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Effect of Maternal Sensitiveness and Demographic Variables on Auditory and Speech Outcomes in Pediatric Cochlear Implant Users-Prospective Study

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Abstract

Background: Congenitally deaf children receive cochlear implantation at a young age to gain almost ordinary language development. Improvements in children's functioning after cochlear implantation are noted particularly in their spoken language and ability to communicate. However, the rehabilitation technique following pediatric cochlear implantation rests heavily on parental involvement in some important dimensions.

Methods: A prospective study was carried out to determine maternal sensitiveness using parental questionnaire administered on parents of 205 children who have undergone Cochlear implant surgery and aural rehabilitation. The parental questionnaire was administered through telephone monitoring interview and face to face interview,

Results: A significant difference between parental questionnaires in terms of auditory and speech outcome measure were observed. On analysis maternal education and age of implantation has a significant effect on parental sensitiveness score and auditory and speech outcome scores. No significant correlation was observed between implant ages, number of siblings with parental sensitiveness, CAP & SIR score.

Conclusion: This study shows that maternal sensitiveness or responsiveness towards cochlear implant recipient, higher maternal education, implantation within critical period and demographic variables like family structure had greater effect on auditory and speech development in cochlear implant recipient.

Keywords: Cochlear Implantation; Maternal Literacy; Age Of Implantation; Parental questionnaire; Categories Of Auditory Performance; Speech Intelligibility Rating

Abbreviations: CI: Cochlear Implant; HA: Hearing Aid; AVT: Auditory Verbal Therapy; CAP: Category of Auditory Performance; SIR: Speech Intelligibility rating.

Introduction

Speech and language impairments are a complex group of disorders that have a wide range of characteristics, severities,

and causes. One such causative factor that adversely affects speech and language development is hearing impairment. Hearing impairment can be described as any loss in the capability to discover sound. The effects of the hearing impairment depend on the section of the auditory pathway that is being affected. When an infant has hearing concerns, the areas of the brain used for communication may not be developing as they should be. The loss of hearing can in turn have a variety of consequences on an individual's life; from social to having psychological and even physiological impacts. These consequences of hearing loss affect the quality of daily life, and an estimated 10% of the population in a range of western international locations has a degree of hearing impairment that impacts their day-to-day activities. The earlier the hearing loss takes place in a child's life; the extra serious are the effects on the child's development. It causes delay in the development of receptive and expressive language skills. Intervention for individuals with hearing impairment may include multiple sorts of facilities for the enhancement of their lives. Cochlear impairment is a technology that has become an increasingly common habilitation option for children who are deaf [1]. Cochlear Implant (CI) is currently the only medical remedy reachable to partially fix the hearing ability in patients with severe to profound hearing loss. CI is fundamentally awesome from hearing aid (HA) use, as implants are surgically placed under the skin behind the ear where they bypass the normal sound conducting mechanism, convert sound signals into electrical stimulation, and directly stimulate the residual auditory nerves. In recent years, CI has evolved into one of the most profound advances in modern medicine and provided hearing to more than 3, 20,000 deaf patients [2].

Congenitally deaf children who receive cochlear implants at a young age have the viable to gain almost ordinary language development. An increasing body of research demonstrates improvements in children's functioning after cochlear implantation, in particular their spoken language and ability to communicate [3]. As the developmental results of a profound hearing loss are multiple, cochlear implants are prescribed to many young children with hearing impairment in order to provide those better habilitation options. However, rehabilitation therapists need to recognize that intensive and long-duration auditory verbal therapy is required post-operatively to gain its benefits [4]. The rehabilitation technique following pediatric cochlear implantation rests heavily on parental involvement in some important dimensions, many of which are viewed in the contemporary study. First is the effectiveness of attending Auditory Verbal Therapy (AVT) on a day-to-day basis. Secondly, Speech-language pathologist's function to assess lost language and conversational abilities after the surgical procedure has been performed. Thirdly, parents have an interactive role together with children both in therapy and in intensive home training activity. Fourth is the number of siblings and family size. Fifth, maternal literacy rate, age of implantation, implant age, and maternal sensitivity towards pediatric cochlear implant recipient play a crucial part in a variety of communication contexts, auditory perception, and speech and language development.

Materials and Methods

Caretakers of 205 children with severe to profound congenital hearing loss were chosen for this study. These children had undergone cochlear implant surgery and received aural rehabilitation program in the period from 2015 to 2021. It included both male and female children who received cochlear implant at Rajiv Gandhi Government General Hospital. The assessment tools included a questionnaire entitled parental remark and guidance report given by means of MED-EL. The questionnaire comprised 2 subgroups, each scored by five-point rating scale. The two sections included sensitivity to child and communicative behavior. Other tools used for assessment were category of auditory performance (CAP) scale which is an index of 8 categories to determine outcome of CI procedure in daily life. The CAP scale ranges from 0 to 7 with category 0 meaning that patient has no awareness of sound and category 7 meaning that patient is able to use telephone. Speech Intelligibility rating (SIR) is another tool that was administered which is based on 5 categories, 1 meaning that the major part of a patient's communication is manual and category 5 meaning that patient's speech is understood easily. Both scales are valid and reliable to assess speech production and auditory perception of CI children. CAP and SIR scores were obtained via telephone monitoring and face to face interview. The data were collected between July 2021 and August 2021. The study classified CI implanters into two major groups primarily based on age of implantation; below 3 years and above 3 years. The parental questionnaire scores were correlated with the demographic variables such as maternal literacy, nuclear/joint family, number of siblings, implant age and the relative auditory and speech outcomes were assessed. Maternal literacy was classified as 1- no schooling, 2- elementary, 3- secondary, 4- graduation. Implant age ranged from 6 years 7 months to 3 months.

