



Original Article

Comparison of Social Interaction between Cochlear-Implanted Children with Normal Intelligence Undergoing Auditory Verbal Therapy and Normal-Hearing Children: A Pilot Study

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OBJECTIVE: A cochlear implant is a device that helps hearing-impaired children by transmitting sound signals to the brain and helping them improve their speech, language, and social interaction. Although various studies have investigated the different aspects of speech perception and language acquisition in cochlear-implanted children, little is known about their social skills, particularly Persian-speaking cochlear-implanted children. Considering the growing number of cochlear implants being performed in Iran and the increasing importance of developing near-normal social skills as one of the ultimate goals of cochlear implantation, this study was performed to compare the social interaction between Iranian cochlear-implanted children who have undergone rehabilitation (auditory verbal therapy) after surgery and normal-hearing children.

MATERIALS and METHODS: This descriptive-analytical study compared the social interaction level of 30 children with normal hearing and 30 with cochlear implants who were conveniently selected. The Raven test was administered to the both groups to ensure normal intelligence quotient. The social interaction status of both groups was evaluated using the Vineland Adaptive Behavior Scale, and statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 21.

RESULTS: After controlling age as a covariate variable, no significant difference was observed between the social interaction scores of both the groups ($p>0.05$). In addition, social interaction had no correlation with sex in either group.

CONCLUSION: Cochlear implantation followed by auditory verbal rehabilitation helps children with sensorineural hearing loss to have normal social interactions, regardless of their sex.

KEYWORDS: Child, cochlear implantation, rehabilitation, social interaction

INTRODUCTION

Sensori Neural hearing loss (SNHL) is considered as a severe disorder. It is estimated that three out of every 1000 Iranian infants are annually born with profound hearing loss; however, no accurate statistics are available in this regard. Research in some Western countries shows that about 0.1% of live births experience profound hearing loss^[1]. In Iran, cochlear implant surgery has been performed since about 25 years. In one of the cochlear implantation centers in southern Iran, nearly 150 surgeries are performed annually, and to date, 1500 patients have undergone cochlear implantation.

Children with profound SNHL usually encounter language delays, which has a negative effect on their communication and social interaction. Before the invention of cochlear implant, hearing aids were the only source for receiving sounds in hearing-impaired

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children in the developing as well as developed countries, until cochlear implantation made a positive breakthrough in their lives. Currently, cochlear implantation has effectively facilitated speech and language acquisition in sensorineural hearing-impaired children [2-4].

Various studies have focused on the different aspects of language acquisition, speech perception, and production skills in cochlear-implanted patients. Although it is now clear that cochlear implants offer acceptable and nearly normal hearing for hearing-impaired children, the facilitation and promotion of social interaction in cochlearimplanted children is another important goal that must be considered [5-8]. It can be said that improving these children's social interaction and communication will lead to a reduction in the level of isolation, which is one of the most important advantages of cochlear implantation [7-10].

The bulk of existing research has indicated that cochlear implants can have positive effects on children's communication skills compared with hearing aids [8, 11]. However, it seems that only few existing research articles have clearly and sufficiently depicted the differences in the social interaction of cochlearimplanted children and normal-hearing children [7-11].

Comparing social interaction between these two groups of children will help us understand whether acquiring nearly normal hearing levels at an early age yields nearly normal social development and social interaction skills in cochlear-implanted children. Alternatively, since one of the ultimate goals of cochlear implantation is to help hearing-impaired children become equipped with social abilities that normal-hearing children have, it is important to know whether cochlear implant surgery during the critical period of language acquisition, followed by rehabilitation, provides hearing-impaired children with social abilities comparable to normal-hearing children [12].

There is a rather large prevalence of children with congenital hearing impairment in Iran compared with the Western countries; also, the number of children undergoing cochlear implantation and the importance of achieving nearly normal social skills in cochlear-implanted children is increasing. No study to date has depicted the differences in social interaction between Persian-speaking cochlear-implanted children and normal-hearing children. Therefore, this pilot study aimed to determine and compare the social interaction in Iranian cochlear-implanted children who had received auditory verbal rehabilitation after surgery with that of the normal-hearing children.

MATERIAL and METHODS

This descriptive-analytical study compared the level of social interaction in two groups of children: cochlear-implanted children with a mean age of 7.96 ± 0.91 years and normal-hearing children with a mean age of 7.16 ± 0.77 years.

