



Educational Support for Primary School Children with Hearing Impairments After Cochlear Implantation

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Abstract. The article presents information on the modern organization of postoperative rehabilitation and correction after cochlear implantation of children with hearing impairments in Mongolia and also provides an analytical review of the results of cochlear implantation surgery on the example of primary schoolchildren with a cochlear implant in a school for deaf children. In addition, the article describes the directions of complex hearing and speech support for persons with hearing impairment after cochlear implantation. The present study was based on data of school for deaf children No. 29 in Ulaanbaatar, Mongolia. The experiment, carried out using questionnaires, involved 22 deaf primary school children after cochlear implantation.

Keywords: children with hearing impairments · cochlear implantation · primary school children · educational support

1 Introduction

Scientists note that a persistent violation of the auditory analyzer leads to significant deviations in the speech development of the child, negatively affects the mental status of the individual, entails a limitation in the possibility of knowing the world around, mastering knowledge, skills, attitudes and prevents full verbal communication with people around (V. I. Belyukov, R. M. Boskis, L. A. Venger, T. A. Vlasova, K. A. Volkova, L. S. Vygotsky, G. L. Vygodskaya, A. I. Dyachkov, S A. Zykov, E. I. Isenina, B. D. Korsunskaya, E. I. Leongard, E. M. Mastyukova, N. F. Slezina, I. M. Soloviev, F. A. Rau, F. F Rau, T. V. Rozanova, J. I. Shif, etc.). Early identification of children with hearing impairment and early start of medical care (prosthetics with modern digital hearing aids, cochlear implantation [CI] operation) and educational support will contribute not only to the formation of their speech as the main means of communication, but also to harmonious development the personality of the child holistically.

The innovative technology of multi-channel cochlear implantation is considered the most modern means of rehabilitation for children with profound hearing loss, which, from a scientific and practical point of view, is regarded as the most effective means of

restoring the hearing of children with hearing impairment. At the present, this method is also spreading in Mongolia as one of the modern methods of rehabilitation of persons with hearing impairments. Therefore, the current provision of assistance and educational support to persons after cochlear implantation seems to be a significant and urgent issue for Mongolian society.

From a social point of view, this method allows children with prelingual deafness to become members of the world of hearing, and adults with acquired deafness to return to their usual way of life. A cochlear implant (CI) opens up the possibility for children to integrate inclusively into the classical education system.

The basis of inclusive education is the recognition of the individual needs of each student. Therefore, work in inclusive education provides for the creation of various forms of pedagogical support - special conditions for training and education, allowing to take into account the special educational needs of children with disabilities through the individualization and differentiation of the educational process [9].

2 Educational Support

The processes of inclusive education and upbringing should be considered and initiated in a broad aspect, in which the efforts of various specialists are combined: class teachers, educators, speech pathologists, psychologists, speech therapists, rehabilitation specialists, as well as parents raising children with developmental disabilities. The main way to organize this process is the educational support of a student with disabilities.

Educational support is a complex system of inclusion and assistance to children with disabilities and their parents in solving the problems of adaptation, development, training, education, and socialization by specialists of different profiles acting in concert [6, 7, 9]. In the case of a school for deaf children in Mongolia, we investigated the educational support of primary school children with hearing impairments after cochlear implantation.

3 Cochlear Implantation

Cochlear implantation is not only a surgical operation, but a whole system of measures that includes preoperative diagnostic examination and selection of patients, surgery, and postoperative long-term auditory and speech rehabilitation of patients [1].

After implantation and adjustment of the implant processor, the hearing sensitivity of patients increases significantly, on average, to the level of the 1st degree of hearing loss (25 dB from the norm). These conditions provide patients with the ability to distinguish between whispered speech and soft sounds.