Results

A total of 205 children were included in the study, of which 91 were female and 114 were male. The subjects' age was in the range of 5 to 13 years (Average age: 87 months). In all the subjects, surgery for cochlear implantation was performed between 10 months to 7 years of age (Average age: 4.141 years) of which 85 children had undergone surgery

before 3 years of age and 120 children had undergone surgery above 3years of age. The implant age of the cochlear implant recipients was between 1 month to 7 years of age (Average age: 42.5 months). In our study, 24(11%) mothers were illiterate, 105(51%) had done elementary schooling, 37(18%) had done secondary schooling and 39(19%) mothers had a bachelor degree. Among 205 subjects, 15 children had no siblings, 135 had 1 sibling, 50 had 2 siblings and 5 children had 3 siblings (Mean: 1.28). With respect to family size, 86(42%) children were a part of a joint family and 116(56%) were living in a nuclear family. Study findings revealed that the mean score along with standard deviation value for CAP was 3.99 ±1.084 and that for SIR was 2.29 ±0.87 (Table 1).

Correlations							
			Parental questionnaire	**CAP**	**SIR**	**Number of sibling**	**Implant age (in months)**
Spearman's rho	Parental questionnaire	Correlation coefficient		0.827	0.811	0.057	0.137
		Sig (2-tailed)	-	0	0	414	50
		N		205	205	205	205
	CAP	Correlation coefficient	.827**		0.773	0.05	0.328
		Sig (2-tailed)	0	-	0	479	0
		N	205		205	205	205
	SIR	Correlation coefficient	.811**	0.773		0.005	0.197
		Sig (2-tailed)	0	0	-	938	5
		N	205	205		205	205
	Number of sibling	Correlation coefficient	0.057	0.05	0.005		0.01
		Sig (2-tailed)	414	479	938	-	886
		N	205	205	205		205
	Implant age (in months)	Correlation coefficient	0.137	0.328	0.197	0.01	
		Sig (2-tailed)	50	0	5	886	-
		N	205	205	205	205	
**** Correlation is significant at the 0.01 level (2-tailed)**							

Table 1: Correlation of the variables.

On analysis, Kolmogorov Smirnov test showed that the data doesn't fall on normal distribution ($p<0.05$), so non-parametric test was chosen for data analysis. On analysis of the 2 group data (below and above 3 years with reference to age of implantation), Mann-Whitney test shows significant difference between 2 groups in parental score, CAP & SIR score. The Mann-Whitney test also shows significant difference in CAP & SIR score in nuclear and joint family. Using Spearman's Rank correlation, it was found that there was high correlation between parental score and CAP, parental score and SIR, CAP & SIR score ($p<0.05$). Spearman's Rank correlation showed no significant correlation between implant age and parental score, CAP & SIR. Younger age of implantation led to better CAP and SIR scores. Parental Sensitivity also increased with higher degree of maternal education, which led to increased CAP and SIR scores. Cochlear implant recipients in a joint family setting had improved CAP and SIR correlation. Number of siblings and implant age did not have any significant correlation with maternal sensitiveness or CAP and SIR score (Table 2).

Age of implantation		CAP	SIR	Parental Questionnaire
<3years	Mean	4.2625	2.4874	39.0924
	N	119	119	119
	Std Deviation	1.10823	0.91934	10.97686
>3years	Mean	3.6163	2.0349	31.2558
	N	86	86	86
	Std Deviation	0.93518	0.72676	10.37439
Total	Mean	3.9902	2.2976	35.8049
	N	205	205	205
	Std Deviation	1.08451	0.87124	11.38286

Table 2: Mean and Standard deviation.

Discussion

Our study highlighted the effect of parental sensitiveness and other demographic variables on auditory and speech development in CI recipient. The parents were asked about their sensitiveness towards child using parental questionnaire, which was then correlated with CAP and SIR scores. We also correlated demographic variables such as maternal education, number of sibling, nuclear/joint family, age of implantation & implant age with parental questionnaire and CAP and SIR scores. Age of implantation and CAP and SIR score correlation depicted that earlier the implantation, better the auditory and speech outcome. This was same as demonstrated by the study done by Nicholas & Geers, et al. [5] that showed effect of age of implantation on language level was more significant than effect of duration of implant use.

Also, our study's correlation with age of implantation was same as that of James, et al. [6] who found that early implanted children performed better on language measure than late implanted children. Regarding correlation of maternal sensitiveness with CAP and SIR, our findings were same as the study of Saad H Alenzi, et al. [7]. Influence of family environment on the outcomes of cochlear implantation in children shows significant relationship between maternal sensitiveness and CAP and SIR score. This correlation was contrary to the study of Necula, et al. which found no significant relationship between maternal sensitiveness and speech intelligibility and auditory perception score. The result of our study also indicated a significant relationship between maternal education and parental questionnaire and maternal education with CAP and SIR score. The result was same as that of the study done by Saad H Alenza, et al. [7] which showed significant relationship between the scores obtained with CAP and SIR and the level of mother's education [8-10].

Conclusion

In conclusion, our findings revealed that higher parental score showed higher CAP and SIR values which indicate better outcomes in speech and auditory performance. Our study also showed that age of implantation played a significant role in obtaining the benefits from a cochlear implantation. Concerning parental questionnaire, the mother's level of education was found to have significant correlation with parental sensitivity and CAP and SIR score. Other demographic data such as implant age, number of siblings, were found to be insignificant in determining the outcome of cochlear implant recipient.

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