Cochlear implantation in severe traumatic brain injury and paranoid schizophrenia: Two case studies

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Abstract

In view of the demanding instruction and training requirements associated with cochlear implantation, patients with cognitive impairments have typically been considered to be poor candidates for this procedure. This presumption persists in part because experience and research in this area are limited. We describe our experience with implanting cochlear devices in 2 patients who had significant psychological impairments; 1 patient had experienced a severe brain injury, and the other had paranoid schizophrenia. Nevertheless, both patients were able to follow the implant training program, and they experienced different degrees of improvement in their hearing. We discuss our preoperative evaluations of these patients and the key factors that led to our decision to proceed with surgery.

Introduction

Cochlear implants improve overall quality of life for most adults.1-8 Even so, the definition of success remains controversial.5 Moreover, predicting the actual degree of benefit in any individual is difficult. In order to achieve the greatest possible benefit from cochlear implantation, recipients must undergo extensive training. Therefore, an adequate level of cognitive ability is a prerequisite for surgical candidacy. Also, because significant benefits may not be realized for 6 to 12 months postoperatively, implant recipients should demonstrate a satisfactory level of motivation and an ability to actively participate in mapping and aural rehabilitation before they undergo the procedure.7,9

Adults with organic brain syndromes, severe psychiatric disorders, or severe cognitive impairment have typically been considered to be incapable of meeting the cognitive demands of cochlear implant training.5,10,11 Any effort to change traditional attitudes toward cochlear implantation in these patients has been hindered by insufficient experience and by an absence of standardized evaluation protocols to assess their candidacy and to modify interventions as needed.11,12 Research based on standardized measures of intellectual functioning (i.e., intelligence quotients) has not been a reliable predictor of candidate suitability. Therefore, the routine administration of intellectual tests to help select implant candidates does not appear to be indicated.3,13,14 Preliminary attempts to identify other measures of cognitive ability have suggested that rapid responses to stimuli may be predictive of implant success,9 but the extent to which memory plays a role has not been determined.

Thus far, no empiric research has provided cochlear implant teams with either clear guidelines or specific measures with which to make selection decisions regarding the candidacy of hearing-impaired patients whose comorbid conditions (e.g., neurologic conditions such as brain injury or psychiatric disorders such as mental retardation, bipolar disorder, and schizophrenia) raise questions about their ability to use an implant well enough to derive satisfactory benefit.

In this article, we describe our experience with implanting cochlear devices in 2 patients with significant psychological impairments at the University of Minnesota Cochlear Implant Program. One patient had earlier experienced a severe traumatic brain injury, and the other had paranoid schizophrenia that was relatively well controlled by medication. We discuss our preoperative evaluations, the key factors that led to our team’s decision to proceed with surgery, and the postoperative results. These cases illustrate some of the challenges inherent in extending the use of cochlear implant technology to complex patients.

Patient 1: Brain injury

A 61-year-old man, a nursing home resident, was brought to our center by his family members to be evaluated for cochlear implantation. The patient had sustained a severe frontal lobe brain injury some 30 years earlier as a result of a work-related accident in which he was hit by a train. Since then, he had been admitted for psychiatric evaluation...
and treatment of complications of his injury on numerous occasions. These complications included depression with suicidal ideation (including one attempted suicide), disinhibition, seizures, impulsivity, impaired insight and judgment, and impaired emotional control manifested by aggressive behavior and assault. He also had a history of alcohol abuse.

The patient’s medications included haloperidol 5 mg nightly and 2 mg every 6 hours as needed for increased agitation, sustained-release nifedipine 30 mg daily, albuterol 2 puffs four times daily, carbamazepine 400 mg twice daily and 200 mg once daily, phenytoin 450 mg nightly, buspirone 10 mg three times daily, and ranitidine 150 mg nightly.

The patient had been fitted with hearing aids, but family members reported that he rarely wore them because he perceived the benefit as limited. His ability to read lips was also limited, and he usually communicated through writing. His receptive and expressive language skills were intact. The family had hoped that a cochlear implant might improve his hearing enough to increase his socialization and thereby lessen his aggressive, impulsive, and disinhibited behavior.

**Preoperative evaluation.** The patient’s preoperative evaluation included radiologic, audiologic, otolaryngologic, equilibrium, neuropsychological, neurologic, and speech pathology assessments.