The effectiveness of cochlear implantation depends on the age of the patient, the duration and etiology (cause) of deafness. The most encouraging results are observed in postlingual or late-deafened patients: in adults who have mastered speech, but for some reason lost their hearing (trauma, meningitis, etc.). The most important, lengthy and requiring appropriate attention stage is also postoperative rehabilitation, the purpose of which is to educate the young patient and provide qualified assistance aimed at listening to speech, its comprehension. The implant provides such an opportunity, but the medical

community and teachers equally should also pay attention to the rehabilitation period, because often for children with congenital deafness at this stage the question of learning to speak, the question of habilitation, will often arise for the first time. Postoperative measures, the number, frequency and effectiveness of their course and, in general, the rehabilitation of persons after the installation of a cochlear implant, depend on a variety of factors, one of the most important of which is the moment of hearing problems in a child, the age at which hearing was lost. It takes 1 to 3 months for late-deafened adults and children to learn to understand speech well with an implant. In children with congenital deafness, the duration of hearing and speech rehabilitation is 5 years or more [4, 8, 10, 11].

In order for a child to successfully pass the primary stage, a conscious, systematic, coordinated work of parents with a teacher of the deaf, based on an individual approach to the child, is required. At the same time, the most significant is the work aimed at helping in the postoperative period by relatives, relatives and parents of the child. This is due to the fact that the child Ulaanbaatar's mastering of the language picture of the world and speech skills occurs in the background on a daily basis. In the scientific literature, this phenomenon is called the spontaneous method of speech and is the norm. In this regard, spending several hours with a specialist and a teacher is insufficient in the process of postoperative measures aimed at the rehabilitation of the child. The success of this venture lies precisely in the joint work of family members with teachers, working out the recommendations of specialists at home [1–3].

Deaf pedagogical support and qualified assistance on a permanent long-term basis is necessary for both the child and their parents, who are links in the same chain. It is also worth noting that along with the operation to install a cochlear implant, as a modern medical and technical method of treatment, the child needs to create conditions for high-quality rehabilitation based on modern, technological methods as well [5].

4 A Comprehensive Study of Deaf Children with Cochlear Implants at 29th Special School in Mongolia

At the analytical stage of the study, the experience of working on the educational support of children with hearing impairments after cochlear implantation on the basis of the 29th special school for children with hearing impairments in Ulaanbaatar, Mongolia is analyzed. This school is the only school in Mongolia that provides special education services for deaf children. This academic year, it has a total of 298 students. In total, cochlear implants were installed at the school by 33 children, 22 of which were junior schoolchildren. Thus, the experimental group included children with a cochlear implant of primary school age. The study covers 22 children from 7 to 14 years old. According to the audiological examination, children with CI had such diagnoses as sensorineural deafness - in 19 children, hearing loss of IV degree - in 3 children. A characteristic feature is that all children received a unilateral implant. There were no other diagnoses and pathologies, except for 1 child, who had an additional diagnosis of hyperactivity.

The study consisted of three types of questionnaires. The first questionnaire is a survey of parents of children with CI and consists of 18 questions. The goal is to find

Table 1. Immediate cause of hearing loss

For acquired causes of hearing impairment, state age	Immediate cause of hearing loss						Total
	had meningitis	injections	birth injury	brain pressure	born prematurely	antibiotics	
at birth	0	0	1	0	1	0	2
up to 1 year	1	2	0	0	0	1	4
2 years 4 months	0	0	0	1	0	0	1
Total	1	2	1	1	1	1	7

out general information about the child, his state of health, the level of speech development of the child before cochlear implant surgery, as well as the child's attendance at rehabilitation classes.

The second questionnaire is also intended for parents and consists of 22 questions. The purpose of this questionnaire is to provide general information about pediatric cochlear implant surgery and postoperative rehabilitation.

The third questionnaire is intended for school coordinators and consists of 7 questions. The purpose of the survey was to find out what kind of pedagogical support is provided to children with CI by the school. The data of the questionnaire is shown in the appendix.

A general overview analysis of the results of the summarized survey results is shown below.

Most elementary school children with cochlear implants have had congenital hearing loss. However, 7 out of 22 people had acquired causes.

Table 1 shows the causes of hearing loss in these seven children and at what age they were diagnosed.

Two of these children with acquired hearing loss were diagnosed at birth, four were diagnosed with hearing loss before two years of age, and one child was diagnosed with hearing loss after two years of age.

Figure 1 shows that most children are diagnosed by age 2. At the earliest, one of these children was diagnosed with deafness at birth and, at the latest, at the age of 3 years and 4 months. This means that most children are not diagnosed with hearing loss at an early age. Due to the lack of early diagnosis of hearing impairment, parents cannot start rehabilitation and Educational support for their children in time.

