

Word Recognition in Relation to Phoniatic Evaluation in Aided Hearing-Impaired Children

Original
Article

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ABSTRACT

Objectives: Speech recognition tests are used to reveal the accuracy of patient auditory reception and processing of speech material, usually in terms of a percent correct score for monosyllabic words. This can be problematic when testing children because their speech recognition scores are affected by their level of language development as well as by their auditory capabilities. Phoniatic evaluations using articulation test detect articulation disorders affect the final word recognition scores. Accordingly, the aim of this current work was designed to assess word recognition according to language age of hearing-impaired child and to compare results of word recognition tests before and after phoniatic evaluation.

Patients and Methods: Thirty-two hearing-impaired children fitted with appropriate digital hearing aids with comparable technologies. Comparison of speech recognition scores was done before and after application of Arabic articulation test. Errors in speech production was used to correct speech recognition scores after phoniatic evaluation.

Results: Scores of word recognition were improved after correction of speech production errors detected by Arabic articulation test. Scores also reflected importance of language rehabilitation and age of interventions.

Conclusion: Detection of speech errors using an appropriate articulation test is an important step in evaluation speech recognition of hearing-impaired children.

Key Words: Auditory perception, hearing aids; hearing impairment, speech articulation, word recognition.

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INTRODUCTION

Verbal language is a humanized skill which is acquired gradually during a defined step-by-step process. Language is acquired through daily life interactions without any training in normal hearing children. Hearing loss hampers this process and causes language disorder. Therefore, normal language acquisition in the hearing-impaired child requires special training based on the degree of hearing loss^[1]. The ability to segment and discriminate phonemes from incoming speech, as well as acquire knowledge of sound patterns of a language are important for developing word knowledge^[2].

Children with hearing impairment show delays in verbal semantic ability throughout the developmental period. They show difficulty in using concept words, figurative and multiple meanings. In addition to troubles in understanding connected discourse in both spoken and written modes. In addition, they always have element of delayed language development in all parameters (semantics, syntax, pragmatics & phonology), with decreased vocabulary

size at word level together with decreased the ability to utter complete sentences with complete phrase at sentence formulation level (sentence simplification)^[3].

Spoken word recognition tests assess the effects of hearing loss on spoken word recognition and speech perception. Speech recognition tests are used to reveal the accuracy of patient auditory reception and processing of speech material, usually in terms of a percent correct score for monosyllabic words. This can be problematic when testing children because their speech recognition scores are affected by their level of language development as well as by their auditory capabilities^[4].

There is currently considerable debate as to whether the difficulties seen in speech recognition tests are due to a low-level deficit affecting auditory discrimination, or whether they reflect impairment of a specialized language processing system^[5]. Accordingly, the aim of this current work was designed to assess word recognition according to language age of hearing-impaired child and to compare results of word recognition tests before and after phoniatic

evaluation. Phoniatic evaluations using articulation test detect articulation disorders affect the final word recognition scores.

PATIENTS AND METHODS:

2.1- Subjects:

The study consisted of 32 hearing-impaired children fitted with appropriate digital hearing aids with comparable technologies. The study was conducted in Audiology unit at Otorhinolaryngology department.

Inclusion criteria included children 4 to 6 years old, regular use of hearing aids with satisfactory aided response, average and above IQ and receiving aural and oral rehabilitation.

Hearing-impaired children with other causes of velopharyngeal insufficiency were excluded from the study including children with cleft palate, post-adenotonsillectomy, mental retardation and neurologically affected cases.

This study was performed after fulfilling the requirements of the ethical committee at the ENT department and the approval of the Institutional Research Board of the faculty of medicine in our university. Written informed consent was also obtained from the parent of each patient who participated in this study. All parents of patients presented written informed consent in accordance with the Declaration of Helsinki.

2.2- Equipment:

1. Two channel pure tone diagnostic audiometer model (Madsen Itera II)

2. Sound treated room (locally made).

2.3- Methods:

1- Full medical and otological history.

2- Otological examination.

3- Aided audiological evaluation: performed through sound-field using warble tones at 0.5, 1, 2 and 4kHz. Applied via loudspeakers placed at a 45 degrees azimuth at a distance of one meter from the child. According to the degree of aided response, they were satisfactory aided response with average pure tone audiometry (PTA) better than 40dB PTA.

4- Aided speech discrimination test: using phonetic balanced Kindergarten word list Arabic version^[6] delivered in a sound field of 55 dB HL sound pressure level.

