlling for their children's language age at Time 1, these same parent language-facilitation strategies were also associated with their children's receptive and expressive language outcomes. Conversely, mothers who felt less involved in their children's intervention program exhibited lower-level language strategies (eg, linguistic mapping, imitations, and directives). Such lower-level strategies, in turn, were negatively related to their children's language abilities. In essence, parents who perceived themselves as more involved in their children's early-intervention program had children who did better; these mothers also interacted with their children in ways that better facilitated their children's later language development.

Maternal self-efficacy

Although parental involvement may be important, it may not, by itself, be enough to optimally foster children's language development. An additional factor may involve parental efficacy, or the feelings that mothers possess about their own effectiveness as parents.

According to the self-efficacy theory (Bandura, 1989), parental self-efficacy beliefs should incorporate (1) the level of specific knowledge pertaining to the behaviors involved in child rearing and (2) the degree of confidence in one's own ability to carry out the specific parental role. For example, Conrad, Gross, Fogg, and Ruchala (1992) note that mothers' increased knowledge alone did not result in better interactions with their young children. Increased knowledge and confidence together, however, resulted in more effective interactions with their young toddlers.

A key component of self-efficacy theory involves parental follow-through. Essentially, a mother's efficacy beliefs are linked to the developmental goals endorsed for her child (Bandura, 1989). These goals may translate into parental practices that support their children's ability and persist until the goals are attained (Brody et al., 1999). In other words, a person who is self-efficacious both knows about and persists in a given task until success is achieved, whereas self-inefficacious individuals may have the knowledge needed but may be unable to persist because of self-doubt. In the case of young children with cochlear implants, mothers who feel efficacious—that is, perceive that they have both the knowledge and competence in their role as a parent—may formulate appropriate developmental goals for their child and carry out prescribed language intervention strategies.

Surprisingly, only a few studies have yet examined maternal self-efficacy beliefs as they relate to the mother-child relationships of hearing children. In a sample of mothers and their young infants, Teti and Gelfand (1991) found that maternal self-efficacy mediated the negative relationship between mothers' depressive symptoms and mothers' behaviors reflecting responsiveness (eg, warmth and sensitivity) to their infant. Maternal self-efficacy also remained significantly associated with maternal responsiveness after controlling for all other factors, such as demographic variables, mothers' competence with their infants, perceptions of infant difficulty, and social-marital supports (Teti & Gelfand, 1991). In short, mothers with higher self-efficacy were more responsive to their infants.

But this link between mother's self-efficacy and maternal behaviors may also need to be tailored to the specific needs of children with cochlear implants. As suggested by Bandura (1989), parental perceived knowledge and confidence of specific skills need to be measured for a particular population. Although there are several parental self-efficacy or parental empowerment scales available for other populations of children with disabilities, only 1 has been specifically designed for parents of young children with hearing loss (DesJardin, 2003). Using this particular measure, DesJardin (2004) examined a sample of 32 mothers with preschool children with cochlear implants (M = 3.7 years). Mothers who felt that they were knowledgeable and competent about their children's language development at the first time point in data collection (Time 1) had children with higher receptive and expressive language skills 1 year later (even after controlling for their child's language abilities at Time 1). Conversely, mothers who felt less knowledgeable and competent had children with lower language abilities.

In that same study, mothers' sense of efficacy was also related to specific facilitative language strategies employed during mother-child interactions. Specifically, mothers who perceived themselves as more knowledgeable and competent in developing their children's language skills provided their children with higher-level language strategies, including parallel talk, recast, and open-ended questioning. These same strategies were associated with better child language outcomes.

Conversely, mothers who perceived themselves as less knowledgeable and competent in their children's language learning used lower-level language strategies that included linguistic mapping, directives, and imitations. Although there is evidence to suggest that strategies such as linguistic mapping and imitation facilitate language growth in younger children with expressive language delays (Girolametto, Weitzman, Wiigs, & Pearce, 1999; Yoder, McCathren, Warren, & Watson, 2001) and preschoolers with cognitive delays (Kasari, Freeman, & Paparella, 2001), these strategies do not seem to be sufficient for preschool deaf children with cochlear implants. Consistent with Bandura's model of self-efficacy, mothers' perceived knowledge and competence appears to relate to the developmental language goals endorsed for their children.