Three children have minor remnants of hearing, ie. Two of these children had congenital deafness and one had acquired hearing loss.

4 children in the family have persons with hearing impairment. Two of them are twin girls who participated in this study. The remaining children do not have persons with hearing impairment in the family.

To the question "What actions were taken when a child with a hearing impairment was found?", the parents answered the following, as shown in Fig. 2.

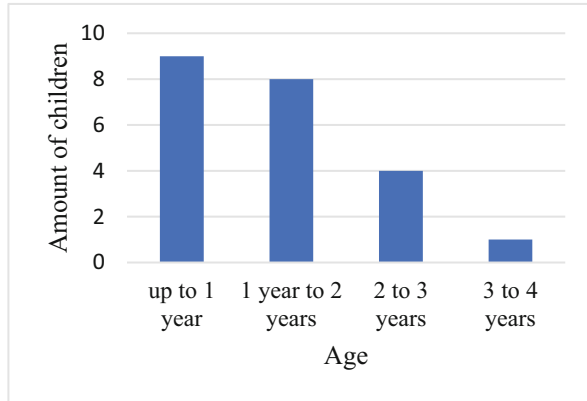


Fig. 1. Diagnosis of deafness

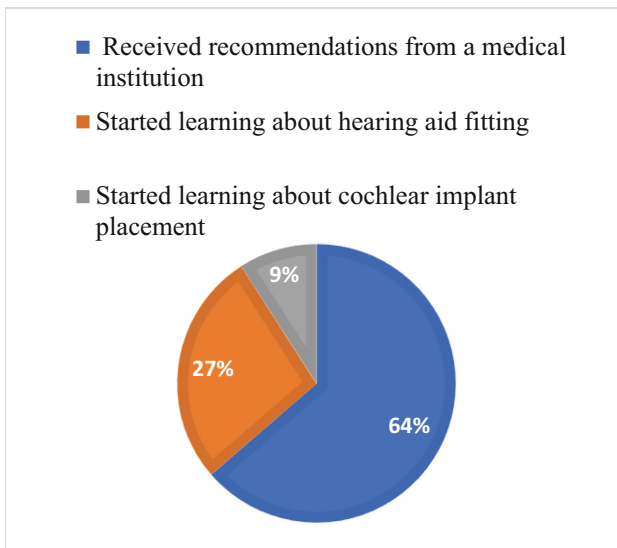


Fig. 2. Actions taken when a child is found to have a hearing impairment

Of the 22 children surveyed, 11 had some form of hearing aid and wore it from 1 to 5 years. All children wore hearing aids behind the ears. Although, of the 11 children who wore these hearing aids, only two attended rehabilitation classes after hearing aids were fitted.

Figure 3 show how parents communicated with their child before the cochlear implant surgery. This shows that until the child had cochlear implant surgery, most parents communicated with their children in sign language.

Figure 3 shows that most parents communicated with their children in sign language prior to cochlear implant surgery, and also reported that before cochlear implant surgery

