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Study of Phonological Awareness of Preschool and School Aged Children with Cochlear Implant and Normal Hearing

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Background and Objectives: The primary purpose of this study was to assess whether very early access to speech sounds provided by the cochlear implant enables children to develop age-appropriate phonological awareness abilities in their preschool and school years. A secondary purpose of this study was to examine whether children who had cochlear implantation before 18 months of age will develop better skills in phonological awareness than children who had cochlear implants in 18−36 months of age. A third purpose of this study was to examine whether some factors like the child's age or sex would have any effects on developing of age-appropriate phonological awareness abilities. **Subjects and Methods**: 48 children with 70 to 95 months of age who had been utilizing their cochlear implant(s) before 36 months of age (CI group) and 30 normal hearing peers (NH group) were enrolled in this study. **Results**: Child's age had a significant effect on phonological awareness, but sex had absolutely no effect in each group. Children in the cochlear implanted group were outperformed by their normal hearing peers in the area of phonological awareness, especially in phonemic awareness. The age of implantation was another significant variable. **Conclusions**: Although children with a younger age at implantation got better scores in phonological awareness test, they were outperformed by their normal hearing peers in this area. **Korean J Audiol 2014;18(2):50-53**

KEY WORDS: Phonological awareness · Cochlear implant · Normal hearing · Preschool · School aged.

Introduction

Studies have indicated that with early use of cochlear implants, many children who are deaf have been able to develop language and literacy skills that are within normal limits (i.e., within one standard deviation of the mean) when compared to their peers with normal hearing.[1-4] Other studies have indicated that children with cochlear implant have weakness in phonological awareness skills.[5,6] For those children who communicate using oral language, these improvements are often apparent before entry into elementary school.[7,8] Literacy studies are only beginning to emerge and have almost exclusively examined the reading skills of school-age children.[4,5,9] Thus, they evaluate the interaction between cochlear implant use and formal literacy instruction. It is well known, however, that children with normal hearing begin developing emergent literacy skills, such as phonological awareness, well before their formal literacy instruction begins.[10-13] Despite the importance of phonological awareness on later reading skills among young hearing children, little is known about the development of phonological awareness skills in children with cochlear implants.

There are four related factors that indicate that the phonological awareness skills of young children with cochlear implants might be an area of special weakness and an area in great need of investigation. First, the primary goal of cochlear implantation is to provide children with an ability to perceive speech, thus allowing them to develop oral language and literacy abilities. However, cochlear implants cannot fully normalize children's auditory experiences, and children with cochlear implants typically demonstrate deficiencies in speech

perception.[14,15] Indeed, the speech perception skills of children with cochlear implants have been documented as being equivalent to the speech perception skills of hearing aid users with severe hearing loss.[8,16] Second, children with cochlear implants typically remain delayed in the acquisition of speech and language skills. Specifically, the speech production skills of children with cochlear implants are often significantly delayed, even after the children have had years of experience with their cochlear implant, and even when they are compared to younger children whose age is matched with the deaf children's duration of cochlear implant experience.[17,18] Similarly, oral language is often not age-appropriate in young children with cochlear implants prior to school entry.[7] Third, among hearing preschoolers, these skills (speech perception, speech production, and oral language) are correlated with the phonological awareness abilities.[19-27] Additionally, recent studies have indicated that the phonological awareness abilities of school-age children with cochlear implants are delayed in comparison to those of their peers with normal hearing.[5,6,28,29] Taken together, these factors place children with cochlear implants at significant risk for educationally relevant delays in the development of phonological awareness skills.

This study was designed to assess whether very early access to speech sounds provided by the early cochlear implantation would enable children to develop age-appropriate phonological awareness abilities in their preschool and school years. Additionally, this study examined whether children with cochlear implantation before 18 months of age will develop better phonological awareness skills than children with cochlear implantation at 18−36 months of age. This study also examined whether some factors like the child's age or sex would affect developing of age-appropriate phonological awareness abilities.

Subjects and Methods

Participants

The study group consisted of 30 children with normal hearing and 48 children with cochlear implant from both sexes equally. All of them were classified in three groups including preschool children (age: 60 to 71 months), children in first grade (age: 72 to 83 months) and children in second grade (age: 84 to 95 months).

All of the cochlear implanted (CI group) children were collected from normal children schools. Children were recruited for the study if they met the following criteria: 60 to 71 months of age for preschool, 72 to 83 months of age for first grade and 84 to 95 months of age for second grade, sensorineural hearing loss, utilization of a cochlear implant before age 3, no additional disabilities, and no home language other than Farsi, having no treatment for phonological awareness. The group consisted of 24 females and 24 males. There were the same number of children per grade.

All the normal hearing children were assigned to the control group (NH group). All children in the NH group were reported as having passed a hearing screening or were screened for hearing loss. As with children in the CI group, participants in the NH group were 60 to 71 months of age for preschool, 72 to 83 months of age for first grade, and 84 to 95 months of age for second grade, had no additional disabilities, and lived in homes where the primary language was Farsi. The group consisted of 15 females and 15 males. There were the same number of children per grade.