**Radiologic evaluation.** Magnetic resonance imaging (MRI) demonstrated severe bilateral damage to the frontal lobe of the brain and the presence of smaller lesions in the areas of the basal ganglia and pons.

**Audiologic evaluation.** Audiometry without the hearing aids documented a profound bilateral sensorineural hearing loss. Aided sound-field testing with warble tone stimuli at an 85-dB HL presentation level yielded the following scores:

- Four-Choice Spondee Test: 25%
- Northwestern University Auditory Test No. 6 (phonetically balanced monosyllabic words): 0%
- Central Institute for the Deaf (CID) Everyday Sentence Test, list 1 (auditory only): 0%
- CID Everyday Sentence Test, list 3 (lip-reading only): 11%
- CID Everyday Sentence Test, list 5 (lip-reading plus audition): 14%

These findings documented that the patient was eligible for cochlear implantation in terms of hearing impairment.

**Otolaryngologic evaluation.** Findings on the ENT examination were normal.

**Equilibrium evaluation.** Equilibrium and balance testing suggested that the patient had a bilateral vestibular deficit and a cerebellar/brainstem dysfunction with regard to the central vestibular adaptation mechanism.

**Neuropsychological evaluation.** A neuropsychologist concluded that the patient’s immediate recall ability, written receptive and oral/written expressive language function, and vocabulary fell within the average range at a level suggesting that the patient’s premorbid language ability had been adequate. The patient’s delayed free recall of verbal and nonverbal information was severely impaired, but with cueing, he was able to recall 68% of learned verbal material, suggesting that he had a greater problem with information retrieval than with learning. Other cognitive impairments were noted with respect to his speed of information processing, mental flexibility, and visual scanning and tracking.

Given the patient’s impaired self-control, disinhibition, impaired judgment, and explosivity, the neuropsychologist judged that an attempt to improve the patient’s information processing by enhancing his hearing had the potential to yield some benefit in terms of making it easier to provide his care in the nursing home. The structured living environment of the long-term care setting, where he was expected to remain, appeared to provide the necessary support he would need to learn to use the cochlear implant for basic functions. It was also presumed that the nursing home staff would be able to compensate for the facets of the patient’s cognitive impairment (e.g., short-term memory problems) that might otherwise interfere with his adaptation to the implant.

**Neurologic evaluation.** A neurologist confirmed the presence of the severe frontal lobe damage seen on MRI. Although it was not possible to assess the status of the auditory nerves or the brainstem auditory pathways on MRI, other evidence suggested that the central auditory pathways were damaged. Also, although it was not possible to confirm the status of the patient’s auditory cerebral cortex, no lesions were evident on MRI. The neurologist concluded that the damage did not appear to significantly disrupt auditory processing and speculated that a cochlear implant might indeed facilitate greater social interaction.

**Speech pathology evaluation.** Language function testing showed that the patient’s basic comprehension, word retrieval, and phonologic processing abilities were sufficient to support receptive processing following cochlear implantation. His comprehension of written material was in the average range for main ideas. He did experience mild difficulty in processing detailed information. A speech pathologist concluded that the patient’s language function was sufficiently intact to suggest that implantation would yield a potential benefit in terms of his ability to communicate.

**Preoperative counseling.** The patient and some of his family members participated in preoperative discussions...
regarding the risks and benefits of the cochlear implant procedure. Outside the formal counseling sessions, the patient and his family members reviewed the patient education materials that were provided to them. The patient also completed a true/false test developed by one of our audiologists to assess his comprehension of basic information regarding the use, benefits, and risks of a cochlear implant and the surgical procedure itself. The patient’s responses indicated that he had a minimal but adequate understanding of the risks and benefits of implantation. At the completion of counseling, we obtained informed consent to proceed with the procedure.

The implant team—which was made up of the audiologist, surgeon, and clinical psychologist—discussed the findings and recommendations of all the specialists involved. Such a multidisciplinary approach is a valuable aid to decision making, especially in complex cases. It allowed us to thoroughly review the identifiable risks and benefits of implantation in this case and to identify conditions under which it would be appropriate to proceed. The team developed several criteria for proceeding with implantation, including the active participation of the patient’s family and the nursing home staff; one requirement was their attendance at mapping sessions and training sessions regarding postoperative maintenance of the implant device. Given the commitment of the family and nursing home staff and the combined recommendations of all the specialists involved, we decided to proceed with implantation despite the fact that the patient’s comorbidities might have limited the chances for a successful operation.

