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Scientific and Theoretical Foundations for Teaching Future Special Educators to The Development of Speech of Children with Cochlear Implants

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This article covers the scientific theoretical basis of cochlear implantation. Research conducted by foreign and Uzbek scientists and the meaning, purpose, and tasks of cochlear implantation are highlighted.
Keywords: implant, deafness, cochlear, surgical practice, sensitive, sensorineural, complex memory, compensatory, adaptive, social factor.

1. Introduction

Today, among the leading countries, special attention is paid to the social adaptation of children, adolescents, and adults with hearing problems in Uzbekistan. Ensuring the free movement of this category of persons among healthy people by restoring hearing with the help of a cochlear implant is defined as a separate task in several state documents. As a result, an average of 3,000 children receive cochlear implants every year as the most modern and effective way to restore hearing. For more than forty years, surgical operations for the restoration of hearing with the help of cochlear implantation have been carried out by experts from Australia, the USA, Austria, Germany, France, Japan, and Russia.

Several foreign scientists, in particular Y. Henkin, D.B. Koch, R.Y. Litovsky, T. P. Nikolopoulos, M. Polak, E. J. Propst, and others have contributed significantly.

About the cochlear implant M.R. Bogomil'sky, I.V. Koroleva, A.V. An example is the works of Russian scientists such as Kruglov, A.V. Pashkov, S.M. Petrov, V.I. Pudov, V.P. Sitnikov, G.A. Tavartkiladze, V.I. Fedoseev.

The issue of education, upbringing, and rehabilitation of hearing-impaired persons requires a comprehensive approach and inter-sectoral systematic communication. It is important to teach children with hearing loss to understand the world and understand the meaning of words by introducing them to the world of hearing because this category of children will be ready for social relations through these processes.

E. I. The program developed by Leongard for parents is based on the following principles:

- the priority of active participation of parents from the first period of child development;

- situational in creating a speech environment in families;

- systematic development of speech hearing and speech communication;

- use of dactyl as an auxiliary tool in the formation of oral and written speech.

Currently, P. in education and training of children with hearing impairment. The "Verbotonal method" developed by Guberin is used. This system makes it possible to determine whether a hearing-impaired child can use his hearing capabilities in natural conditions, receiving high-level speech signals. This approach is called functional diagnostics. Functional diagnosis includes the following steps:

- the study of speech hearing without hearing aids in a free sound field for each ear separately;

- research of speech hearing using hearing aids;

- research of the optimal hearing area;

- use of reverberation (low volume reduction).

From the end of the 20th century to the beginning of the 21st century, the advanced trends in the practice of Russia and other European countries, which are leaders in solving the issue of education, upbringing, and comprehensive rehabilitation of children with hearing impairment, have begun to be thoroughly studied in the special pedagogy of our country. In this regard, N.Sh. Bekmurodov, H.M. Gainutdinov, F.J. Alimkhodzhaeva, U.Yu. Fayzieva, N.H. Dadakhodzhaeva, D. Nazarova, F.U. Kadirova, Z. Mamarajabova, and D. Yakubzhanova are scientifically conducted research.

The scientific research conducted by N.Sh. Bekmurodov, for the first time in the field of sign language pedagogy, resulted in the development of the requirements for organizing the agenda and educational process of special educational institutions by the conditions of our region.

H.M. Gainutdinov researched the scientific and practical basis of training students in deaf children's schools.

F.J. Alimkhodzhaeva has developed a scientifically based system of methodical improvement of the didactic support of training of hearing perception and formation of pronunciation conducted with hard-of-hearing students. U. Yu. Fayzieva researched the linguistic and didactic foundations of teaching literacy to hearing-impaired children, and for the first time, the textbook "Alifbo" was published in Uzbek.

N. Dadakhodjaeva researched methodical aspects of the systematic development of mathematical ideas of deaf and hard-of-hearing children.

D. Nazarova conducted scientific research on the speech preparation of preschool-age hearing-impaired children for school. The scientist's recommendations on the speech development of hearing-impaired children, put into practice, are still effectively used today.

