

## RESEARCH ARTICLE

# Auditory rehabilitation based on auditory verbal therapy approach on children with bilateral sensory-neural hearing loss

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### Abstract

**Background and Aim:** Auditory rehabilitation is an essential step after hearing aid fitting for children with hearing loss. The aim of this study was to evaluate the auditory rehabilitation results based on auditory verbal therapy approach in children with severe to profound sensory-neural hearing loss. Auditory verbal therapy is a popular approach for rehabilitation children with hearing loss.

**Methods:** This is a retrospective study that evaluates the results of auditory rehabilitation of 19 children with severe to profound hearing loss. Most children were about three years old at the beginning of the rehabilitation process. They were received bilateral hearing aid and auditory rehabilitation based on auditory verbal therapy (AVT) approach. Each case progress was measured by Newsha developmental scale.

**Results:** All of the children showed progress during the AVT program ( $p < 0.05$ ). The Newsha developmental scale showed that hearing and receptive language categories had more progress. The progress was similar between male and female participants and there was no difference in all of categories ( $p > 0.05$ ).

**Conclusion:** The AVT approach is beneficial for

rehabilitation of older children with bilateral severe to profound sensory-neural hearing loss. The progress was observed in all categories of Newsha developmental scale.

**Keywords:** Auditory rehabilitation; auditory verbal therapy approach; hearing-impaired

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### Introduction

The universal neonatal hearing screening program and early hearing detection and intervention increased the number of detected infants and children with hearing loss. The hearing screening and evaluation would perform in few first months after birth [1,2], and it leads to a growing need for auditory rehabilitation. Auditory rehabilitation is an essential step after hearing evaluation for children with hearing loss. The acquired or congenital hearing loss interferes with speech and language developments despite the etiology of hearing loss [3].

There are different approaches for auditory rehabilitation. However, both hearing professionals and parents of children with hearing loss show great interest in auditory verbal therapy (AVT) approach over the years [4]. The AVT is the main

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approach for the development of spoken language in children with hearing loss [5]. It based in early intervention on the audition with involvement of child's caregivers [6]. This method is the main approach in family and children with hearing loss centers in our country that endorsed by the state welfare organization of Iran.

Some studies showed the positive effect of AVT approach [6] even in rehabilitation of children older than three years old, these studies showed improvement in receptive and expressive language [7-9], auditory comprehension [7] and speech abilities [9] but, still there is a shortage of evidence for the effectiveness of AVT approach [5,6].

The aim of this study was the evaluation of auditory rehabilitation results based on endorsed approach of AVT in children with bilateral severe to profound sensory-neural hearing loss (SNHL).

## Methods

This is a retrospective study that was performed from May to June 2019. In this study, the results of the auditory rehabilitation of 19 children were evaluated. They had severe to profound hearing loss and receive auditory rehabilitation based on AVT approach in Naghme Center of Family and Children with Hearing Loss in Mashhad (east Iran). Each case was received an AVT program by a multidisciplinary rehabilitation team. A multidisciplinary rehabilitation team was consisted of at least one audiologist, one speech and language pathologist and, one experienced hearing impairment trainer for children. They also frequently used the consultation of other specialists such as occupational therapists and psychologists.

In total, two audiologists and three speech and language pathologists worked on all cases. All members of the team were well aligned together. They performed under the supervision of an audiologist with more than 15 years of experience in auditory rehabilitation (second author).

All of the children were congenital sensory-neural hearing loss. Although they diagnosed at first of three months of life, many of them started the rehabilitation process later. They had no other

problem besides hearing loss. They used regularly and daily basis from their hearing aids. The hearing aids were bilateral power and super-power BTE with different brands like Phonak, Interton, Siemens, etc. that prescribed based on their hearing thresholds.

The children attended at Naghme center and received rehabilitation in six days per week from 8 to 13. Each day, they received three group sessions with hearing impairment trainer, audiologist or speech and language pathologist. They also received two regular individual sessions per week for auditory training and speech therapy.

We excluded all the cases with poor parent-cooperation. All of the remaining parents had good cooperation.