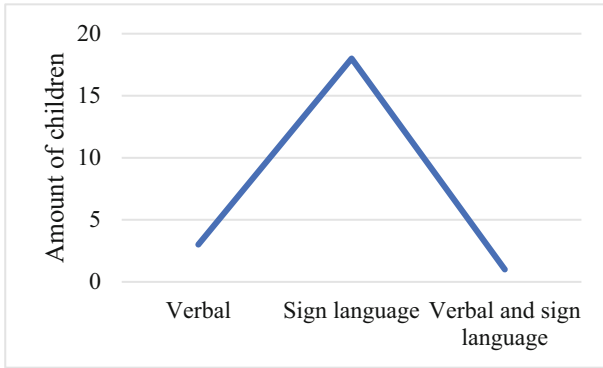


Fig. 3. Communication with the child before the cochlear implant surgery

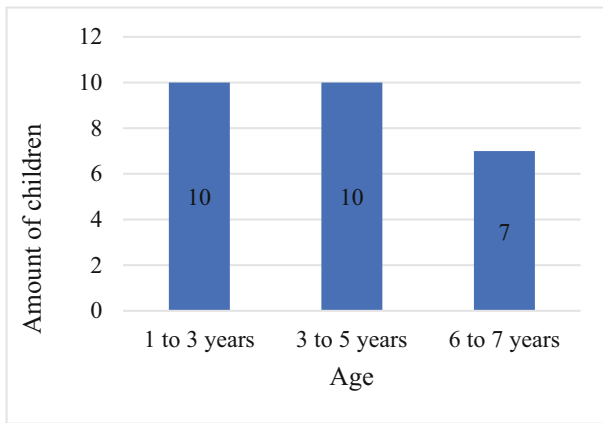


Fig. 4. Age was the cochlear implant surgery performed

it was difficult to assess their child’s language development and was not particularly able to understand each other. About 60 percent of all children have had cochlear implant surgery before the age of 3 years. This is the time when speech development has not yet begun in deaf children. Only 2 children had speech consisting of single words using gestures before the operation (they have people with hearing problems in the family). One of these children underwent cochlear implant surgery at the age of 3 years, and the other at 4 years and 2 months.

Figure 4 shows the age of the children in the study who underwent cochlear implant surgery. Cochlear implant surgery is best done in children with congenital deafness before the age of 3 years, and in children with acquired deafness as soon as possible after hearing loss. The earliest cochlear implant surgery among the children studied was at the younger age of 1 year and 3 months (diagnosed at the age of 3 months, congenital deafness), and the latest operation at the age of 7 years (diagnosed at the age of 1 year and 2 months, acquired deafness).

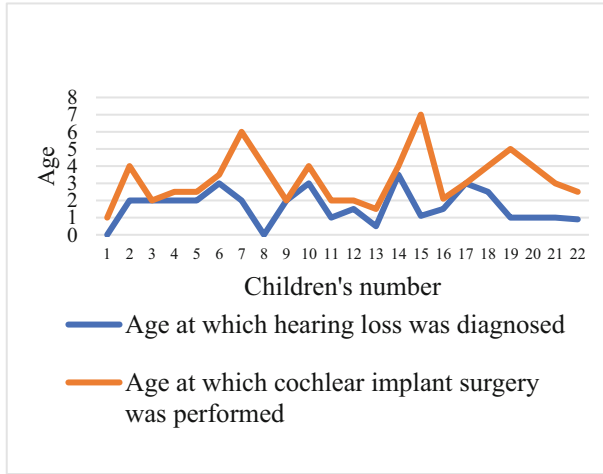


Fig. 5. Age diagnosed with hearing impairment and cochlear implant surgery

Also, the majority of children (11 people) who underwent cochlear implant surgery were advised to undergo this operation when they were 2 years old. Four children underwent surgery immediately after the recommendation, and five children six months later. The rest of the children underwent cochlear implantation after an average of 1.5 years.

Who recommended cochlear implant surgery? When asked, parents answered that 18 doctors (81.82%), 3 pediatricians (13.64%) and 1 self-employed (4.55%). The study shows that at least 7 children underwent cochlear implantation immediately after recommendation, 3 children after 6 months, and 1 child underwent cochlear implant surgery 2 years and 2 months after recommendation. This shows that since parents are advised to have surgery, they send their child for emergency cochlear implant surgery.

However, a comparison of how long cochlear implant surgery was performed after the initial diagnosis of hearing loss reveals the following results. As soon as the children were diagnosed with hearing loss, they underwent cochlear implant surgery as soon as possible. Nine children had it done in less than 6 months. Only one child underwent surgery six years after being diagnosed with deafness.

Table 2, we can see where these children had cochlear implant surgery.

Most of the children who received cochlear implants were operated on in Mongolia, while a small number of children underwent surgery abroad. Most of the children in Mongolia were operated on at the EMJJ and Med-El polyclinic. A small number of children were operated on at the NCMC. Several years have passed since the clinics of EMJJ and Med-El perform cochlear implant operations. And the National Center for Maternal and Child Health of Mongolia /NCMCH/ has only recently begun to carry out cochlear implantation operations.

