

Research Article



Pragmatic Skills in Children with Cochlear Implants

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ABSTRACT

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Introduction: Pragmatics refers to how language is used in social communication. Pragmatics has different dimensions. This study investigated the turn-taking, topic maintenance, and duration of topic maintenance in children with Cochlear implants (CIs) and normal-hearing children matched with chronological age and language age.

Materials and Methods: In this cross-sectional study, pragmatics were compared in 15 CI children, 15 normal-hearing children matched with chronological age, and 15 normal-hearing children matched with language age. Pragmatic skills of subjects such as turn-taking, topic maintenance, and duration of topic maintenance in verbal conversation were observed and measured in two groups including CI children with age-matched peers and CI children with language-matched normal-hearing children. The children's conversations were transcribed and the data were analyzed based on the normality of their distribution by independent-sample t-test and Mann-Whitney U tests.

Results: Findings showed no significant difference between the mean of turn-taking, topic maintenance, and duration of topic maintenance skills of CI children with their hearing peers ($P > 0.05$). Also, the results obtained by comparing the mean of turn-taking, topic maintenance, and duration of topic maintenance skills in CI children with normal-hearing children matched with language age did not show a significant difference ($P > 0.05$).

Conclusion: Children with CIs achieved a level of skills in turn-taking, topic maintenance, and duration of topic maintenance, which was similar to age-matched and language-matched normal-hearing children. Probably, the duration of auditory experience after cochlear implantation, age of implantation of the prosthesis, age of diagnosis of hearing loss, age of rehabilitation intervention, and family follow-up have been effective in achieving these skills.

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1. Introduction

Pragmatics is one of the most important linguistic components that refers to how language is used verbally and nonverbally in social communication [1-3]. The development of pragmatic language skills begins at the age of 9 months and continues into adulthood. Pragmatic language skills include a set of rules such as turn-taking, initiation, topic maintenance, termination, and conversational repair skills by which persons can organize and manage their interactions in the context of conversation [4, 5]. Many children with hearing impairment, despite their appropriate lexical and syntactic skills, may exhibit difficulty developing pragmatic language [2].

Several studies have suggested several reasons for pragmatic difficulty in hearing-impaired children. Some studies argued that poorer performance in pragmatic skills of hearing-impaired children compared to normal hearing is due to insufficient exposure to normal conversational contexts [6]. Lederberg and Everhart suggested that pragmatic difficulties in hearing-impaired children may be due to delays in the development of their language skills [7]. Several studies pointed out that hearing-impaired children perform more poorly on several pragmatic language skills due to hearing impairment [2, 6, 8]. Therefore, it can be expected that by early diagnosis and early receiving of appropriate hearing amplification such as hearing aids, and cochlear implants (CIs), and receiving necessary rehabilitation services and appropriate development of language skills, this delay in pragmatic language skills can be resolved [9]. Yoshinaga-Itano et al. [10] suggested that if hearing loss was diagnosed before the age of 6 months and therapeutic interventions began immediately after diagnosis of hearing loss, it would lead to the development of language proficiency and ultimately improvement of pragmatic language skills. These findings were also confirmed by a study by Nicholas and Geers [11] who explained that regardless of the type of rehabilitation program, early intervention before the age of 2 years will have a positive effect on linguistic ability and communication skills. In contrast, some studies have reported that children with CIs have weaker pragmatic skills than normal-hearing children despite receiving rehabilitation services as well as CI surgery at an early age (up to 2 years of age). Some studies have shown that children with CIs still have difficulty properly using these skills in social communication despite their lexical knowledge and appropriate syntactic skills [2, 12].

A study by Wallenius et al. [13] confirmed that the overall communication skills of children with CIs were weaker than their peers, and all children with CIs, except for one person, experienced problems in their social interactions. In addition, according to the parents' report, after 3 years of CI use, children still had poorer performance in pragmatic skills than their hearing peers.

Guerzoni et al. [14] also indicated that the development of social conversation including assertiveness (the ability to start topics and requests) and responsiveness (the ability to respond to a communication partner and keep the conversation turned) in children with CIs until the age of 2 years is similar to their hearing peers.

Likewise, Some studies have also noted that CIs children show more diverse and better pragmatic skills than younger normal-hearing children with similar language levels [6].

