AMERICAN JURNAL OF ADVANCED SCIENTIFIC RESEARCH
ISSN 2195-1381 Volume- 5 June 2025
http://ijarer.org/index.php/ij/index#

CURRENT CHALLENGES AND DEVELOPMENT PROSPECTS OF COCHLEAR IMPLANTATION

Rakhimova Khurshidakhon Sadikovna
Associate Professor, Department of Special Pedagogy, Kokand State University

ANNOTATION: This article analyzes the psychophysiological characteristics, pedagogical needs, and rehabilitation and educational approaches applied to children with musculoskeletal disorders. Motor limitations resulting from neuromuscular disorders such as cerebral palsy negatively affect a child's emotional, social, and cognitive development. The article substantiates the effectiveness of comprehensive rehabilitation processes based on individualized approaches, special pedagogical and physiotherapeutic methods, as well as speech therapy technologies. The issue is explored in depth through the scientific views of both international and national scholars.

Keywords: motor impairments, cerebral palsy, psychophysiological development, special pedagogy, rehabilitation, individualized approach, speech therapy, physiotherapy, cognitive development.

According to global statistics, approximately 32 million children have hearing impairments. Among every 1,000 newborns, 2 to 3 are diagnosed with significant hearing loss. For 2–3 children, hearing loss occurs during the first years of life. Hearing loss is already present in 2% of school-aged children. Additionally, 8% of children experience central auditory processing disorders, which manifest as difficulties in auditory attention, auditory memory, speech development, and learning.

Hearing impairments in children often lead to secondary developmental delays in mental processes—particularly in areas such as speech, communication, thinking, attention, memory, and emotional and volitional development.

Cochlear implant system manufacturers are continuously improving various aspects of cochlear implants. These improvements are being implemented in the following directions:

- Miniaturization of cochlear implants;
- Development of fully implantable devices;
- Enhancement of acoustic signal processing strategies;
- Improved speech intelligibility through cochlear implants;
- Better music perception with the help of cochlear implants;
- Reduction in power consumption;

- Development of modified electrodes for implantation in cases of cochlear ossification or anatomical abnormalities;
- Design enhancements of electrode arrays and carriers to reduce trauma to the cochlea and improve sound signal transmission quality;
- Development of hybrid models combining cochlear implants with hearing aids (electroacoustic correction);
- Advancement of objective methods for tuning cochlear implant processors;
- Progress in bilateral (binaural) cochlear implantation.
- The initial experimental models of cochlear implants were so large and heavy that they could not be carried by one person at all times. The first commercial cochlear implant systems gradually approached the size of pocket hearing aids. In 2003, the first behind-the-ear cochlear implant model was introduced. Today, the size and weight of behind-the-ear cochlear implant models continue to decrease. There are also models designed specifically for children, with some parts weighing as little as 2 grams when worn behind the ear.
- Fully implantable cochlear implant models are currently being developed. The main challenge in creating such implants is developing models that can function without an external power source.
- Improved speech intelligibility through multi-channel cochlear implants largely depends on the strategy used for signal processing. Early cochlear implant models with basic speech feature extraction strategies offered about 30% speech intelligibility. Modern systems with fast processing strategies, such as Continuous Interleaved Sampling (CIS), which transmit detailed temporal structures of speech, can achieve 80–95% intelligibility (Koroleva, 2002; Cochlear Implants, 2006; Wilson et al., 1991). Today, all leading manufacturers use CIS or similar strategies in their models (Altman & Tavartkiladze, 2003; Cochlear Implants, 2003b; Diller et al., 2005). The development of this strategy in cochlear implant systems like "Opus-2" (by MED-EL) and "Harmony" (by Advanced Bionics) has significantly improved music transmission quality and allowed for a more natural perception of music by patients.
- Modified electrode arrays (shortened or compressed) have been created for individuals with partially ossified cochleae or anatomical anomalies where standard-length electrode arrays cannot be inserted.
- Shortened electrodes are used for implantation in individuals who retain residual hearing in the low-frequency range. In such cases, the cochlear implant transmits high-frequency auditory information, while the low-frequency information is perceived with the help of a hearing aid on the same or the opposite ear. Studies show that this approach results in higher speech intelligibility and a more natural

sound perception. For such patients, special hybrid cochlear implant models have been developed—such as the “Duet” model by MED-EL (Austria)—which combine a cochlear implant and an electric-acoustic (EA) hearing system in one device.