5- Complete phoniatic evaluation

1. Language assessment using the Preschool Language Scale-4 "Arabic Version"^[7] for determination of language age and evaluation of language ability of the children were classified into 4 groups:

- Group 1: hearing impaired children uttering single words.

- Group 2: hearing impaired children uttering simple sentences.

- Group 3: hearing impaired children uttering complete sentences.

- Group 4: hearing impaired children uttering long sentences.

2- Mansoura Arabic Articulation Test [M.A.A.T.]^[8] for detection of any speech disorders (fixed disorder and phonological processes). For facilitation of Articulatory Test results speech disorders divided into 4 categories: substitution, phonological processes, right words and wrong words.

3- Aided speech discrimination after phoniatic evaluation: Correlating speech disorders with the phonetic balanced Kindergarten word list Arabic version for post phoniatic evaluation in relation to speech discrimination test. Speech disorder including substitution, phonological process and right words was considered correct.

RESULTS:

This was a cross sectional study conducted on 31 hearing impaired children with hearing aids attended at audiology outpatient clinics from period between July 2017 & July 2018. The rate of patients was not enough to complete the targeted sample of our study to evaluate 100 patients and the available sample was only 32 patients, they were divided into 4 groups:

- Group 1: hearing impaired children uttering single words. (n= 1) (female child aged 3 years with moderately severe SNHL, poor speech discrimination score before and after evaluation).

- Group 2: hearing impaired children uttering simple sentences. (n= 7)

- Group 3: hearing impaired children uttering complete sentences. (n= 10)

- Group 4: hearing impaired children uttering long sentences. (n= 14).

Statistical analysis was applied only for 31 patients from groups 2, 3 and 4. There was no statistical significance difference among all groups as regards sex and age (Table 1).

Table (2) illustrates descriptive analysis of M.A.A.T results of each group as regards (wrong words, substitution, phonological processes, right words).

There was no significant difference between scores of aided speech discrimination in each of the study groups before and after M.A.A.T. (Table 3).

Table (4) illustrates the results of comparison of aided speech discrimination between 3 study groups before and after M.A.A.T. The results were similar before and after application of M.A.A.T. There was statistically significant difference between the 3 groups. By pairwise comparison using Man Whitney test, there was a difference between (group 2 and group 4) while there was no difference between (group2 and group 3) and between (group 3 and group 4).

Table (5) showed the relation between aided speech discrimination scores before and after M.A.A.T with age, duration of language therapy and duration of hearing aids use.

Table 1: Comparison between 3 groups according patients demographic characteristics (sex and age)

	Group (2) (N=7)		Group (3) (N=10)		Group (4) (N=14)		Test of significance (p)
	No.	%	No.	%	No.	%	
Sex							
• Male	4	57.1	8	80	8	57.1	(MCP=.5)
• Female	3	42.9	2	20	6	42.9	
Age (years)							
• Median (Min -Max)	5 (4 -6)		4.5(4 -6)		6 (4-6)		(H=3.3, P=.189)

MCP: Monte Carlo Exact p value
H; Kruskal Wallis test

Table 2: Descriptive analysis of M.A.A.T results of each group

	Group (2) (N=7)	Group (3) (N=10)	Group (4) (N=14)
Wrong Words	5(3 - 17)	4(0 -14)	2(0 - 10)
• Median (Min -Max)			
Substitution	5(0-6)	5(3 - 10)	4(0 - 11)
• Median (Min - Max)			
Phonological Processes	5(3-9)	6(2 - 8)	3(0 - 6)
• Median (Min - Max)			
Right Words	6(0-14)	8(4 - 17)	14(7 - 22)
• Median (Min - Max)			

Table 3: comparison between Scores of aided speech discrimination before and after M.A.A.T in each study group separately:

	Aided speech discrimination score before phoniatic evaluation (%)	Aided speech discrimination score After phoniatic evaluation (%)	Test of significance (p)
Group (2)			
• Median (Min -Max)	36(0-72)	64 (32 – 84)	(z = -2.37, P=.018*)
Group (3)			
• Median (Min -Max)	38(28 - 68)	78 (56- 84)	(z = - 2.8, P=.005*)
Group (4)			
• Median (Min -Max)	54(28 - 88)	84 (60 – 96)	(z = -3.3, P=.001*)

Z; Wilcoxon Test *: statistically sig

Table 4: Comparison of aided speech discrimination between 3 study groups before and after M.A.A.T.

