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Research Article

Language development in sensorineural hearing loss children using hearing aids

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Abstract

Background: Due to deficiencies in spoken language skills, a child with hearing loss faces specific challenges. Poor language frequently causes reading difficulties and hinders academic achievement. Aim of the work: to evaluate language development in sensorineural hearing loss children using hearing aids and describe the effect of hearing aid in language and speech development. **Patients and method:** This study included 50 children with sensorineural hearing loss children using bilateral hearing aids, age ranging from 5years to 10years. All children assessed with Preliminary Diagnostic Procedures (Parents interview and history taking), IQ assessment, Audiological evaluation, language assessment. **Results:** All language parameters are affected by duration of deafness, age of fitting, and duration of rehabilitation. **Conclusion:** Short period of deafness, early age of fitting, and regular rehabilitation improve language ability in children with bilateral hearing aids.

Key words: Hearing aids, Children language, outcome.

Introduction

Children start to acquire language from birth and almost complete by the time they are six years old. Early exposure to oral language improves a child's expressive and receptive vocabulary, language abilities, and speech quality[1].

Due to inadequate auditory input throughout the crucial period, children with hearing impairments are susceptible to language delay[2].

There is strong evidence that moderate (or more severe) hearing impairment negatively affects speech, language, and cognitive development. These children may benefit greatly from early detection and treatment in terms of improved language, communication, mental health, and employment opportunities[3].

According to Boothroyd et al.,[3] who reported that conventional, hearing aids can provide adequate access to speech information in the low and mid-frequencies for children with severe hearing loss. However, they do not provide sufficient amplification in the high-frequency region beyond 3000 Hz.

Children who have weak oral language abilities at a young age often struggle with tasks that involve phonological awareness. As a result, they tend to face difficulties in reading achievement when they reach school age[4]

Endang and Khofidotur[5] found that hearing impairment could hinder language development and disrupt communication, leading to difficulties in effectively interacting with the environment. This can impede the maturation of emotions, which can disrupt the cultivation of anticipation, empathy, and sympathy in the child's perception.

According to Endang and Khofidotur[5], the development of language in deaf children relies

on the interrelationship of different elements, such as early intervention, language intervention, and the life experiences of children related to hearing loss. Hence, in order for a deaf child to attain academic success comparable to that of their hearing peers, it is crucial to provide early intervention and language assistance for deaf children.

Aim of the work

To evaluate language development in sensorineural hearing loss children using hearing aids and describe the effect of hearing aid in language and speech development.

Patients and Method

This study included 50 Egyptian children age ranging from 5years to 10years.It included 29 males and 21females, 31 children were fitted with bilateral hearing aids. All children were assessed to the followings:

1- Preliminary Diagnostic Procedures:

1- Parents interview and history including personal data, personal history, searching for etiological factors during pregnancy, natal, neonatal, and postnatal periods, developmental milestones, illness of early childhood, duration of deafness , laterality of hearing device fitting ,etiology , time of implantation or using hearing aids, main communication mode (spoken ,sign or spoken and sign), rehabilitation program (speech and language therapy session).

2- Examination including neurological and ENT including ear, nose and throat examination.

3- Subjective auditory perceptual assessment "APA" of both language and speech.

2-Clinical Diagnostic Aids:

1. Psychometric evaluation by Intelligence Quotient "IQ" using Stanford Binet Intillegence Scale (5th edition). The Stanford-Binet scale tests intelligence across four areas: verbal reasoning, quantitative reasoning, abstract /visual reasoning, and short-term memory. The areas are covered by 15 subtests, including vocabulary, comprehension, verbal absurdities, pattern analysis, matrices, paper folding and cutting, copying, quantitative, number series, equation building, memory for sentences, memory for digits, memory for objects, and bead memory. All test subjects took an initial vocabulary test, which along with the subject's age, determines the number and level of subtests to be administered. Raw scores were based on the number of items answered, and were converted into a standard age score corresponding to age group. Mental age was determinded for each child: I.Q = Mental age÷chronological age ×100. [6]

2. Audiological evaluation:

Included middle ear assessment through immitancemetry (Tympanometry and Acoustic Reflex threshold recording) and hearing assessment were performed through one of the following methods:

- Pure tone audiometry (Conditioned play or conventional audiometry).
- Aided audiometry (250-4000 Hz).
- SRT (sound reception threshold).
- Aided discrimination at 30 db SL.

