Effect of electro-acoustic factors on the continuous use of hearing aid in hearing impaired children under 15 years

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Abstract

Objective: The aim of this study was to evaluate the effect of electro-acoustic factors (noise, distortion, feedback) on the continuous use of hearing aids in children under 15 years.

Method: This study was conducted based on a causal - comparative approach and by descriptive - analytical techniques using a questionnaire. In total,168 children under 15 years affected by bilateral hearing loss, and who had used a hearing aid for at least one year and supported by welfare organization of Rasht, were selected as the statistical population. The data obtained was collected using self-administered questionnaires filled out by both children and parents together.

For statistical analysis, both analytical and descriptive techniques were used. The obtained data were summarized as one, two and three dimensional tables. For data analysis the t- test and variance analysis techniques were performed.

Results: The obtained results showed that ear resonating (buzz construction), hearing aid whistling, and annoying hearing of ambient sounds had an inverse relationship with the average hours of daily usage of hearing aid.

Decreasing ability of understanding speech in the presence of noise is one of the main complaints in hearing impaired people. Effective communication in complex listening environments requires the health of peripheral, central and cognitive auditory system. If the process fails at any point in these devices the ability of understanding speech reduces.

Speech is a very complex audio-signal consisting of sections and acoustical properties. Each of the sections have great importance for the formation of correct speech understanding. An impairment in organizing input hearing understanding, similar to the incidence of hearing loss, can cause significant implications in the understanding and identification of complex auditory signals, such as speech and music. Separating these different sounds when simultaneously presented is normally carried out on the basis of their different frequencies and the harmonic relations of each of them.

It seems that small adjustments for the hearing aid and the solving of electro-acoustic problems can improve its daily usage(4).

Key words: Electro-acoustic factors, hearing impaired, hearing aid, continuous usage of hearing aid

Introduction

Hearing is one of most important of human senses, and provides much information for humans, so any hearing impairment could affect the personal aspects of human life. Natural and good hearing is crucial for appropriate speech also (3).

Measurement and analysis of acoustic parameters is one of the objective assays (1). Each receptive human needs to recognize the source of sound production, especially speech, in order to integrate information of their surrounding environment which includes the complexity of various sounds. For this purpose, acoustical properties of sound sources should be separate and classified correctly (13). Hearing impairment leads to delay in development of hearing and speech communicational skills, and under special situations leads to inhibition of development of personal-social aspects of life. Then it leads to problems such as emotional, job, educational, mental, and social problems. Two effective factors seem to be the hearing loss amount and the age at incidence of hearing loss (3). Studies have shown that children with bilateral profound hearing loss cannot improve their oral capabilities because of the failure to appreciate their surrounding sound environment. Therefore, collection of the maximum remaining hearing for these children is important (10).

Hearing loss is one of affective causes on impairing speaking skills. Acoustic stimulation can positively affect the child's nervous development by allowing them to hear speech signals effectively because in deaf children who cannot hear speech and live in a silent environment, viable synapses for hearing-oral skills will drop and gradually be lost (14).

Development of language, speech, education, training skills, social skills and job skills depend on hearing sense in the early years of life. The first step for rehabilitation of the deaf and hearing impaired person is equipment to assist their hearing (11).

A hearing aid is the most frequently employed item of equipment for improvement of hearing loss and is the key to improve the input voices. Hearing aids cannot guarantee the hearing of all voices and sounds. The type, its operation and ear suitability are the critical factors on its efficiency (5). Usage of a hearing aid by patients is more important than prescribing of a hearing aid for them. When the patient does not always use a hearing aid, we should answer some important questions about the extent and causes of patient's satisfaction/dissatisfaction with their hearing aid. Identifying these should be followed by finding the appropriate way to overcome the non-use of hearing aids.

Based on unofficial studies and observation, it is found most Iranian deaf students do not use a hearing aid. Hence their educative-communicational disabilities are at least partly due to non-use of hearing aid. They give many excuses for this. For example, they say I forgot the hearing aid, it is broken, I lost it, the battery has run down etc. However in most cases, the hearing aid is in their bag, but they are not interested in using it (2).

Katz (1994) revealed 25-50% of hearing aids are not used at the desired level in American children. Katz (1994) studied the hearing aids situation in different American schools for 15 years and showed that most causes for failure of routine use of hearing aid are impaired batteries, non-fit frame, broken control keys, high harmonic distortion and non-friendly repair systems (7).

Kochkins (1994) showed 18% of hearing impaired and deaf persons do not use their hearing aid(9). Karstizer (1973) studied the ways of successful application of hearing aids and showed that most patients are satisfied only when they are talking with one person. They have some problems when they talk with two or more persons. Meanwhile, they are satisfied when they are at home alone, during shopping and general meeting, however this satisfaction decreases significantly during trips and work (6).