Both parental involvement and self-efficacy are thus critical family factors necessary for developing language in young cochlear implant users. Indeed, efficacy beliefs and involvement are linked to mothers' behaviors, which advance their children's developmental outcomes (Bandura, 1997; Brody et al., 1999) and specifically to their children's language development (DesJardin, 2004). Parents will need to obtain the knowledge and competence of not only their child's cochlear implant, but also appropriate facilitative language strategies as they interact with their young child. In turn, professionals in early-intervention collaborating with families will need specific training to enhance parents' knowledge and competence as they continue to support their children's spoken language goals.

PRACTICAL IMPLICATIONS FOR EARLY INTERVENTION

On a daily basis, early-intervention programs emphasize the importance of supporting family strengths and collaborating with families to facilitate better interactions with their children (Chidress, 2004; Roper & Dunst, 2003). By tailoring their behaviors to the strengths of individual families, interventionists hope to provide families with a sense of confidence and competence—self-efficacy—about their children's current and future learning and development (Dunst, 2000; Sonnenstrahl-Benedict & Raimondo, 2003). In turn, parental self-efficacy of certain skills (eg, communicative strategies) will improve children's language learning (DesJardin, 2004; Turnbull & Turnbull, 2001).

Although parental empowerment is generally highlighted in early-intervention programs, few studies have investigated the links between self-efficacy and parents' ability to follow through with prescribed strategies to help young children with hearing loss. For this population of children, we have shown that maternal self-efficacy appears to be linked to parental involvement and to the way mothers interact with their children. Thus, bolstering a mother's sense of knowledge and competence in promoting her child's language skills appears to be an important goal in early-intervention programs, and should be taken into consideration when formulating the Individual Family Service Plan (IFSP).

How does an early interventionist bolster a mother's sense of efficacy? Researchers have advocated for more family-focused programs that provide opportunities for parents to practice communicative strategies during naturally occurring interactions with their children within daily routines and activities in their homes (Dunst, 2000; Fewell & Deutscher, 2004; Roper & Dunst, 2003). Particular help-giving practices are associated with parents' feelings of self-confidence (Trivette, Dunst, & Hamby, 1996).

The manner in which professionals present information to parents also will encourage a mother's self-efficacy. Here, it would seem most important for interventionists to adopt a mentorship approach. In a mentorship model, mothers are provided with hands-on training and practice, receiving constructive and encouraging feedback according to the mother's needs and her child's language level. Providing caregivers with verbal feedback enhances caregiver's generalization of newly learned strategies across various activities and settings (Woods, Kashinath, & Goldstein, 2004). Ultimately, the goal of any mentorship relationship is to achieve mother's independent, confident use of behaviors and strategies that enhance her child's language development.

Central to a mother's use of appropriate behaviors and language strategies will be information as to how such language strategies can become embedded into the family's everyday life. Daily routines such as mealtime, hand washing, and playing with toys are the mainstay of child care schedules and exist within nearly all families. Parents benefit from a visual reminder of learning opportunities and activities they can use during the week (Dunst, Bruder, Trivette, Raab, & McLean, 2001). Thus, early-childhood educators should demonstrate how to embed appropriate facilitative language strategies in everyday natural language learning experiences (see Table 1 for facilitative language strategies).

Language strategies also need to be further tailored to a child's language level. As recent research suggests, children with cochlear implants learn language at a similar rate as hearing children (Svirsky et al., 2000). Just as hearing children need certain language strategies depending on their language age, children with cochlear implants need specific language strategies depending on their implant age or "hearing age." For example, for children who have had their cochlear implant for 1 month to 12 months, the same lower-level language strategies should be used that have been shown to facilitate language learning in younger hearing children (eg, linguistic mapping, imitations, and expansions). For toddlers and preschool children who have had their cochlear implant longer than 12 months, however, higher-level language strategies best facilitate children's language learning (eg,

Table 1. Facilitative language strategies useful in everyday routines for children with cochlear implants whose language ages are approximately 12 months and above

