

Analysis of subjective perception and influencing factors of different inclusive education models among prelingually deaf children with a cochlear implant

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Abstract

Objective: We aimed to explore the educational outcome and influencing factors of ongoing verbal rehabilitation training together with inclusive education among prelingually deaf children with a cochlear implant.

Methods: Prelingually deaf children who underwent cochlear implantation, rehabilitation, and had inclusive education placement were randomly divided into two groups: one group received continuous verbal rehabilitation training under inclusive education status; the other group did not receive this training. Speech discrimination scores were determined.

Results: Among 60 included children, subjectively perceived academic adaptability, peer relations, initiative communication, and teacher's involvement under inclusive education, as well as speech discrimination scores, were all significantly different between groups. Continuous verbal rehabilitation training influenced the subjective perception of children and resulted in higher speech discrimination scores and more positive subjective perception. Subjective perception was not significantly correlated with chronological age, sex, age at the time of cochlear implantation, or duration of inclusive education.

Conclusion: Ongoing verbal rehabilitation training within inclusive education can largely improve the education placement outcomes of prelingually deaf children with cochlear implants.

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Cochlear implants, inclusive education, adaptability, subjective perception, prelingual deafness, verbal rehabilitation

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Introduction

Cochlear implant surgery is an initiation of hearing recuperation, and the selection of educational rehabilitation and placement strategies following cochlear implant directly affects the quality of rehabilitation among hearing-impaired children.¹ Peer acceptance and popularity among other children are very important to children with cochlear implants, as these factors affect their future adaptability in society.² Even after undergoing cochlear implantation, prelingually deaf children are still prone to having poor speech abilities and experiencing loneliness during their school years.²

Inclusive education for hearing-impaired children means “learning in a regular class”, where deaf children are enrolled and educated in regular classrooms.³ The determination of whether deaf children with cochlear implants can receive high-quality education in a regular classroom is affected by many factors. Previous research has only explored the effects of the attitudes of teachers from regular schools toward inclusive education, the attitudes of the parents of children without hearing impairment and the parents of deaf children toward inclusive education, and psychological and emotional development and academic adaptation to inclusive education among deaf children in regular schools.⁴ However, there has been no consistent conclusion about which factors are the most critical to education in hearing-impaired children.

We believe that normal hearing ability and verbal ability are essential conditions for children to integrate into a healthy social environment, and the degree of verbal rehabilitation largely affects the

education placement outcome of deaf children. Verbal rehabilitation training should be ongoing in deaf children. In the present study, we explored and aimed to confirm whether continuous verbal rehabilitation training should be conducted as part of inclusive education among hearing-impaired children, to improve the education placement rehabilitation outcomes of prelingually deaf children following cochlear implantation.

Methods

Participants

Using the cochlear implant rehabilitation program database for prelingually deaf children of Shanxi People’s Hospital, we randomly selected children who had undergone cochlear implantation and rehabilitation and had inclusive education placement status.

The inclusion criteria were as follows: (1) prelingually deaf children; (2) those with a duration of verbal rehabilitation training >1 year before inclusive education placement; and (3) children who received inclusive education placement in a regular classroom after rehabilitation training, with a duration of placement >1 year.

The exclusion criteria were as follows: (1) before inclusive education, children who never received speech rehabilitation training or with a training duration <1 year; (2) after speech rehabilitation training, children who never received inclusive education placement or those with inclusive education placement <1 year; (3) children with mental disorders, including autism.

The included children were divided into two groups, depending on whether they received ongoing verbal rehabilitation training: (1) the intervention group who received inclusive education placement together with continuous verbal rehabilitation training; (2) the control group who received inclusive education without rehabilitation training. Continuous verbal rehabilitation training was defined as at least one planned verbal rehabilitation training session every week during the period of inclusive education placement.

Ongoing verbal rehabilitation was conducted at least once a week for ≥ 40 minutes per session. Rehabilitation included hearing training (hearing sensitizing, rhythm constructing, discriminating faint sounds and timbre) and language training (pronunciation, words, sentences, and communication).

