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Effect of cochlear implantation on hearing and speech rehabilitation in pre-lingual deaf children

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ABSTRACT. Objective: *The purpose of this study is to investigate the effect of cochlear implantation on the hearing and speech rehabilitation of pre-lingual deaf children.* ***Method:*** *This study selected 80 children with pre-lingual deafness who were treated by China Hearing and Language Rehabilitation Research Center from January 2015 to 2018 as subjects. All the children were diagnosed to meet the standard of cochlear implantation, and their mother tongue was Putonghua. After completion of treatment, the changes of SIR and CAP scores with rehabilitation time were compared and analyzed.* ***Result:*** *There was a significant positive correlation between IT-MAIS/MAIS score probability and CAP score. ($r=0.485$,$P<0.05$). Rehabilitation effect of two groups of children was consistent, and there were similarities in the interpretation of rehabilitation effect. However, the difference between CAP scores was large, and the occurrence of this result may be related to parents'judgment.* ***Conclusion:*** *Rehabilitation of pre-lingual deaf children after cochlear implantation is a complex and long-term training process, which requires long-term follow-up of relevant personnel in many aspects to obtain the results that meet the law of auditory and speech development.*

KEYWORDS: *Cochlear implant; Prelingual deaf children; Effects of hearing and speech rehabilitation*

At present, cochlear implantation is the preferred treatment for pre-lingual deaf children. However, it is still impossible to evaluate the rehabilitation effect of hearing and speech in children after operation .The effectiveness of SIR, CAP and IT-MAIS in evaluating the rehabilitation of children's hearing and speech after operation has been proved. Questionnaires are used to investigate the three evaluation methods, which will not be affected by children's incompatibility, so it is easy to carry out. This study was to investigate the effect of cochlear implantation on hearing and speech rehabilitation of pre-lingual deaf children. The specific reports are as follows.

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1. Materials and Methods

1.1 Basic data

This study selected 80 children with pre-lingual deafness who were treated by China Hearing and Language Rehabilitation Research Center from January 2015 to 2018 as subjects. All the children were diagnosed to meet the standard of cochlear implantation, and their mother tongue was Putonghua. Among them, 41 were males and 39 were females, aged from 20 to 102 months, with an age range of (52.6±22.4) months. There were 39 children under 3 years old and 51 children over 3 years old. The age of cochlear implantation ranged from 11 to 93 months. The average age of cochlear implantation was (36.4 +19.5) months. Some children wear hearing aids before operation and have certain hearing and speech abilities. All patients were switched on and adjusted reasonably one month after cochlear implantation.

1.2 Method

Significant Auditory Integration Scale (MAIS) and Significant Auditory Scale (IT-MAIS) for Infants and Young Children. These tables include three aspects and ten questions. According to the frequency of each problem, there are five classifications: 0, 1, 2, 3 and 4. The first two of MAIS/IT-MAIS are different. Questions 1 and 2 of IT-MAIS mainly assess infants'active pronunciation. Questions 1 and 2 of MAIS mainly examine infants' dependence on cochlear implants. Questions 3-6 of MAIS/IT-MAIS mainly understand infants'perception of sound. Questions 7-10 mainly evaluate infants' ability to recognize sound.Infants aged 36 months should be assessed by the IT-MAIS scale, and those aged over 36 months should be assessed by the MAIS scale. All scores were obtained by inquiring the parents of infants and young children face to face or by telephone follow-up.If two scores exceed the standard, they should not be included in the statistical scope[1].

CAP and SIR, CAP children's hearing ability is 0 - 9. The scores are assessed by parents according to their children's response to external voices. SIRSIR is classified as 1-5 according to the intelligibility of children's self-spoken language, and the scores also need to be properly assessed by parents.

1.3 Statistical method

SPSS 21.0 statistical software was used to analyze the data. The measurement data were expressed by $\bar{x} \pm s$ method and t-test was carried out. (n) Indicates the number of cases in the counting data, (%) represents the percentage, using the X^2 test, with $P < 0.05$ as the statistical significance.

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2. Result

Table 1 is the statistical results of MAIS/IT-MAIS scores. It can be seen from the table that the scores of auditory development, voice perception and voice recognition are relatively low at the start of one month, but after three months, the scores of three items have increased significantly. However, the three scores increased significantly six months ago and decreased significantly after six months, which may be directly related to the gradual improvement of ability recovery. The scores of MAIS and IT-MAIS are basically the same.