Cochlear-implanted children with a normal intelligence quotient (IQ) and no accompanying disabilities who had received a cochlear implant device approximately 2-3 years before the study were conveniently selected. Other inclusion criteria were using the cochlear implant device at least during 50% of hours in everyday according to parental reports and having completed auditory verbal therapy (AVT) programs (consisting of two sessions a week and a total of 80 sessions during a year). Based on the inclusion criteria as well as the sample size used in various related studies, 30 cochlear-implanted children (19 girls and 11 boys) were selected [6, 13].

Table 1. Parents' educational level in the two groups

	Educational Level	Cochlear implanted Children	Normal-hearing Children	p
Fathers	Primary School	8 (26.7%)	9 (30.0%)	0.105
	High School	12 (40.0%)	6 (20.0%)	
	Diploma	5 (16.7%)	13 (43.3%)	
	Junior College Diploma-Bachelor's	4 (13.3%)	2 (6.7%)	
	Master's Degree- PhD	1 (3.3%)	0 (0.0%)	
	Total	30 (100%)	30 (100%)	
Mothers	Primary School	14 (46.7%)	6 (20.0%)	0.074
	High School	8 (26.7%)	12 (40.0%)	
	Diploma	5 (16.7%)	11 (36.7%)	
	Junior College Diploma-Bachelor's	2 (6.6%)	1 (3.3%)	
	Master's Degree- PhD	1 (3.3%)	0 (0.0%)	
	Total	30 (100%)	30 (100%)	

Overall, 25 of the participants had progressive hearing loss that was initially moderate to severe and had noticeably progressed to severe and severe to profound over their lifetime. The remaining five participants had severe hearing loss that had remained stable since the age of 20-24 months when they had been registered in the cochlear implantation center.

It is also noteworthy that as we faced long waiting lists for surgery and some difficulties in accessing the cochlear implantation device at the time when the study was performed, all of the hearing-impaired participants were recommended to wear bilateral hearing aids and to participate in an AVT program before surgery, which lasted for almost 18 months.

To select normal-hearing children for the comparison group, we recruited children of middle-class families who lived in the city center and generally sent their children to public schools located in their neighborhood. Since all schools in Iran are segregated in terms of sex, two public primary schools (one boys' and one girls' school) were randomly selected as clusters from a list of all public schools available at the city center. Subsequently, 18 girls and 12 boys (30 overall) were randomly selected from a list of all first and second grade students attending those schools, trying to match the number, sex, and age range of the cochlear-implanted children.

An intelligence test was performed for these children to confirm their normal IQ. As an indicator of the socioeconomic status, the educational level of parents in both groups of children was questioned, and it showed no significant difference (Table 1).

Written informed consent was obtained from parents in both groups. Also, none of the children had any objection to participation. All procedures performed in the present study were in accordance with the ethical standards of the University of Social Welfare and Rehabilitation Sciences (USWRS) research committee and with the 1964 Helsinki declaration and its subsequent amendments.

All assessments were performed by an experienced psychologist and speech therapist in a quiet room. For IQ, the Raven test, a per-

formance IQ test for children aged 5-9 years, was used [14]. The test includes 36 colored pictures with an omitted part from each picture. This part must be selected as fast as the child can from the six options below each of the pictures. The maximum time taken for completing all 36 pictures is 30 min. The normal performance IQ range in this test is between 90 and 110.

According to Raven test, the test scores can be categorized in seven grades as follows:

1. The brilliant group in which the scores were more than 95% of the same age children (IQ>127)
2. The intelligent group in which the scores were about 90%-95% of their same age group (IQ=120-127)
3. The bright group in which the scores were about 75%-90% of their same age group (IQ=110-120)
4. The normal group in which the scores were about 25%-75% of their same age group (IQ=90-110)
5. The moderate group in which the scores were about 10%-25% of their same age group (IQ=79-89)
6. The border line group in which the scores were about 5%-10% of their same age group (IQ=73-79)
7. The learning disable group in which the scores was less than 5% of their same age group (IQ>73%)

The Vineland Adaptive Behavior Scale (VABS) was used to assess the social skills necessary for living independently [15]. The test contains questions that parents can respond to on the basis of their knowledge of their child's performance.

The Vineland Adaptive Behavior Scale measures the personal and social skills of individuals from birth through adulthood. Because adaptive behavior refers to an individual's typical performance of daily activities required for personal and social sufficiency, this scale assesses what a person actually does instead of what he or she is able to do.

The Vineland Adaptive Behavior Scale assesses adaptive behavior in five domains: communication, daily living skills, socialization, motor skills, and maladaptive behaviors. In addition to scoring each domain independently, this test also provides a composite score that summarizes the individual's performance across all five domains. According to the aim of the present study, only the socialization domain that mainly focuses on interpersonal relationships and coping skills was analyzed for participants. This domain includes 71 questions for assessing children and adolescents from birth to 20 years old. However, in accordance with the age of the participants and their ability to perform the special skills required for each age range in the test, almost 30-35 questions were administered to each child. Since the test guidelines indicate that administering the test should be stopped when the child is unable to accomplish all the skills of a specific age range, the number of administered questions varies from one participant to another.

