The Effect of Language Ability and Residual Hearing on Speech Perception Outcomes for Older Children Using Multichannel Cochlear Implants

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Early-deafened teenagers or young adults have shown somewhat disappointing performance with cochlear implants in the past, however, in recent years a proportion of older children have demonstrated excellent speech perception performance. There is a great deal of variability in speech perception performance within this group. It is important to investigate the factors influencing performance so that adolescents and their families can make informed decisions regarding cochlear implant surgery. This study considered a number of possible predictive factors in a group of 25 children implanted in Melbourne between the ages of 8 and 18 years. Subjects completed open set speech perception testing using BKB sentences both pre- and postoperatively, and pre-operative language testing using the Peabody Picture Vocabulary Test. Data were collected regarding the type of hearing loss, age at implant, age at hearing aid fitting, audiometric details, and the pre- and post-operative communication mode. Multivariate analysis suggested that three factors were associated with post-operative speech perception performance. Results were improved for subjects with better pre-operative speech perception, better pre-operative language ability, and when the duration of profound hearing loss was shorter. These three factors accounted for 66% of the variance in this group. The results of this study suggest that children who have useful pre-implant speech perception, and higher age-equivalent scores on language measures, would be expected to do well with a cochlear implant. A shorter duration of profound hearing loss is also advantageous. Mean speech perception scores for the older group were not significantly different from younger children.

The Effects of Post-Implant Habilitation on Long-Term Outcomes for Children Using Multichannel Cochlear Implants

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Those working in the cochlear implant field advocate a regular habilitation program for young children receiving implants. Developing auditory skills and the incorporating these into general language development are considered to be key areas for such programs. Investigations of speech perception and language outcomes have demonstrated that the emphasis of spoken language development appears to enhance the results for implanted children. It remains difficult, however, to demonstrate the effect of habilitation as a separate factor and to determine how much individual attention is desirable for each child. This preliminary study considered the long term speech perception and language outcomes for two groups of children who received Nucleus cochlear implants in Melbourne. The first group (n = 17) was identified as receiving regular habilitation from the Melbourne Cochlear Implant Clinic over a four year post-operative period. A second group (n = 11) was identified as receiving very little regular habilitation over the post-operative period. Language and speech perception results for these two groups showed significant differences in performance on a wide range of measures. The group who received regular,
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formal habilitation demonstrated better performance on all measures. These groups included only congenitally, profoundly hearing-impaired children and did not differ significantly on mean age at implant or experience at the time of assessment. A more comprehensive study is needed to clarify these results on a larger group of children, and to control for additional confounding variables. Nonetheless, these results provide support for the incorporation of regular long-term habilitation into cochlear implant programs for children.

Predicting Speech Perception Results for Children Using Multichannel Cochlear Implants

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It is most helpful in counselling families considering cochlear implantation to have some ability to predict outcomes for individual hearing-impaired children. Speech perception results for open-set words and sentences have been collected for all children implanted with the Nucleus device in Melbourne. Assessments are available at approximately six month intervals following implantation. Data was collected for each child regarding type of hearing loss, duration and age at onset of profound hearing loss, age at implantation, pre and post-implant communication mode, developmental delay, speech coding scheme and implant experience. These data were used as predictor variables in step-wise multiple linear regression analyses with the speech perception scores as the dependent variables. Shorter duration of profound hearing loss, later onset of profound hearing loss, exclusively oral communication mode following implantation, and longer implant experience were associated with significantly ($p < 0.001$) improved open-set speech perception. The use of the SPEAK signal coding scheme was shown to provide significantly better speech perception performance for children ($p < 0.001$). Developmental delay was associated with poorer speech perception outcomes ($p < 0.01$). Over 50% of the variance in speech perception scores was accounted for by these variables. The study suggests that younger implantation for congenitally deaf children leads to improved speech perception results. On the other hand, the development of auditory language skills in implanted children may be as important as age at implantation in enhancing long term outcomes. Regression equations derived from these results can be used to predict outcomes for cochlear implant candidates with a reasonable accuracy.

Improving and Preserving Speech Perception in Noise Using Advanced Digital Directional Technology

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Poor performance in noise is a leading user complaint about hearing instruments. The use of amplification alone does not solve this problem. Enhancement of the signal-to-noise ratio is needed (Killion, 1997), and the most successful method until now seems to be the use of directional microphones and especially multi-microphone technology (Valente, 1998). Recently this technology has been further improved with the introduction of adaptive directional systems. The purpose of these systems is to automatically optimise the directional characteristics to reduce the interference from the most intense noise sources in the environment. Another important issue is amplitude and phase mismatch between the two microphones. This can be corrected for in the manufacturing process, but drift over time and influence from user specific physical factors such as head shape and hairstyle can only be eliminated employing an automatic microphone.
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