Overall, these findings show that there are different and sometimes contradictory findings regarding pragmatic skills. The differences in the findings may be due to the sample size, the age range of children, the age of diagnosis of hearing loss, the age at the time of cochlear implantation, the type and duration of the rehabilitation program, as well as conversational context and even communication partners. However, there is evidence to confirm that children with CIs have difficulty with some but not all components of pragmatic skills.

Consequently, the purpose of this study is to compare pragmatic skills including turn-taking, topic maintenance, and the duration of topic maintenance between children with CIs aged 6 to 8 years and 11 months during the conversation with age-matched and language-matched normal-hearing children.

2. Materials and Methods

Study subjects

The present study was carried out on 15 children with CIs, 15 age-matched normal-hearing children, and 15 normal-hearing children matched on language age.

Three groups of study participants were divided into two conversational groups. The first conversational group consisted of 15 children with CI and 15 hearing-matched children of the same language level. The second conversational group consisted of 15 children with CI and 15 normal-hearing children matched in chronological age.

A total of 15 children with CIs (7 boys and 8 girls) with an average age of 7 years and 3 months (SD= 1.91 years) were recruited. The mean age of diagnosis of hearing loss was 4.5 months (SD= 5.4 months). CI children were selected from audiology and speech therapy centers in Mazandaran province in Iran who received at least 80 sessions of rehabilitation services after cochlear implantation and all of them used verbal communication, were monolingual, and had no records such as seizures, TBI, metabolic disorders, certain genetic syndromes, visual impairment, motor problems, autism, learning disorder, and intellectual disability in their medical records and rehabilitation. Out of 15 CI children, 12 used hearing aids bilaterally before cochlear implantation. The mean duration of hearing aid use was 8.66 months (SD= 9.78 months). Also, the mean of their auditory deprivation was 12.13 months (SD= 7.74 months). CI surgery was performed unilaterally in all children and 6 out of 15 CI children used hearing aids in the other ear, bimodal array. The mean age of CI surgery in children was 21 months (SD= 8.80 months) and the mean duration of cochlear implantation was 66 months (SD= 9.84 months).

A total of 15 normal-hearing children with an average age of 7 years and 5 months (SD= 1.92 years) were matched with children with CIs in terms of chronological age. This group of children was selected from classmates of children with CIs and their language age was different from children with CIs.

A total of 15 normal-hearing children matched with children with CIs in terms of language age with an average chronological age of 75.2 months were selected from kindergartens in Mazandaran province in Iran after evaluating language age using the test of language development (TOLD-P3). These two groups of normal-

hearing children were included in the study by examining their health records in kindergartens and schools, as well as parents' reports of their normal development of speech and language and normal hearing threshold in both ears (0-10 dB). Tables 1 and 2 show details of the demographic information. Finally, all three groups of children entered the conversation according to the fact that the minimum average length of their utterances was 3 (in words). In the context of the conversation, they should have the ability to express at least 50 utterances to analyze their conversations for pragmatic skills.

Instruments

Test of language development (TOLD-P3)

The TOLD-P3 is based on a two-dimensional model for evaluating children's language level: in one dimension, language systems with listening, organizing, and speaking components, and in the other dimension, semantics, grammar, and phonology components were nominated. This two-dimensional model formed the theoretical basis of 9 main subtests. Six main subtests include picture vocabulary subtests (with 30 items), rational vocabulary (30 items), oral vocabulary (28 items), syntactic understanding (25 items), sentence imitation (30 items), and morphological completion (28 items). The first three subtests measure semantics and the second three subtests measure children's syntactic skills. The test is conducted individually. The validity and reliability of this test were well established. The correlation between the main subtests of the test and age was reported as one of the structural validity evidence between 0.38 and 0.61. The internal consistency coefficient of the main subtests is between 0.44 and 0.79. The results of factor analysis showed that the subtests had a load factor, which was called speech-language gain. In this test, the

Table 1. Demographic data of participants

Variables	No. (%)			P
	Age-Matched Normal-Hearing Children	CI Group	Language-Matched Normal-Hearing Children	
Gender	Female	8(53)	7(47)	8(53)
	Male	7(47)	8(53)	7(47)
Average chronological age (by month)	89.8	87	77	P=0.167*
Average language age (by month)	87.2	75.3	75.2	P=0.907**
The average difference in chronological and language age (in months)	2	15.13	1.6	

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*Comparison of mean chronological age in children with CIs and age-matched normal-hearing children; **Comparison of mean chronological age in children with CIs and language-matched normal-hearing children.