Experimental methods

Basic data collection and determination of speech discrimination scores. Basic information was acquired from all children, including sex, physical age, age at the time of surgery, duration of attendance at a regular school, and determination of whether ongoing verbal rehabilitation training was received by the participant. In addition, speech discrimination scores were determined. Test signal intensity was 20 dB above participants' average auditory threshold; in addition, 25 monosyllables were played through a speaker and participants were requested to repeat them. Speech discrimination scores were calculated as the percentage of items that participant could identify.

Subjective perception among deaf children using a visual analog scale (VAS). Children and their family members were instructed to complete a self-developed VAS evaluation. Subjectively perceived academic adaptability, peer relations, initiative contact degree, and attention from teachers in inclusive

education were recorded. VAS scores ranged from 0 to 10, with 0 indicating academic inadaptability, poor peer relations, no initiative contact, and no attention from teachers; a score of 10 indicates high academic adaptation, good peer relations, active contact, and high level of attention from teachers. Then, VAS scores for these four items were added together for each participant and used as an index to evaluate the overall outcome of inclusive education placement. A total score of ≥ 24 indicated a satisfactory outcome.

Ethical considerations and consent

This study was conducted with approval from the Ethics Committee of Shanxi Provincial People's Hospital, Affiliated to Shanxi Medical University. This study was conducted in accordance with the Declaration of Helsinki. The legal guardian of all children provided a signed written informed consent form.

Statistical methods

Statistical analysis was conducted using IBM SPSS version 20.0 (IBM Corp., Armonk, NY, USA). First, the mean values of academic adaptability, peer relations, degree of initiative contact, attention from teachers, and speech discrimination scores were compared between groups using an independent samples *t*-test. Then, logistic regression analysis was conducted for the independent variables of sex, physical age, age at the time of cochlear implantation, duration of attendance at a regular school, receiving continuous verbal rehabilitation, and speech discrimination score.

Results

Demographic information

Among 60 prelingually deaf children who underwent cochlear implantation,

rehabilitation, and had inclusive education placement, there was no statistically significant difference in the proportions of the two sexes (Table 1). There was also no statistically significant difference among age groups (<6 years, 6–12 years, >12 years), age at the time of surgery (<2 years, 2–5 years, or >5 years), or duration of attendance at a regular school (1–2 years or >2 years) between the two groups.

VAS scores for subjective perception and speech discrimination

As shown in Table 2, the VAS scores for subjectively perceived academic adaptability ($P=0.004$), peer relations ($P=0.035$), initiative communication degrees ($P=0.012$), and degree of teacher's involvement with children who had inclusive education status ($P=0.015$) in the intervention group were all significantly higher than those in the control group. Furthermore, speech discrimination scores in the intervention group were significantly higher than those in the control group ($P<0.01$).

Factors influencing the outcome of inclusive education placement

We found that receiving ongoing verbal rehabilitation training as well as speech discrimination scores were relevant factors influencing the outcome of inclusive education placement. Children who received continuous verbal rehabilitation training and education in a regular classroom had higher speech discrimination scores and better outcomes of inclusive education placement (odds ratio=0.006, 95% confidence interval: 0.000–0.206; $P=0.005$; Table 3).

Discussion

Inclusive education is a current trend in the development of special education worldwide, which is conducted in such a way that children with special needs can join their normally developing peers in regular classrooms at preschool, elementary, and higher educational levels. In general, deaf children can adapt well to regular schools,

Table 1. Basic information of participants.

Item	Intervention group		Control group		P
	Number of cases	Proportion (%)	Number of cases	Proportion (%)	
Sex					
Male	16	57.1	15	46.9	0.297
Female	12	42.9	17	53.1	
Age, years					
<6	4	14.3	6	18.7	0.860
6–12	21	75.0	22	68.8	
>12	3	10.7	4	12.5	
Age at surgery, years					
<2	12	42.9	13	40.6	0.994
2–5	15	53.6	17	53.1	
Duration of attendance at regular school					
>5	1	3.5	2	6.3	0.466
1–2 years	11	39.3	14	43.8	
>2 years	17	60.7	18	56.2	

Table 2. Visual analog scale (VAS) scores of subjective perceptions and speech discrimination scores in the two groups.

