



Evaluation of gap filling skills and reading mistakes of cochlear implanted and normally hearing students



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ABSTRACT

Objective: This study aimed to (1) evaluate the gap filling skills and reading mistakes of students with cochlear implants, and to (2) compare their results with those of their normal-hearing peers. The effects of implantation age and total time of cochlear implant use were analyzed in relation to the subjects' reading skills development. **Methods:** The study included 19 students who underwent cochlear implantation and 20 students with normal hearing, who were enrolled at the 6th to 8th grades. The subjects' ages ranged between 12 and 14 years old. Their reading skills were evaluated by using the Informal Reading Inventory.

Results: A significant relationship were found between implanted and normal-hearing students in terms of the percentages of reading error and the percentages of gap filling scores. The average order of the reading errors of students using cochlear implants was higher than that of normal-hearing students. As for the gap filling, the performances of implanted students in the passage are lower than those of their normal-hearing peers. No significant relationship was found between the variables tested in terms of age and duration of implantation on the reading performances of implanted students.

Conclusion: Even if they were early implanted, there were significant differences in the reading performances of implanted students compared with those of their normal-hearing peers in older classes.

1. Introduction

Reading and writing skills are necessary for the academic structuring of knowledge. The early acquisition of these two skills in this frame will have a very positive effect on the student in the progressive educational life. A child who is able to read and write properly throughout the course of his/her education is likely to be successful in other lessons; because reading and writing skills are pre-requisite for the acquisition of other academic skills [1]. Experts advocating that the academic performance of students can improve with adequate reading performance and that this situation would negatively affect the academic achievement of students in the event of a delay in reading acquisition [2].

Communication skills of children with hearing loss can be developed with the use of cochlear implants. Such implants have become popular among children with profound hearing loss, especially those who do not benefit from conventional hearing aids. In primary school, both normal and hearing-impaired children are taught to read and write at the same time under the same educational curriculum. In such a system, hearing-impaired children are included in the same educational program within the same classrooms as their normal-hearing peers.

However, when examining the classroom skills of hearing-impaired children, several differences in their reading and written expression skills can be found compared with their normal-hearing peers. For example, in comparison with their normal-hearing peers, hearing-impaired children use fewer words in their written narratives [3]. In the literature, there are a lot of studies which reports that reading levels of hearing-impaired students are far behind those of their normal hearing peers [4–7]. Gap filling ability used to evaluate what you read provides important information about the skills and strategies used to derive meaning from the text. Therefore, it is a sign of understanding the text [8–11]. Filling in the gaps in the text is a difficult task for every student. It is stated that the hearing-impaired students are difficult to fill the gaps in the text like hearing students [12]. However, It is stated that the hearing-impaired students have more space filling errors than the hearing students, there is no difference between hearing-impaired students and hearing students' responses to the gaps in the text [13]. This is caused by the delay in reading ability and that these students use similar reading strategies with hearing readers, as well [14].

The purpose of this study is to examine the gap filling skills and reading mistakes of cochlear implanted students and to compare the results with normal hearing peers. The second aim of the study is to

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examine the characteristics of students with cochlear implants, especially those have a significant impact on the reading skills of students.

2. Methods

2.1. Participants

The research population consisted of 20 normal-hearing and 19 implanted students. The latter consists of children who have undergone cochlear implant surgery at Marmara University Medical Faculty Hospital. The students who participated in the research were 12–14 years old, and enrolled in as 6th, 7th, and 8th grade students. All students had prelingual bilateral severe to profound sensorineural hearing loss and have been using a unilateral cochlear implant for at least two years. All implanted students used hearing aid before implantation except for one. Students with hearing impairment have no additional physical/psychological disabilities other than being hearing-impaired.

The control group of the study consisted of children in the same age group, who has been going to the same classes (6th, 7th, and 8th grades) in normal primary schools. These children passed the DPOAE (Distortion Product Otoacoustic Emission) test with no additional psychological/physiological disabilities (see Table 1).

Frequency distributions were presented according to the class levels of students, who were categorized as either normal-hearing or implanted students. According to this classification, out of 19 implanted students, 8, 4, and 7 students were enrolled in the 6th, 7th, and 8th grades, respectively. Meanwhile, of the 20 normal-hearing students who participated in the study, 10, 5, and 5 students were enrolled in the 6th, 7th, and 8th grades, respectively.

