

Speech Perception Results for Children With Implants With Different Levels of Preoperative Residual Hearing

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Objective: Many reports have established that hearing-impaired children using the Nucleus 22-channel cochlear implant may show both significant benefits to lipreading and significant scores on open-set words and sentences using electrical stimulation only. These findings have raised questions about whether severely or severely-to-profoundly deaf children should be candidates for cochlear implants. To study this question, postoperative results for implanted children with different levels of preoperative residual hearing were evaluated in terms of speech perception benefits.

Study Design/Setting: A retrospective study of the first 117 children, sequentially, to undergo implantation in the Melbourne and Sydney Cochlear Implant Clinics was undertaken. All children had been assessed by and received their implants in a tertiary referral centre.

Main Outcome Measures: To assess aided residual hearing, the children were grouped into four categories of hearing on the basis of their aided residual hearing thresholds measured preoperatively. To assess benefits, the scores of children on

standard speech perception tests were reviewed. As different tests were used for children with different ages and language skills, children were grouped into categories according to the level of postoperative speech perception benefit.

Results: The results showed that children in the higher categories of aided preoperative residual hearing showed significant scores on open-set word and sentence perception tests using the implant alone. For children in lower categories of aided residual hearing, results were variable within the groups. More than 90% of children with implants with aided residual hearing thresholds in the speech range above 1 kHz achieved open-set understanding of words and sentences.

Conclusion: While the results of this preliminary study confirm previous findings of differential outcomes for children with different levels of preoperative residual hearing, they suggest that children with severe to profound hearing impairments should be considered for cochlear implantation. **Key Words:** Cochlear implants—Speech perception—Residual hearing. *Am J Otol* 18(suppl):S125-S126, 1997.

Many clinical studies have established that multiple-channel intracochlear implants can significantly improve speech perception for postlinguistically deafened adults (1,2). Studies of cochlear implant benefits for children using the Nucleus 22-channel cochlear implant have also shown that children can obtain significant benefits to speech perception, speech production, and language, including open-set understanding of words and sentences using the cochlear implant alone (3-6). Whereas cochlear implant candidates have traditionally been adults and children with profound hearing impairment, there has been continued pressure to evaluate the benefits for patients with severe or severe-to-profound hearing impairment, particularly those who do not show significant benefits to communication through use of conventional amplification (7). Similarly, there has been pressure from parents of se-

verely hearing-impaired children to review their candidacy for cochlear implants. A primary concern in such a reassessment is the relative potential benefits that might result from a cochlear implant versus a conventional hearing aid, and in particular, the prospect that an individual child will develop the ability to understand words and sentences using the cochlear implant alone. While each potential implant candidate receives a trial of a hearing aid during the preoperative period, communication benefits from either a hearing aid or an implant may not be evident for several years, and individual studies of particular children may not provide statistical data on which to base clinical management recommendations to parents.

To provide some information on potential benefits from cochlear implants, we investigated the postoperative speech perception benefits achieved by children with different levels of aided preoperative residual hearing.

METHODS

The study design was retrospective, investigating the first 117 children who received cochlear implants in both the Royal

Supported in part by the Commonwealth of Australia through the Cooperative Research Centres program.

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TABLE 1. *Speech perception categories achieved by implanted children (n = 117)*

	Speech perception category						
	1	2	3	4	5	6	7
No. of children	2	9	7	17	26	23	33

Victorian Eye & Ear Hospital/University of Melbourne Cochlear Implant Clinic, and the Children's Cochlear Implant Centre (New South Wales). The children were initially divided into four groups on the basis of established preoperative aided residual hearing thresholds as follows: group 1, no response (vibrotactile only); group 2, up to 500 Hz in 70 dB speech spectrum; group 3, up to 1 kHz in 70 dB speech spectrum; and group 4, up to 2 kHz in 70 dB speech spectrum.

Direct comparison of speech perception results across children is difficult, since the children vary by cause of hearing impairment, age at onset, duration of profound deafness, hearing thresholds, history of hearing aid use, and communication and social skill development. For this reason, a categorization scale was used to assess the children's speech perception benefits. A seven-step scale was used, with benefits classified according to the following criteria: category 1, sound detection only; category 2, prosodic discrimination; category 3, vowel recognition; category 4, consonant recognition; category 5, open-set understanding of words (scores <20%); category 6, open-set understanding of words (scores 20–50%); and category 7, open-set understanding of words (scores >50%). A clinician familiar with the children's results reviewed each case and assigned each child to both hearing group and speech perception benefit categories.

RESULTS

Table 1 shows the number of children who achieved each of the seven speech perception categories. As shown, 82 of the 117 children (70%) were in categories 5 through 7, indicating that they could perceive some words and sentences through the cochlear implant alone. It is also evident that only 2 of the 117 children (1.7%) achieved only sound detection. Table 2 shows the number of children in each of the four aided residual hearing groups. The largest number of children were in hearing group 1 (63 children), while, as expected, the smallest number were in hearing group 4 (9 children). Figure 1 shows the percentage of children in each of the four hearing groups who were able to achieve open-set speech perception results (categories 5–7). As shown, over 90% of children in each of aided residual hearing groups 3 and 4 achieved open-set speech perception benefits.

TABLE 2. *Number of children in each preoperatively aided residual hearing group (n = 117)*

	Hearing group			
	1	2	3	4
No. of children	63	28	17	9

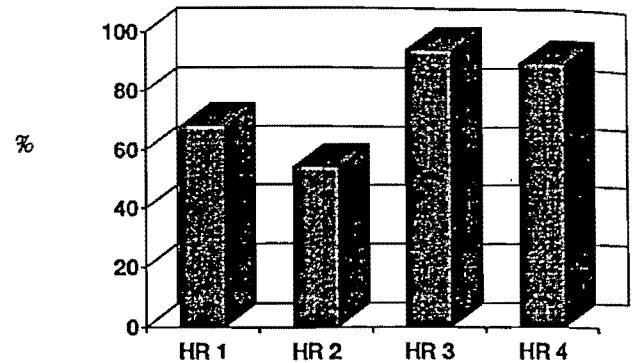


FIG. 1. Percentage of children in each preoperative aided residual hearing group achieving open-set understanding of words and sentences. HR, residual hearing group.

DISCUSSION

The results of this pilot study suggest that a large proportion of children receiving the Nucleus 22-channel cochlear implant are achieving significant scores on open-set word and sentence tests. The results also suggest that children who have higher levels of preoperative aided residual hearing also have a high probability of achieving open-set benefits. Children with lower levels of preoperative aided residual hearing may also achieve open-set benefits; however, the results are more variable. These preliminary data should be confirmed in a larger patient group, and the effects of particular factors, such as preoperative aided residual hearing, etiology, length of deafness before implant, and education setting, should be assessed for their contributions to these findings.

Acknowledgment: The authors are grateful for the cooperation and assistance of the parents and children in the Melbourne and Sydney programs.

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Title:

Speech perception results for children with implants with different levels of preoperative residual hearing

Date:

1997

Citation:

Cowan, R. S. C., DeIDot, J., Barker, J. Z., Barker, E. J., Sarant, J. Z., Pegg, P., et al. (1997). Speech perception results for children with implants with different levels of preoperative residual hearing. *The American Journal of Otology*, 18 (suppl.), S125-S126.

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