Table 2. Demographic data of CIs children

Variable	Mean±SD	Range
Age of diagnosis of hearing loss (in months)	4.5±5.4	1-19
Duration of auditory deprivation (in months)	12.13±7.74	1-30
The age of starting hearing aids (in months)	7.06±6.45	0-20
Duration of hearing aid use (in months)	8.66±9.78	0-35
Age of cochlear implant surgery (in months)	21±8.80	8-36
Duration of implantation prosthesis (in months)	66±9.84	48-88

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Cronbach alpha coefficient for each subtest was calculated separately between 0.74 and 0.94. The full implementation of the test requires 40 to 60 minutes. For 10 age groups with 6 months intervals from each other, percentage scores, standard scores, and age equivalents were calculated [15].

Camera for conversation recording

In this study, we used a Canon digital camera EOS 4000D which was set on a stool to record the conversation between children with CIs and normal-hearing children in interaction with each other.

Study procedure

In this study, first, 15 children with CIs were studied to achieve their language age using TOLD-P3. After calculating the raw scores of children with CIs, age equivalents were calculated. Then, 15 normal-hearing children matched with them in terms of language level were selected from relatives, kindergartens, and schools in Mazandaran province in Iran and were evaluated for assurance using language development t-tests to calculate their language age. In the next step, 15 normal-hearing children who were matched with children with CIs in terms of chronological age were selected. Then, to investigate pragmatic skills in a conversational context, the samples in the research were separated into two conversational groups: 1) children with CIs and normal-hearing children matched on language age and 2) children with CIs and age-matched normal-hearing children.

Conversations between children with CIs and their partners (in terms of language age and chronological age) were recorded at home or the clinic using a digital camera for 10 minutes.

Normal-hearing children had been entered into the conversational context based on their familiarity with CI children. When some of them were unfamiliar, the examiner tried to make a play or talk about interesting topics to familiarize them. They, then, were entered into the conversation. There was also a time interval between each conversation by the examiner when a child felt tired during the study, which was flexible from one hour to a day.

Interactions between children with an open-end question (example: What do you do at school?/ Explain your favourite cartoon such as Sponge Bob or talk about your favourite game? / What do you do at home and like that) were started by the examiner.

At the end of the speech sampling, children's utterances over conversations were transcribed by the first author from video records, and then the first and third authors analyzed the speech samples separately and the agreement coefficient between the two evaluators was calculated. The outline of the survey prepared to study the pragmatic skills includes:

Turn-taking

The number of times the speakers' and listeners' roles change during a conversation with a pause which includes two types of verbal turn-taking (compose of simple and extension turn-taking) and non-verbal calculated in the interaction between CI and normal-hearing children [6, 16].

Verbal turn-taking

The number of times the speakers' and listeners' roles change during a conversation with each other with a pause and verbal response including two types of verbal turn-taking with simple and expanded verbal responses calculated in the interaction of children with CIs and normal-hearing children [16].

Simple turn-taking

The number of times an appropriate and simple answer without any details from any communication partner during the conversation (conversation sample: CI child: What cartoon do you like? /Child with normal hearing: I like a shoebox girl) calculated in the interaction of CI and normal-hearing children with each other [16].

Extension turn-taking

The number of times an appropriate response comes with additional details and unsolicited information from each communication partner during the conversation (conversation example: a child with normal hearing: our teacher gives homework, reads, and gives the Koran/child with CI: she teaches us, for example, teaches us Persian, teaches words and teaches math, I have reached the math of the environment and area) calculated in the interaction of children with CIs and normal-hearing children with each other [16].

Non-verbal turn-taking

The number of behaviours such as head movement, etc. from each communication partner during the conversation is calculated in the interaction of children with CIs and normal-hearing children with each other [6].

Topic maintenance

The number of times a topic is maintained in multiple and consecutive turns during interactions of children with CIs and normal-hearing children with each other [6].

Duration of topic maintenance

The time spent to perpetuate the topic during the discourse was by each communication partner who interacted which was calculated in the interaction of children with CIs and normal-hearing children with each other [17].

