

Comparison Study of the Pronunciation of Vietnamese Phonemes (Vowels and Consonants) by Pre-School Deaf Children Before and After Cochlear Implantation (Case Study)

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Abstract: *By comparing the hearing and pronunciation abilities of deaf children at 2 time points (before and after cochlear implantation), this study aims to show the impact of cochlear implantation on the hearing and speaking quality of hearing-impaired children in private lessons of the pre-school deaf children in Vietnam, through the case of Hanoi Sunny AVT Therapy Center. The study was conducted on the basis of surveying 25 pre-school deaf children at the Center, with profound and severe deafness (22 children with profound hearing loss and 3 with severe deafness). Research data included notes, recordings and videos of children's ability to hear and pronounce Vietnamese vowel and consonant phonemes before and after cochlear implantation. The results of the comparative study have shown that cochlear implantation has helped deaf children to pronounce Vietnamese phonemes (vowels and consonants) much better than before implantation.*

Keywords: deaf children, hearing - loss, hearing - impaired children, cochlear implantation, pre-school deaf children

1. Aims of the Study

By comparing the hearing and pronunciation abilities of deaf children at 2 time points (before and after cochlear implantation), this study aims to show the impact of cochlear implantation on the hearing and speaking quality of hearing-impaired children with cochlear implants in private lessons of pre-school deaf children in Vietnam, through the case of Hanoi AVT. From there, it is possible to propose therapeutic solutions for hearing and pronunciation problems of hearing-impaired children in Vietnam in general.

2. Research Objectives

Surveying and comparing the pronunciation ability of the deaf children mentioned above, according to 6 different cochlear age groups, at 2 time points (before and after cochlear implantation) to find out the progress in the ability to hear and pronounce the Vietnamese phonemes (vowels and consonants) of hearing-impaired children after cochlear implantation.

3. Materials and Methods

3.1. Materials

General Information

This study was conducted on a survey of 25 pre-school deaf children (including 16 boys and 9 girls) at Sunny AVT Hanoi Center in 2020 - 2021, with profound and severe deafness (22 children with profound hearing loss and 3 severe deafness). These deaf children, who received Cochlear implants, were divided into six groups, according to their cochlear age criteria. The study data included notes, audio and video recordings of children's hearing and speaking before and after cochlear implantation. The ages

according to different criteria are as follows:

- *Age at survey:* from 19 – 77 months, before cochlear implantation and 29 – 103 months, after cochlear implantation.
- *Cochlear implant age:* 3 – 48 months;
- *Age of Hearing:* 0 - 48 months, before cochlear implantation and 3 - 73 months, after cochlear implantation.
- *Age of Speech therapy:* 0 - 48 months (before cochlear implantation) and 3 - 73 months (after cochlear implantation).

Types of materials:

The first type: The questionnaires assessing the language ability of the surveyed children are kept at the therapy facility. Each child has 2 ratings: 1) At the time before cochlear transplantation. 2) At the time points after cochlear implantation.

The second type: Video files recording images and speech of the surveyed children (in individual classes in the therapy facility).

The third type: In-depth interviews with experts on children receiving cochlear implants, teachers directly teaching children, and caregivers.

Study time: 2 time points (before and after hearing impaired children received cochlear implants).

3.2 Methods

In this study, the following research methods were applied: *Field survey method, Auditory method, Analytical and Synthesis method, Descriptive method and Comparative method.*

4. Results

First, we have an overall and detailed comparison of the results of speech and hearing therapy for the number of hearing impaired children being surveyed. Children are divided into 6 groups according to the age of cochlear

implantation, each age group has 2 or more children. Particularly, the last group consisted of 3 children in 3 cochlear age groups who were surveyed in the same group to verify in order to increase the objectivity of the results (Table 1).

