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Original Article

Application and Usage of Tactile Aid in Iran

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Background: Most deaf and severe to profound sensorineural hearing loss patients are incapable to communicate well because of a lack of receiving sound signals. Cochlear implant is one of the effective measures, which has been of great help to the deaf. Up to now, more than 1000 cochlear implants have been accomplished successfully in Iran. Since cochlear implantation is faced with numerous problems and difficulties, we should establish other methods for sound communication. Tactile aids can be a very effective help regarding this issue.

Methods: We designed and accomplished a study on the use of tactile aid, along with rehabilitation and training of these patients in our department. We designed four educational stages to check the improvement of subjects who used one-, two-, and seven-channel tactile aids.

Results: Hundred percent of the cases passed the first stage (detection) successfully. In the second stage (beginning pattern perception) all the cases with two and seven channel tactile aids were able to distinguish all kinds of sounds. They could differentiate between speech and non-speech sounds. In the third stage (recognition of speech), all the cases were able to recognize environmental and "sound maker" sounds, but only 43% of the individuals were able to recognize speech sounds and repeat correctly with two-channel tactile aids. In the fourth stage (comprehension of words), identification and repetition of the words were only possible with seven-channel tactile aids.

Conclusion: The results of our study show that tactile aids are well accepted by the patients with severe to profound sensorineural hearing loss who do not benefit from usual hearing aids.

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Introduction

The deaf cannot utilize one of the most important communication organs, the "auditory systems". Many studies have been performed to develop the use of hearing aids, lip reading, and sign language to help the deaf to communicate. Recently, surgical procedures such as cochlear implants have been the most effective methods to help them communicate with others and enable them to talk.

In order to help the deaf, tactile aids have also been made. Tactile aids can be used in the deaf who cannot use hearing aids successfully, or in those for whom cochlear implant is impossible.

These devices convert sound patterns into patterns of vibrotactile stimulation. They are personal electronic instruments, which can help the deaf to understand sounds by allowing them to feel the unique pattern of vibration presented in each sound. These devices do not provide the details available through hearing, but they inform the user through the skin and sense of touch.

The idea of using sense of touch as a means of communication for profoundly impaired hearing is very old. The first person, who invented a device to convert sound into vibrating stimuli, was Gult (1924).[1] In recent decades, personal tactile aids with modern teaching methods have been made.

Patients and Methods

We performed this study in the ENT

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At first, we enrolled 43 patients to this prospective study. Thirteen of them were excluded because of personal problems and noncooperation. Seven patients left the survey after the first stage because of inability to perform the auditory training stages and refusing the use of tactile aids. So, we carried out this clinical study on remaining 23 patients (7 males and 16 females). The age range of the patients were 5 to 17 years.

The inclusion criteria were:

1. Severe or profound hearing loss (70 – 90 dB) in both ears, while the usual hearing aids were not effective.

2) Being familiar with speech reading and sign language.

3) Having no mental and physical disease, interfering with the process of education.

We used three types of tactile aids; single-channel tactile aid, which was ordered by the researchers and was made in Iran by Karbord-Electric Company, two-channel (Tactile II plus), and seven-channel tactile aids (Tactaid 7), which were imported to Iran by the Audiological Engineering Corporation.

Single-channel aids transmit the stimuli via a single vibrator placed on the thumb skin; two-channel aid has two vibrators placed on the wrist skin; and seven-channel aid has seven vibrators placed on the neck, chest, and/or abdominal skin.

We took the history and examined the hearing and lip reading ability of the patients. We also evaluated the effectiveness of usual hearing aids. Then, educational stages were carried out as follow, using the tactile aids:

Stage I (detection): in this stage, the patients would be able to respond whether they can detect any sound.

Stage II (beginning pattern perception): in this stage, the patients responded to beginning pattern perceptions such as long versus short sounds, continuous versus intermittent, fast versus slow, strong versus weak sounds, and also sound discrimination. In this stage, the patients were exposed to sound produced by sound makers such as drum, bell, whisper, squeeze toys, knocking on the door, and environmental sound or speech. We asked the patients to distinguish the differences between the two sound makers.

Stage III (advanced pattern perception): in this stage, we asked the patients to identify the environmental and speech sounds. At first, we exposed the patients to both visual and sound stimuli, and then to only sound stimuli. The patients were also asked to differentiate speech sounds from nonspeech sounds.

Stage IV (advanced speech perception): we asked the patients to identify the short sentences (maximally two to three words and work in closed setting). The patients were exposed to words and lip reading. Then, they were requested to repeat the words in closed setting without exposure to lip-reading. The same process was applied for short sentences. Duration of teaching was half an hour per week.

