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Audiovisual spoken word recognition as a clinical criterion for sensory aids efficiency in Persian-language children with hearing loss

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ABSTRACT

Objectives: The aim of this study was to examine the role of audiovisual speech recognition as a clinical criterion of cochlear implant or hearing aid efficiency in Persian-language children with severe-to-profound hearing loss.
Design: This research was administered as a cross-sectional study. The sample size was 60 Persian 5–7 year old children. The assessment tool was one of subtests of Persian version of the Test of Language Development-Primary 3. The study included two experiments: auditory-only and audiovisual presentation conditions. The test was a closed-set including 30 words which were orally presented by a speech-language pathologist.
Results: The scores of audiovisual word perception were significantly higher than auditory-only condition in the children with normal hearing ($P < 0.01$) and cochlear implant ($P < 0.05$); however, in the children with hearing aid, there was no significant difference between word perception score in auditory-only and audiovisual presentation conditions ($P > 0.05$).
Conclusions: The audiovisual spoken word recognition can be applied as a clinical criterion to assess the children with severe to profound hearing loss in order to find whether cochlear implant or hearing aid has been efficient for them or not; i.e. if a child with hearing impairment who using CI or HA can obtain higher scores in audiovisual spoken word recognition than auditory-only condition, his/her auditory skills have appropriately developed due to effective CI or HA as one of the main factors of auditory habilitation.

1. Introduction

Speech is an audiovisual (AV) event, so due to lips and tongue movements the visual cues of speech can improve speech perception [1,2]. Several studies have been administered to find modality preference during speech perception in both children with normal hearing (NH) and prelingually hearing loss (HL). Although earlier studies asserted that visual cues are unnecessary for most individuals with NH under quiet conditions [3], recent studies have indicated that children with NH spontaneously integrate auditory and visual information in spoken words [4]. As to children with HL, although it was believed that observation of both auditory and visual cues probably is the typical mode of speech perception for most persons with HL in order to communicate orally [5], current findings have suggested that children with hearing aids (HA) cannot compile auditory and visual information [4]. Even, children with cochlear implants (CI) are not initially able to integrate AV information, but AV fusion is gradually formed due to auditory experience [4,6]. Accordingly, a randomized clinical trial on Persian-language children with CI indicated that the children who were instructed using either the A-only or AV modes during 12 months post-implantation acquired auditory and oral language skills at the same rate [7]. However, according to some research, there is a sensitive period for AV integration post-implantation; auditory-visual fusion occurs appropriately, if cochlear implantation is done under age 2.5 years [8]. It seems that these findings have had important implications for CI candidacy [9–11].

Initially, CI was only suggested for children with profound HL, but the recent studies indicated that children with much more residual hearing can gain much more from CI than from HA [12]. So, according to the common protocol of CI candidacy, a child with severe to profound HL should use an appropriate HA and receive an intensive habilitation services pre-implantation [13]. Eventually,

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the child should be implanted, if he or she cannot adequately achieve auditory and speech skills in the period. Therefore, some children with severe-to-profound HL continue using HA based on their progress. Usually, the speech perception of children using CI or HA is clinically evaluated under auditory-only (A-only) condition to find the child's auditory improvement in quiet circumstances by a speech-language pathologist (SLP) or an audiologist [14]. However, current findings suggest that AV speech perception may be applied as a reliable predictor for determining CI candidacy [9–11]. So, some materials have been suggested in order to assess audiovisual word-in-sentence recognition in English-language adults with HL [14].

The aim of this study was to examine the role of AV speech perception as a clinical criterion of CI or HA efficiency in Persian-language children with severe-to-profound hearing loss. Our assumption was that audiovisual integration routinely occurs in children with NH during speech perception under quiet circumstances. So, the scores of spoken word recognition in AV presentation would be higher than in A-only presentation conditions in the children with normal hearing. Therefore, the same outcomes will be predicted for the children with CI or HA if sensory aids are efficient for them.

2. Materials and methods

This research was carried out as a cross-sectional study. Informed consent was obtained from the parents of each child participating in the study and the research protocol was approved by the Ethics Committee of Shiraz University of Medical Sciences, Shiraz, Iran. The sample size was 60 Persian 5–7 year old children including 30 with NH and 30 with HL (21 using CI and 9 using HA). The children with HL and their normal peers were recruited through consecutive sampling method from Soroush Rehabilitation Centre and a preschool centre in Shiraz, respectively. The inclusion criteria for the subjects with HL included normal IQ, bilateral severe-profound, sensory-neural hearing loss, using HA or CI, using oral language as communication method, educating in the same educational program, and no other disabilities. All the children had unilateral CIs or bilateral HAs. The inclusion criteria for the subjects with NH were normal IQ, normal hearing, lack of speech/language impairments, and lack of other disabilities.