**Surgical procedure.** A Nucleus 22 cochlear device was implanted on the right side. The patient’s brain injury had made it difficult to maintain deep anesthesia, but the anesthetist overcame the challenge. At one point during surgery, the patient moved unexpectedly, which caused the rotating shaft of the mastoid cutting bur to burn the facial nerve. The burn resulted in a right facial nerve palsy (a score of III to IV on the House facial paralysis scale) during the immediate postoperative period; the palsy improved somewhat (to House grade II) in time. Postoperative radiology showed that the implant was in the proper position in the cochlea.

**Postoperative evaluation.** One month postoperatively, the patient’s implant was connected to a Spectra 22 speech processor. Procedures for mapping and aural rehabilitation were modified to accommodate his cognitive and personality impairments. Instead of alternating measurements of threshold (the presence or absence of sound) with comfort levels (volume), all 22 threshold measurements were taken first, followed by comfort levels; we chose this sequence because the alternating measurements had confused the patient. The sessions were conducted according to the standard schedule—10 sessions during the first year, with 7 of them occurring within the first 3 months.

At the 6-month audiologic evaluation, sound-field testing with the cochlear implant functioning and with warble tone stimuli yielded responses consistent with only a mild hearing loss. These results compared favorably with the patient’s profound hearing loss preoperatively. Speech recognition testing conducted in the sound field with a 50-dB HL presentation level was 80% on the Four-Choice Spondee Test, compared with 25% preoperatively. Administration of auditory-only CID sentence testing was attempted, but the patient refused to participate in this particular test. Auditory and visual CID sentence testing yielded a score of 21%, compared with 14% previously. However, this was not considered to be a valid result because of poor patient cooperation.

Despite the limited amount of formal testing, informal evaluation suggested that the patient had derived benefit from implantation. Informal conversation with the patient indicated that his comprehension appeared to have improved. Moreover, interviews with family members and nursing home staff indicated that he was having more frequent and positive interactions with other nursing home residents and responding more appropriately to the staff that provided his daily care.

A follow-up interview with the nursing home staff 23 months postoperatively indicated that the patient continued to wear his implant during all waking hours. However, he had not maintained his earlier behavioral improvements. Staff reported inappropriate conduct of a sexual nature, outbursts of anger, a decrease in desired participation in activities of daily living, and a deterioration in his social interactions with staff and other patients (no changes had been made in his haloperidol regimen to manage his behavior).

**Discussion.** Prior to implantation, we had harbored significant concerns about how the patient’s neurologic and psychiatric conditions would affect (i.e., presumably limit) his capacity to derive benefit from the device. Specifically, we considered whether and how (1) these conditions might prevent adequate processing of the information provided by the device, (2) his short-term memory impairment and behavioral problems would interfere with postoperative training, and (3) the nursing home setting would be able to maintain proper operation of the implant unit. These maintenance functions included daily battery recharging, cable replacement, replacement of broken plastic parts on the speech processor, and appointment scheduling for annual remapping.

Three major factors led to our decision to proceed with implantation. First, although there was no confirmation that the patient’s auditory processing capability was functional, neither was there any evidence that his central nervous system auditory processing was not functional. Second, despite the patient’s extensive brain damage, he manifested sufficient expressive and receptive language functions to...
suggest that his cognitive processing capability was adequate to benefit from the device. Finally, his family and the nursing home staff had made a commitment to provide structured and consistent support during the training period and to provide ongoing maintenance of the device.

Quantitative follow-up evaluations suggested that the audiologic benefits were limited. Qualitative assessments suggested that although the patient’s problematic behaviors continued, he (and his family) did derive some benefit from the limited improvements in communication. In any event, implantation did not exacerbate any of the patient’s problems related to communication or behavior.

Addressing the expectations of patients, families, and health professionals regarding behavioral changes that might follow cochlear implantation is vital in cases such as this. We had hoped that improved communication might diminish patient 1’s disruptive behaviors, although we anticipated that improvement would be limited; similar problems are evident in brain-injured patients whose hearing is adequate. The fact that behavioral improvement was not sustained in this patient does not contraindicate implantation in patients with neurologically mediated behavioral problems. Although it is possible that implantation may induce positive behavioral changes or enhance the management of behavioral problems, such a potential outcome cannot be used as the primary criterion for determining whether to proceed with implantation in patients with complex disorders. Just as it would not be reasonable to expect implantation to resolve marital conflicts for a cognitively intact individual in a troubled marriage, establishing an expectation of significant improvements in a patient with a long-standing pattern of disruptive behavior would be misguided and could be construed as discriminatory.