Results

Twenty three patients participated in the auditory training stages. All of them passed the first or detection stage successfully with each type of tactile aids.

In the second stage, all patients were able to distinguish all kinds of sounds (such as long versus short, continuous versus intermittent, fast versus slow, and strong versus weak). The patients could differentiate between speech and nonspeech sounds with two-channel and seven-channel tactile aids, but with one-channel tactile aid they failed to pass the exam (Table 1).

In the third stage, the subjects were exposed to speech sounds such as vowels (/æ/, /a/, /e/, /i/, /o/, and /u/) and consonants (/s/, /sh/, and /r/). In the vowels part, differentiation between /a/, /e/, /o/, and /æ/ was difficult when using single-channel tactile aids, while it was easy when using seven-channel tactile aids.

In patients who used two-channel tactile aids, regarding vowels /a/ and /u/, sound was detected fully by 81% of the cases. Thirty-six percent of these cases detected the /i/ sound fully, while 45% could not detect it at all. The /e/ sound was detected by 54% fully, while the /æ/ sound was not detected by 45%. Seventy-two percent of these

Table 1. Percentage of sound and speech perception in I-, II-, and VII-channel tactile aids.

Channel	Sound detection	Sound perception	Identification of speech sound	Speech perception
I	100%	100%	5%	0%
II	100%	100%	See Table 2	0%
VII	100%	100%	See Table 2	20%

Table 2. Vowels and consonant sound perception with II and VII channel tactile aids.

Channel	Vowel						Consonant			
	a	u	i	e	æ	o	r	s	sh	Other
II	81%	81%	36%	54%	55%	72%	100%	63%	63%	0%
VII	100%	100%	100%	100%	100%	100%	100%	100%	100%	9%

patients detected the /o/ sound.

It is important to know that patients with seven channel tactile aids could detect all the vowels (Table 2).

In the consonants part, only /r/ was differentiated by all subjects. /s/ and /sh/ could be differentiated by subjects with two- and seven-channel tactile aids. Using the two-channel tactile aid, 63% of the cases could detect /s/ and /sh/ fully, while 9% could not detect them at all. All the cases with seven-channel tactile aids could detect /sh/, /s/, and /r/ sounds completely. Other consonants could not be differentiated because of the similarity in vibration, and only 9% of the cases with seven-channel tactile aids could detect some of them.

In stage IV or advanced speech perception, which consisted of the identification of short sentences and words in closed setting, identification and repetition of the words were only possible with the seven-channel tactile aids. The seven-channel tactile aid users could only identify short sentences in closed setting when there were significant differences between the words (such as monosyllable and multisyllable words).

Discussion

Numerous similar studies have revealed that tactile aids, particularly multi-channel devices, can have a significant benefit in speech perception.[2 – 5] They have suggested that even a relatively brief period of training with a tactile aid can lead to improvement in speech production by hearing-impaired children.[4, 6]

Comparison between relative performance of single- and multi-channel tactile aids for speech perception was studied by others. [1, 2] They found that single-channel and multi-channel devices performed similarly in rhythm and stress perception, but the multi-channel aids in many cases showed a better performance.

Our results showed that two- and seven-channel tactile aids provided a better sensation of environmental and speech sounds. There is some difficulty in using these types of tactile aids, because of their placement on the neck, chest, or abdomen. In this study, recognition of vowels and consonants, with the use of two- and seven-channel tactile aids, were possible, but this recognition in closed setting was only possible in 20% of the cases (Table 2).

Since the deaf usually speak loudly, these devices help them to regulate speech loudness. Tactile aids are also useful for the production of speech sound.

Some studies have stated that the usefulness of tactile aids may be equal to cochlear implants.[6 – 9] Goldstein et al and Weisenberger et al believe that for prelingual deaf children, tactile aids may facilitate the acquisition of lip reading, and improve vocal production. [2, 10]

The results of this study have shown that tactile aids are preferred by the deaf who can not take advantage of powerful aids, especially on the sensation of environmental sound and speech. If the training continues regularly for one or two hours a day, the patient can recognize lots of environmental and speech sounds after 5 – 10 sessions.

Several factors such as age,[9] duration of education before using these devices,[9, 11] memory, and type of the tactile aid can affect the final results.[5] Patients older than seven, especially those who have completed kindergarten education, prefer to use tactile aids.

The results of the present study show that tactile aids are useful in those patients who are not good candidates for using cochlear implant.[12, 4, 5] If these devices are used with lip-reading, detection of words as well as short sentences will be possible.

Since there is a large population of deaf people and these devices are not expensive in general, they can help the deaf to have a better quality of life. We suggest further studies in this regard to be carried out.

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