Group	n	Speech discrimination score	VAS score of subjective perception			
			Academic adaptability	Peer relations	Initiative communication degree	Attention from teachers
Intervention group	28	87.29 ± 8.61	7.32 ± 1.54	7.07 ± 1.49	7.14 ± 1.60	7.50 ± 1.77
Control group	32	75.38 ± 9.56	6.09 ± 1.59	6.22 ± 1.56	6.13 ± 1.45	6.41 ± 1.60
<i>t</i>		5.041	3.023	2.157	2.579	2.508
<i>P</i>		0.000	0.004	0.035	0.012	0.015

Table 3 Regression analysis of factors influencing the outcome of inclusive education placement.

Influencing factor	OR	95% CI	<i>P</i>
Sex	0.154	0.013–1.853	0.141
Physical age	0.579	0.279–1.202	0.143
Age at surgery	0.787	0.338–1.832	0.578
Duration of attendance at a regular school	0.990	0.454–2.156	0.979
Receiving continuous verbal rehabilitation training	0.006	0.000–0.206	0.005
Speech discrimination score	0.762	0.611–0.952	0.016

OR, odds ratio; CI, confidence interval.

With contact among children who are not hearing impaired, deaf children can learn diverse contact skills in how to get along and interact with others. These children can acquire greater stimulation and be educated in a regular environment; they can progress more quickly and by imitating and learning from others, which are the values of inclusive education for children with hearing impairment.⁵

It should be noted that deaf children face problems in adapting to inclusive education, such as independence ability, peer communication, understanding speech and rules, and misconceptions about the expectations of parents, which can lead to problems of withdrawal.⁴ In stressing the

importance of inclusive education for deaf children after cochlear implantation, the specialties of auditory and verbal rehabilitation following cochlear implantation cannot be ignored. As reported, poor outcomes of inclusive education among deaf children may be owing to lack of listening strategies in these children, the inability to correctly understand what others say, poor listening habits, or hearing undercompensation, which lead to the problems faced by deaf children during subsequent education. Other researchers hold that language barriers are the main reason that deaf children cannot integrate into a regular learning environment.⁶ Given the relationship between language and social development,

speech intelligibility is critical for basic communication and is a key factor that affects the social and emotional feelings of children.⁷ Verbal rehabilitation training for deaf children with a cochlear implant should be ongoing. Thus, the precise aim of the present study was to determine whether continuous verbal rehabilitation training is a factor that can influence the outcome of inclusive education placement.

We found that VAS scores in the intervention group were all significantly higher than those in the control group. Furthermore, speech discrimination scores in the intervention group were significantly higher than those in the control group. Ongoing verbal rehabilitation training and speech discrimination scores were factors that affected the outcomes of inclusive education placement in our study. Children who received ongoing verbal rehabilitation training and learning in a regular classroom had higher speech discrimination scores and better outcomes of inclusive education placement. A possible reason for our findings is that the hearing ability of deaf children was preoperatively deprived; the auditory nervous pathways lacked effective stimulus, the articulating organs (e.g., tongue, soft palate, and lips) were rigidified, or vibration of the vocal cords could not be efficiently controlled. It has been reported in previous research that residual acoustic hearing before cochlear implantation has little impact on the verbal ability of children whereas training after implantation has a greater influence on the ability to discriminate speech,⁸ which is consistent with the present results.

Conclusion

Cochlear implantation should be accompanied by long-term auditory and verbal rehabilitation training that is ongoing. Hence, verbal rehabilitation training should be continuously provided to children with

cochlear implants. Persistent verbal rehabilitation training following cochlear implantation in prelingually deaf children within inclusive education can substantially improve the outcomes of inclusive education placement among deaf children.

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Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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