Ethical consideration:

This study was approved by Ethical Committee for research, Faculty of Medicine, Minia University approved (Approval No. 7:2/2021), and consents were obtained from subjects.

Result

Table (1): sociodemographic data:

In this study, 22(44%) were positive family history and 28(56%) were negative family history. there were 26 (52%) are positive consanguinity and 24(48%) are negative consanguinity. There were 46(92%) had irrelevant complication and four children were preterm (8%). There were 46(92%) had average weight and four children were low birth weight (8%). There were 30(60%) were positive history of jaundice and 20(40%) were negative history of jaundice. There were nine (18%) were positive history of incubation and 41(82%) were negative history of incubation. There were six children (12%) with positive history of ear discharge and 44(88%) children were negative history of ear discharge.

Table (2): Age of first word and age of first sentence by months in sensorineural hearing loss children who were rehabilitated by hearing aids. The mean and standard deviation of age of first word is 24.70±10.197with range (12-48) months.

The mean and standard deviation of age of first sentence is47.96 ± 15.191with range of (24-72) months.

Table (3): Audiological history:

History of hearing loss, onset of hearing loss were congenital in 27(54%) of child and acquired or late in 23(46%) of child and course of hearing loss were progressive in 20(40%) of child and stationary in 30(60%) of child.

The mean and standard deviation duration of deafness is 40.74±21.94 with range (12-96) months.

There were two (4%) children with right moderate hearing loss, 19(38%)children with right moderate to severe hearing loss, 11(22%) children with right severe hearing loss , six (12%) children with right severe to profound hearing loss and 12(24%) children with right profound hearing loss, There were Three (6%) children with left moderate hearing loss, 9(18%)children with left moderate to severe hearing loss, 23(46%) children with left severe hearing loss, six (12%) children with left severe to profound hearing loss and nine (18%) children with left profound hearing loss .

The mean and standard deviation of duration of hearing aid use is 42.76±19.87. The mean and standard deviation of age of child at first the hearing aid fitting is 42.80±22.84 with range (11-96) months.

Table (4): Place of rehabilitation, main mode of communication and duration rehabilitation program in sensorineural hearing loss children who were rehabilitated by hearing aids:

According to place of rehabilitation there were 4(8%)child took in our unit, 8(16%) child took in private phoniatric clinic, 33(66%) child took by therapist, 5(10%) child took by therapist and private phoniatric clinic.

The main mode of communication is 50(100%) child had spoken language.

The mean and standard deviation of year of rehabilitation program is 18.00±10.42 with range (12-48) months.

Table (5): IQ assessment:

The mean and standard deviation of IQ assessment is 86.200±4.9115with range (80-96). The mean and standard deviation of mental age is 74.14±17.266 with range (46 - 107) months.

Table (6): language assessment:

One child had poor vocabulary and 49(98%) child had rich vocabulary**,** five (10%) children had single word, 14(28%) children had two-word sentence and ten (20%) children had three to four sentence, 12(24%) children had long sentence, nine (18%) children can tell story.

Table 7: Audiological evaluation:

The mean and standard deviation of aided SRT is 39.76±11.2 with range (20-55) regarding binaural sound discrimination (SD) the mean and standard deviation is 59.70 ± 29.991 with range (8-96).

Result

Table (1): Sociodemographic data:

Variables	Descriptive statistics
Family history:	
Positive	22(44%)
Negative	28(56%)
Consanguinity:	
Positive	26(52%)
Negative	24(48%)
Prenatal complication:	
Irrelevant	46(92%)
Any complications	4(8%)
Perinatal history:	
Weight at birth:	
Normal	46(92%)
Below	4(8%)
Above	0(0%)
Jaundice:	
Negative	30(60%)
Positive	20(40%)
Incubation:	
Negative	41(82%)
Positive	9(18%)
Neonatal cyanosis:	
Negative	50(100%)
Positive	0(0%)
Postnatal complication:	
Fever:	
Negative	48(96%)
Positive	2(4%)
Ear discharge	
Negative	44(88%)
Positive	6(12%)
Fits and trauma:	
Negative	50(100%)
Positive	0(0%)