Kiese-Himmel et al (2000) evaluated the hearing aid acceptance among children. They revealed children with unilateral profound hearing loss, use hearing aids less than children with bilateral profound hearing loss (8).Non-appropriate adjustment of hearing aid and non-maximal output are the most causes of its non-acceptance.

Franks and Beckman (1982) showed one of the causes of 88% of elderly patients for rejection of their hearing aid is high amplification of voices. Although these authors believed non-appropriate adjustment of hearing aid output had not led to its non-acceptance, it has a negative experience for patients (4).

Schuchman and Montgomery (1978) studied some questions about new users of hearing aids. They included 430 patients in their study and concluded 63% of causes of non-compliance is noise feedback (12). Since there is a difference between other studies and our Iranian people from the viewpoint of age, culture and society conditions, we investigated the effect of electro-acoustic factors on the continuous use of hearing aid in hearing impaired children under 15 years.

Materials and Methods

This trial was a causal-comparative study. A total of 168 hearing impaired children under 15 years who were affected by bilateral hearing loss, supported by welfare organization of Rasht, Iran and who used hearing aid for at least one year, were selected as the statistical population. All patients are new users of hearing aids (2011-2014). Obtained data were collected using self-administered questionnaires, filled out by both children and parents together.

For assessment of stability and robustness of questionnaires, 10% of the sample population filled them out again after one month. The questionnaires had more than 80% compatibility. For assessment of validity of questionnaires, the content was assessed by hearing aid experts and a specialist and then edited to remove objections.

A list was prepared using all new (2011-2014) users of hearing aids who received their hearing aid from welfare organization of Rasht, Iran. The patients were sorted based on hearing aid type. There were 196 patients, although we could get access to addresses and telephones for only 168 patients. All 168 patients were therefore chosen as the sample. We could access home telephone for 57 patients. We contacted them and requested a visiting appointment at the welfare organization of Rasht, Iran. Thereafter 38 patients came into the welfare organization of Rasht, Iran and filled out the questionnaire. Also 63 patients come into the welfare organization of Rasht, Iran for routine checks of frame, battery etc and filled out the questionnaire. Some questionnaires were sent by regular post to the home addresses of patients and thus we collected 53 filled questionnaires by post also. Finally, we visited the home address for 14 patients and filled out the questionnaire at their home (38+63+53+14=168). If both hearing impaired and parents were illiterate, we filled out the questionnaire by means of interview.

For statistical analysis, both analytical and descriptive techniques were used (absolute and relative frequency, average, and middle). Obtained data were summarized as one, two and three dimensional tables. For data analysis the t- test and variance analysis techniques were performed. SPSS software was used for statistical analysis.

Results

Based on Table 1, it is shown that the individuals with less than 5 hours hearing aid usage daily had the most distortion; the individuals with more than 8 hours hearing aid usage daily had the lowest distortion.

Table 1: Frequency of distortion when patient used hearing aid based on hours of hearing aid usage daily

Hours hearing aid usage daily	Distortion when patient used hearing aid		Number
	Yes	No	
Less than 5 hours	23	29	52
5-8 hours	10	30	40
More than 8 hours	10	66	76
Total	43	125	168

Table 2: Average of daily hearing aid usage based on distortion

Distortion when patient used hearing aid	Frequency	Average (hours)	Standard Deviation	t-value	P-value	df
Yes	43	5.5814	3.3469	-3.797	0.000	=E.V.A166=E.V.N.A; 80/614
No	125	8.0240	3.7319			

From Table 2 it is shown that average of daily hearing aid usage for patients who had distortion is 5.8 hours and average of daily hearing aid usage for patients who had no distortion is 8. So the differences of these two values is significant (t=3.797; P-value=0.000). Therefore the null hypothesis (average of daily hearing aid usage for patients who had and had not distortion is equal) is rejected. It is concluded that distortion affects the average daily hearing aid usage.

From Table 3 it is shown that among the total of 168 studied patients, that 81 individuals (48.2%) experienced whistling of the hearing aid; and most of whom used the equipment for less than 5 hours daily, whereas 23 (28.4%) patients used it more than 8 hours daily. On the other hand, between 87 patients who did not have whistling of hearing aid, 53 (60.9%) individuals used it more than 8 hours daily.

Table 3: Frequency of whistling of hearing aid based on hours of hearing aid usage daily

Hours hearing aid usage daily	Whistling of hearing aid		Number
	Yes	No	
Less than 5 hours	36	16	52
5-8 hours	22	18	40
More than 8 hours	23	53	76
Total	81	87	168

Table 4: Hours of hearing aid usage daily based on whistling of hearing aid

Whistling of hearing aid	Frequency	Average (hours)	Standard Deviation	t-value	P-value	df
Yes	81	6.0494	3.4238	-4.741	0.000	=E.V.A166=E.V.N.A; 166/000
No	87	8.6552	3.6816			

Table 4 shows hours of hearing aid usage daily for patients who were faced with whistling of their hearing aid is 6.0 hours, and for patients who did not face whistling it is 8.6 hours. So the differences of these two values is significant (t=-4.741; P-value=0.000). Therefore the null hypothesis (average of daily hearing aid usage for patients who had and had not whistling of hearing aid is equal) is rejected. It is concluded whistling of hearing aid definitely affects the average of daily hearing aid usage.

