Original Article

Expressive language development in 45 cochlear implanted children following 2 years of implantation

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Introduction: Profound hearing loss encounters children with delay in speech and language. As it is known language acquisition in young deaf children is a lengthy process, but cochlear implanted children have better spoken language skills than if they had not received the device. According to the importance of cochlear implant in deaf child's language development, this study evaluates the effect of different variables on child's language performance.

Method and Material: 45 cochlear implanted children were tested, all of whom had used the device for at least 2 years. In order to evaluate the children, the NEWSHA test which is fitted for Persian speaking children was performed and language development of the children was compared through stepwise discriminative analysis.

Results: After evaluation of the effect of different variables like child's age of implantation, participating in rehabilitation classes, parent's cooperation and their level of education, we came to a conclusion that the child's age of implantation and rehabilitation program significantly develop the child's language performance.

Discussion: The value of cochlear implant in improvement of deaf children in speech language perception , production and comprehension is confirmed by different studies which have been done on cochlear implanted children. Also, the present study indicates that language development in cochlear implanted children is highly related to their age of implantation and rehabilitation program.

Key words: Language development, Expressive language, Cochlear implant, Age, Rehabilitation

Submitted: 04 Dec 2010
Accepted: 11 Apr 2011

Introduction

Children with significant congenital or prelingual deafness shown to have noticeable delays in their mastery of all aspects of the spoken language (1,2). When hearing aids provide little or no benefit, cochlear implants seem to provide oral access to language. As the acquisition of spoken language by young deaf children is a lengthy process, measuring outcomes in those with implant requires time. Preliminary data suggest that the cochlear implanted children have better spoken language skills than if they had not received implants (3, 4). It is because of the fact that cochlear implants apparently restitute the inner ear functions and increase consciousness of pre- and post lingual deaf children (5). However, not all deaf cases make equal benefits from the implantation of this electronic device and several variables seem to have critical effects on linguistic performance after implantation.

For some, a cochlear implant allows the full development of linguistic competence and provide marked benefits in a wide range of psychological and social abilities, whereas others remain language delayed or develop a functional but imperfect command of language(5). This may depend on various factors like child's age of implantation,… . So, this study is done with the aim of the evaluation of the impact of child's age of implantation, participating in rehabilitation classes, parent's cooperation and their educational level on language development of 6 years old cochlear implanted children, who received the device at least 2 years before.

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Method and materials

45 cochlear implanted children who were at the age of 6 years old and had been implanted at least 2 years before were selected. After that the expressive language subset of NEWSHA test was performed on them. The NEWSHA test which is fitted for Persian speaking children from birth to 6 years old consist of a set of scales for testing the child's audition, receptive and expressive language, speech, cognition, social communication, and motor development.

The test result divided children into 13 groups from birth to 6 years old. For example it may be possible that the expressive language age of a 5 years old child equals to a 3.5 years old child. As it discussed before, in the present study the expressive language subset of NEWSHA test was performed and data analysis was done through stepwise discriminative analysis.

Results

The main purpose of this study was to evaluate the expressive language development in cochlear implanted children based on their age of implantation, participation in class, learning ability, parent's level of education and cooperation.

The results of expressive language test separated the children into 2 groups: the weak group who could answer the questions that were related to an approximately 3 years old child and the strong group whose expressive language age and chronological age were the same as each other. To assess the effect of different variables like child's age of implantation, participation in rehabilitation classes, learning ability, parent's level of education and their cooperation, stepwise discriminant analysis was done .The results are illustrated in 2 tables below.

Table 1. The effect of different variables on child's expressive language

		Wilks' Lambda							
						Exact F			
Step	Entered	Statistic	df1	df2	df3	Statistic	df1	df2	Sig.
1	class	.443	1	1	43.000	54.156	1	43.000	.001
2	age1	.405	2	1	43.000	30.895	2	42.000	.001

Table 2. Analysis of the variables

Step		Tolerance	F to Remove	Wilks' Lambda
1	class	1.000	54.156	
2	class	.998	46.750	.855
	age1	.998	3.937	.443

According to the above tables, the child's improvement in expressive language was highly related to the age of implantation and his participation in rehabilitation classes. Also, the Eigen value=1.47, Wilks' lambda=0.405 and $p<0.001$ confirmed this finding.

