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Original Article

A study to determine factors influencing outcomes of paediatric cochlear implants

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ABSTRACT

Background: Cochlear implantation is a powerful tool for helping children with severe to profound sensorineural hearing loss to gain the ability to hear, achieve age appropriate communication skills. However patient selection is of utmost importance to achieve optimum results.

Method: A cross sectional study was done on 75 children who had undergone unilateral cochlear implantation. Hearing was assessed by, The Meaningful Auditory Integration Scale (MAIS) and speech perception was assessed by the Meaningful Use of Speech Scale (MUSS) as a parent reported scale in an interview format.

Results: The cochlear implantation improved auditory skills and speech perception of the children who underwent cochlear implantation. Children who had less than 40 months auditory deprivation and those who had higher educated parents had better auditory skills and speech perception.

Conclusion: Early cochlear implantation and good auditory verbal therapy have better outcomes of hearing and speech.

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Introduction

Cochlear implantation is a powerful tool for helping children with severe to profound sensorineural hearing loss to gain the ability to hear, and to achieve age appropriate communication skills. Evaluating the development of auditory, speech, language skills and the personality of implanted child is useful for the parent, the teacher, the therapist, and the subsequent rehabilitation progress.¹

However the final outcome in paediatric implantation is yet not entirely predictable as there are a large number of factors which alone or in combination will decide the outcome of cochlear implantation.^{2,3} Categorizing these determinants increases the ability of clinicians to offer educated preoperative prognosis and might potentially allow for manipulation of variables in an attempt to achieve the best possible outcome. In this study cochlear implant candidacy criteria guidelines were used.⁴ The primary aim of this study is to assess the

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Table 1 – End point scores for the outcome measures.

	Good	Satisfactory
MUSS	25 and above	24 and below
MAIS	25 and above	24 and below

factors affecting the audiological, speech and language outcomes achieved by the recipients of multichannel cochlear implants.

Materials and methods

The cross sectional study was carried out at the Bionic ear centre at this institute. The study group consisted of 75 children who underwent cochlear implantation. Informed written consent was taken from the parents of children. Hearing was assessed by the Meaningful Auditory Integration Scale (MAIS) as a parent reported scale in an interview format.^{1,5} The parents were asked to report in as much detail as possible the reaction and behaviour of their child in response to noise and state for how long they are willing to have the speech processor switched on each day. A maximum of 40 points is obtainable under the scoring system. Each of the 10 questions is scored on a five-rung scale from 0 (lowest) to 4 (highest). Speech perception was assessed by the Meaningful Use of Speech Scale (MUSS) which is, as with the MAIS, a parent reported scale. A maximum of 40 points is obtainable under this scoring system. Each of the 10 question is scored on a five-rung scale from 0 (lowest) to 4 (highest). Questionnaires of MUSS and MAIS administered to parent in a structured interview and the response to each question was noted. This interview was carried out by independent observers including the audiologist and speech therapist who were not involved in the selection of the patient for surgery. Factors chosen for this study were:

- Duration of auditory deprivation,
- Duration of implant use,
- Morphological abnormalities of inner ear,
- Parent education.

End point scores for the outcome measures in this study are depicted in Table 1. Statistical analysis was done using SPSS software and the chi square test applied.

Results

The onset of hearing loss in all cases of the sample was at birth and of congenital aetiology. All the children studied had bilateral profound sensorineural hearing loss and were pre-lingual in onset. They were using hearing aids prior to cochlear implant surgery for a period ranging from three months to four years and there were no post-operative complications. The sampled children underwent unilateral cochlear implantation and the minimum period of use of the device was 12 months. The children in the study also underwent auditory verbal therapy. The parents of cochlear implanted children were educated and these children were admitted to normal schools.

As evident from Table 2 depicting MAIS scores and MUSS scores correlation with factors under study the following outcomes were seen.

The parental education ($p = 0.00$ for MAIS, $p = 0.003$ for MUSS), duration of auditory deprivation ($p = 0.00$ for MAIS, $p = 0.00$ for MUSS) and cochlear morphology ($p = 0.002$ for MAIS, $p = 0.00$ for MUSS) is statistically significant for the outcome of auditory and speech perception. However duration of use of cochlear implantation was not significant ($p = 0.5$ for MAIS, $p = 0.2$ for MUSS).

Discussion

The cochlear implanted children showed improvement in their auditory skills in the first year of cochlear implant device use. Most studies of paediatric cochlear implant surgery have focused on assessing auditory skills and speech.^{6,7} In this study, we have evaluated the correlation of performance measures of auditory skills by Meaningful Auditory Integration Scale and Speech by Meaning use of Speech Scale measures done one to three years after Cochlear Implantation.

In the absence of a standard criteria for measuring optimal childhood development, we have assessed parental perceptions of development because parents are uniquely situated to observe a child's developmental growth and abilities in a home setting on a day-to-day basis. Assessing the relationship between parental perceptions of development with currently used outcome measures may provide insight into how well our clinical instruments reflect a child's abilities as demonstrated in natural environs.

Table 2 – MAIS scores and MUSS scores correlation with factors under study.

		MAIS satisfactory	MAIS good	MUSS satisfactory	MUSS good
Cochlear morphology	Normal	15	45	16	44
	Abnormal	10	5	10	5
Duration of auditory deprivation (months)	Less than 40	10	45	10	45
	More than 40	15	5	16	4
Parental education	Undergraduate	20	10	25	5
	Graduate and above	5	40	5	40
Duration of use of CI (months)	12	5	15	6	14
	More than 12	10	45	10	45

This study strongly correlates the duration of pre implant auditory deprivation, parental education and cochlear morphology with the outcome. The study results showed cochlear implantation can be done in children with abnormal cochlea morphology as 50% of these implantees showed good results, while, the other half performed satisfactorily.

All the children have shown significant improvement in auditory skills and speech perception and were able to join normal schools for their education. Duration of implant use is an important factor for improving outcomes but in our study it was not statistically significant. This can be attributed to the short duration of study viz two years. A long-term analysis may prove the positive correlation of development of hearing and speech and language acquisition with duration of device usage.

Conclusion

Cochlear implantation improves the auditory skills and the speech perception of the children who are not benefited by hearing aid use however the outcome of children who have been implanted depends on a number of variables. These variables can affect the outcome singly or in combination. The statistical analysis of the present study reveals that factors like the duration of auditory deprivation, parental education and cochlear morphology have a direct impact on the outcomes of cochlear implantation.

Conflicts of interest

All authors have none to declare.

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