

COCHLEAR IMPLANTATION AS A WAY TO OVERCOME HEARING PROBLEMS

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ABSTRACT

The ear, as an organ of hearing, can be damaged or have problems during intrauterine development. As a result, hearing is impaired, which negatively affects speech, mental development and the communication process in children. Schoolchildren with special educational needs (SEN), suffer not only from general speech disorders and phonetic speech disorders but are mainly related to the damage of the higher cortical centers of the brain responsible for speech, as well as to hearing problems. The

latter can be alleviated by using hearing aids at the early stage or by performing a cochlear implantation process. However, a question suggests itself. Do families that have children with such problems cope with their social and financial problems? An issue requiring public attention and care and is directly related to the improvement of education quality.

Keywords: children with special education needs, children with disabilities in need of special conditions for upbringing, SSD-speech sound disorder, general speech underdevelopment, cochlear implantation.

INTRODUCTION

The ear a sensory organ of hearing can be damaged or simply have functional problems from the period of intrauterine development. Problems that are the cause of deafness and sometimes deafness in children at different stages of individual development, ontogenesis.

Hearing problems have a negative impact on children's speech development, communication and intellectual development. Moreover, currently among students with special educational needs (SEN), general speech underdevelopment (SPE), speech phonological underdevelopment (SPU)/speech sound disorder (SSD), as well as different degrees of hearing impairment are directly related to hearing problems (Harutyunyan, Bakhshinyan, & Shukuryan, 2008).

The results of the social survey conducted in inclusive schools located in Yerevan, as well as some regions of the Republic of Armenia, document that among the students there are many children who have AMT, PRC, mild intellectual disabilities, visual impairments, various degrees of deafness, autism, locomotor system, also developmental disorders accompanied by damage to the central nervous system (Badalyan, 1987).

Disruptions have a direct negative impact on the quality of education. The causes of hearing impairment are various, including infectious diseases, hereditary or genetic abnormalities, hearing-impairing drugs, otitis media developing in the middle ear, the formation of a sulfur plug in the outer ear, nose, narrowing of the auditory canal - stenosis, lack of mobility of the auditory ossicles - otosclerosis, the pathological course of pregnancy, birth asphyxia, the use of aminoglycoside antibiotics, damage to the auditory nerve - neuritis or cerebral blood flow, which damages the auditory centers of the cortex of the hemispheres (Badalyan, 1987).

According to the observation of the Ministry of Health of the Republic of Armenia and Chief Otorhinolaryngologist of Yerevan Artur Shukuryan, deafness in children is mainly caused by chromosomal mutation or congenital deafness caused by birth complications, and in adults, it is the result of certain diseases (for example, meningitis, meningioma) (Khudaverdyan, 2018, Shukuryan, 2017).

Currently, according to the international classification of deafness, deafness is distinguished based on the site of the lesion. According to which there are three categories of hearing loss: conductive (when the pathways that transmit sound vibrations are damaged), sensorineural (when the subcortical areas of the brain that perceive the auditory signal flow are damaged) and mixed hearing loss (when both are damaged). There are different degrees of hearing loss, including 1st degree, when the audibility limit is 26-40dB, 2nd degree, when the audibility limit is 41-55dB, and 3rd degree, when the audibility limit is 56-70dB. , to the 4th degree, when the limit of audibility is 71-90dB. while in the case of a limit of audibility of 91dB and more, deafness is simply recorded. According to its clinical course, sudden, acute and subacute, and chronic deafness is distinguished (Harutyunyan, Bakhshinyan, & Shukuryan, 2008).

It is known that hearing aids are widely used to improve the auditory perception of children and adults with various hearing disorders, which may help improve hearing rather than cure it. It can be used by everyone regardless of age. However, the use of hearing aids does not always lead to a significant improvement in the auditory perception of speech.