In addition, the standardized canonical discriminant function coefficient was -0.380 with age and 0.942 with participation in classes. Based on the discriminant function which included child's age of implantation and participation in classes, 93.3% of the predictions in discriminant analysis were correct predictions.

Table 3. Child's age of implantation and rehabilitation class

		group	Predicted Group Membership		Total
			0	1	
Original	Count	0	27	2	29
		1	1	15	16
	%	0	93.1	6.9	100.0
		1	6.2	93.8	100.0

Discussion

Cochlear implants enable different degree of improvement for deaf patients in the areas of speech and language perception, production and comprehension depending upon the extent of their hearing loss and other variables (5). According to the present study, two important factors that have significant impact on child's performance after cochlear implantation are the child's age of implantation and his participation in rehabilitation classes. In other word,

the younger children who completely participated in rehabilitation program developed in expressive language acquisition significantly. Over the past several years , the lower age limit for implantation has decreased, with the current age limit of 24 months. At birth, the cochlea has already reached adult size and the related structures are appropriately developed by the age of two (6). However, considering the critical periods for auditory system and language acquisition(7) and the negative correlation between age at onset of deafness and the development of speech perception, speech production and language competence following an implantation, it is clear that younger children can derive significant benefits from an implantation (6).

Implantation may also result in better speech perception and overall linguistic performance in children as young as 16 months (8), probably because it reduces the language development delay. A study in 1997 indicated that gains in receptive and expressive language are highly related to children's use of the device and participation in rehabilitation program. The two discussed variables will help the cochlear implanted children in language development similar to that is observed in normal hearing children (9).

The patients response therefore progress from a phase of sound detection to speech discrimination to the ability to repeat fragments of speech and finally to true understanding of speech (10).

Cochlear implants may also make it possible to have access to auditory perceptual information otherwise unavailable. Speech perception is enhanced by increasing the auditory signals. Research results of speech perception tests, one year following implantation were significantly higher than pre-implantation observations in a majority of prelingually deaf children, even when preoperative levels suggested a limited verbal ability(5).

Miyamoto et al (11), also showed a pattern of word identification development in their implanted children, with no great changes in performance after 6 months of experience; the largest performance occurred one year after operation and rehabilitation, followed by steady improvement.

In another study,100% of phoneme detection was achieved 3 months after implantation in children with prelingual deafness, whereas both identification of closed-set word and sentence and open-set recognition increased gradually, reaching 100% and 80% respectively, by 48 months of implantation and rehabilitation(12).

The primary role of cochlear implant is to enable speech perception. One of the secondary important roles is to let the speech production and help patients acquire and produce consonants and vowel features which are difficult for individuals with profound hearing loss. Language development in implanted pre lingually deaf children may be significantly faster than predictions based only on maturation of unimplanted peers would suggest. At the 12 months post operative interval, expressive language scores have been shown to be higher than the predicted corresponding scores based on non-operated peers-this effect was not seen at the 6 months interval. Although, implanted children were delayed compared to normal hearing children at each interval tested, their rate of language growth matched that of hearing controls. What implanted children have gained in expressive language were similar to those expected from hearing children and more than those expected from unimplanted deaf children at each testing interval from 6 months to 2.5years after implantation. There is however, significant interpersonal variability in linguistic abilities following the operation, with some patients reaching near normal language level, whereas others remain delayed and show a wide gap between linguistic age and chronological age(3). Support from home and school, (re) habilitation, and education are essential factors that determine linguistic improvement (7, 9) and permit the achievement of adequate phonetic and phonological competencies. An implantation should be done in case that the cochlear implant center can offer multidisciplinary team support before the operation, as well as immediate and intensive speech rehabilitation in which both parents and teachers must cooperate (10).

The rehabilitation program may take months and lasts longer for prelingually than postlingually deaf patients (13).To develop hearing and speech abilities, patients must receive adequate stimulation. The habilitations should focus on the use of audition

to optimize language development and production skills. Parents are encouraged to preferentially use audition in their interactions with children (14)
and guide them into auditory-verbal education and linguistic interactions on a daily basis (15). Finally, either oral (speech, listening) or total (sign plus speech and listening) modes of communication may be applied to help the child being improved in learning language.

Acknowledgment:
We thank parents and children who cooperated to do the test.

Conflict of interests: The authors declare that they have no conflict of interests.

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