The success or failure of cochlear implants in patients as complex as patient 1 is probably best assessed by focusing on the changes in hearing function rather than on a range of psychosocial outcomes, especially when there is evidence of a neurologically mediated impairment in behavioral and social functioning.

Patient 2: Paranoid schizophrenia
A 36-year-old man presented for evaluation of congenital deafness in the right ear and an 18-year history of progressive hearing loss in the left ear. He had been diagnosed with paranoid schizophrenia approximately 14 years earlier. He also had a history of tinnitus, which had begun when he was in his early 20s.

The patient lived in an apartment with a roommate, and he communicated via lip-reading and sign language. Through a state agency (Minnesota Rehabilitation Services), he had been working with an organization that assesses people with disabilities (e.g., mental illness) and prepares them for employment. The patient had not worked since he was approximately 25 years old, but he had completed vocational training as a cook. His goal was to return to cooking in a hotel setting.

The patient’s psychotic symptoms had been managed with haloperidol for 3 years and had stabilized. He reported no medication side effects, and he had experienced no auditory hallucinations for approximately 15 years. However, he had a history of multiple hospital admissions, including a 6-month hospitalization that followed a minor assault on a person who the patient believed had insulted him. None of these hospitalizations had been related to depression or suicidal ideation.

Preoperative evaluation. The patient’s preoperative evaluation included audiologic, otolaryngologic, equilibrium, and psychological assessments.

Audiologic evaluation. Audiologic testing without hearing aids documented a profound bilateral sensorineural hearing loss (table). Aided (Siemens 684 PPAO) sound-field testing with warble tone stimuli at a 50-dB HL presentation level yielded the following scores:

- Four-Choice Spondee Test: 15%
- Consonant-Nucleus-Consonant (CNC) Words Test, list 3: 0%
- Hearing in Noise Test (HINT), lists 24 and 18 (auditory only): 0%
- CID Everyday Sentence Test, list 1 (auditory only): 0%
- CID Everyday Sentence Test, list 3 (lip-reading only): 43%
- CID Everyday Sentence Test, list 5 (lip-reading plus audition): 47%

These results documented the patient’s eligibility for a cochlear implantation in terms of hearing impairment.

Otolaryngologic evaluation. Findings on the ENT evaluation were unremarkable.

Equilibrium evaluation. The results of equilibrium and balance testing suggested that the patient had a bilateral vestibular deficit.

Psychological evaluation. On the mental status examination, the patient exhibited a logical flow of thought. His paranoid thinking was limited to a belief that others spoke negatively of him. Neither the patient nor the implant team believed that his paranoid ideation interfered with his ability to develop adequate working relationships with members of the implant team.

The patient verbalized his hope that a cochlear implant would confirm his suspicions that people were indeed talking negatively about him. When members of the implant team told him that this goal was unrealistic, he said that he did not consider this pathologic wish to be his primary motivation for seeking the implant. Instead, he claimed that his primary goals were to improve his communication and
to be able to listen to music. Although he was competent at lip-reading and sign language, he said, “Communication is very important, and English is my first language.”

On psychological screening, the patient scored 1 on the Beck Depression Inventory (BDI), which is within the normal range. On the Spielberger Self-Evaluation Questionnaire (SSEQ), his raw scores of 39 (64th percentile) on the State Anxiety Inventory and 36 (59th percentile) on the Trait Anxiety Inventory were considered to be within the normal range for men his age. His SSEQ scores were at the 41st and 33rd percentiles for State and Trait Anxiety, respectively, for men in the general medical/surgical population.

The cochlear implant team communicated with the patient’s psychiatrist, who had been treating him for the preceding 4 years, and the psychiatrist confirmed that the patient’s psychiatric symptoms had stabilized. It was the judgment of the psychologists associated with the implant team that the patient’s diagnosis of paranoid schizophrenia in and of itself ought not disqualify him from receiving a cochlear implant. Given the patient’s compliance with his psychiatric treatment and his enduring and relatively stable condition, his candidacy for surgery was approved, provided that he promised to continue his psychiatric care and that a psychologist participate in at least one of the early postoperative training sessions.