R. Rustamova developed a system of educational tasks for forming the grammatical structure of the speech of hard-of-hearing students. Z.Mamarajabova developed didactic support for the development of the speech of hearing-impaired students of grades 1-5 based on an innovative approach to the genres of literary education and created a correctional-pedagogical model for the development of the speech of hearing-impaired students in the process of literary education.

D.Yakubzhanova developed methodical recommendations for the development of professional creativity in future speech and language therapists and improved the model consisting of need-motivation, cognitive-emotional, and at the same time spiritual-spiritual components based on the structure of the educational environment aimed at designing professional-problematic and correctional situations.

F. Kadirova researched the periods of speech development of deaf and hard-of-hearing children and provided a scientific basis for the factors and technologies affecting the adaptation of this category of children to social life.

Based on the analysis of theoretical data on the education of deaf and hard-of-hearing children, we made the following conclusions:

Correct diagnosis is important in the organization of education and upbringing of deaf and hard-of-hearing children;

It is necessary to give priority to the use of hearing aids in the development of speech of children with hearing impairment. In this process, it is important to choose different means of impact on auditory perception, taking into account the physiological and psychological characteristics of children;

appropriate use of oral, written dactyl, and gestural forms of speech is required as the most optimal way to develop speech in deaf and hard-of-hearing children;

when working with deaf and hard-of-hearing children, it is necessary to work on both hearing and speech in parallel from the first period;

In developing hearing perception and speech of deaf and hard-of-hearing children, sound amplification devices, including a cochlear implant for hearing restoration, have great potential.

The cochlear implant is recognized as a means of intensively ensuring the effectiveness of the work aimed at performing correctional-pedagogical and developmental tasks with the listed deaf and hard-of-hearing children.

Cochlear implantation means the placement of a system of electrodes in the inner ear to restore hearing by direct electrostimulation of the afferent fibers of the auditory nerve.

Over the past forty-five years, the development of the science of deaf technology and deaf pedagogy and the practical application of innovative technologies have increased the need for the use of a new multi-channel cochlear implant hearing aid for hearing impaired children.

Considering that it is appropriate to analyze data on the history of cochlear implantation in practice, the sources of the creation of hearing aids in France, America, Australia, and Russia were studied.

In 1790, the famous physicist Alexandro Volta discovered that electrical stimulation of the auditory system could lead to the perception of sound, and attached metal conductors (wires) to his ears, connecting them to a 50-volt electric circuit. Then he hears the sound of boiling water. After that, scientists began to deal with the problem of sound amplification using electricity. In 1961, an American doctor, William House, based on Journot's work, created a hearing device and implanted it in three patients. In 1969, Dr. House collaborated with Jack Urban to create the first wearable hearing aid. The technology used by House used only one electrode and was designed to help deaf people read lips.

Graham Clarke, a scientist at the University of Melbourne, developed an artificial ear device in 1970 and was the first to test it on his deaf father.

Due to the development of electronics in the 90s of the last century, the size of the external part of cochlear implants gradually decreased. Since the size of the ear in small children did not allow the external part of the device to be worn behind the ear, it was placed separately above the knee, on the shoulder, or elsewhere. E. V. According to Mironova, the idea of restoring the hearing of people with hearing loss through cochlear implantation appeared in France about 45 years ago. During middle ear surgery on a hearing-impaired person, an electrode attached to a supply unit accidentally touches the mucous membrane, and the client feels that his ear is "hearing better than before." Doctors began to carefully study this phenomenon. In this way, a new direction has appeared that allows people with hearing impairment to improve their perception of speech. Doctors of the Australian Medical Center in Melbourne began to deal with this problem separately, and the 1st operation to attach a 10-channel electrode in this center was carried out in 1978. Since 1982, surgery with 22-channel electrodes began to be performed. By 1985, similar surgeries were being performed in the United States, Japan, and European countries, including Germany.

In Russia, this type of surgery was performed for the first time in 1982, and later in 1990, doctors of the Scientific Center of Audiology and Hearing Prosthetics of the Russian Federation G. A. Under the guidance of Tavartkiladze, together with the specialists of the German company "Cochlear" on the attachment of the 22-channel Nucleus electrode 1st surgery was performed. Since then, such surgeries have been performed several times a year at the center. In 1995, the doctors of the center developed and published the recommendation "Instructions for cochlear implantation". Currently, such operations on children and adults can be found in Moscow and St. Petersburg.

