Speech Intelligibility in Hearing Aid users with and without Auditory Training

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ABSTRACT:

Background: Intelligibility of speech refers to the accuracy with which a normal listener can understand a spoken word or phrase. Speech is often disrupted in congenital hearing loss but with assistive devices and therapeutic approaches some hearing impaired children develop intelligible speech.

Purpose of the study: The purpose of the study was to compare the speech intelligibility in digital hearing aid users with and without auditory training.

Methodology: The research was analytical comparative cross sectional in nature. The study looked at 4 to 6 year old 20 children with severe to profound hearing impairment by using digital hearing aids in both ears. One group of 10 children received speech therapy with auditory training and the other group of 10 children received speech therapy without auditory training (lip reading) for at least two years. The speech sample of both groups was taken through connected speech. The sample was audio recorded. Inter rater validity was used and intelligibility was marked employing a 5 point rating scale.

Results: The results with Auditory Training on conversation obtained a mean score (3.5) and standard deviation was (.85). With lip reading the mean score was (2.3) and standard deviation was (.42).

Conclusion: On the basis of the present research, it is concluded that auditory training improves speech intelligibility with hearing aids in severe to profound hearing loss.

Keywords: Intelligibility of speech, auditory training, lip reading, hearing impairment.

INTRODUCTION:

Verbal expression of our thoughts, ideas, emotions and feelings is called speech. During this process our four systems respiration, phonation, resonance and articulation work together. Dysfunction to any of these systems results in poor fluency or unintelligibility of speech. [1]. Thus speech intelligibility is the precise perception of a normal listener to understand a spoken word or phrase [2]. However for obtaining information regarding the world, hearing and vision are essential elements. Hearing impairment effects the normal development of speech due to limited or lack of auditory feedback. It diminishes the ability to hear faint sounds and often complain

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difficulty in understanding speech in noise. Speech is a multidimensional, though useful and learnable method for children who are deaf [3].

Hearing aids and cochlear implantation are devices which make speech audible at a comfortable level and provide as many acoustic cues as possible without over-amplifying any sounds, especially loud sounds [4]. Researchers have highlighted hearing aids are electronic devices which increase the incoming sound signals to make it audible and improve speech understanding of an individual [5]. A study described that the children who received hearing aid (cochlear implant) before age of 10 years demonstrated the highest speech intelligibility as compared to the subjects who did not receive their device until after 10 years of age [6]. Speech is more intelligible when it is automatically and fluently produced by a hearing aid user with auditory training of linguistic and nonlinguistic sounds. The child could use amplified hearing to recognize sounds. Learning of speech skills by children with hearing aid may be classified into: Articulation, Voice and Prosody. Articulation is principal aspect of speech fluency and clarity but nasality, voice and prosody leads to more balanced intelligibility [7].

Auditory training is used for development of speech in hearing impaired children, it is an important part of the speech therapy addressed to the hearing impaired children and must start as soon as possible [8]. A study showed that auditory performance and development of speech intelligibility was significantly improved in congenitally deaf children who had cochlear implantation before the 4 years of age [9]. Lip reading compensate for loss of hearing at every stage of deafness but conversational speech emerged slowly after using cochlear implants or hearing aid for at least 5 years 33–45% were fully intelligible [10].

In the assessment of speech intelligibility, the five point speech intelligibility rating scale is used to measures the speech intelligibility of children with hearing impairment using hearing aids or cochlear implants consisting. It describes several degrees of speech intelligibility from unintelligible speech to intelligible speech that is understandable to all listeners [11]. Speech material which is used for analysis is another parameter and it is represented in the form of spontaneous speech vs. read speech [12]. The assessment of speech intelligibility is also affected by the type of listener judge, roughly, experienced vs. inexperienced because there is often a connection between the type of material and the type of listeners involved in the protocol [13]. Hearing age has been used to evaluate outcomes of intervention for children with hearing impairments. This is the length of time that the child has been receiving amplification and outcomes are seen after two years of implantation or hearing aid fitting. [14].

The present study aims to assess speech intelligibility with and without auditory training in hearing aid users in Pakistan. Study also provides evidence for the importance of amplification and method of training in speech development for speech intelligibility and serves as a bench mark to refine comparisons of speech intelligibility by auditory training and lip reading in hearing aid users. Such comparisons will continue to strengthen the knowledge base to make clinical decisions regarding pediatric hearing aid users for speech intelligibility.

MATERIALS & METHODS:

The study was analytical and comparative / cross sectional. School going 20 children, of age group 4-6 years having severe to profound prelingual bilateral sensory neural hearing impairment by using bilateral digital hearing aids with 2 years speech therapy on lip reading and auditory

training basis had been included in the present study. 10 children for auditory training and 10 for lip reading are selected. Purposive non probability sampling technique was used to select the sample because the number of children using audition for oral communication with digital hearing aids was very limited. The obtained sample has severe to profound hearing impaired children, with digital hearing aids with and without auditory training, in their respective settings of Lahore. Two judges experienced speech therapist and child's mother rated the speech samples on 5 point rating scale. Pilot study was conducted prior on 5 children to verify the administration of the five point speech intelligibility rating scale.

Measures:

Demographic information was collected through demographic data sheet. After taking consent the speech intelligibility rating scale was used to assess the intelligibility of subjects. It describes several degrees of speech intelligibility from unintelligible speech to intelligible speech that is understandable to all listeners. The scores range from low score of "1" to high score of "5". The scale is keyed in such a way that the higher the score, the higher the level of speech intelligibility.

