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Original Article

Comparison of Auditory Perception in Cochlear Implanted Children with and without Additional Disabilities

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Abstract

Background: The number of children with cochlear implants who have other difficulties such as attention deficiency and cerebral palsy has increased dramatically. Despite the need for information on the results of cochlear implantation in this group, the available literature is extremely limited. We, therefore, sought to compare the levels of auditory perception in children with cochlear implants with and without additional disabilities.

Methods: A spondee test comprising 20 two-syllable words was performed. The data analysis was done using SPSS, version 19.

Results: Thirty-one children who had received cochlear implants 2 years previously and were at an average age of 7.5 years were compared via the spondee test. From the 31 children,15 had one or more additional disabilities. The data analysis indicated that the mean score of auditory perception in this group was approximately 30 scores below that of the children with cochlear implants who had no additional disabilities.

Conclusion: Although there was an improvement in the auditory perception of all the children with cochlear implants, there was a noticeable difference in the level of auditory perception between those with and without additional disabilities. Deafness and additional disabilities depended the children on lip reading alongside the auditory ways of communication. In addition, the level of auditory perception in the children with cochlear implants who had more than one additional disability was significantly less than that of the other children with cochlear implants who had one additional disability.

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Keywords ● Cochlear implant ● Auditory perception ● Disabilities ● Child

What's Known

- Improvement in the speech, language, and auditory performance of patients with additional disabilities is less than that in children with cochlear implants but with no additional disabilities.
- Results of cochlear implantation in children with additional disabilities have prompted many studies around the world.

What's New

- We specify the types of stimulations that improve communication in children with cochlear implants and additional disabilities, among whom communication is especially based on lip-reading.
- The number of additional disabilities is a negative predictor of the level of auditory perception in children with cochlear implants.

Introduction

Recent years have seen a drastic rise in the number of children receiving cochlear implants who have significant disabilities in addition to their deafness.[1] Different studies show that approximately 30 to 40% of children with cochlear implants have coexisting disabilities.[2-4] This group of children are more difficult to define than are those born with hearing loss alone. The manner in which multiple conditions coexist and manifest is unique to every child.[5,6] In an attempt to categorize these children in a more straightforward fashion, the Individuals with Disabilities Education Act (IDEA) currently states that a child who has one

or more physical, cognitive, communication, social, emotional, or adoptive developmental disabilities may be placed in just one category of developmental delay.[7,8] Nonetheless, these children are liable to struggle with diverse associated disabilities. Indeed, special types of developmental disabilities have been reported to coexist in children with hearing loss, giving rise to multiple issues.[3,5,6]

The results of cochlear implantation in children who have additional disabilities are noticeably different from those in deaf children who have no additional disabilities. However, in comparison with the extensive literature on speech, language, and communication outcomes following pediatric implantation in children without complex needs, the available literature on this special group of children is relatively spare. As an example, most of the research hitherto conducted in our centers around children's language acquisition or parents' view about cochlear implantation and various aspects of its impact.[9-11] Accordingly, we strove to compare the level of auditory perception in children with cochlear implants with and without additional disabilities.

Patients and Methods

This cross-sectional study was performed in the Cochlear Implant Center, in the Iranian city of Shiraz. Sample selection was done by matching all congenitally deaf children with cochlear implants who had at least one additional disability with no severe motor or mental disorders (16 patients) with 16randomly selected congenitally deaf children with cochlear implants who had no additional disabilities. One of the children with additional disabilities left the study (parents' divorce) before its completion; as a result, the whole final sample size was 31 patients. The mean chronological age of the children was 7.5±1.7 years, and the mean cochlear implant age was 3.32±1.7 years. The additional disabilities in the present study included attention deficiency hyperactivity disorder, epilepsy, and mild cerebral palsy.