The assessment tool was one of the subtest of Persian version of the Test of Language Development-Primary:3 (TOLD-P:3). The Picture Vocabulary subtest was used to measure the children's spoken words recognition. The TOLD-P:3 for Persian-language children is a highly valid and reliable norm-reference test for assessing the development of language skills in children. The mean of Cronbach's alpha as a measure of the test's consistency and the mean of validity coefficient as a measure of a test's usefulness have been reported 90.7 and 43.7 for the test, respectively.

The study included two experiments: A-only and AV presentation conditions. A speech-language pathologist measured each child's word perception ability by administrating the test in two ways: A-only and AV. The test was a closed-set including 30 words which were orally presented by the examiner. The examiner produced one word each time, while the child was asked to show the word's picture among three other pictures. In the first experiment, the subjects were assessed by using auditory modality while in the second experiment, they were examined under AV condition. There was one-week interval between two experiments because of preventing the effect of familiarity with the items of the test. The examiner covered her mouth by using a paper during the first experiment in order to eliminate the child's lip-reading in the A-only presentation condition. Finally, the children's scores in the two experiments were calculated. The scores were compared within and between the groups through statistical tests in $\alpha = 0.05$ including Kruskal–Wallis test, Wilcoxon Rank-Sum test, and Pearson Correlation Coefficient. The data were analyzed using IBM SPSS 21.

3. Results

The mean and standard deviation of the children's age are shown in Table 1. There was no significant difference among the three groups ($P > 0.05$) with regard to the children's age.

The children's word perception score within groups in two presentation conditions, auditory-only and audiovisual, are shown in Table 2. Accordingly, the scores of AV word perception were significantly higher than A-only condition in the children with NH ($P < 0.01$) and CI ($P < 0.05$) while in the children with HA, there was no significant difference between the word perception score in A-only and AV presentation conditions ($P > 0.05$).

There was no significant correlation between the children's age of all three groups with the scores of A-only and AV speech perception ($P > 0.05$) (Table 3). There was no significant correlation between the age of receiving HA (Mean = 35.89, SD = 12.23) and the scores of A-only and AV speech perception ($P > 0.05$) (Table 3). There was no significant correlation between the age of receiving CI (Mean = 40.66, SD = 13.14) and the scores of A-only and AV speech perception ($P > 0.05$) (Table 3). Also, there was no significant correlation between the duration of HA use

Table 1
Comparison of the age of subjects in three groups.

Group	Age (month)	df	χ^{2b}	*P*-value
NH[c]	70.33[a] (7.11)	2	0.632	0.729
CI[d]	73.24 (10.25)			
HA[e]	72.78 (9.80)			

[a] Mean(standard deviation).
[b] Kruskal–Wallis test.
[c] Normal hearing.
[d] Cochlear implant.
[e] Hearing aid.

Table 2
Comparison of the A-alone and AV speech perception scores in the three groups.

Group	Spoken word recognition		Z[b]	*P*-value
	A-only	AV		
NH[c]	19.00[a] (2.79)	20.77 (2.64)	4.446	0.000
CI[d]	11.95 (3.88)	13.00 (3.53)	2.381	0.017
HA[e]	12.44 (3.39)	13.33 (3.94)	1.222	0.222

[a] Mean(standard deviation).
[b] Wilcoxon test.
[c] Normal hearing.
[d] Cochlear implant.
[e] Hearing aid.

Table 3
The correlation among age, HA[e]/CI[d] receiving age and duration with scores of A and AV speech perception.

Factors	A-only		AV	
	r^b	P^c	*r*	*P*
Age[a]	0.077	0.557	0.033	0.801
HA receiving age[a]	−0.119	0.760	−0.324	0.396
CI receiving age	−0.401	0.071	−0.216	0.347
Duration of HA[a]	0.083	0.832	0.367	0.331
Duration of CI	0.671	0.001	0.487	0.025

[a] Month.
[b] Pearson correlation.
[c] *p*-value.
[d] Cochlear implant.
[e] Hearing aid.