**Surgical procedure.** A left cochlear implantation of a Clarion 1.2 S-Series device was performed without difficulty. Radiologic findings confirmed that the implant had been properly positioned. The patient was discharged from the hospital the following day.

**Postoperative evaluation.** One month postoperatively, the patient’s implant was connected to an S-Series speech processor. Mapping and aural rehabilitation procedures were performed according to standard guidelines. An audiologist periodically consulted with a psychologist regarding ways she could work with the patient to enhance his use of the device in light of his schizophrenic phenomena, such as paranoid ideation and inattention.

Audiologic tests were conducted at 3 and 6 months postoperatively, and results were compared with the preoperative findings (table). Sound-field testing with the patient’s cochlear implant operating and with warble tone stimuli revealed that the patient’s hearing had improved from profoundly impaired to borderline normal. Speech recognition testing was conducted in the sound field with a 50-dB HL presentation level at 3 months and 60-dB HL at 6 months.

<table>
<thead>
<tr>
<th>Test</th>
<th>Preoperative*</th>
<th>3-month postoperative*</th>
<th>6-month postoperative†</th>
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</thead>
<tbody>
<tr>
<td>Four-Choice Spondee Test</td>
<td>15%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>CNC Words Test</td>
<td>0% (list 3)</td>
<td>60% (list 8)</td>
<td>84%</td>
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<tr>
<td>HINT (in quiet)</td>
<td>0% (list 24)</td>
<td>87% (list 5)</td>
<td>96% (list 25)</td>
</tr>
<tr>
<td>HINT (in quiet)</td>
<td>0% (list 18)</td>
<td>96% (list 16)</td>
<td>98% (list 18)</td>
</tr>
<tr>
<td>HINT (in noise +10 S/N ratio)</td>
<td>N/A</td>
<td>23% (list 21)</td>
<td>72% (list 5)</td>
</tr>
<tr>
<td>HINT (in noise +10 S/N ratio)</td>
<td>N/A</td>
<td>49% (list 23)</td>
<td>61% (list 12)</td>
</tr>
<tr>
<td>CID Everyday Sentence Test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>List 1 (auditory only)</td>
<td>0%</td>
<td>98%</td>
<td>N/A</td>
</tr>
<tr>
<td>List 3 (lip-reading only)</td>
<td>43%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>List 5 (lip-reading plus audition)</td>
<td>47%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
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*50-dB HL presentation.
†60-dB HL presentation.
N/A = not applicable; S/N = signal-to-noise.
These results suggested that the patient experienced a significant improvement in the auditory-only mode over his preoperative performance. Although the addition of noise degraded his hearing performance, he nevertheless demonstrated a substantial ability to understand speech. He was also observed to be able to participate in interactive telephone conversation.

Psychological testing administered 3 months postoperatively suggested that the patient’s psychological symptoms may have worsened slightly since he had undergone surgery, particularly with respect to his anxiety. Although his BDI score was within the normal range both preoperatively (BDI score: 1) and postoperatively (BDI score: 5), he reported an increase in feelings of irritability. In retrospect, these results likely reflected an increase in paranoid ideation, which had become evident at the 6-month follow-up.

At that evaluation, the patient told the clinical psychologist that he wore his implant during all waking hours. His adjustment to the implant had not been complicated, and he indicated that he was able to obtain benefits immediately. He reported that he was able to use the telephone, hear environmental sounds (e.g., birds chirping), and understand some conversation without lip-reading. He said that although he continued to lip-read, his overall communication had become easier and less fatiguing because he did not have to rely entirely on lip-reading. He also reported that he had begun to attain significant pleasure from being able to listen to music again, which he had claimed was one of the primary reasons he had undergone implantation; he was not at all disappointed in this regard. All in all, he said that his hearing had become so good that he was “beginning to take it for granted.” His relationship with his family, which had been emotionally close presurgically, remained positive postsurgically.

The patient did report one negative aspect of his improved hearing—to wit, he was now able to “hear the rude and nasty things that other people say about me.” He was unhappy with this circumstance even though he had initially expressed a desire to hear what people were saying so that he could confirm his suspicions, based on his observations of their nonverbal behavior, that they did not like him. He complained that the frequency with which he was hearing negative comments about himself had been increasing. As a result, he said he had withdrawn from social activities...
to some degree and he had limited his social contacts to a small group of people. He also said that he was not interested in pursuing employment at that time.