	Group (2) (N=7)	Group (3) (N=10)	Group (4) (N=14)	Test of significance (p)
Aided speech discrimination score before phoniatic evaluation (%)	36(0-72)	38(28 -68)	54(28 -88)	(H=7.5, P=.024*)
• Median (Min -Max)				
P1		1		
P2			0.104	
P3	0.05*			
Aided speech discrimination score after phoniatic evaluation (%)	64(32-84)	78(56-84)	84(60-96)	(H=10.5, P=.005*)
• Median (Min -Max)				
P1		0.9		
P2			0.09	
P3	0.007*			

H; Kruskal Wallis test

P: Significance between groups; p1 Significance between group 2 and group 3, P2: Significance between group3 and group4, p3: Significance between group2 and group4; Significance between groups assessed by Man Whitney test

. *: statistically sig

Table 5: Relation between Score of aided speech discrimination before and after phoniatic evaluation with age, duration of language therapy and hearing aids use.

		Age (N=31)	Aided speech score (N=31)	Duration language therapy (N=31)	Duration hearing aid (N=31)
Aided speech score before phoniatic evaluation	Spearman Correlation (r)	0.45	0.9	0.135	0.01
	P	0.011*	0.0001*	0.47	0.95
Aided speech score after phoniatic evaluation	Spearman Correlation (r)	0.432	0.9	-0.006	-.003
	P	0.015*	.0001*	0.97	0.98

DISCUSSION

The present study was a cross-sectional study conducted on 31 hearing-impaired children with hearing aids who attended at audiology outpatient clinics period between July 2017 & July 2018. The rate of patients was not enough to complete the targeted sample of our study to evaluate 100 patients, and the available sample was only 32 patients; statistical analysis was applied only for 31 patients from groups^[2, 3, 4].

The current study revealed that the mean duration of hearing aid use was 1.9 +1 years, with a wide range of duration of language therapy ranging from 6 months to 4 years (mean: 1.8 +1.3 years), which reflects the effect of impaired hearing on language production and speech perception.

Several previous studies have found the effect of early intervention in children with hearing loss on language outcome^[9, 11]. The current study found early intervention's consistently positive effect on hearing-

impaired children's language development. The results of the present study also agreed with Tomblin *et al.*^[10], who concluded that mild to severe hearing loss places children at risk for delays in language development, and risks are moderated by the provision of early and consistent access to well-fit hearing aids that provide optimized audibility.

On the other hand, Davis *et al.*^[11] concluded that age at intervention was not correlated with outcome in children who were first fit between 3 and 9 years of age.

The aided speech discrimination score results before and after a phoniatic evaluation showed statistically significant differences between the three study groups and in each group separately. This result was against the results of Zhang *et al.*^[12]; they showed no significant difference in speech discrimination scores under the quiet condition between the two groups.

The result of the current study of aided speech discrimination scores after phoniatric evaluation in groups^[2, 4] showed significant positive correlations with pre-phoniatric evaluation scores. Still, it showed a negative correlation in the group^[3]. No correlations were found regarding age, language therapy, and duration of hearing aid in the three groups. The current results follow Kennedy *et al.*^[9], who stated that later age at identification and access to screening predicted delayed language ability but found no such relationship to speech production. While the results of Fulcher *et al.*^[13] were against this proposition, they conducted that the early-identified children with hearing loss significantly outperformed the late-identified at all ages and for all severities of hearing loss.

The results of aided speech discrimination scores before phoniatric evaluation in the studied patients (n=31) showed a significant positive correlation between age and post-evaluation score. Bochner *et al.*^[14] showed that the performances of hearing-impaired listeners were much more strongly related to high-frequency hearing loss and listener age.

In the current study, the results of phoniatric evaluation showed statistically significant differences between study groups as regards right words and phonological processes; this was in agreement with Lejeune and Demanez^[15] study on hearing-impaired children fitted with either conventional hearing aids or cochlear implant. However, the results of Briscoe *et al.*^[5] were against the current results; they stated that no significant differences between group means were observed in vocabulary, digit, sentence recall, sentence comprehension, and literacy scores.

CONCLUSION

Application of an articulation test that detects speech production errors can help in the precise scoring of speech evaluation tests, therefore improving hearing-impaired children's fitting. The study concluded that the phoniatric evaluation and correction of speech discrimination for aided hearing-impaired children was essential in better judgment of results outcome.

CONFLICT OF INTEREST

There are no conflicts of interest.

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