Most children are connected to the speech processor one month after the operation. In Mongolia, the first connection of cochlear implants is performed after an average of 4 weeks. Of the 22 children who underwent surgery, 18 children constantly wore devices, and 4 children did not wear them constantly. Of the 22 children surveyed, 19 attended

Table 2. Length of speech therapy session

Where did you attend classes in speech therapy and speech development	You are engaged in speech therapy and speech development				Total
	Daily	2–3 times a week	1 time a week	1–2 times a month	
n the polyclinic “EMJJ”	1	6	0	1	8
in the polyclinic “Med-El”	0	5	1	0	6
NCMCH	0	0	0	2	2
In Korea	0	1	0	0	1
At school №29	0	2	0	0	2
Total	1	14	1	3	19

Table 3. The duration of speech therapy

Duration of one lesson	After surgery, how long did you attend speech therapy and speech development classes after cochlear implant surgery?			Total
	3 months	6 months	1 year	
20 min	0	1	0	1
30 min	1	3	6	10
40 min	1	0	2	3
1 h	0	0	2	2
2 min	2	0	1	3
Total	4	4	11	19

postoperative classes. And 3 children could not complete postoperative rehabilitation classes. Currently, medical institutions performing cochlear implant surgery in Mongolia are responsible for post-operative rehabilitation and remedial classes. Therefore, most often the children attended the postoperative correctional class in the clinic, where cochlear implantation was performed.

Children undergoing postoperative classes also attended postoperative rehabilitation for a minimum of 3 months and a maximum of 1 year. One-time speech therapy sessions for these children lasted from 20 min to 2 h.

Information about remedial classes is detailed in Table 2.

As can be seen from the table above, the duration of speech therapy classes for postoperative rehabilitation for 13 children who underwent cochlear implant surgery was 30–40 min.

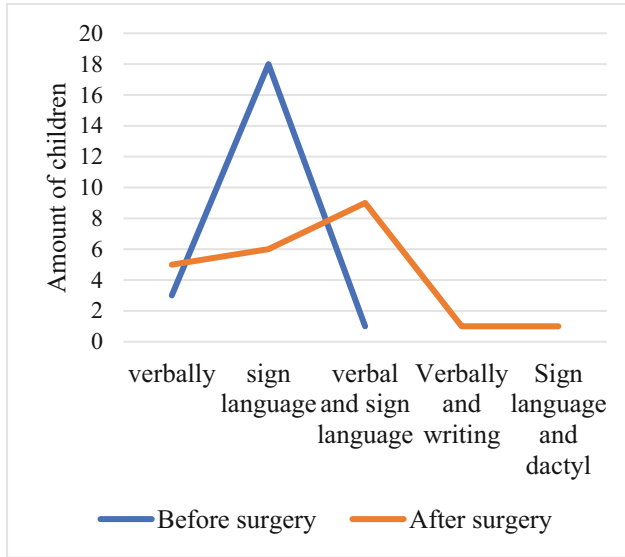


Fig. 6. Comparison of communication with a child before and after cochlear implant surgery

You can see that the duration of one speech therapy course varies from child to child. It depends on the program of the institution, which organizes the correctional classes.

Figure 6 compares how parents communicate with their children before and after cochlear implant surgery. This shows that communication between parents and their children has changed positively as a result of cochlear implant surgery.

As mentioned earlier, a total of 19 children attended postoperative speech therapy classes for a period of 3 months to 1 year. Of these, 13 mastered sound speech to a lesser extent. 6 children did not master sound speech at all. But of these, 3 children learned to distinguish sounds, recognize simple words by ear.

Children who attended speech therapy classes 2–3 times a week during the year achieved the greatest results in speech development.

As can be seen from the above study, the duration of postoperative speech therapy sessions for 13 children who underwent cochlear implantation was 30–40 min. Of the 22 children who underwent cochlear implant surgery, 14 children had a low degree of mastering sound speech. Of the remaining eight children, although four did not master sound speech, they began to distinguish sounds and hear simple words. The remaining 4 children showed no change.

The study showed that 36.36% of all children who underwent cochlear implant surgery and received postoperative pedagogical support mastered sound speech in low stenosis. In terms of parental satisfaction with cochlear implants, 40.91% said they were satisfied,

22.73% said they were average, and the remaining 36.36% said they were dissatisfied with the operation and results. This indicates the need to improve this process.

Of the four children who had no results, 3 had congenital hearing loss and one had hearing loss due to birth trauma. These children at the age of 2–3 years underwent

cochlear implantation. One of them had a broken device after the operation, so he did not attend rehabilitation. The remaining three children attended postoperative rehabilitation classes from 3 months to 1 year. As a result, we can conclude that it is necessary to improve the conditions of postoperative classes.

