



Effectiveness of FM System and Hearing Aids to Improve Articulation for Children with Hearing Loss

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ABSTRACT

Background:

In Pakistan there is high prevalence of disabilities e.g. physical disabilities, hearing impairment and communication problems etc, therefore here is immense need for making a lot of preventives measures. There are also a number of institutions and organizations who are concerned with different aspects of the problems relating to these impairments and disabilities.

Objective:

To compare the effectiveness of FM system with hearing aids in children with articulation errors with moderate to severe hearing loss by using Traditional Articulation Therapy (TAT).

Methodology:

The interventional study was conducted at Hamza Foundation Academy for hearing impaired children with articulation errors who participated in this experimental study. Four participants were using FM (Frequency Modulation) system during therapy and other four were using digital Hearing Aids. All children were with moderate to severe hearing loss, wearing same quality of hearing aid and studying in same grade. Same quality of FM system was used. From TAAPU (Test for assessment Articulation and Phonological Urdu) portion of articulation was used for pre and post assessment of articulation. After assessment, Traditional Articulation Therapy (TAT) was applied on both groups. Same test had been conducted after therapy as post-assessment. It had shown the difference of both devices.

Results:

For improvement in articulation of sounds on all positions (initial middle and final), FM system showed better results than hearing aids. There was also significant decrease in different types of articulation errors in those children who were using FM system. FM has showed significant improvement for substitution error in word on all positions (initial middle and final). According to these results it was estimated that most of the time the mean scores were decreased in hearing aids users but not more than FM system.

Conclusion:

According to results, the expected benefits of FM system are better than hearing aids. Effect on Articulation of FM users has better effects on all positions of sounds (initial middle and final). Significant improvement was seen in omission and substitution error with use of FM system.

Keywords:

Hearing impairment, Hearing Aids, FM system, TAT therapy

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INTRODUCTION:

In Pakistan there is high prevalence of disabilities e.g. physical disabilities, hearing impairment and communication problems etc, therefore here is immense need for making a lot of preventives measures. There are also a number of institutions and organizations who are concerned with different aspects of the problems relating to these impairments and disabilities. A comparison of the 1961 and 1981 demographic result shows an

alarming growth of the disabled population in Pakistan. But compared to the 1973 prevalence of hearing loss in Pakistan was 7 to 8 per 1000 live births and this rate is increasing every year.⁽¹⁾ Though children with bilateral hearing impairment are often impaired language and speech abilities.⁽²⁾ It is a fact that hearing ability plays a vital role that makes us able to access the sounds in the surroundings and by the people. If a child has a hearing loss, immediate attention of others is



necessary for him. That is just because language, communication and other skills develop most rapidly in childhood, particularly before the age of three. When hearing loss goes unnoticed, children are delayed in developing major skills specially speech and language.⁽⁷⁾

So hearing aids partially overcome the deficits associated with the hearing loss. Hearing aids can help in listening sounds that person cannot hear without aiding device. The hearing impaired person needs to make better signal-to-noise ratio than a normal person.⁽⁴⁾ On the second hand technology of F.M system picks up the voice of the speaker with a body-worn transmitter microphone. It has harmless radio waves that send this signal to the listener who wears a FM receiver.⁽⁵⁾

Hearing loss measurements are done through an increase in decibels (db) threshold of persons hearing (a sound that is softer which persons detect) that compared with levels of a normal hearing that is (0 – 20 db). These thresholds are checked by the speech frequencies. The threshold of mild hearing loss is explained between 21db and 45 db. Thresholds of moderate Hearing Loss is between 46db to 65db and the threshold of severe Hearing Loss is between 66db and 90 db and threshold of profound is 91 and greater.⁽⁶⁾

Erin et al. studied on 5 adults and 5 students who have moderate-to-severe hearing loss, finished objective and subjective speech recognition in the noise measures with 2 main types of FM processing. They measured sentence recognition evaluation in a classroom, while, the subject was measured by 2 classroom activities. The objective measures resulted that, adaptive FM processing has significantly improved speech recognition in noise rather than fixed FM processing. On the other hand subjective measurement results that all individuals favored to adopt fixed processing for half part of their activities. Finally, the adaptive FM processing works best, most significantly in

the higher noise levels.⁽⁷⁾

Relatively another device teleloop (which transmit sounds directly from a microphone to a hearing aid or receiver) or direct input system needs to be assessed on the child in arrangement with his/her personal normal hearing aid. A relationship of functional gain with the hearing aid alone and joined with its FM system reveals some dissimilarity with its configurations. In this analysis the receiver of FM volume ménage-taper also has effects of different FM receivers that were investigated. The results shows considerable microphone-teleloop response differences.⁽⁸⁾