Conversational balance

The number of words uttered by each communication partner during the conversation is a conversational balance that was calculated in the interaction of children with CIs and normal-hearing children [16].

Statistical analyses

The statistical package for the Social Sciences (SPSS) version 26 was used for analyzing the data. The significance level was considered at 0.05. First of all, the

Kolmogorov-Smirnov test was run to investigate the normality of the data distribution, and then, based on the results of normal data, an independent t-test or Mann-Whitney U test was used.

3. Results

Comparison of mean turn-taking (total number of turn-taking, verbal turn-taking, turn-taking with simple response, extension turn-taking, and nonverbal turn-taking) in CI Children with age-matched and language-matched normal-hearing children

The result showed that the difference between children with CIs and age-matched peers in the mean score of turn-taking (total number of turn-taking, verbal turn-taking, simple verbal turn-taking, extension turn-taking, and nonverbal turn-taking) was not statistically significant. Also, using the non-parametric Mann-Whitney U test, it was found that there was no statistically significant difference between the mean of turn-taking (total number of turn-taking, verbal turn-taking, simple turn-taking, extension turn-taking, and nonverbal turn-taking) in children with CIs and normal-hearing matched with language age (Table 3).

Comparison of mean topic maintenance and duration of topic maintenance in CI children with age-matched and language-matched normal-hearing children

Independent t-test showed no significant difference between the mean duration of topic maintenance in both groups (CI children with age-matched normal-hearing children and CI children with language-matched normal-hearing children). The mean of maintaining the topic in children with CI and age-matched normal-hearing children was not statistically significant. The results of the Mann-Whitney U test showed no significant difference in the difference between the mean of topic maintenance in children with CIs and language-matched normal-hearing children (Table 3).

Comparison of mean conversational balance in CI children with age-matched and language-matched normal-hearing children

Using the non-parametric Mann-Whitney U test, it was found that there was no statistically significant difference between the mean conversational balance in both groups of children (children with CIs and age-matched normal-hearing children, children with CIs and language-matched normal-hearing children) which is observed in Table 3.

Table 3. Comparison of variables between groups

	N	Mean±SD			
		TT	VTT	STT	ETT
CI	15	32.67±20.941	30.53±20.966	10.87±11.032	6.67±5.715
NH (chronological age)	15	35.27±19.433	30.80±19.771	11.67±15.300	7.20±8.283
P		0.575	0.835	0.815	0.933
CI	15	28.07±15.971	26.60±15.656	8.33±4.254	6.53±4.454
NH (language age)	15	27.40±10.183	23.53±7.511	6.87±5.357	5.93±5.216
P		0.708	0.983	0.212	0.831

	N	Mean±SD			
		NVTT	Maintenance	D. Maintenance	CB
CI	15	2.13±4.40	4.13±4.612	90.367±79.903	133.867±105.183
NH (chronological age)	15	4.40±4.911	4.27±3.535	143.067±106.306	180.200±150.551
P		0.125	0.461	0.573	0.245
CI	15	1.47±2.100	3.80±4.021	108.600±116.359	163.533±131.755
NH (language age)	15	3.80±8.308	3.47±3.270	113.300±93.252	172.267±105.920
P		0.45	0.736	0.402	0.633

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TT: Turn-taking; VT: Verbal turn-taking; STT: Simple turn-taking; ETT: Extension turn-taking; NVTT: Nonverbal turn-taking; CB: Conversational balance; CI: Cochlear implant; NH: Normal hearing.

The percentage of agreement between evaluators using the kappa coefficient results was 0.96, indicating excellent agreement between the examiners (P=0.001).

4. Discussion

The purpose of this study was to analyze whether there is a difference between children with CIs and age-matched normal-hearing children and children with CIs and language-matched normal-hearing children in pragmatic skills including turn-taking (total number of turn-taking, verbal turn-taking, simple turn-taking, extension verbal turn-taking and nonverbal turn-taking), topic maintenance, and duration of topic maintenance.

One of the most fundamental pragmatic factors in conversational context is turn-taking skills. Reduced use of pragmatic skills during conversation leads to communication breakdown and ends the conversation. Therefore, appropriate use of this skill is very important in daily interactions [18]. The present study showed that there

was no statistically significant difference between turn-taking skills in children with CIs and age-matched and language-matched normal-hearing children in conversational context. Children with CIs scored lower on all pragmatic skills in this study. This result is consistent with several studies on using CI prosthesis compared to hearing aids in children with severe to profound hearing loss led to their better performance in language skills and oral communication [19-22].