Hearing aids are widely used in more than 80 countries. The best approach to regulate hearing is cochlear implantation, which is carried out in Germany, Turkey, Spain, Korea and Israel (Musheghyan et al., 2018). In Armenia, cochlear implantation has been carried out for about 18 years, for the first time it was carried out in the "Erebuni" medical center back in 2004 (Harutyunyan, 2008). According to Artur Shukuryan, chief otorhinolaryngologist of Yerevan, cochlear implantation is targeted only when the problem is related only to the inner ear, in other cases, it is contraindicated.

The cochlear implant does not work effectively if the deafness is caused not by the damage or destruction of the hair cells of the cochlea, but by damage to the auditory nerve or the central parts of the auditory analyzer, which are localized in the brain stem and the temporal areas of the cortex of the large hemispheres.

Two state programs of audiological screening of newborns have been in place operating in the Republic of Armenia since 2007, which include almost all maternity hospitals of the republic (Shukuryan et al., 2017). The latter makes it possible to detect hearing impairment in infants at an early stage, within 36-72 hours of life, thereby preventing muteness, developmental delay, and therefore disability caused by hearing impairment, and finally, thanks to early intervention, to contribute to the integration of the child in the verbal environment.

However, it should be taken into account that the process of cochlear implantation has its indications and contraindications. Cochlear implantation is indicated in cases of bilateral deafness, low effectiveness of prosthetics with hearing aids, high level of oral speech development in adults and adolescents, absence of physical contraindications for surgical intervention, absence of neuropsychological disorders, absence of normal anatomical structure of the inner ear, absence of

physical diseases. In the case of children, cochlear implantation is indicated for children aged from 1-1.5 years (up to 2-3 years).

Cochlear implantation is contraindicated in complete or partial obliteration of the cochlea (when the cochlear tube is closed with 2.5 turns of the cochlea), post-cochlear pathology, a negative result of the promontory test (when there is a negative result of the electroaudiometric test of sound-sensing hair cells), concomitant severe physical diseases, pronounced intellectual disability, brain in the presence of pathological foci in the subcortical and cortical structures. If the patient's hearing problem is in the middle and upper cortical areas of the auditory analyzer, in such cases an intracerebral implant or a retrocochlear implant is used. However, cochlear implantation has its pros and cons (Table 1).

Table 1

Pros and cons of cochlear implantation

Positive aspects of cochlear implantation	Negative aspects of cochlear implantation
Applicable for severe hearing impairment	Requires surgical intervention
After implantation the person hears sounds clearly and the way they sound	After surgery, special training and rehabilitation are necessary
After the operation and rehabilitation, the person is able to communicate freely and be more independent	Quite expensive
After the operation, the safety of the person is ensured, for example, the rapid perception of the sound of an approaching car	There are postoperative difficulties, namely dizziness, pain, discomfort
The surgery is applicable to different age groups	Outdoor equipment requires special care and maintenance
Long-term, the cochlear implant is placed for life and can be hidden behind hair	The person is forced to give up many types of sports

THE COMPONENT PARTS OF A COCHLEAR IMPLANT

Cochlear implantation for hearing restoration involves placing an electrode system in the inner ear that provides electrical stimulation of the auditory nerve.

A Cochlear implant consists of 2 main parts.

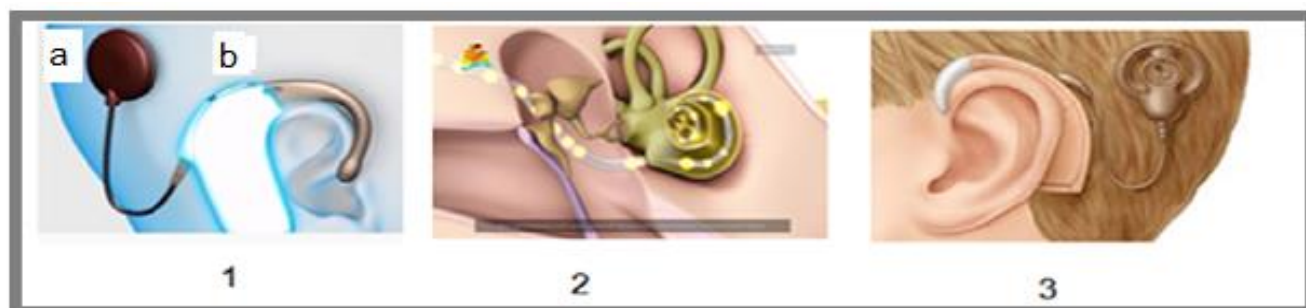
- external
- internal (implantable).

