

Deafness and hearing loss are the most common form of sensory disability experienced by humans. According to WHO experts, around 400 million people worldwide suffer from moderate to profound deafness. For people with profound deafness, the optimal solution is often a cochlear implant. This is an electronic device that provides direct electrical stimulation to the acoustic nerve in the auditory system, bypassing the damaged part of the auditory pathway to create sound perception. Unlike a typical hearing aid, which is worn externally, a cochlear implant consists of both internal and external components.

The modern cochlear implant enables hearing-impaired people to understand sound and speech. It enables communication, the development of language skills and the use of media such as music and television.

A prerequisite, although not sufficient for optimal implant results, is the correct matching of the parameters of electrical stimulation by the implant electrode to the patient's auditory pathway.

To set these parameters correctly, psychoacoustic and electrophysiological (objective) tests are available. Especially with children, where reliable psychoacoustic responses are often difficult to obtain, objective measurements are important.

In addition to objective tests measuring the periphery of the auditory pathway, it seems more important to measure its higher levels, which take into account processes in the auditory cortex. Such measurements should make it possible (together with novel CT imaging techniques) to assess relation between parameters of electrically evoked brain recordings with perception and to develop the fitting algorithms based on these recordings.

The limited use of cortical auditory testing of evoked potentials in CI recipients was due to the necessity to use surface electrodes placed on the scalp surface. Unfortunately, such a solution is sensitive to interference generated by the patient's movements, plus the correct placement of the electrodes and ensuring their good contact can often be a challenge for those performing the test.

The optimal solution to these problems seems to be recording cortical potentials using an implant electrode placed in the cochlea. Thanks to this positioning, interference from muscle potentials is significantly minimised and there is no need to prepare and stick electrodes on the head.

Such a measurement, however, requires pioneering software and a dedicated protocol.

In order to achieve the research goal of obtaining electrically evoked brain recordings through the implant, examining morphology of the responses, setting optimal parameters of stimulation via cochlear implant and finally developing the fitting algorithm based of these recordings, this project plans to carry out an intracochlear recording of auditory potentials generated by the cortical region of the brain, evoked by stimuli, investigate the morphology of these signals and investigate the relationship between their parameters and the state of the brain through results of speech and signal discrimination tests.

State-of-the-art methodology will be used to fulfil the research objective, including utilization of BEEP (Bionics Ear Evoked Potential), – an innovative research tool for conducting Auditory Evoked Potentials (AEPs) measurements on subjects with Advanced Bionics cochlear implant systems. It provides the means for researchers to directly measure the AEPs using the intra-cochlear electrodes and the CI implant through back-telemetry.

A multidisciplinary team of specialists will evaluate the benefits of the cortical – based fitting.

The research planned in the project will provide insights into the cortical mechanisms underlying the effective and efficient use of cochlear implants in humans. Thus, they will contribute significantly to the development of the field of life sciences.