## Procedure

First, the demographic data and auditory evaluation tests were extracted from children's files. Each case was received the routine assessments that confirm the presence of bilateral severe to profound sensory-neural hearing loss. The auditory tests were included tympanometry, otoacoustic emissions (OAE), auditory brainstem response (ABR), auditory steady-state response (ASSR), and behavioral audiometry based on the age of children. The inclusion criteria were normal (An) tympanogram, absent OAEs for excluding children with auditory neuropathy, bilateral absent ABR waveforms at the maximum intensity level (100 dB nHL), and bilateral severe to profound hearing loss based on ASSR and behavioral audiometry in all frequencies. The results of these tests could confirm the presence of bilateral severe to profound SNHL in infants and young children. In the ABR test, most of the children were evaluated with click-evoked ABR response. The results of ASSR were absent at the maximum intensity level (100 dB nHL) for most frequencies especially the higher frequencies.

After evaluating the results of auditory tests, we evaluated the received auditory rehabilitation for each case. The received auditory rehabilitation was included the fitting of appropriate bilateral behind the ear (BTE) hearing aid regarding the hearing loss in different frequencies, auditory rehabilitation based on auditory verbal therapy

**Table 1. Statistics of the scores of Newsha developmental scale at the beginning and end of the auditory verbal therapy program (n = 19, female = 7, male = 12)**

	Beginning			End			Progress			p
	Min	Max	Mean (SD)	Min	Max	Mean (SD)	Min	Max	Mean (SD)	
<b>Hearing</b>	1	9	3.95 (2.84)	1	13	6.74 (3.43)	0	7	2.79 (2.10)	< 0.001
<b>Speech</b>	2	11	5.42 (2.89)	4	13	7.37 (3.22)	0	6	1.95 (1.65)	< 0.001
<b>Receptive language</b>	1	8	4.11 (2.08)	4	13	6.63 (2.98)	1	7	2.53 (1.81)	< 0.001
<b>Expressive language</b>	1	12	4.47 (2.95)	3	13	6.42 (3.24)	0	6	1.95 (1.58)	< 0.001
<b>Cognition</b>	3	12	7.47 (2.61)	6	13	9.21 (1.84)	0	4	1.74 (1.24)	< 0.001
<b>Social communication</b>	2	13	7.63 (3.11)	6	13	9.79 (2.55)	0	5	2.16 (1.61)	< 0.001
<b>Motor</b>	3	13	8.63 (3.00)	6	13	10.16 (2.48)	0	3	1.53 (0.90)	< 0.001

(AVT) approach and follow-ups on hearing aids and rehabilitation progress. The AVT is a rehabilitation approach that currently used in the family and children with hearing loss centers in our country. The BTE hearing aids were fitted for each ear based on auditory thresholds obtained in ASSR or behavioral audiometry tests. The appropriate functions of hearing aids were regularly monitored by audiologists and other rehabilitation team members. Moreover, each participant was formally evaluated at the beginning and at the end of the AVT program with Newsha developmental scale. It has good validity and reliability [10]. The content validity index of this scale is between 0.8 to 1 in different categories [10].

#### Data analysis

The analyses were performed by SPSS 19. The quantitative results including Newsha developmental scale were expressed by the mean and standard deviation (SD). The normal distributions of data were checked by the Kolmogorov-Smirnov test. The difference between beginning and end scores of Newsha developmental scale were analyzed by paired t-test.

#### Results

The children had  $38.3 \pm 21.8$  month old at the

beginning of the rehabilitation program. The youngest participant was eight months old. The 7 (36.8%) persons were female. The data had normal distribution ( $p > 0.05$ ). The AVT program was performed for  $8.9 \pm 3.1$  months. The scores of Newsha developmental scale at the beginning and end of the AVT program were presented in Table 1.

The highest scores, in the beginning, were related to the motor and social communication categories. These categories also had the highest scores at the end of the AVT program. All categories showed progress at the end of the AVT program but the hearing and receptive language categories had more progress.

The beginning scores were similar between male and female participants and there were no significant differences between the two groups in all categories ( $p > 0.05$ ). Although both female and male participants had more progress in different categories, these differences were not statistically significant (Table 2).