The outer part includes the directional speaker transmitter (the radio transmitter that is placed with its own mold) and the speech processor, which is the main and most complex part of the cochlear implant and is placed behind the ear. The speech processor is powered by a battery and looks like a hearing aid (Picture 1/1). The internal part of the implant includes the receiver or stimulator, the mold of which is made of titanium or ceramic, as well as the circuit of active electrodes and the reference electrode (Picture 1/2). A chain of active electrodes is placed in the cochlea, it seems to replace the hair cells located in the organ of Corti. When stimulating the cochlear implant with an electric current, it is able to direct the electrical impulses transmitted from the electrode to the brain, which ensures the generation of the hearing sensation (Picture 1/3). The outer part is placed on the scalp and connected to the inner implantable part by a magnet through the skin (Picture 1/3).

Thanks to the cochlear implant, patients are given an opportunity to perceive the sounds of the outside world, understand speech, and information from the world, communicate, and the latter contributes to the activation of human interaction and prevents isolation, as well as ensures orientation in space and surroundings.

Picture 1.

Parts of cochlear implant (1. Outer part: 1a, 1b; 2. Inner part: 2; Placement on ear 3).



THE PROCESS AND CIRCLES OF THE COCHLEAR IMPLANTATION

The whole process of cochlear implantation includes three periods. Pre-operative, operative and post-operative. In the pre-operative period, objective and subjective hearing tests are carried out, as well as radiological, pedagogic and psychological tests. Consultations of a therapist, anesthesiologist, psychotherapist, neurologist and otolaryngologist are also carried out. The purpose of the research is to evaluate the patient's condition, the condition of the inner ear, cochlear impermeability and the effectiveness of the hearing prosthesis. The auditory function, oral speech and the condition of the higher functions of the brain are also evaluated.

During surgery, a chain of active electrodes is inserted into the helix and its functionality is checked/tested at the time of surgery. The actions of the postoperative period are divided into two sub-periods. One month after the surgery is considered a period of healing of the wound. A month later, the long-term rehabilitation of the postoperative period begins, when the speech processor is connected. Psychologists and surdo-pedagogues take an active part in that process, and it should also be noted that from the very first period of work, a parent is involved in the entire course of work and actively cooperates with the pedagogue.

The duration of postoperative work is at least one year, with three meetings a week. During a year, the beginning of speech is ensured, that is, the activation of passive vocabulary and the development of auditory perception, voice recognition and speech perception, in parallel, the formation of verbal abilities and the understanding of the meaning of speech. 1-2 years after surgery, although with defects, the speech should already be formed.

In the postoperative period, the activities carried out by the pediatrician with children of preschool age are aimed at:

- developing the child's auditory perception, speech, phonetic phonemic hearing, cognitive activity, breathing,
- carrying out cognitive communication activities,
- performing voice exercises,
- preparing the vocal and oral cavity organs for articulation
- teaching the child to wear the hearing aid and also preparing the child to lead an independent life.

It has also been revealed that the results of post-operative rehabilitation in preschoolers, depending on a number of factors, may differ, in particular:

- the level of development of children's language ability and speech activity, and individual psychological characteristics are different,
- there are accompanying problems (related to vision and mental development),
- possibility for parents or their substitutes to take an active part in post-operative rehabilitation works.