In contrast to the auditory apparatus, which amplifies acoustic signals, the scientist Korolyova argues that the cochlear implant signals electrical impulses that move the auditory nerves to the auditory centers of the brain to produce auditory sensations. With the help of the cochlear system, situations that are technically impossible in other devices, that is, the hearing of high-frequency sounds are improved, the frequency selectivity of hearing is restored, and the dynamic ranges are not limited.

E.V. According to Mironova, cochlear implantation refers to the placement of electrode

systems in the inner ear to restore hearing by directly stimulating the auditory nerve fibers with electric current.

Currently, several theories underlie the cochlear implant method. The main place in them is D. Davis's electromechanical theory and L.A. Vinnikov L. K. The cytochemical theory of titovas is taking over. Other theories cite a cochlear implant base. For example, electromagnetic, electrostatic, and electrodynamic theories, etc. According to all theories, the resulting endpoint (space) of Sound Energy in a spiral organ is the potential inside the shell. The next steps in the development of cochlear implantation can be seen in the 80s of the last century. Deaf people in different countries W. Hause, F. Simmons, M. Many operations are performed by White, G. Clark, C. Chouard, K. Burians. We can mention the operations performed by W. Hause (1976) as a stage of development of the cochlear implant. In the later periods, prosthetics of the auricle with electrodes were carried out in two directions. A group of scientists from the USA and France turned their attention to the maximum number of operations. Among them, Professor M. R. Under the leadership of Bogomilsky, the Moscow group worked to achieve maximum efficiency in the improvement of cochlear prostheses.

In the 70s and 80s of the last century, the development of the multichannel system of the cochlear implant was redeveloped in many countries of the world. For the first time, 8-channel cochlear implants were installed in 5 people in Austria in the 70s. Med-El, which developed them, works with a coded strategy. In 1978-1979, in Australia, G. Clarc and his group installed a 20-electrode system (10 active electrodes) cochlear implant on 3 adults. In 1982, Cochlear's 1st commercial multi-channel Nucleus system was produced. In 1978, in France, S. Chouard installed 8-12 channel models for 22 people. In several centers in the USA: Los Angeles, Stanford, San Francisco, and Utah, work was carried out on the development of a multichannel cochlear implant system.

Los Angeles University scientists R. Michelson, M. Merzenich, and R. Schidler's work became the basis for the creation of the Clarion commercial cochlear implant system developed by Advanced Bionics.

In recent years, the number of children who received cochlear implants at an early age has increased significantly. I. V. According to Korolyova, in this age period (2000-2009), children can achieve high results in speech development and general development.

Compared to other types of hearing aids, cochlear implants are designed to last a lifetime. Cochlear implantation has the following goals:

- increase speech intelligibility by 10-12% in noisy conditions;

- improving the localization of the sound source in space;

- increase the intelligibility of speech when talking with several speakers in reverberation conditions;

- learning to distinguish and speak different sounds, increase vocabulary.

The tasks of cochlear implantation are as follows:

1. Early diagnosis and elimination of abnormalities in the child's development.

2. Restoration of hearing.

3. Development of speech due to the development of auditory perception.

4. Providing the possibility of harmony among healthy people.

According to I.V. Korolyova, "The earlier cochlear implantation is done, the better the results."

Sensorineural deafness is caused by damage to the inner ear, i.e. fibrous tissue. However, despite the damage to most of the sensory tissues, the fibers of the auditory nerve are preserved in such patients. When these fibers are directly activated by an electric current, they can send a signal to the brain that produces auditory sensations. It is in this process that the principle of cochlear implantation is based, which, in turn, means an artificial inner ear.

Today, cochlear implants are becoming a real means of hearing prosthesis for people with total deafness and a high degree of sensorineural hearing loss. One of the most common cochlear implant systems is the 22-channel Nucleus cochlear implant distributed by Cochlear.

Different people may have different sensations as a result of electrical stimulation of the auditory nerve. Therefore, it is necessary to use different strengths of the stimulating current when stimulating different channels in the same person or when stimulating the same channel in different people. In addition, the same person can individually distinguish different tones of the voice under the stimulation of different channels. For this purpose, a fine adjustment is provided in the speech processor, which is individually adjusted according to the client's reception of electrical stimulation.