Procedure

For children in both groups, one or two testing sessions lasting a total of approximately 1 hour were conducted at their schools. We have used the phonological awareness test of "Dastjerdi & Soleimani", which is the phonological awareness test that has been standardized in Iran. This test consists of three subtests: phonemic awareness[1], intra syllabic awareness[2], and syllabic awareness[3]. Before executing the phonological test, parents filled the acceptance form showing their approval of the procedure, afterwards we executed the phonological test.

Stimuli

The phonological awareness test has three categories including phonemic awareness that has seven subtests, intra syllabic awareness that has two subtests, and syllabic awareness that has one subtest.

Execution of task

Before executing the test, we communicated with the children. For each age group, we used special subtests. We explained each subtest with some guiding words that were at the beginning of each subtest. If the child could answer each question, he/she would get a score of 1, but if he/she could not answer or his/her answer were wrong he/she would get a score of 0. Although we did not help the child in giving the correct answers, we encouraged her/him to stay active throughout the entire test.

The subtests consisted of syllable segmentation, alliteration recognition, rhyme recognition, synthesis of phonemes,

[1]The awareness to focus on and manipulate individual phonemes in spoken words.
[2]The awareness to separate a word to onset and rhyme or alliteration and entire part of the word.
[3]The awareness to divide a word to its related syllables.

recognizing words with similar beginning phoneme, recognizing words with similar ending phoneme, phoneme segmentation, recognizing the ending phoneme, deleting it and then uttering it, deleting middle phoneme, recognizing the beginning phoneme, deleting it and then uttering it.

Results

Data collected from this study was analyzed with two nonparametric statistical methods: Mann-Whitney and Kruskal-Wallis to determine the relationship between phonological awareness and the child's audition. The results showed that the mean of phonological awareness in children with cochlear implants had a statistically significant difference from normal children ($p < 0.05$)(Table 1).

The comparison of results showed that sex had no significant effect, but age had a significant effect on phonological awareness scores. Therefore, older children would gain higher scores (Table 2).

Another important evaluated variable was the age of implantation. As shown in Table 3, there was a relationship between the age of implantation and phonological awareness scores. Children with a lower age of implantation had higher phonological awareness scores.

Discussion

The results show that the functions of the cochlear implanted children in phonological awareness skills are significantly lower than the normal hearing children. These results are similar to the previous studies.[5,6,28,29] In these studies, cochlear implanted children also experienced some problems with phonological awareness skills.

As shown above, there is a relationship between age of implantation and phonological awareness. Children with lower age of implantation would get better results because of their fast development. In many countries all over the world, doctors try to implant these prostheses before 1-year-of-age. In our country (Iran), we have some problems in achieving this goal. So we could find more children who got implantation before 18 months of age and we chose this criterion to divide children. The children with lower age of implantation gained higher scores and had better function. These results are similar to previous findings.[30] Other studies also reported that early auditory experience has a better effect on linguistic skills.[31,32] Therefore, we can now emphasize the advantage of early usage of cochlear implantation on children's language functions.

As we mentioned above, the child's age has significant effect on phonological awareness scores because this ability is related to literacy acquisition, therefore older children would gain higher scores. However, in this study, the difference between ages 5 and 7 years were more distinguishable in the cochlear implanted group. Although in the cochlear implanted group of children, differences between these age groups are statistically significant (p=0.003), in the normal hearing group of children, differences were not statistically significant (p= 0.09). Although there were significant differences between the phonological awareness scores of the two groups (CI group, NH group), these results were statistically significant in only some of the subtests. The only subtest with significant difference was phoneme awareness.

Table 1. Comparison between phonological awareness of the two groups

	Audition type	n	Mean	p
Phonological awareness	Normal hearing	30	9.47	<0.001
	Cochlear implant	48	8.82	

Table 2. Comparison between mean of phonological awareness in the age groups

	Audition type	Age (yrs)	Mean	p
Phonological awareness	Cochlear implant	5	8.395	0.003
		6	8.812	
		7	8.956	
	Normal hearing	5	9.316	0.092
		6	9.457	
		7	9.64	
	Between groups	5	8.885	0.01
		6	9.134	
		7	9.298	

Table 3. Comparison between the age of implantation and phonological awareness scores (n=48)

Variable	Age of implantation	n	Mean	p
Phonological awareness	Before 18 months	24	9.036	<0.001
	After 18 months	24	8.406	

According to the present and prior results, cochlear implantation prostheses have some problems in facilitating the acquisition of the phonological awareness. However, by the increase in the child's experience in utilizing this prostheses, better results are gained. Younger implanted children have better function in phonological awareness test. Since we know that phonological awareness is a significant skill for acquiring formal literacy skills, we should allocate some sessions to the treatment of these skills in our schedule.

Conclusion

We conclude from this study that children with lower age of implantation got better scores in phonological awareness test than children with higher age of implantation. But they were outperformed by their normal hearing peers in this area, especially in phonemic awareness.

We also conclude that phonological awareness skills would improve by child's growth and females scores did not differ from males scores.

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