Over the years, children who have undergone cochlear implantation still experience various difficulties, particularly pain, discomfort and balance problems are also very often observed, but all these eventually disappear after some time (Harutyunyan, 2006).

It has been found out that in terms of hearing recovery after cochlear implantation, the most promising groups are children suffering from congenital deafness and children who lost hearing at the

age of speech formation. Cochlear implantation has a successful outcome even when the patient's speech and pronunciation skills are preserved.

In the postoperative period, the speech environment of the child is also important. Kindergarten attendance is mandatory for young children. In kindergarten, as a rule, difficulties are not observed, difficulty can be observed by not damaging the outer part of the device and maintaining it. At school, the picture is different. In a noisy environment, the device has a problem focusing the sound, and for this, there are FM systems that transmit the sound to the interior via Bluetooth. Problems are noticeable if the child also has other combined problems, for example, vision problems, autism, etc. Children also have problems with wearing the external part of the implant during adolescence, in this case, children have psychological complications.

ABOUT THE OUTPUT OF THE COCHLEAR IMPLANTATION

The outcome of cochlear implantation can be effective or ineffective. It has been found out that cochlear implantation is generally useless in cases where the cochlea undergoes calcification (accumulation of calcium salts in the body tissues, cerebrum), which interferes with the placement of electrodes in the cochlea, thus questioning the success of the operation.

In today's society, many families are unable to take care of their child's hearing problems in time, and in the case of children suffering from sensorineural hearing loss, they are unable to purchase not only simple hearing aids, but also carry out the process of cochlear implantation. Therefore, for many years, children live "in complete silence". As a result, the branches of the auditory nerve gradually die and undergo atrophy due to insufficient stimulation.

ABOUT STATISTICS

It is known that such operations are quite expensive, only the part of the device that is inserted into the cochlea costs between 17,000 and -38,000 U.S. dollars [these links are not mentioned in the footnotes. The statistics of cochlear implantation have an interesting picture in the world, particularly, in Armenia as well. According to the World Health Organization, 360 million people, which makes up 5% of the world's population, have a hearing impairment, of which 32 million are children.

Since 2004, 176 people have been operated on in Armenia: 150 children (mostly of preschool age) and 32 adults, the youngest of those operated on is 9 months old and the oldest is 70 years old. Up to 40 deaf children are born in Armenia annually. A large number of hearing problems occur between 1-3 years of age., although it also occurs in middle and high school-age children.

Such a statistical picture indicates that, although not in large volumes, the process of cochlear implantation is carried out in RA, which is the only effective approach to overcoming hearing problems in children. Moreover, although today the Ministry of Education, Science, Sports and Culture provides public schools with financial resources to organize the education of children with developmental problems even more effectively, to provide their attached specialists with educational, didactic, non-verbal means, nevertheless, hearing problems are recorded in public educational institutions-children, whose parents either did not take care in time to relatively alleviate these problems, to carry out cochlear implantation or do not have sufficient means to provide it.

As early as 2020, the Ministry of Labor and Social Affairs in RA presented a project according to which, within the framework of state support, certificates can be provided to cochlear implant recipients so that they have the opportunity to purchase cochlear implant speech processor parts. This is a very encouraging and useful approach to helping children with hearing problems.

CONCLUSION

Thus, summarizing the above, it is worth noting that in educational institutions, phonemic disorders of speech and hearing difficulties are directly related to hearing problems among students of special education institutions. Hearing problems have a negative impact on children's speech development, communication, knowledge acquisition and mental development in general. In this regard, it is important to overcome hearing problems, to provide children with hearing problems with hearing aids on time, to regularly monitor and highlight the results in all regions of the country, to try to provide social and financial assistance, public attention and care to many families with children with hearing problems. It should be realized that cochlear implantation from an early age already contributes to the restoration/recovery of hearing and the improvement of the quality of education, which is also the key to having a healthy society.

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