The inclusion criteria consisted of congenital deafness or deafness by the age of 3 years and cochlear implantation 2 years prior to study commencement. The exclusion criterion was a severe motor or mental disorder that might restrict the child's learning ability. Also, children who had received the cochlear implant device after the critical period of language learning were excluded from the study.

The auditory perception ability of the two groups was evaluated using the spondee test. The spondee test is a two-syllable word test presented aurally, visually, or both. The normalized form of the test which is suitable for Farsi-speaking children includes words such as *baba* and *mahi*. This test evaluates the ability to hear conversational speech in children with hearing aids or cochlear implants. If the aural recognition of the words is impossible, the words will be given to the child through lip reading or a combination of lip reading and auditory ways. After data collection, statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS), version 19. The normality was evaluated through the Kolmogorov–Smirnov test. The variables were assessed using the chi-square, the Student *t*, Mann–Whitney U, and Kruskal–Wallis tests. $P<0.05$ were considered statistically significant.

Results

In the present study, the level of the auditory perception of 15 (48.4%) children with cochlear implants who had at least one additional disability was compared with the auditory perception in 16 (51.6%) children with cochlear implants who were only deaf. The mean chronological age of the samples was 7.55±1.7 years, with a mean cochlear implant age of 3.32±1.19 years.

Table 1 illustrates the relation between the number of additional disabilities and the children's level of auditory perception. The results indicated that that the number of additional disabilities was a negative predictor of auditory perception ($P<0.001$).In other words, additional disabilities interfered with the children's auditory perception and rendered them dependent on other types of stimuli like visual ways instead of hearing.

In addition, the children with cochlear implants who had at least one additional disability were highly in need of visual ways or a combination of auditory and visual ways to communicate with others ($P<0.001$), while the children with cochlear implants who were only deaf were able to interpret auditory stimuli well. (table 2)

Discussion

The present study focused on a special group of children with cochlear implants: those who

Table 1: Relation between auditory perception and additional disabilities

Patients' status	Auditory perception	P value
Normal hearing loss	83.44±21.66	0.001
One additional disability	65±18.9	0.001
More than one additional disability	27.86±11.5	0.001

Table 2: Types of stimulation in the study population

Patients	N (%)	Types of stimulation	P value
Normal hearing loss	16 (53.3)	Hearing	0.001
Hearing loss+one additional disability	8 (26.7)	Hearing/lip reading	0.001
Hearing loss+multi additional disabilities	7 (20)	Lip reading	0.001

had difficulties or disabilities in addition to their deafness, which made the task of meeting their complex needs particularly challenging. Between 30and40% of deaf children are consistently reported to be afflicted with additional disabilities, although the definitions of what constitutes an additional disability do vary.[1] Gallaudet University[2,12] defines an additional disability as any physical, mental, emotional, or behavioral disorder that significantly adds to the complexity of educating a hearing-impaired child.

In the early years of pediatric cochlear implantation, it was typical for children with known significant additional disabilities to be considered unsuitable for the procedure and the main group selected for cochlear implants comprised children with bilateral severe-to-profound hearing loss(e.g., >70 dB HL), a physiologically intact cochlea, and surviving auditory nerve fibers (e.g., spiral-ganglion cells). According to these selection criteria, deaf children with additional disabilities were not considered at all. Nonetheless, cochlear implantation, far from being useless, might improve language and social interaction in most of these children and have a positive impact on their parents.

A child with multiple disabilities is capable of achieving benefit and success through a cochlear implant, in a way approximately similar to a child without additional issues. Thus, the criteria for candidacy have broadened in many respects in recent years such that children with multiple handicaps and complex needs are now assessed and may go on to receive implants.[13] Nowadays, although many such children have received implants, the vast majority of the published articles specifically exclude them from their samples in order to make their groups as homogeneous as possible. As a result, there are only a small number of papers that specifically focus on outcomes in children with additional disabilities. A study conducted in the year 2000 examined speech perception outcomes in 75 children aged up to 5 years and compared the results between children with and without cognitive and/or motor delays.[14] The results revealed that the former group was significantly slower in developing speech perception skills following cochlear implantation. The findings of that research are in agreement with ours inasmuch as in both studies, the performance of the children with cochlear implants who had additional disabilities was noticeably poorer than was the performance of the children with cochlear implants who had no additional disabilities.