The improvement of electrode design is aimed at achieving the following:

- **Minimizing trauma to the cochlea**, thereby preserving any residual hearing;
- **Bringing the electrodes closer to the modiolus**, i.e., nearer to the auditory nerve, which allows for more localized stimulation of the cochlear region by each electrode. This reduces both the harmful effects of electrical current and energy consumption;
- **Facilitating easier insertion during surgery**.

To this end, models with **directional stylets** and **flexible electrode carriers** have been developed.

For individuals in whom cochlear implants are ineffective due to damage to the auditory nerve, a **brainstem implant** has been created to restore hearing. This type of implant is placed in the cochlear nuclei of the brainstem during a **neurosurgical procedure**. It uses a processor similar to the one used in cochlear implants. The first brainstem implant surgery was performed in 1993 using the **Cochlear** company’s system. Currently, several hundred people around the world benefit from auditory brainstem implants.

Manufacturers of cochlear implant systems are striving to develop improved models that allow users to **replace the external components of older implants with newer versions** without requiring repeat surgery. For many patients who were implanted earlier, the original **body-worn processors** have been replaced with **behind-the-ear models**. These behind-the-ear devices are now being further upgraded to **modern, more advanced versions**. Additionally, **new internal modifications** of cochlear implants have been developed and are now being implanted in new patients.

References

1. Sadikovna, Raximova Xurshidaxon, et al. "OG‘IR NUTQ KAMCHILIGINI BARTARAF ETISHDA MUTAHASSIS VA OILA HAMKORLIGI." E Conference World. No. 3. 2023.

2. Sadikovna, Raximova Xurshidaxon, and Akbarov Sarvarjon Sodiqjon o’g’li. "INKLYUZIV TA’LIMNING MAQSAD VA VAZIFALARI." E Conference World. No. 3. 2023.

3. Sadıkovna, Rakhımova Khurshıdakhan, and Sattorova Dildora Mirzaakbarovna. "THE ESSENCE OF THE CONTENT OF “INCLUSIVE” AND

"INTEGRATED" EDUCATION." Galaxy International Interdisciplinary Research Journal 11.12 (2023): 431-435.

4. Sadikovna, Rakhimova Khurshidakhan. "IMPROVING EDUCATIONAL WORK FOR CHILDREN WITH HEARING IMPAIRMENT." Open Access Repository 9.12 (2023): 397-402.

5. Sadikovna, Rakhimova Khurshidakhon. "Theoretical Foundations For Teaching Future Surdopedagogs To The Development Of Speech Of Children With Cochlear Implants." Onomázein 62 (2023): December (2023): 2408-2416.

6. RAKHIMOVA, DAUGHTER OF AMATJANOVA MOKYNUR OIBEK, and KHURSHIDAKHAN SADIKOVNA. "FORMATION OF WRITTEN SPEECH OF CHILDREN WITH HEARING DEFECTS IN INCLUSIVE EDUCATION." Confrencea 12.12 (2023): 478-484.

SADIKOVNA, SATTOROVA DILDORA MIRZAAKBAROVNA RAKHIMOVA KHURSHIDAKHAN. "THE FIRST INSTITUTIONS OPENED FOR THE DEAF IN THE HISTORY OF DEAF PEDAGOGICS. THE IMO SIGN AND ORAL EDUCATION SYSTEM IS IMPLEMENTED FOR THEM." Confrencea 12.12 (2023): 461-468