Language strategy	Description	Example during everyday family routine or activity
Parallel talk	Caregiver talks about what the child is directly looking at or playing with.	During playtime—child is playing with a toy car and mother says, "Ian is making the car go fast!"
Open-ended question/phrase	Caregiver provides a phrase/question in which the child can answer using more than 1 word.	During storybook time—mother asks child, "What is happening in this picture?"
Expansion	Caregiver repeats child's verbalization by maintaining the child's word order without adding new words.	While riding in the car—child says, "go store" and mother says, "Yes, we are going to the store."
Expatiation	Similar to expansions except that caregiver adds new information.	"We are going to the grocery store to buy milk."
Recast	Caregiver repeats the child's verbalization into a question format.	During mealtime—child says, "no more" and parent says, "Do you want more?"

parallel talk, recast, and open-ended questions) (DesJardin, 2004).

Finally, families of children with a cochlear implant require a collaborative team approach. Professionals working with families in early-intervention programs need to ensure that parents have the knowledge and competence to provide their children with the necessary language learning activities. Potential team members who work with families typically include an early-education teacher with expertise in developmentally appropriate practices, a teacher of the deaf or hard of hearing or a speech-language pathologist to assist parents with listening and language activities in their home, and an audiologist to offer support in troubleshooting the cochlear implant (see Table 2 for a list of additional resources that team members may find useful).

SUMMARY

Cochlear implantation of young deaf children has become common practice. Many infants and toddlers now have greater opportunities to perceive and understand speech for the first time. Recent research indicates that young children with cochlear implants have the potential to reach language milestones at a rate similar to their hearing peers. In the pediatric cochlear implant population, however, there is considerable variability in spoken-language skills. This article describes 2 theoretical family constructs that may partially explain some of the spoken-language variability seen in young deaf children with cochlear implants: parental involvement and maternal self-efficacy. As Bandura's model contends, self-efficacy beliefs are a driving force behind parenting decisions and behaviors (Bandura, 1997; Pajares, 2004). Early-intervention programs that capitalize on parents' sense of knowledge and competence will empower parents as they support their children's development. Parental involvement and self-efficacy are critical aspects to consider as professionals support language learning in families of young children with cochlear implants.

Table 2. Cochlear implant resources

Organization	Description	Phone/Web site
Advanced Bionics Corporation	One type of cochlear implant used for young children.	(800) 678-2575 www.bionicear.com
Alexander Graham Bell Association for the Deaf	Organization for parents and professionals working with families of children with hearing loss.	(800) HEAR-KID (202) 337-5220 www.agbell.org
American Academy of Audiology	Organization that provides information to audiologists and speech-language pathologists.	(800) 222-2336 www.audiology.org
American Speech, Language, Hearing Association	Organization that promotes the interests of and provides services for professionals in audiology, speech-language pathology, and speech and hearing science, and to advocate for people with communication disabilities.	(800) 638-8255 www.asha.org
Auditory-Verbal International	The Auditory-Verbal philosophy supports the option for children with all degrees of hearing loss to develop the ability to listen and to use verbal communication within their family	(703) 739-1049 www.auditoryverbal.org
Baby Hearing	Supported by Boys Town National Research Hospital—provides information for parents regarding amplification and language development.	www.babyhearing.org
Beginnings	A nonprofit agency that provides an objective approach to meeting the diverse needs of families with children who are deaf or hard of hearing and the professionals who serve them.	www.beginningssvcs.com
Cochlear Corporation	Nucleus-24 cochlear implant	(800) 523-5798 www.cochlear.com
House Ear Institute Care Center	Research and clinical institute that provides families with audiological and speech-language services for their children with hearing loss.	(213) 483-4431 (213) 353-7005 www.hei.org
John Tracy Clinic	Private, nonprofit education center in Los Angeles, Calif. Offers guidance to families of infants and preschool children with hearing losses by providing free, parent-centered services worldwide.	(213) 748-5481 www.johntracyclinic.org
Listen Up	This Web site is a 1-stop place for information, answers, help, ideas, resources, and anything else related to hearing impairment.	www.listen-up.org
Med-El Medical Electronics	One type of cochlear implant	www.medel.com

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