Table1 MAIS/IT-MAIS Score Statistics $\bar{x} \pm s$

Table	Scores	1 month	3months	6months	12months
IT-MAIS	Overall score of auditory development	11.74±7.71	42.81±14.17	52.33±12.70	69.91±17.67
	Voice perception ability score	15.47±12.67	51.73±22.14	63.17±29.09	74.37±12.73
	Voice Recognition Ability Score	1.13±1.17	21.61±13.17	43.13±23.11	79.19±24.91
MAIS	Overall score of auditory development	10.98±7.56	43.11±14.23	51.87±12.69	69.90±17.59
	Voice perception ability score	15.67±11.99	51.44±22.37	63.14±29.09	74.27±12.67
	Voice Recognition Ability Score	1.11±1.16	21.71±13.39	42.89±23.07	79.37±24.17

The changes of SIR and CAP scores with rehabilitation time were compared between the two groups as shown in Table 2. Table 2 shows the results of SIR and CAP. Statistical results show that children's SIR and CAP scores increased more than 6 months ago. This result is similar to that of MAIS/IT-MAIS.

Table2 The changes of SIR and CAP scores with rehabilitation time were compared between the two groups $\bar{x} \pm s$

Team	n	1 month	3months	6months	12months
	≤3	1.01±2.37	1.75±2.01	3.59±2.70	4.93±2.68
CAP	>3	1.41±2.89	1.89±2012	3.07±3.0	4.15±2.84
	≤3	1.31±2.0	1.64±2.14	2.78±1.98	3.79±1.60
SIR	>3	1.45±2.12	1.86±2.18	2.63±2.01	3.29±1.90

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3. Discuss

The auditory development of children with cochlear implantation is obviously more advantageous than that without cochlear implantation. If the implantation age is very small, the auditory development curve will become steep. After cochlear implantation, the auditory development of children will be improved. On the contrary, the auditory development curve of children with cochlear implantation is relatively flat. According to the specialty clinicians of otolaryngology in China, early detection and timely cochlear implantation for children with severe or severe sensorineural symptoms is helpful to improve their hearing and language proficiency [2].The study showed that SIR, CAP and IT-MAIS scores increased with the time of rehabilitation treatment. The improvement rate of 6 months before rehabilitation treatment was significantly better than that of 6 months after rehabilitation treatment. The rehabilitation effect of children in the group above 3 months was significantly better than that in the group below 3 months. The reason may be that the sensitive period of children's auditory central nervous system can be stimulated by cochlear implantation as soon as possible. Therefore, the faster the development of hearing, the more remarkable the effect of rehabilitation [3].

Prelingual deafness was monitored by cochlear implantation with SIR and CAP scales for 5 years. The results showed that children under 3 years old had a higher CAP score. After 3 years of rehabilitation, CAP could reach the plateau stage, while SIR could reach the plateau stage only after 5 years of rehabilitation. The results showed that the SIR and CAP scores of the two groups increased gradually with the time of rehabilitation treatment. The SIR and CAP scores of children with 6 months or less increased faster than those of children with 6 months or more, and the growth rate of SIR scores was significantly lower than that of CAP scores. The reason is that the hearing level of children with pre-linguistic illness is equal to that of newborns. It needs to start with the observation of sound and gradually develop into voice recognition, voice understanding and communication. The SIR score usually focuses on the level of communication. Therefore, the growth of CAP score is relatively backward. SIR and CAP score have not reached a significant plateau period, so they can not. The time of SIR and CAP score recovery plateau period was clearly estimated [4].

According to the professional clinicians of otolaryngology in China, SIR is correlated with CAP score and most evaluation methods. The results show that there is a significant positive correlation between IT-MAIS and MAIS score and CAP score ($r = 0.485$, $P < 0.05$). It shows that there is consistency in evaluating the curative effect of rehabilitation between the two groups, and there is some similarity in explaining the curative effect of rehabilitation, but it also shows that the scores of IT-MAIS and MAIS are identical, and the difference between CAP and IT-MAIS is great. Both of them are subjectively assessed by the parents of the child by evaluating the response of the patient to voice in daily life and the surrounding environment. IT-MAIS and MAIS focus on understanding, recognizing and perceiving voice, while CAP focus on communication, recognition and perceiving voice. Therefore, the two scales can not be equal to each other. We should pay more

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attention to the differences between them when evaluating children's hearing and speech.

In a word, the rehabilitation of pre-linguistic deaf children after cochlear implantation is a complex and long-term training process, which requires long-term follow-up of relevant personnel in many aspects, in order to obtain the regular results to meet the development of auditory and speech.

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