Table (2): Age of first word and age of first sentence by months in sensorineural hearing loss children who were rehabilitated by hearing aids

	N	Mean	Std. Deviation	Minimum	Maximum
first word by months	50	24.70	10.197	12	48
first sentence by months	45	47.96	15.191	24	72

Table (3): Audiological history:

Audiological history:	
Onset of hearing loss **congenital** **late onset**	 27(54%) 23(46%)
Course **Progressive** **Stationary**	 20(40%) 30(60%)
Duration of deafness	M ±SD 40.74±21.94 Range (12-96)ms
Degree of hearing loss:	
Right: **Moderate** **Moderate to severe** **Severe** **Severe to profound** **Profound**	 2(4%) 19(38%) 11(22%) 6(12%) 12(24%)
Left: **Moderate** **Moderate to severe** **Severe** **Severe to profound** **Profound**	 3(6%) 9(18%) 23(46%) 6(12%) 9(18%)
Duration of using hearing aids	M±SD 42.76±19.87 Range (12-90)ms
Age of child at the first hearing aid fitting	M±SD 42.80±22.84 Range(11-96)months

Table (4): Place of rehabilitation, main mode of communication and duration rehabilitation program in sensorineural hearing loss children who were rehabilitated by hearing aids :

Place of rehabilitation: **Our unit** **Private** **Therapist** **Private +therapist**	 4(8%) 8(16%) 33(66%) 5(10%)
Main communication mode **Spoken**	 50(100%)
Duration of rehabilitation program	M±SD 18.00±10.42 Range(12-48)ms

Table (5): IQ assessment:

	N	Mean	Std. Deviation	Minimum	Maximum
IQ	50	86.200	4.9115	80.0	96.0
mental age	50	74.14	17.266	46	107

Table (6): language assessment:

Language assessment:	
• **APA of language and speech**	
1. Passive vocabulary: **Poor** **Rich**	 1(2%) 49(98%)
2. Active vocabulary: **Single words** **2 words sentence** **3-4 words sentence** **Long sentence** **Can tell story**	 5(10%) 14(28%) 10(20%) 12(24%) 9(18%)

Table 7: Audiological evaluation:

	N	**Mean**	**Std. Deviation**	**Minimum**	**Maximum**
SRT	42	39.76	11.205	20	55
SD%	47	59.70	29.991	8	96
250	46	37.50	8.283	20	50
500	50	42.10	10.695	25	60
1000	50	45.80	15.628	20	80
2000	50	43.40	16.826	20	75
4000	50	50.70	17.143	20	90

SRT (sound reception threshold) _ SD (sound discrimination)

Discussion

For children with severe to profound sensorineural hearing loss, there is evidence that CI is more beneficial than traditional hearing aids; nevertheless, there is debate regarding the implantation of children who have more residual hearing[7]. Conventional hearing aids can provide children with severe hearing loss with adequate access to speech information in the low and mid-frequency range, but they cannot provide sufficient gain in the high-frequency region beyond around 3000 Hz.[3]

In this study, the mean and standard deviation of age of first word is 24.70±10.197with range (12-48) months.

The mean and standard deviation of age of first sentence is 47.96 ± 15.191 with range of (24-72) months. This result may be explained by different degree of hearing loss. In addition, early identification of hearing loss & early intervention services have a positive effect for both language and cognitive development. This result was in agreement with **Bruce et al.,[8]** who reported that enhancing speech and language development in young children is one of the goals of HAs.

In this study, One child had poor vocabulary and 49(98%) children had rich vocabulary**,** five (10%) children had single word, 14(28%) children had two word sentence and ten (20%) children had three to four sentence, 12(24%) children had long sentence, nine (18%) children can tell story. This may be explained with the hearing aid children had significantly better unaided hearing, thus early access to auditory and spoken language information that was inaccessible to the cochlear implant childern.. This came in agreement with **Elizabeth et al.,[9]** who stated that children who wear hearing aids scored higher on tests of receptive vocabulary, language, phonological memory, and reading comprehension than their cochlear implanted peers. The findings also indicated that children with moderately severe or severe hearing loss could develop spoken language skills that are within the range expected for normal hearing children.