Overall, patient 2 was very pleased with his cochlear implant, and he said he “would do it again.” Hearing others make negative comments about him was disconcerting, but he acknowledged that “all things have good and bad parts to them,” and he was trying to learn ways to cope with these remarks.

The patient’s psychiatrist was contacted during the follow-up period and notified us that just before the patient had undergone implantation, he had switched the patient’s medication from haloperidol to olanzapine 15 mg daily. From the psychiatrist’s perspective, the increase in the patient’s paranoid ideation might have been a result of either the change in medication or poor compliance rather than improved hearing. The psychiatrist suggested that the paranoid ideation was likely a function of the schizophrenic disease process. While we had hoped that his acquisition of hearing would diminish his paranoid ideation, it did not appear that his distorted thinking was associated with hearing. Still, it is possible that his paranoid ideation might have become even worse without implantation.

Overall, the psychiatrist observed that patient 2 had enjoyed benefit from the implant, and he speculated that as a result, the patient might become more open to psychotherapy and learn to cope with his paranoid experiences.

Discussion. The implant team deliberated before proceeding with implantation for patient 2 and focused on several considerations. We were concerned that his schizophrenia might interfere with his ability to trust us and complete his training in a consistent and satisfactory fashion. At the extreme, we wondered if the team members would become incorporated into his paranoid ideation. We were also concerned that his recovery of hearing function might exacerbate what had otherwise been a stable pattern of schizophrenic symptoms, especially in light of his expressed hope that the implant would allow him to hear the negative comments he believed were being directed against him.

Fortunately, these fears were not realized, as the patient’s interactions with the implant team were positive and productive throughout the preoperative process. The patient demonstrated a thorough understanding of the procedure,
the device, and the training required to learn to use it. He attended appointments consistently. This early experience provided us with confidence that he would be able to complete the process in an appropriate fashion.

The patient’s psychiatrist endorsed our decision to proceed with the implantation in view of the patient’s history of stability. The psychiatrist also hoped that the restoration of hearing would widen the scope of the patient’s treatment options (e.g., psychotherapy and day treatment).

Although the patient’s paranoid ideation had increased postoperatively, we cannot know whether the restoration of hearing was a factor. It appears more likely that the cause could be attributable to the medication change or to other factors, such as an unrelated exacerbation of his schizophrenia.

In terms of learning to use the implant device, patient 2 was considered by the cochlear implant team to be “a star performer.” Subjectively, he said the restoration of his hearing was a significant improvement in his quality of life.

Discussion
Cochlear implantation in a patient with a severe cognitive impairment or psychiatric disease can pose a difficult challenge to an implant team. Insufficient experience and a paucity of evaluation criteria on which to base a determination of surgical candidacy have limited the number of implants in such patients.

Based on our experience with the 2 cases we have described, we identified four patient characteristics that a multidisciplinary team should consider when making management decisions in complex cases. The patient should exhibit evidence of:

- an auditory processing capability
- a receptive and expressive speech processing capability, documented by neuropsychological and speech pathology evaluations
- long-term stability of the psychiatric disease, documented by psychological and psychiatric evaluations and by communication with treating professionals
- a social structure sufficient to support training and device maintenance, demonstrated through interviews with family and facility staff (when there are indications of cognitive or memory processing difficulties)

In addition, it is desirable that the patient have access to a systematic, multidisciplinary process in which implant team members can (1) weigh the potential auditory, functional, and psychosocial benefits of implantation against the surgical risks and (2) justify the allocation of healthcare resources.

Psychosocial improvements in quality of life beyond audiologic changes in such patients are likely to be less predictable than they are in candidates without these problems. Consequently, managing the expectations of the family, the staff at the facility where the patient may be residing, and the implant team is also an important part of the process.

Based on our preliminary experience, it seems appropriate to consider complex patients for cochlear implantation only if adequate resources are available to properly assess them and to modify training programs to meet their individual needs.

As these 2 cases illustrate, the range of patients who might benefit from cochlear implantation may be somewhat wider than previously suspected. Whereas further experience with such complex patients may provide an empirical basis for assessing their eligibility, at this point decisions to implant complex patients need to be made on an individual basis. Although such patients pose ethical, clinical, management, and systems challenges, their candidacy for cochlear implantation deserves thoughtful consideration.

References

SIEGAL, ROBINER, SMITH, LEVINE