Of the 22 children who underwent cochlear implant surgery, only one had a change in behavior after surgery. The child has become angry and does not like to wear the apparatus.

Next, we will consider what factors influenced the outcome of cochlear implant surgery.

The following graph shows how the cause of the hearing loss in these children affected the outcome of the surgery. As a percentage, 60% of children with congenital hearing loss and 71% of children with acquired hearing loss mastered speech after surgery. 40% of children with congenital hearing loss and 29% of children with acquired hearing loss did not master sound speech after surgery.

Figure 7 shows the relationship between cochlear implant age and postoperative sound perception. According to the results of the survey, half of the children who underwent cochlear implant surgery at an early age up to 3 years, mastered the sound speech. The largest number of children (5 children with an implant at the age of 3 to 4 years) underwent surgery and mastered sound speech.

How attendance at preoperative rehabilitation sessions affected postoperative outcomes:

Two children attended rehabilitation classes after hearing aid placement prior to cochlear implant surgery. One of them communicated with his parents only in sign language before the operation, and at the age of four he underwent cochlear implantation. After cochlear implant surgery, the child attended daily speech therapy classes for 6 months. The child mastered sound speech and began to communicate with others verbally. Preoperative and postoperative rehabilitation had a very good effect on the results of this child.

Another child underwent cochlear implant surgery at the age of three. After cochlear implantation, the child attended speech therapy classes 1–2 times a month for a year. At

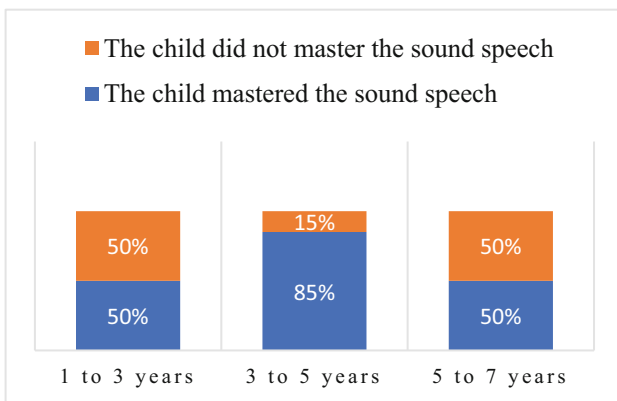


Fig. 7. Does the age of cochlear implant surgery affect the outcome?

the beginning there was no result, later it appeared. Although the child did not master sound speech, he began to distinguish sounds.

The third questionnaire is intended for school coordinators and consists of 7 questions. The purpose of the survey was to find out what kind of educational support is provided to children with CI by the school. A breakdown of the first survey results is shown below.

Information from the coordinator/specialist at the school.

School No. 29 is a 12-year high school. The school has 33 students who have had cochlear implants installed. The school does not have a special program for children who have had cochlear implants. The program is the same as for other children. Also, educational support for children with cochlear implants is limited to the main school curriculum. However, parents, class teacher, speech therapist, social worker and psychologist work together on some tasks.

The elementary school curriculum includes such disciplines as speech therapy, art therapy, sign language and exercise therapy.

Speech therapy, a lesson in rhythm and physical therapy are correctional lessons that are included in the school curriculum. Depending on the type, level of hearing loss, and diagnosis, students in grades 1–10 attend in individual lesson 20-min speech development sessions twice a week. Therefore, younger students who have a cochlear implant also attend these classes.

The content of the rhythm lesson consists of a theoretical part and a musical exercise. Rhythm music lessons include piano and music. This class lasts 40 min once a week.

Separately, physical education classes are held, the lesson lasts 20 min once a week. However, this lesson is not suitable for every child. Only children with physical therapy appointments are allowed. This includes children who have had cochlear implant surgery. The parents of the children interviewed expressed a strong desire to increase the number of hours of speech therapy classes for children with CI in the school curriculum.

5 Findings

The results of the study show that after the diagnosis of deaf children, there are almost no rehabilitation measures. Parents also do not enroll their children in remedial classes, although they have.