From Table 5 it is shown that among the total of 168 studied patients, 25 individuals (14.9%) had noise, of whom16 individuals were those who used their aid less than 5 hours daily.

Table 5: Frequency of annoying hearing of ambient sounds based on hours hearing aid usage daily

Hours hearing aid usage daily	Annoying hearing of ambient sounds		Number
	Yes	No	
Less than 5 hours	16	36	52
5-8 hours	4	36	40
More than 8 hours	25	53	76
Total	25	143	168

Table 6: Hours hearing aid usage daily based on annoying hearing of ambient sounds

Annoying hearing of ambient sounds	Frequency	Average (hours)	Standard Deviation	t-value	P-value	df
Yes	25	5.0800	3.1744	-3.428	0.001	=E.V.A166=E.V.N.A; 36/712
No	143	7.8042	3.7421			

From Table 6 it is shown that hours of hearing aid usage daily for patients who experienced annoying ambient sounds was 5.0 hours, whereas patients who did not face annoying ambient sounds was 8.6 hours. So the differences of these two values is significant (t=-3.428; P-value=0.001). Therefore the null hypothesis (average of daily hearing aid usage for patients who had and had not annoying hearing of ambient sounds is equal) is rejected. It is clear that annoying hearing of ambient sounds does affect the average daily hearing aid usage.

Discussion

The aim of the present study was the investigation of the effect of electro-acoustic factors on the continuous use of hearing aid in hearing impaired children under 15 years supported by welfare organization of Rasht city. In one study about problems during hearing aid usage Raanaei and Goorabi (1994) revealed that among 932 impaired veterans, 874 (93.7%) individuals did not have a hearing aid or did not have a problem in hearing aid usage. Meanwhile 0.85% individuals had nonsense sounds in their hearing aid (12). In the present study, 13.7% individuals faced rustle and nonsense sounds. Raanaei and Goorabi (1994) showed 0.43% individuals noted high and annoying sounds (12), whereas in our study 14.9% individuals faced high and annoying sounds. Raanaei and Ghoorabi (1994) showed 0.75% individuals reported whistling of their hearing aid (12), whereas in our study 48.2% individuals faced this.

Akbarlou-Shabgahi (2001) studied 513 Tehran deaf students and revealed 16.98% students did not use their hearing aid, since they rejected uncomfortable sounds from it, and also 11.32% students rejected hearing aid use because of nonsense and non-clear sounds. In our study 13.7% individuals had nonsense and non-clear sounds, 14.9% individuals were faced with uncomfortable sounds from the hearing aid and 25.6% individuals were faced with distortion of hearing aid. Therefore there are fundamental differences between our and their study. It could be due to statistical population and sample size.

The results showed that the ear resonating (buzz), whistling of hearing aid, and annoying hearing of ambient sounds had an inverse relationship with the average hours of daily usage of hearing aid.

One of the important factors on continuous usage of hearing aid is whistling of hearing aid. This problem is due to the hearing aid's frame mostly. In powerful hearing aids care should be taken that the frame can snugly fit with the ear canal. Most available hard frames are not appropriate. Hence the costs should cover the provision of soft frames in welfare organizations. Meanwhile, for growing children, new frames should be prepared regularly due to gradual development of ear canal.

Other factors relevant to hearing aid whistle problems are disturbance of the frame's tube, speaker's tube, microphone, ear wax etc and the non-appropriate adjustment of the hearing aid, etc. These factors could be overcome by using appropriate consultation and education, periodical review of hearing aid, and periodical inspection of ear canal.

In addition, electro-acoustic factors contribute to the annoying hearing of ambient sounds. This factor could be detected by audiological tests (SRT-MSL-SDS-USL) and the study of the dynamic range by audiologists so that the problem could be overcome by the prescription of an appropriate hearing aid.

Conclusion

Based on our findings, it is recommended that welfare organizations should provide hearing aids that have minimum internal noise and also recommend the provision of digital hearing aids that are adjustable, based on the type and extent of hearing loss. It is recommend that analogue and Digitrim hearing aids should be replaced by automatic and multi-program hearing aids. Providers should pay attention to shape, size, quality and patient's requirements. Meanwhile it is necessary to educate on careful use and daily control of the hearing aid by audiologist experts. It is recommended that there is periodical inspection of patients (ear canal control for ear wax etc) such as planned and monthly hearing aid control by audiologist experts. We recommend the preparation of a special form to order a hearing aid evaluation, to collect patients' ideas and also monitor the hearing aids each six months.

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