Table 1: Comparison of pronunciation of Vietnamese phonemes before and after cochlear implantation of the groups of children with hearing impairments surveyed

Groups of Cochlear Age	Time Points of Survey	Results of Survey	Ability to pronounce Vietnamese phonemes			
			Vowels		Consonants	Vowel combinations • a-i; o-i; u-i; a-o; e-o; a-u; • o-a; oe
			Single Vowels	Diphthongs (3) uô/ua; iê/ia; ươ/ưa		
1. Under 6 months (6 children)	Before implantation	Detail	<ul style="list-style-type: none"> 2/6 children can pronounce a single vowel "a" 4/6 remaining children: can't pronounce any single vowels 	6/6 children can't pronounce any diphthongs	<ul style="list-style-type: none"> 2/6 children can pronounce a lip consonant "b" 4/6 remaining children can't pronounce any consonants 	6/6 children can't pronounce any combinations
	After implantation	Detail	<ul style="list-style-type: none"> 3/6 children can pronounce 3-9 long single vowels 3/6 remaining children can't pronounce any single vowels 	6/6 children can pronounce 1 - 3 diphthongs	6/6 children can pronounce 2-3 consonants (b, h, m)	6/6 children have pronounced all the above combinations
		Improvement	+ 8 long single vowels more (pronounced)	+ 1 - 3 diphthongs more (pronounced)	+ 2 consonants (h, m) more (pronounced)	All of the above combinations have been pronounced by the group
6 months (3 children)	Before implantation	Detail	<ul style="list-style-type: none"> 1/3 children can pronounce 2 single vowels (1 long single vowel "a" and one short single vowel "ă") 2/3 remaining children can not pronounce any vowels 	3/3 children do not pronounce any diphthongs	<ul style="list-style-type: none"> 2/3 children can pronounce 2 lip consonants (b, m) 1/3 remaining children can't pronounce any consonants 	3/3 children can't pronounce any combinations
	After implantation	Detail	3/3 children can pronounce 9 long single vowels.	3/3 children can pronounce 3 diphthongs.	3/3 children can pronounce 2-12 consonants.	3/3 children can pronounce all of the above combinations.
		Improvement	+ 8 long single vowels more (pronounced)	+ 3 diphthongs more (pronounced)	+ 10 consonants more (pronounced)	All of the above combinations have been pronounced by the group
7 – 11 months (7 children)	Before implantation	Detail	<ul style="list-style-type: none"> 3/7 children can pronounce 7 long single vowels (e, a, e, o, o, i, u) 4/7 remaining children can't pronounce any vowels 	7/7 children can't pronounce any diphthongs	<ul style="list-style-type: none"> 3/7 children can pronounce 4 consonants (b, p, m, t) 4/7 remaining children can't pronounce any consonants 	<ul style="list-style-type: none"> 3/7 children can pronounce 2 combinations of vowels (ao, ai) 4/7 remaining children can't pronounce any combinations
	After implantation	Detail	7/7 children can pronounce 2-9 single vowels	7/7 children can pronounce 3 diphthongs	7/7 children can pronounce 9 consonants (p, b, m, h, n, t, d, nh, th)	7/7 children can pronounce all the above combinations
		Improvement	+ 2 long single vowels more (pronounced)	+ 3 diphthongs more (pronounced)	+ 5 consonants (h, n, d, nh, th) more (pronounced)	All of the above combinations have been pronounced by the group
13-23 months (4 children)	Before implantation	Detail	4/4 children can't pronounce any single vowels	4/4 children can't pronounce any diphthongs	<ul style="list-style-type: none"> 2/4 children can pronounce a lip consonant (b) 2/4 remaining children can't 	4/4 children can't pronounce any combinations