The study found some changes in the majority of children who underwent cochlear implant surgery. However, it's all about distinguishing sounds and mastering speech at a very low level. The most effective children limit themselves to memorizing simple words. And in some children, there was no change, improvement in hearing or speech. This indicates the need to improve this process.

For congenitally deaf children, rehabilitation after cochlear implantation can take up to 7–8 years, but in Mongolia, rehabilitation is limited to a maximum of one year after surgery only in the medical institution that installed the cochlear implant. Thereafter, there is no formal system of educational support. Therefore also a need to introduce special programs for children with cochlear implants in the school environment. This requires a well-organized postoperative pedagogical support by the team.

In response to a parent's question about cochlear implants, the majority of interviewed parents are satisfied with cochlear implant surgery. However, the focus should be on postoperative care and pedagogical support. In this area, it is necessary to train a large number of specialists. Parents also expressed their sincere wishes for professional advice on how to communicate with and support their children who have received cochlear implants.

In Mongolia, cochlear implant surgery is a relatively new option for people with deafness from a sensorineurological cause of hearing loss. No more than 10 years have passed since the introduction of this method in Mongolia. So, you can see that it is in the early stages of development. In particular, there is an urgent need to improve post-operative rehabilitation programs and remedial training, as well as to develop common standards, curricula and guidelines for postoperative rehabilitation.

Appendix

Questionnaire 1 (for parents).

Please fill out our questionnaire. It's very simple. For each question, choose and write the answer that best suits you. In the column "other" you can enter your own answer.

1. Full name;
2. Class;
3. Date of birth;
4. Gender;
5. Age.
6. Causes of hearing loss:
 - congenital.
 - acquired.
7. In case of acquired causes with hearing loss, indicate age;
8. Immediate cause with hearing loss;
9. Age at which hearing impairment was diagnosed;
10. Are there any remnants of hearing;
11. Are there people in the family with hearing problems? If available, then specify the property;
12. What actions were taken when a child with a hearing impairment was found?
13. Did you wear a hearing aid?
14. What kind of hearing aid was used?
15. How long have the hearing aid been worn?
16. Have you attended recovery and rehabilitation classes after hearing aids?
17. How was the communication with the child before the cochlear implant surgery?
 - verbally;
 - Sign language;
 - Dactile;
 - In writing.
18. What was the Level of the CHILD'S Speech Development Before the Cochlear Implant Surgery?

Questionnaire 2 (for parents).

1. Who recommended a cochlear implant? At what age is the child?
 2. At what age was the cochlear implant surgery performed?
 3. Where, in which medical institution was the cochlear implant surgery performed?
 4. How long after the diagnosis was the operation performed?
 5. On which ear?
 6. What company?
 7. Where, in which medical institution was the cochlear implant surgery performed?
 8. How long after the cochlear implantation was the speech processor connected?
 9. Where was the speech processor connected?
 10. Does the child wear the speech processor all the time (when awake)?
 11. Have you attended speech therapy and speech development classes since your cochlear implant surgery?
 12. Where did you attend speech therapy and speech development classes after cochlear implant surgery?
 13. Do speech therapy and speech development.
 - Daily;
 - 2–3 times a week;
 - 1–2 times a month;
 - If not, please state the reason.
 14. How long is one session?
 15. After surgery, how long did you attend speech therapy and speech development classes after cochlear implant surgery?
 16. Has the child mastered sound speech?
 17. Communication with a child after cochlear implant surgery. Changes before and after?
 - verbally;
 - Sign language;
 - Dactile;
 - In writing.
 18. What changes and results do you notice after the cochlear implant surgery for speech therapy and speech development classes?
 19. Has the child's behavior changed since cochlear implant surgery? If yes, what changes?
 20. Are you satisfied with your child's cochlear implant surgery?
 21. What actions are family members doing to support children's language development at home? Have you received advice from a professional organization?
 22. Share your impressions and leave your comments about the cochlear implant surgery and subsequent classes in speech therapy and speech development?
- Questionnaire 3 (for school coordinator/specialist).
1. Does your school have a special rehabilitation program for children with CI?
 2. What types of pedagogical support are provided for children with CI?
 3. What remedial lessons are included in the school curriculum?
 4. How is the speech therapy class conducted, how many times a week and for how long?
 6. How is the rhythm lesson conducted?

7. How are physical therapy classes conducted?

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