RESULTS:

Table 01: Mean values and S.D of auditory training and lip reading on conversation

	Mean	N	S.D	Std. error mean
Auditory training	3.5	10	.85	.27
lip reading	2.3	10	.42	.13

The table No 1 shows that the mean score of speech intelligibility with Auditory training (3.5) is greater than the mean score of speech intelligibility with lip reading (2.3). Whereas Auditory Training S.D is (.85) and lip reading S.D is (.42).

Table 02: Difference between auditory training and lip reading on conversation

	Mean	S.D	t	df	P
Conversation with AT and LR.	1.2	1.00	3.77	9	.004

The table No 2 indicates that there is a significant difference (.004) between speech intelligibility of lip reading and auditory training on conversation.

Table 03: Mean values and S.D of auditory training between therapist and mother

	Mean	N	S.D	Std. error
Conversation therapist	3.2	10	.91	.29
Conversation	3.8	10	.91	.29

mother				

The mean value of speech intelligibility on conversation with therapist is (3.2) and mother is (3.8). The values of standard errors and standard deviation are equal on conversation with therapist and conversation with mother.

Table 04: Difference between therapist and mother on conversation with auditory training

	Mean	S.D	t	df	P
Therapist and Mother	-6000	.699	-2.71	9	.02

The results of the table 04 reveals highly significant difference between therapist and mother on conversation with auditory training (t=-2.71) and (p<0.02).

Table 05: Mean values and S.D of lip reading between therapist and mother

	Mean	N	S.D	Std. Error
Therapist	1.9	10	.57	.18
Mother	2.7	10	.67	.21

The table No.5 shows the mean values of therapist and mother are (1.9) and (2.7) respectively. The standard deviations are (.57) and (.67).

Table 06: Difference between therapist and mother on conversation with lip reading

	Mean	S.D	t	df	P
Conversation lip reading therapist and mother	-80	.92	-2.8	9	.022

The results of the table 06 reveals that there is a significant difference between therapist and mother on conversation with lip reading (t=-2.8) and (p<0.022).

DISCUSSION:

Previous studies have pointed out the positive impact of auditory training with cochlear implantation for speech intelligibility [15] but the comparison of speech intelligibility with hearing aid users with and without auditory training (lip reading) had limited mention in the literature. Many studies focused on use of digital hearing aids and their effects with auditory training on over all speech intelligibility.

Significant difference existed in speech intelligibility of both groups, and hypothesis was accepted. This study showed the mean score of speech intelligibility with Auditory training (3.5) was greater than the mean score of speech intelligibility with lip reading (2.3). Whereas Auditory Training SD was (.85) and lip reading SD was (.42). There was a significant difference (.004) between speech intelligibility of lip reading and auditory training on conversation. A study was conducted with 68 pre lingual profoundly hearing-impaired children with either hearing aids or

cochlear implants on speech intelligibility and concluded that significant differences in performance of that children who were educated in oral programs as compared to educated in total communication settings [15]. Another study was conducted on 227 profoundly deaf adults for the measurement of speech intelligibility. The results indicated that auditory and speech production skills were well developed in those children who were using spoken language intensively with consistent hearing aid use, early amplification and good parental support [16]. Similar results were found in this study. Degree of hearing loss, amplification as well as use of residual hearing is very important for the production of intelligible speech. It is investigated that the children with severe degree hearing loss showed 91% speech intelligibility and with profound degree hearing loss 76% speech intelligibility[17].

A research explained that a normal child's speech by 2 years is 50% understandable on reading / picture description and conversation because child's speech production level by 2 years is 2 words [18]. Another study showed that age, duration of amplification and therapy affect the level of speech production and comprehension of primary school child. [19].

Speech intelligibility depends upon listening skills deaf children. Prelingually deaf children showed significant improvement in auditory performance and speech intelligibility. After cochlear implantation, the difference between the speech intelligibility rating increased significantly each year for 3 years ($p<0.05$) [20]. Eight severe-to-profoundly hearing-impaired children with sensory hearing aids were examined by speech intelligibility. Three types of speech materials were used: words in sentences, isolated words, and syllable contrasts. Results showed significant difference in speech intelligibility between isolated words and sentences. Their mean scores were higher on isolated words [21].

A study was conducted on hearing impaired adults and children and results were revealed by experienced and inexperienced listeners to measure the speech intelligibility. Results indicated that the experienced listeners understood more. 40% of speech intelligibility was for adults and 27% for the children and this difference was statistically significant [22]. In another study a sample of spontaneous speech of twenty four children with sever to profound hearing loss was recorded. The intelligibility of each child was assessed by two judged. Six point rating scale was used. Results obtained from experienced and inexperienced listeners. Experienced listeners understood speech 31% and inexperienced only 19% [23].

It is described that auditory training assist hearing aid and cochlear implant users to improve their listening skills however "it did take a sincere commitment by the user: five days a week, for at least thirty minutes per session, for a minimum of a month for minimum three years". Researchers reviewed all the studies they could find that might even have remotely be as related to auditory training. The best results were obtained with the more intensive programs (longer duration and more sessions per week) [24].

CONCLUSION AND RECOMMENDATION:

The study concluded a significant difference and strong correlation is found between speech therapy with auditory training and lip reading in the speech intelligibility of hearing aid users. It is concluded that hearing impaired children trained through audition with hearing aids have improved speech production skills compared to lip reading.

A large number of variables possibly influenced the results of present study and sample size was small and taken from a limited population, so the generalization of the results to all children with hearing impairment with auditory training and lip reading for speech intelligibility is not possible.

In future studies with larger number of participants with various variables should be employed for more authentic and comprehensive results for expanded generalization.

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