Blake R et al. (1991) investigated disabled students in a classroom and evaluated the effects of FM auditory training on them. He hypothesized that attention will get better with decreasing noise level in a classroom. Four special attending behaviors were found in students and those were studied to check the work effectiveness of FM system in classroom environment. Auditory training systems have been used on the students' population of hearing-impaired and also measured the attention span of each individual and other population with LD (learning disability) as well. Each individual's attending behavior was measured when speech signal presented for listeners. All possible attending behaviors included factors like, when body turned or moved toward the direct signal source, eyes response toward the direct signal source. They keep record of even all absent extraneous body movements and absence of extraneous vocal/verbal behaviors. The conclusion of this study described that learning-disabled children are equipped with FM auditory trainers which enhanced their attending behavior.⁽⁹⁾

Anderson KL et al's (2005) study used a single-subject alternating treatment design to evaluate children speech recognition capabilities which were facing some problem with normal hearing while using some hearing aids with each of three frequency modulated (FM) or infrared devices.



Children from eight to nine and one to two years old with mild to severe hearing impairment repeated Hearing in Noise Test (HINT) sentence lists under controlled conditions in an ordinary kindergarten classroom with a school background noise. FM systems are joined with their personal hearing aids, infrared sound field systems works with speakers placed in all over the classroom, and desktop personal sound field FM systems. Results show that infrared ceiling sound field system did not provide appropriate benefit as much that was presented by hearing aids alone. On the other hand, desktop and personal FM systems in relation with personal hearing aids give substantial improvements in speech recognition. These results will clinically helps to assist in making Sensory Neural S/N' enhancing device decisions for students using hearing aids. In a noisy classroom setting, classroom sound field devices are not found helpful to speech perception for students with hearing aids, whereas either personal FM or desktop sound field systems provide that listening comes out as a Better alternative.⁽¹⁰⁾

The purpose of the current study was to find out the effectiveness of functional articulation for children with moderate to severe hearing loss. Speech intelligibility was assessed by the effectiveness of FM systems and hearing aids. Thus, the study signifies the importance of better speech intelligibility for children with hearing impairment. Effective devices used for enhancement of speech intelligibility were FM system and Hearing aids. So, it does not only serve the purpose of better speech but also influences the method of education for children with moderate to severe hearing impairment.

METHODOLOGY:

Materials and methods: Experimental study was conducted on regular students with hearing difficulties from Hamza foundation academy for deaf. Both male and female students were included in this study between the age ranges of 7

to 10 years. Children with moderate to severe bilateral hearing loss and who were using digital hearing aids in their regular life. Purposive sampling technique was used. Presence of any other co-morbidity of social, emotional, psychological or organic disorders with hearing impairment was excluded.

Sample size was calculated on the basis of prevalence according to the hearing disabilities. As stated by 1973 prevalence of hearing loss in Pakistan, it was 7 to 8 per 1000 live births and this rate is increasing every year.⁽¹¹⁾

Following formula was used for sample size calculation according to the prevalence of hearing impaired persons in Pakistan.

$$N/1 + [N + (0.5)(0.5)]$$

Two groups A and B were made, having 4 children in each group. Sample of 8 children was taken in two groups A and B and each group having same intervention technique with different hearing devices. Group A received therapy with hearing aids and group B received therapy with F.M system. TAAPU (Test for assessment Articulation and Phonological Urdu) was used to pre and post data collection. Study was completed from January 2014 to July 2014.

To compare the effectiveness of FM system and hearing aids on articulation errors, Traditional Articulation Therapy (TAT) was used. TAT used in isolation for 3 months, 3 sessions per week and duration of each session was 40 minutes.

SPSS-20 was used for statistical analysis. The mean score was found at the level of different positions and different types. On the basis of mean score results were calculated.



Table No.1: Users of F.M systems

	Error Mean Scores of F.M System users					
	Pre – Test Scores			Post – Test Scores		
	Initial	Middle	Final	Initial	Middle	Final
Substitute	46.00	35.25	30.00	43.00	23.50	28.00
Omission	40.00	30.75	41.25	37.25	28.50	35.00
Distortion	35.25	27.25	25.50	34.25	27.00	25.25
Addition	32.75	27.50	25.00	32.75	26.75	25.00

This table shows the mean score of the pre and post-test of those who were using FM system. According to this table the mean score of H.A at substitution and omission were decreased and showed significant improvements, and most of the time the mean scores were decreased.