Restoration of hearing through the physical and technical capabilities of the above-mentioned cochlear implant device provides the following opportunities to a person.

- the sense of hearing up to 40 dB compared to normal hearing is restored;

- the level of differentiation increases by hearing everyday non-speech sounds found around;

- by hearing speech sounds, a person effectively penetrates the world of listeners;

- children and adults with cochlear implants begin to understand the interlocutor's speech by hearing. These listed cochlear implant options are outlined below.

Conductive hearing loss or partial hearing loss can be compensated with individual hearing aids.

In practice, it has been observed that there are many controversial questions, namely, is the sound amplifier good? Or Cochlear Implant? As a practical solution to this question, we list the following medical, pedagogical, and sociotechnical conclusions:

1. A multi-channel implant can restore the frequency selectivity of hearing, that is, the ability to distinguish simultaneously existing frequencies in an acoustic signal. Hearing aids cannot in principle restore the frequency selectivity of hearing.

2. The use of the implant does not allow acoustic feedback (often when listening with a sound amplifier, the sound reflection in the room has a negative effect on a person). Accordingly, the ability to perceive very low sounds in spoken speech is provided.

In addition to the conveniences of cochlear implantation listed above, there are also some disadvantages:

1. Variability (various haze) of the results of speech hearing improvement after cochlear implantation. To date, although several factors have been identified to predict speech perception in implantees, no clear prediction has been made.

2. People with implants have difficulty perceiving complex sounds, such as musical sounds. In addition, the microphone can pick up sounds from a certain distance, but it is not possible to hear from great distances. Today's advances in electronic technology can eliminate this shortcoming.

The primary indication for cochlear implantation is the highest degree of sensorineural deafness. The selection criterion for subsequent cochlear implantation focuses on the effectiveness of hearing prosthetics with a simple hearing aid. If a person can understand 30-40% of words using a normal hearing aid, a recommendation for a cochlear implant may lead to good results. If the patient's responses are less than 5% and there are no contraindications, it can be confidently recommended for implantation.

Educators and parents should be aware of the following complications that may occur in a child after surgery:

- complicated cases of injury;

- damage to the facial nerve;

- loss of sensation and stiffness in the area behind the ear;

- disturbance of the sense of taste and balance;

- a significant increase in noise in the ear.

It should be said that cochlear implant failure has been observed in rare cases. However, it is possible that the implant will not significantly improve speech understanding. The duration of electrical stimulation has not yet been determined.

The first year after surgery is an important period in the formation and development of physical and mental characteristics that the child will need throughout his life. Researchers consider this period to be the period of the fastest development of children.

It is known that during the infancy of a normally born and developing child, the sensory systems, i.e. vision, hearing, and tactile senses, develop intensively. The social situation of this period is characterized by the inseparable joint activities of adults and children. In this case, adults influence the child as a trigger of visual and auditory senses.

The period of infancy and early childhood is dangerous for the development of a child. It is during this period that the brain becomes highly sensitive to sensing and using environmental stimuli such as speech sounds. This auditory function means that sounds are necessary for speech imitation, speech activity, feedback acoustic communication, and understanding the meaning of words and phrases at the stage of brain development.

The differentiated auditory sense of phonemes serves as a necessary condition for their correct pronunciation. A 5-6-year-old child develops his pronunciation and can fully master all aspects of speech development. That is, the phonetic and rhythmic structure of the word, the varied decoration of phrases with tones, and the full mastery of expressive speech based on various

communicative purposes, lay the groundwork for learning the nuances of emotional states in later age periods.

For the first speech movements to appear, there must be a certain cognitive reserve that occurs with the functioning of the cerebral cortex. The emergence of targeting when hearing the mother's voice and other sounds, seeing the face of the speaker, looking with interest at brightly colored toys, etc. are important factors for the overall development of the child. A 1.5-month-old child has the first non-verbal reactions to communication, such as smiling when he sees his mother's face and hears her voice. By the age of 3 months, the child's laughter is synchronized with the parents' laughter.