This was supported by **Tomblin et al.,[10]** who demonstrated that the more severe the hearing loss and the lower the quality of the aided speech audibility, the more negative the effects. This came in disagreement with **Taina et al.,[11]** who revealed that for children with HAs, HA use is a crucial auditory component to take into account. According to recent findings, some children do not use their HAs in a systematic way, and this has a detrimental effect on children' development of speech and language.

Conclusion

In children wearing bilateral hearing aids, linguistic ability is improved by a brief period of deafness, early age of fitting, and consistent rehabilitation.

References

1- Holt RF, Shirks MA (2008) :An exploratory look at pediatric cochlear implantation: is earliest always best? Ear Hear 29: 492-511.

2- Nicholas, J.G. and Geers, A.E. (2007): Will they catch up? The role of age at cochlear implantation in the spoken language development of children with severe to profound hearing loss. Journal of Speech, Language and Hearing Research; 50: 1048-1062.

3- Boothroyd A. JR Madell., C Flexer., eds. (2008): The acoustic speech signal. In: Pediatric Audiology: Diagnosis, Technology, and Management. New York: Thieme Medical Publishers, Inc., pp. 159–167.

4- Ezell, H. K., & Justice, L. M. (2005): Shared storybook reading: Building young children's language and emergent literacy skills. Baltimore, MD: Paul H. Brookes Publishing.

5- Endang Purbaningrum and Khofidotur Rofiah (2018): The Impact of Language Skills Guidance on ChildrenWith Hearing Impairment Language Development Advances in Social Science, Education and Humanities Research, volume 212 2nd International Conference on Education Innovation.

6- Hanoura M. &A. Hamid. (2002): Stanford Binet Intelligence test: Arabic Version. Cairo: Anglo press.

7- Kennedy C, McCann D, Campbell MJ, Kimm L, Thornton R (2005) Universal newborn screening for permanent

childhood hearing impairment: an8-year follow-up of a controlled trial. Lancet 366(9468): 660- 662

8- J. Bruce Tomblin, PhD, Jacob J. Oleson, PhD, Sophie E. Ambrose, PhD, Elizabeth Walker, PhD, and Mary Pat Moeller(2014): The Influence of Hearing Aids on the Speech and Language Development of Children With Hearing Loss JAMA Otolaryngol Head Neck Surg. 2014 May 1; 140(5): 403–409.doi: 10.1001/jamaoto.2014.267

9- Elizabeth M Fitzpatrick 1, Janet Olds, Isabelle Gaboury, Rosemary McCrae, David Schramm, Andrée Durieux-Smith (2012): Comparison of outcomes in children with hearing aids and cochlear implants PMID: 22340747 DOI: 10.1179/ 146701011X12950038111611
Comparative Study Cochlear Implant Feb; 13(1):5-15.

10- Tomblin J. B., Harrison M., Ambrose S. E., Walker E. A., Oleson J. J., Moeller M. P. (2015): Language outcomes in young children with mild to severe hearing loss. Ear Hear. 36(Suppl 1), 76S–91S. [PMC free article] [PubMed] [Google Scholar]

11- Taina T. Välimaa, Sari Kunnari, Antti A. Aarnisalo, Aarno Dietz, Antti Hyvärinen, aakko Laitakari, Sari Mykkänen, Satu Rimmanen, Jaakko Salonen,Ville Sivonen, Tanja Tennilä, Teija Tsupari, Sari Vikman, Nonna Virokannas, Päivi Laukkanen-Nevala, Anna-Kaisa Tolonen,Krista Tuohimaa, and Heikki Löppönen (2021): Spoken Language Skills in Children With Bilateral Hearing Aids or Bilateral Cochlear Implants at the Age of Three Years Ear Hear. 2022 Jan-Feb; 43(1): 220–233. Published online Jul 13. doi: 10.1097/AUD.0000000000001092
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