Table 2 shows that 12 children received cochlear implant at 36 months old or earlier and 7 children were implanted after the age of 36 months of age. Time of cochlear implant use ranged from 24 months to 132 months. Average implanted hearing thresholds of students were from 27 dB HL to 34 dB HL.

2.2. Materials

Informal Reading Inventory has been prepared for the purpose of assessing reading ability by Karasu, Girgin, Uzuner in 2012 [15]. The inventory contains stories and informative texts appropriate to each grade level. Each text is evaluated in four subcategories: gap filling texts, reading assessment form, response forms to questions, and error analysis forms. This inventory have been verified in terms of their reliability and validity for research [15].

In this study, two subcategories of inventory were used to assess reading performances of students. They were gap filling texts and reading assessment form. In the application of the Informal Reading Inventory, the student was given a blank version of the story text, he/she was requested to fill it with the words according to the reading text. Then, the reading error was recorded by the researcher during the student's reading aloud.

For the evaluation of gap filling score, the sum of the words which are different from the text but which do not change the meaning and proper word in the text is divided by the number of all the gaps specified in the text and multiplied by hundred.

For the evaluation of reading error, the total number of words in the story text corresponding to the class level was calculated and the total

Table 1
Participants' distribution by class level.

Class level	Number of implanted students	Number of normal hearing
6.	8	10
7.	4	5
8.	7	5

Table 2
Age at CI surgery, total time of CI use, PTA's and average Implanted thresholds of children with Cochlear Implant.

Total number of students (N = 19)	Groups	Age of cochlear implant surgery (months)	Number of students	Total usage time of cochlear implant (months)	Average implanted thresholds of students (500Hz-6 kHz)
12	36 months and before	24	3	120,120,144	30,31,29
		28	2	121,116	28
		29	1	84	33
		18	1	120	29
		36	4	108,112,120,122	30,28,27,28
		30	1	120	27
7	After 36 months	54	1	149	30
		72	1	72	34
		41	1	122	31
		40	1	132	30
		60	2	108,120	30,28
		57	1	122	28

PTA:Pure tone average, CI:Cochlear Implant.

reading error of the student was multiplied by one hundred divided by the total number of words in the text.

This study was approved by the institutional review board at 19.01.2016/14. Also written informed consent form was obtained from the parents of the students who participated in this study.

2.3. Statistical analysis

Mann–Whitney *U* Test was employed in the analysis of gap filling and reading mistakes because the data were not homogeneous. The effects of implantation age and total time of implant use, which were thought to influence the levels of reading and writing performances, were analyzed by using regression analysis. SPSS version 21 were used for the statistical analysis of this study.

3. Results

Descriptive statistics for the total reading scores of normal-hearing and implanted students are given in Table 3, respectively. Table 3 shows the reading error and gap filling scores of implanted and normal-hearing students. A significant relationship can be found between implanted and normal-hearing students in terms of the percentages of reading error (Mann–Whitney *U* = 21.00, *Z* = -4.750, *p* < 0.001) and the percentages of gap filling scores (Mann–Whitney *U* = 109.00, *Z* = -2.286, *p* = 0.22, *p* < 0.05). The average scores of the reading errors of students (27.31) using cochlear implants was higher than that of normal-hearing students (5.15). Meanwhile, the reading errors of implanted students exceeded those of their normal-hearing peers. On the contrary, for the gap filling variable, a higher average scores was found in normal-hearing students (80.75) than those using cochlear implants (24.63). As for the gap filling, the performances of implanted

Table 3
The reading error and gap filling scores of implanted and normal hearing students.

Variables	Cochlear implanted group	Normal hearing group	Mann Whitney U
	Ave. ± SD	Ave. ± SD	
Reading errors	27.31 ± 37.36	5.15 ± 3.93	21.00*
Gap filling scores	24.63 ± 25.02	80.75 ± 10.11	109.00*

Note 1: Ave. order: average order, Ave. = average, SD = Standard deviation.

Note 2: Gap filling scores and reading errors were calculated as a percentage value.

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