The results of this study were inconsistent with the study by Kondurova et al. [23] that noted the turn-taking skills of hearing-impaired children one year after CI surgery were lower than their hearing peers, while their pause during turn-taking was higher than their hearing peers. In the present study, it was shown that although there was no significant difference between the turn-taking skills of children with CIs and their hearing peers, children with CI used less turn-taking skills in interaction than their hearing peers, and the pause of children with CIs was higher than that of normal-hearing chil-

dren. Caissie et al. [24] argued that the reason for the long pause of children with CIs during interaction is their efforts to preserve the topic and to express more about the topics.

Most et al. [6] have found that children with CIs face limitations in using conversational strategies such as turn-taking because they are not exposed to normal environments for communication in the early stages of development. While children with CIs participating in current study experienced normal context placement, there was no statistically significant difference between the turn-taking skills of children with CIs and age-matched and language-matched normal-hearing children. Also, Martin et al. [25] claimed that the placement of children with CIs in mainstreaming schools created opportunities for them to have better access to interactions, as well as pragmatic skills in conversations with normal-hearing children. In the present study, all children with CIs attend the same general education settings. Maintaining the topic is very important in the continuation of conversation and discourse. This is in accordance with the results of Duncan's study who indicated that hearing-impaired children were not significantly different in topic maintenance skills compared to their hearing peers [26]. According to studies conducted by Roth et al. and Bloom et al. [27, 28], it can be argued that children used two types of strategies to follow up the topic: providing short answers without any new information and providing answers with new information, in which children with CIs used short answers without providing new information to maintain the topic.

Several studies on pragmatic skills of children with CIs showed that the mastery of this skill depends on several factors such as the impact of communication partners, the level of partner tolerance, as well as the conversational context in which children with CIs are engaged in [8, 29-31]. In addition, some studies showed that hearing-impaired children had better pragmatic skills in interaction with adult communication partner such as teacher, which actually shows the level of tolerance and control in relation to hearing-impaired children, which plays a role in better development of pragmatic skills [8]. Other studies have revealed that normal-hearing children in interaction with hearing-impaired children reduced their demands and acted as a supporter and mediator in interaction with hearing-impaired children, and took responsibility for controlling the flow of conversation, which contributed to better pragmatic skills by hearing-impaired children. The lower range of tolerance of normal-hearing children in conversation with CI children leads to more problems in children with CIs [6].

Some researchers reported that many factors influenced the development of pragmatic and communication skills in children with CIs including individual characteristics, age of diagnosis of hearing loss, age of CI surgery, and residual sense of hearing and rehabilitation program type [21, 32-34]. A study by Nicholas et al showed that if rehabilitation intervention had been performed before the age of 2, it would have a positive effect on language development and communication skills and reduce restrictions on interactions [11]. In addition, a study by Shoeib et al. [35] showed that the cause of weakness in pragmatic skills in CI children depended on the severity of hearing loss as well as the duration of hearing deprivation.

Lin et al claimed that children with disabilities used pragmatic skills during the interaction as mediators. Therefore, pragmatic skill development is very effective in children with disability to interact with their peers [36]. In addition, Curtiss et al. [37] pointed out that hearing-impaired children expressed pragmatic purposes in a single word and nonverbal manner, which is proportional to their age level, despite delays in verbal skills. In the present study, it may be argued that a reason for these findings might be a decrease in the average age of cochlear implantation, the use of hearing aids such as hearing aids before CIs, and completion of rehabilitation treatment programs of children with CIs. Children with CIs used cochlear implant prostheses for 5 years and 10 months and the mean age of diagnosis of hearing loss and their average auditory deprivation were 4.5 months and 12.13 months, respectively. However, since this study was conducted with low sample size, it is necessary to consider more sample size in future studies and also examine the pragmatic skills mentioned in the normal-hearing children with normal-hearing children during conversation as a control group.

5. Conclusion

In the conversational context, the turn-taking, topic maintenance, and duration of topic maintenance in children with CIs are comparable to their age-matched and language-matched normal-hearing children.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by ethical committee of **Iran University of Medical Sciences** (Code: IR.IUMS.REC.1398.212).

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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