#### Discussion

The results of this study show the effects of AVT approach on the rehabilitation of children with bilateral severe to profound sensory-neural hearing loss. The AVT showed beneficial to the development of different aspects of hearing,

**Table 2. Mean and standard deviation of progress of male and female participants in different categories of Newsha developmental scale**

	Hearing	Speech	Receptive language	Expressive language	Cognition	Social communication	Motor
Female (n = 7)	2.29 (2.36)	2.43 (2.37)	2.29 (1.60)	2.57 (2.15)	1.71 (1.11)	2.43 (1.62)	1.43 (0.98)
Male (n = 12)	3.08 (1.97)	1.67 (1.07)	2.67 (1.97)	1.58 (1.08)	1.75 (1.36)	2.00 (1.65)	1.58 (0.90)
p	0.440	0.346	0.670	0.197	0.954	0.590	0.730

language, and speech even in children older than three years old. These results are similar to previous findings [7-9].

Even in older children, speech and language improvements may become as good as normal hearing children [7]. In this study, the children in the control group were matched with cases in many aspects, including age, sex, language, receptive vocabulary, and education of parents. Similar results were found in another study [8] which showed that good improvement in language could be achieved even in older children, and even the mathematics and reading scores of children with hearing loss could improve and be analogous to age-matched children in the normal hearing group [9]. However, these excellent results were obtained in the educated parents [8] or education-matched studies. The speech and language improvement of older children may be different in the population and their improvements may relate to different factors such as education of parents.

Although, The main purpose of the AVT approach is improving spoken language [5]. Like these studies, we also observed improvements in different aspects including receptive and expressive language, speech and hearing abilities. The AVT approach even may lead to better voice and better communication in children with bilateral profound hearing loss [11]. The better speech intelligibility was also observed for cochlear implanted children who received AVT approach [12].

Some aspects of AVT approach could be hopeful. In this study for example, we used AVT on children with bilateral hearing aids. However, the results of AVT program is also promising in

adults with cochlear implant [13]. In another study, the social interaction of children who received cochlear implant and AVT approach was so improved that it was similar to normal hearing children [14].

The age of children who receive intervention such as auditory rehabilitation is an important factor that could affect the rehabilitation results [15] including different factors such as emotional, social, language, and speech development [16]. Unfortunately, at present, there are limitations in employment of auditory rehabilitation in our area. Despite growing knowledge about the importance of early intervention and rehabilitation in our hearing specialists and population, many children still participated very late for hearing aids fitting and starting auditory rehabilitation program. For instance, the mean age of participants in the present study at the beginning of rehabilitation program is 38 months old or approximately more than three years old. Their late participation in the auditory rehabilitation program could affect the results. Starting auditory rehabilitation in less than 6 months old is recommended based on the Joint Committee on Infant Hearing (JCIH) guideline [17]. Different studies also showed the importance of early intervention in children with hearing loss. The benefit and importance of early intervention rise with the degree of hearing loss and therefore, it has more importance in children with severe and profound hearing loss [18].

It is noteworthy to mention that these results were obtained in children who received auditory rehabilitation. Auditory rehabilitation is an essential step after hearing evaluation. But unfortunately, some children with hearing loss still do

not receive a complete auditory rehabilitation and the rehabilitation program ends with hearing aid fitting. It was shown that the most common reason for late intervention such as cochlear implant is lack of knowledge about the intervention [19]. This issue shows the need for better education for our hearing and related specialists. It also shows the need for better counseling and guiding system for parents of children with hearing loss in our country. In some cases, the far distance between rehabilitation centers and family living areas could cause withdrawal and low acceptance of rehabilitation programs. In these situations, we could use the telemedicine AVT programs. The results of these programs are also satisfactory [20,21]. The other option is using home-based intervention in young children that could be helpful for their auditory and speech developments [15].

This study had some limitations. The lack of an appropriate control group (such as participants from the waiting list) make it difficult to compare the results and show the effects of AVT approach separate from different other factors. Having a control group and more assessment tests can improve the quality of future studies. Also, the age of children may seem like a limitation. However, It was shown that the AVT approach could even be useful in the rehabilitation of children older than three years old [5].

### Conclusion

The auditory verbal therapy approach is beneficial for rehabilitation of older children with bilateral severe to profound sensory-neural hearing loss. The progress was observed in all categories of Newsha developmental scale.

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This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.REC.1398.030). The authors thank the Deputy of Research of Mashhad University of Medical Sciences for supporting this study.

### Conflict of interest

The authors had no conflict of interest.

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