Fukuda et al.[15] provided a case study on a 10-year-old congenitally deaf child described as having moderate mental retardation who received a cochlear implant at 4 years of age. Before implantation, the child's language development was delayed by 34 months in comparison with his chronological age. This gap narrowed to 23 months at 2 years' follow-up after surgery, but the extent of his cognitive delay remained unchanged (at about 15 months). Although the child's language was improved 2 years after implantation, a significant difference was observed between him and other children with cochlear implants who were only deaf.

Chiming in with the results of the current study, a study performed in the year 2005compared 19 deaf children with cognitive delays and 50 deaf children who had no additional disabilities.[16] Although both groups demonstrated a significant improvement in speech and language skills over time, the children with cognitive delays had noticeably lower scores, not least in receptive and expressive language, and slower rates of auditory sentence recognition than did their normally developing peers with implants. The children with cognitive delays made relatively good progress in developing speech perception skills but struggled with the tasks involving higher levels of language skills such as sentence recognition and receptive and expressive language. The authors concluded that cochlear implantation in children with a mild cognitive delay produced sufficient benefit to make it an appropriate intervention for this group. However, they questioned how benefit should be defined and highlighted the need for appropriate assessment measures for children with additional disabilities.

In one of the largest studies of children with cochlear implants who have multiple difficulties, Waltzman et al.[17] documented the progress of 29 children with disabilities ranging from attention deficit disorder and dyspraxia to cerebral palsy. Many of the children were unable to perform the standardized tests, either preoperatively or at any time after implantation. However, some children did gradually become able to attempt the tests using audition alone. Just over half of the children used oral communication rather than total communication or sign (visual cues). The authors concluded that although the children with multiple handicaps developed in

auditory perception skills, the progress was slow compared to that in the deaf children with implants. This result is concordant with the results of some other studies[18-20] and is, more or less, in agreement with our findings.

In a smaller study on 10 children with multiple disabilities, Hamzavi et al.[21] used the Evaluation of Auditory Responses to Speech (EARS) battery to assess progress following implantation. The patients' disabilities comprised severe hearing loss, blindness, hyperactivity, psychomotor retardation, and autism. The authors reported various outcomes, such as no speech recognition or production through differentiating voice and using some vocalizations to communicate, and concluded that such children and their parents might benefit from cochlear implantation despite not being traditionally considered good candidates.

In a study on 60 prelingual deaf patients with additional disabilities such as mild mental retardation, moderate mental retardation, learning disability, hyperactivity, cerebral palsy, autism, and congenital blindness, all the children with the exception of those with autism and congenital deafness/blindness improved in speech perception. These groups of children with cochlear implants required unique rehabilitation in order to achieve more auditory development.[22] Although we excluded children with mental retardation on the grounds of insufficient cooperation in rehabilitation programs, the results of both studies indicated that the severity of additional disabilities had a negative impact on the children's auditory performance.

According to the aforementioned studies, although cochlear implantation can be used for deaf children with additional disabilities, the results of surgery and rehabilitation, especially in those with at least on disability, are significantly weak and the rehabilitation program should focus not only on auditory stimulations but also on other ways of communication such as learning through visual ways.

Conclusion

Different studies have shown that about 30 to 40% of children with cochlear implants have one or more additional disabilities. Additional disabilities decrease the level of language and auditory performance in these children compared to children with cochlear implants who are only deaf. This problem is much more considerable in children with cochlear implants who have more than one additional disability. However, cochlear implantation may help them improve their communication skills.

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Conflict of Interest: None declared.

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