Table No.2: Users of Hearing aids

	Error Mean Scores of Hearing Aid users					
	Pre – Test Scores			Post – Test Scores		
	Initial	Middle	Final	Initial	Middle	Final
Substitute	44.50	32.75	26.75	41.75	30.50	26.50
Omission	38.00	31.75	44.25	37.75	30.50	39.75
Distortion	37.00	29.75	26.75	36.25	28.50	26.50
Addition	33.00	28.25	25.25	33.00	28.00	25.50

This table shows the mean score of the pre and post test of those who were using hearing aids. According to this table the mean score of H.A at substitution and omission was decreased and it was estimated that most of the time the mean scores were decreased but not than FM system

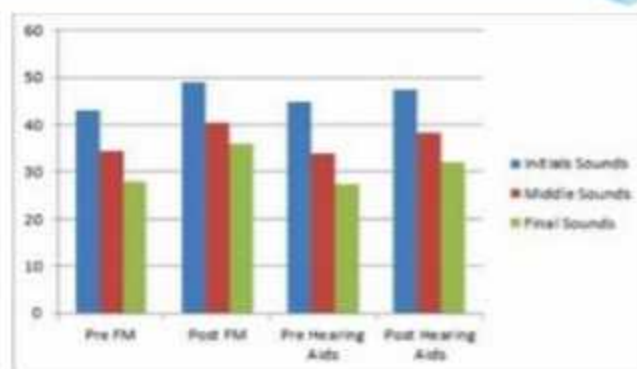


Figure No. 1: Mean scores of sounds of FM System vs. Hearing Aids

The above graph describes the overall comparative mean scores of sounds (initial, middle and final) positions. According to these scores the FM system has significant improvements on initial and middle sounds than hearing aids.

DISCUSSION:

FM system permit sounds to be picked up closer to a speaker sound source or connected directly to the sound supply and it is transmitted to the individual providing greater clarity of sounds of speech and also help in reduction in background noise. So the basic advantage for H.A wearers is that FM transmission is tough to noise and it interference helping to preserve the quality and the clarity of the sound transmitted.⁽¹⁾

Hearing aids keep getting better results. But hearing aids alone do not make listening easier in all times and in all situations. Things that can interfere with listening are background noise distance from a sound and reverberation or echo. People with hearing loss have even more problems than people with normal hearing when trying to listen in difficult situations. Babies and young children are listening in difficult situations every day of their life. Some examples are listening in the car, playing outside or at the park, at day care and also during watching television. The best way to hear better in all of these tough situations is to remove first the background noise and also to have a short distance between the



speaker and listener. Most people do not talk without having distance of 3 to 6 inches. You could not talk at the very close distance in a car or while your children were playing at the park. So the background noise usually cannot be removed or cannot be changed. Because of this, there are many devices designed to make it easier to hear in difficult situations for the hearing impaired children and those children who are hard of hearing. The device used most often today is the Frequency Modulated or FM system.⁽⁹⁾

A research was conducted by A Boothroyd in 2004, to describe the benefits and limitations of a FM microphone using as a hearing aid accessory. The goal of this study was to determine the predictors of aided and FM-assisted speech perception with hearing loss, in noise and quiet environments, using Articulation Index theory. This research showed that remote FM microphone system reduces the negative effects of noisy and distance, for a single talker. The methods derived from Articulation Index theory are well predicted to recognition of phonemes in noise during FM assistance.⁽¹⁰⁾

The results of another study showed that, adaptive FM processing has significantly improved speech recognition in noise rather than fixed FM processing. On the other hand subjective measures results that, all individuals favored to adopt fixed processing for half part of their activities. Finally, the adaptive FM processing works best most significantly in the higher noise levels and was favored highly by the participants in most of the circumstances.⁽¹¹⁾

FM system and Hearing Aids were used to improve articulation among children, aged from 7 to 10 years with moderate to severe hearing loss. After measuring the articulation errors at initial middle and final position FM system was found more competent than a normal hearing aid. Some studies were conducted on FM system and comparisons with hearing aids. Most of the studies were about the speech perception with

FM system and also the combination of F.M system with hearing aids. So F.M system was found an effective strategy to make children more efficient in articulation. After using FM system, mean value 125.50 and on the other side children were using hearing aid had a mean score of 117. In the light of above FM system works effectively than the normal hearing aid. It was observed that number of substitution, omission, distortion and additions were made. But differences were noticed among children who were using F.M. So with the reference of present and much other research FM system play a crucial role among hearing impaired children. In addition, subjective reports of FM system benefit suggest that appropriate use of the device may facilitate effective communication in a variety of listening situations.⁽¹²⁾

CONCLUSION:

In this research two hearing devices were used which were FM system and Hearing Aids. In daily routine both groups were using digital hearing aids but during therapy one still with hearing aids and other with FM system because the FM system that was available not latest and portable. The expected benefits of F.M system were better than hearing aids in this research. F.M users have better effects at all positions of sounds (initial middle and final). It was observed that while using FM system the responses of children were much better than hearing aids. Especially in some sounds like /k/ /g/ children showed less errors than hearing aids. At the end results show that F.M systems have significant effects on articulation than hearing aids.

SUGGESTIONS:

It is suggested that FM system should be used as regular hearing aid in school and home environment. It will give more accurate results if same research design would be applied on large population. FM system is launched on a new design so if new techniques of FM system will use it will be more practical.



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