					pronounce any consonants	
	After implantation	Detail	4/4 children can pronounce 9 long single vowels	4/4 children can pronounce 3 diphthongs	4/4 children can pronounce 8 consonants (<i>b, m, h, n, t, ph, s, ng</i>)	4/4 children can pronounce all the above combinations
		Improvement	+ 9 long single vowels more (pronounced)	+ 3 diphthongs more (pronounced)	+ 7 consonants (<i>m, h, n, t, ph, s, ng</i>) more (pronounced)	All of the above combinations have been pronounced by the group
25 – 35 months (2 children)	Before implantation	Detail	2/2 children can't pronounce any vowels	2/2 children can't pronounce any diphthongs	2/2 children can't pronounce any consonants	2/2 children can't pronounce any combinations
	After implantation	Detail	2/2 children can pronounce 6 - 8 single vowels	2/2 children can pronounce 1 - 3 diphthongs	2/2 children can pronounce 4 - 10 consonants	2/2 children can pronounce all of the above combinations.
		Improvement	+ 6 - 8 single vowels more (pronounced)	+ 1 - 3 diphthongs more (pronounced)	+ 4-10 consonants	All of the above combinations have been pronounced by the group
12 months, 24 months, 48 months (3 children)	Before implantation	Detail	<ul style="list-style-type: none"> 1/3 children can pronounce 7 long single vowels (a, o, e, o, o, u, i) 2/3 remaining children can't pronounce any single vowels. 	<ul style="list-style-type: none"> 1/3 children can pronounce a diphthong (<i>ua</i>) 2/3 remaining children can't pronounce any diphthongs 	<ul style="list-style-type: none"> 1/3 children can pronounce 2 lip consonants (<i>b, m</i>) 2/3 remaining children cannot pronounce any consonants. 	<ul style="list-style-type: none"> 1/3 children can pronounce 3 combinations (<i>oa, oi, ui</i>) 2/3 can't pronounce any combinations.
			Detail	3/3 children can pronounce 8-9 long single vowels	3/3 children can pronounce 3 diphthongs	3/3 children can pronounce 1-6 consonants
	After implantation	Improvement	+ 1 - 2 long single vowels more (pronounced)	+ 2 diphthongs more (pronounced)	+ 4 consonants more (pronounced)	All of the above combinations have been pronounced by the group

Note: The column of vowel combinations includes combinations with the final and pretonal sounds: semi-vowels *i; u/o*

5. Discussion

The improvements of 6 children groups after implantation is as follows (Table 2)

Table 2: The improvements after implantation of the deaf children surveyed in 6 age groups of cochlear implants

Ordinal Number	Groups of Cochlear Age	Vowels	Diphthongs	Consonants	Combination of vowels
1	Under 6 months (6 children)	+ 8 long single vowels more (pronounced)	+ 1 - 3 diphthongs more (pronounced)	+ 2 consonants (<i>h, m</i>) more (pronounced)	All of the above combinations have been pronounced by the group
2	6 months (3 children)	+ 8 long single vowels more (pronounced)	+ 3 diphthongs more (pronounced)	+ 10 consonants more (pronounced)	All of the above combinations have been pronounced by the group
3	7 – 11 months (7 children)	+ 2 long single vowels more (pronounced)	+ 3 diphthongs more (pronounced)	+ 5 consonants (<i>h, n, d, nh, th</i>) more (pronounced)	All of the above combinations have been pronounced by the group
4	13-23 months (4 children)	+ 9 long single vowels more (pronounced)	+ 3 diphthongs more (pronounced)	+ 7 consonants (<i>m, h, n, t, ph, s, ng</i>) more (pronounced)	All of the above combinations have been pronounced by the group
5	25 – 35 months (2 children)	+ 6-8 single vowels more (pronounced)	+ 1 - 3 diphthongs more (pronounced)	+ 4-10 consonants more (pronounced)	All of the above combinations have been pronounced by the group
6	12 months, 24 months, 48 months (3 children)	+ 1-2 long single vowels more (pronounced)	+ 2 diphthongs more (pronounced)	+ 4 consonants more (pronounced)	All of the above combinations have been pronounced by the group

Tables 1 and 2 show that, after implantation, the pronunciation of Vietnamese phonemes of the 6 groups of deaf children after implantation has improved significantly: almost the number of pronounced phonemes in each group has increased and as well as nearly equivalent ability of pronunciation of all groups for vowel combinations containing the pretonal and final sound. In general, the

older age of the cochlear implantation, the better the child's ability to hear and speak.

6. Conclusion

As the survey results show, before being implanted with a cochlear devices, almost deaf children could not pronounce

Vietnamese vowel and consonant phonemes. However, there are a few cases where some children can pronounce some phonemes before implantation which may be due to their age or outliers (groups 2,3,6).

Through this study, we also see how important the role of early intervention is in the development of hearing and pronunciation of deaf children. These children with disabilities need early intervention right from birth. Early intervention steps are: newborn audiometry to detect hearing loss, having deaf children wear hearing aids or cochlear implantation as prescribed by doctors, giving deaf children speech therapy at clinics treatment facility. The aim is to restore language and speech function, communication, and community integration for these children.

This study serves as an experiment to help deaf children in particular and children with disabilities in general receive early treatment and integrate into the community early from early childhood. Its results can hopefully be used as a reference for speech and language therapy for deaf children in Vietnam and other countries.

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