Some of the test items are mentioned below:

1. The child can participate in games that need him/her to compete against others.
2. The child can buy things, such as ice cream and chocolate, for himself/herself.
3. The child can participate in daily activities, such as cleaning the house.
4. The child can understand the differences between imaginary and real stories.

This test was administered as a semi-structured interview with an informant who knew the children well. The interviewer asked general questions to examine the children's adaptive behavior. The given score to any question might be 0, 0.5, or 1. By converting raw scores to age-equivalent standard scores, the test eventually resulted in the calculation of "social age" and finally the "social quotient" (mean, 100; standard deviation, 15). The score ranges are as follows:

1. 70-80: Borderline adaptive functioning
2. 50-70: Mildly deficient adaptive functioning
3. 35-50: Moderately deficient adaptive behavior
4. 20-35: Severely deficient adaptive behavior
5. Less than 20: Markedly or profoundly deficient adaptive behavior

Data were analyzed using Statistical Package for Social Sciences version 21 (IBM Corp.; Armonk, NY, USA). Based on the Shapiro-Wilk test, the data distribution was not normal ($p<0.05$); consequently, the Mann-Whitney test was used to compare social interaction scores between the two groups. As the mean age of the two groups was shown to be significantly different, the ANCOVA model was used to control the age as a covariate variable. Also, qualitative data analysis was performed using the Pearson Chi-square and Fisher exact tests.

RESULTS

The Fisher exact test was performed to evaluate the differences in the parents' educational level in both the groups. According to Table 1, no significant difference in the educational level of parents in both the groups was seen. Thus, as a variable that may potentially influence the social development and social interaction of children in a family, the parents' educational level as a confounding variable was not a concern.

Table 2 shows the age range and mean age of the two groups of children at the time of study. According to this table, the mean age of the two groups was significantly different. With significantly different ages in the two groups and considering that age is an important factor that can influence the social development of a child, it could act as a confounding factor in this study, which had to be controlled when comparing the outcome in the two groups.

The mean IQ scores of cochlear-implanted and normal-hearing children were 98.66 ± 7.18 and 98.50 ± 5.89 , respectively, and no significant differences were observed ($p=0.921$).

As demonstrated in Table 3, the univariate tests indicated a significant difference between the two groups' social interaction status ($p<0.05$). However, since we had already depicted a significant difference in the mean age of the intervention and the control group, we used the ANCOVA model to control age as a covariate variable (Table 4), following which no significant difference was observed between the two groups' level of social interaction ($p=0.208$). This indicates that in similar age groups, the social interaction status of cochlear-implanted children was comparable and similar to normal-hearing children.

In addition, the Pearson Chi-square test showed no significant correlation between sex and social interaction in either of the two groups. This shows that social interaction was not influenced by sex, and no stratification was needed in terms of sex in the two groups (Table 5).

Table 2. Descriptive statistics of age in the two groups

	Age	N	Mean±SD	p
Cochlear implanted children	6 years to 6 years, 11 months, and 29 days	4 (13.3%)	7.96±0.9	0.001
	7 years to 7 years, 11 months, and 29 days	9 (30%)		
	8 years to 8 years, 11 months, and 29 days	12 (40%)		
	9 years to 9 years, 11 months, and 29 days	5 (16.7%)		
Normal hearing children	6 years to 6 years, 11 months, and 29 days	10 (33.34%)	7.16±0.77	
	7 years to 7 years, 11 months, and 29 days	15 (50%)		
	8 years to 8 years, 11 months, and 29 days	4 (13.33%)		
	9 years to 9 years, 11 months, and 29 days	1 (3.33%)		

Table 3. Comparison of social interaction scores in the two groups

	Cochlear Implanted Children	Normal Hearing Children	p
Social interaction score	112.13±7.63	116.32±6.72	0.021

Table 4. Comparison of social interaction in two groups with age controlled using the ANCOVA¹ model

Source	Sum of Squares	df	Mean Square	F	Sig.
Intercept	11958.798	1	11958.798	241.112	0.000
Age	173.471	1	173.471	3.498	0.067
Group	80.463	1	80.463	1.622	0.208
Error	2827.110	57	49.598		
Total	786151.405	60			

¹Analysis of Covariance**Table 5.** Correlation between social interaction and sex in the two groups