Visual communication determines emotional reciprocity, auditory attention capture and retention, auditory perception, and verbal communication determines speech perception. E. N. According to Vinarskaya, "By the 9th-10th month of a child's life, the understanding of adult speech is formed, and at 18-20 months, he understands simple words spoken in syllables."

Hearing impairment in deaf children reduces the sensory side of mental development. In addition, spatial perceptions in the emotional sphere, and secondary disturbances in objective-practical activity appear. Children who lose their hearing at an early age do not have the opportunity to independently acquire the mother tongue. In healthy children, this possibility is available at the level of imitation.

E.V. According to Mironova: "In a child with normal hearing, hearing impairment for some reason affects not only the ability to receive speech directed at him by others but also the quality of his speech. Intonation becomes impoverished, the tempo of pronouncing words changes, the vocabulary becomes shorter, the sounds are not pronounced to the end, they are dropped, etc. As a result, verbal communication is bilaterally impaired.

Scientists dealing with hearing-impaired children believe that children with severe hearing impairments hear low-frequency sounds better when they use hearing aids. Experience shows that implanted children begin to receive a wide spectrum of sounds, as well as high-frequency sounds, as soon as the speech processor is connected once. In this way, other opportunities for acquiring speech appear.

Acoustic and speech signals transmitted through a cochlear implant differ from natural sounds. Nevertheless, in all categories of clients (congenital deafness or acquired deafness), adaptation to a new sound image involves a certain period.

It is observed that children with cochlear implants in their early years develop their personal auditory-speech skills when provided with comprehensive support, and have a high level of psychophysical development, being close to their peers with normal hearing.

In the early period of cochlear implantation in Uzbekistan, the priority was for specialists to work with children individually. That is, specialists conducted targeted training with a child with a cochlear implant before and after surgery. In the initial period, pedagogues developed the content of the lessons based on the tasks that teach to distinguish non-speech and speech sounds by listening.

Then, as a result of organizing a scientific-practical seminar at the Tashkent RIPIAT center, a comprehensive pedagogical system of creating the content of the training was put into practice.

The content of this system includes the following directions.

1. Learning to hear and distinguish non-speech sounds.

2. Learning to hear and distinguish speech sounds.

3. Learning to distinguish between sentences and texts.

Russian practice in pedagogical work with children with cochlear implants leads. Russian scientist O. Zontova implemented several methods of working with children with cochlear implants. The peculiarity of these methods is that children with cochlear implants are allowed to choose the type of communication that is convenient for them in the speech environment. In particular, this approach was applied to children who were implanted with cochlear implants after the formation of speech or while studying in special educational institutions.

In the listed studies, methodical recommendations were put into practice regarding the preparation of hearing-impaired children for cochlear implantation, methodical aspects of deaf-pedagogical influence before and after surgery, specific forms of education, and the use of special didactic tools. It is known that children with cochlear implants have the same opportunities for intellectual development as healthy children. Therefore, the views on the appropriateness of education of children with cochlear implants in the general education process, which are effectively used in the practice of the leading countries of Europe, in particular, Russia, are considered as a basis in Uzbekistan. That is, the requirement to involve children with cochlear implants in general education and preschool education organizations is a priority.

From the analysis of the research conducted on the purpose and possibilities of post-surgical pedagogical work with children with cochlear implants, we determined the following:

- in practice, cochlear implantation is given priority to work only on hearing and pronunciation of children;

-not enough attention is paid to hearing children's speech and developing skills and competencies necessary for their adaptation among healthy people. This direction requires systematic methodological work.

In the analysis of the literature and the content of the studied experiences, priority was given to the formation of the necessary vocabulary for school education in the preparation of children with cochlear implants for auditory-speech activities, and scientific research aimed at developing the desire for self-expression in these children were not conducted. Although this issue has been partially studied in the course of scientific research and various projects, targeted recommendations for deaf-pedagogical and speech therapy practice have not been introduced.

There was a need for a comparative study of hearing-speech capabilities of hearing-impaired children and children with cochlear implants in order to justify the social significance of hearing-impaired children's hearing and developing their independent auditory-speech skills and abilities. In addition, theoretical data justifying the relevance of special methodical works for the development of auditory-speech skills and competencies in children with cochlear implants were analyzed.

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