Group	Sex	Social Interaction	p
Cochlear implanted Children	Female	111.25±8.66	0.4
	Male	113.64±5.46	
Normal hearing Children	Female	115.41±5.47	0.4
	Male	117.62±8.55	
Total	Female	113.3±7.42	0.2
	Male	115.7±7.37	

DISCUSSION

In this pilot study, we compared the social interaction status of cochlear-implanted children who had received AVT before and after implantation with that of normal-hearing children. We aimed to investigate whether one of the most important goals of cochlear implantation, which is to improve social skills, was achieved and to find out how close did the normal-hearing children get in achieving those skills. According to our findings, cochlear implantation followed by AVT provides the profoundly hearing-impaired children with social interaction abilities comparable to those of normal-hearing children. Also, the results indicated that when controlled for age, the group of profoundly hearing-impaired children who underwent cochlear implantation followed by AVT demonstrated social interaction abilities similar to those of normal-hearing children. Since the parents of children in the two groups were insignificantly different in terms of educational level, we did not need to control that variable. Moreover, as social interaction was

not shown to be related to sex in either of the two groups, stratification in terms of sex was not required.

According to a study by Khan et al. [16], wherein children with cochlear implants, normal hearing, and hearing aids were compared in terms of cognition and behavior, the performance of cochlear-implanted and normal-hearing children was approximately the same, whereas the achieved scores of hearing-aided children were significantly lower than those of the first two groups. Similar findings were reported in studies by Faber [12], Kushalnagar [17], and Fortunato-Tavares et al. [18].

A study in 2008 concerning the level of self-esteem and social well-being of cochlear-implanted and normal-hearing children showed that cochlear-implanted children's performance in the two-stated variables were equal or better than that of normal-hearing children [19].

Also, in a longitudinal study wherein data were collected through interviews with parents, cochlearimplanted children showed a noticeable progress in communication and social skills. Although this study compared two groups of children with cochlear implants and conventional hearing aids, the authors speculated that cochlear-implanted children were not only comparable to hearingimpaired children but also to their normal-hearing peers [11].

A study in 2006 confirmed improvement in cochlear-implanted children's self-esteem during the course of time. Also, no significant difference was seen in their level of social interaction compared with normalhearing children during adulthood [6].

Similar to our findings, another study in 2012 obtained no significant difference in behavioral adoptability of cochlear-implanted boys and girls compared with their normal-hearing peers [20].

Although the results of the above mentioned studies are in line with our findings, Punch et al. [21] reported a slightly poorer performance for cochlear-implanted children in communication abilities that confronted children's parents and teachers with some challenges, particularly children's social interaction and participation, than for normal-hearing peers. It is necessary to indicate that approximately 25% of the selected children in the abovementioned study had other associated disabilities, which may have been the reason for the results, which was in contrast to the findings in most studies of its kind.

The present study had some limitations. The selection of a small group of normalhearing children as the comparison group was done to partially overcome the absence of norms for social interaction status in Persian-speaking normal-hearing children. Another limitation was that the normal-hearing children were selected from those living

and attending public schools at the city center, presuming that they could be considered to nearly represent average normal children.

As a pilot study, this study needs to be continued and completed with a longitudinal study that will evaluate the social interaction status of cochlear-implemented children several years later. Also, conducting a parallel study for arriving at norms for social interaction in the population of normalhearing Persian-speaking children will alleviate the need to recruit a normal-hearing comparison group in such a longitudinal study. Furthermore, the comparison between cochlear-implemented and noncochlearimplanted hearing-impaired children in terms of social interaction should be another research priority. Also, due to the known preference of lower age for cochlear implantation as well as the expansion of implantation indication and candidacy to include children younger than 2 years, it is recommended that this study be conducted with the participation of younger groups of cochlearimplanted children, which may yield even more successful results.

Despite the shortcomings of this pilot study, the results of the present study are clear and promising and cannot be overlooked. Timely cochlear implantation followed by AVT may save hearing-impaired children from solitude they have experienced over centuries by promoting their social interaction status. Evidently, this goal can be achieved by clarifying the positive effects of cochlear implantation for experts and parents, and by providing financial support for families who choose to apply this promising, but somewhat expensive therapeutic approach for their hearing-impaired children.

CONCLUSION

Cochlear implantation at an early developmental age followed by an AVT program can improve the social interaction of children with SNHL to a level not significantly different from the same aged normalhearing children, regardless of their sex.

Ethics Committee Approval: Ethics committee approval was received for this study University of Social Welfare and Rehabilitation Sciences (USWR) Research Committee.

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

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