Options for stroke survivors: From stroke to conventional therapy

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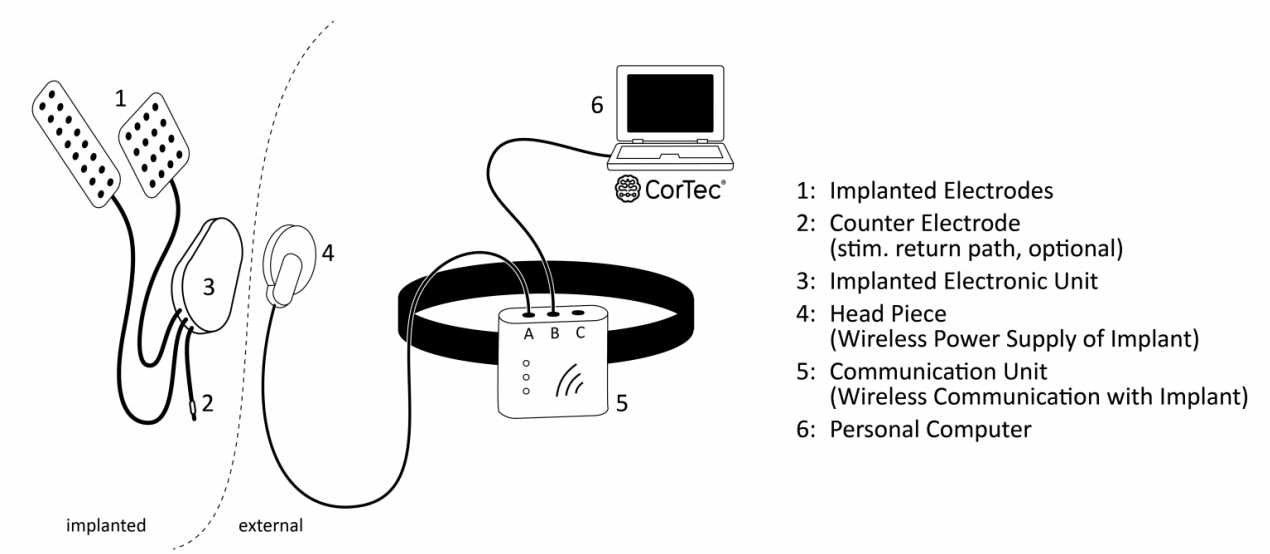

Discovery of novel treatment options for stroke survivors – requirements for implanted systems

In countries with modern healthcare infrastructure, stroke patients are treated in so-called stroke units directly after the stroke occurs. A few days later, the health situation is stable and the patient enters the rehabilitation phase.

Stroke survivors are often faced with lost motor functions or speech impairments which are treated using conventional occupational therapy, logopedic therapy or other therapies focusing on the recovery of the patient's individually compromised functions.

Plasticity: The superpower of the brain

Rehabilitation therapies activate a hidden superpower of the brain. The so-called 'plasticity' describes the brain's potential to reorganise itself and to compensate for lost or impaired functions by rewiring its own electrical circuits. During the rehabilitation phase of stroke patients, this mechanism is used to help the patients overcome or milden the acquired disabilities.

Over a time of about one year after a stroke, the brain shows an improved ability to reorganise itself, which permits the relearning of lost functions, at least to a certain degree. Unfortunately, not all stroke patients are able to recover to a full extent or well enough after a stroke.

Roughly 50% of patients [1] that are treated using the standard care after stroke, as well as rehabilitation treatment, are left with severe impairments that reduce their quality of life. To help those 50%, the hope in stroke recovery is the enhancement of plasticity to permit a better outcome of conventional rehabilitation treatments.

Stimulation for rehabilitation

One method to achieve the enhancement of plasticity is electrical stimulation of the brain. Fundamental studies [2, 3] already demonstrated the effectiveness of this mechanism successfully. The therapeutic success of conventional therapy is expected to be substantially improved when the plasticity is enhanced.

Consequently, patients who do not benefit from conventional rehabilitation might be able to regain functions, and patients who are responding to conventional rehabilitation might improve or accelerate the results of their therapy.

To make this dream come true, a novel medical device for plasticity enhancement needs to be developed and built. CorTec is tackling this exact mission to bring a device to market, from which stroke patients will benefit in the future.

CorTec's solution to offer better treatment after stroke

CorTec wants to provide patients with an implanted brain stimulator, which they can easily use at home or in their local rehabilitation centres.

Mild electrical pulses will stimulate the brain during conventional rehabilitation treatment in synchrony with the brainwaves of the patient. An implant system for individualised electrical treatment of stroke must be able to:

- Record electrical brain activity (brainwaves) from various brain areas.
- Process recorded brain signals using algorithms. These algorithms decipher the brain status and activate the implant stimulation circuitry in synchrony with the brainwaves.
- Electrically stimulate the brain for enhancing plasticity.

Since this novel therapeutic concept still has many unknowns, CorTec decided to build a versatile system in which the brain signal recording and the electrical stimulation are carried out by wirelessly operating implanted electronics, while the processing of the brain signals happens outside the body on a small computer.

This concept permits easy adaptation/individualisation of the signal processing algorithms, allows the running of very power-hungry algorithms which implanted devices cannot run because of limited implant battery power and also ensures that all acquired brain signal and stimulation data is saved for later review, which can be used for further improvement of the therapeutic concept.

The system is sketched in Fig 1. It consists of implanted electrode grids that electrically interface with the brain. The soft and flexible electrodes are used for sensing brain signals, which are amplified and digitised by the implant. Data is wirelessly sent out through the skin and received by the communication unit, which forwards the data by cable to a portable computer, where the data is saved and analysed.

The computer takes decisions on therapeutic stimulation pattern, intensity and location on the brain and sends stimulation commands to the communication unit, which forwards it wirelessly to the implant for immediate execution.

Besides relaying information between computer and implant, the communication unit also supplies the implant wirelessly with power.

The system operates in closed-loop mode, which means it continuously records and analyses brain activity, delivers electrical stimulation accordingly and measures the – now modulated – brain status, which is analysed for calculating the stimulus, etc.

Currently, commercially available implants offer only a fraction of the functionality described above. To overcome the current technological limitations, almost all components of the system required new developments. The system is tailored to closed-loop functionality and offers a huge potential for discovering new therapeutic applications which require a stimulation implant that adjusts to the brain signals of the patient.

A fit for stroke rehabilitation and more

The system's design and functionality will open up a novel treatment for stroke rehabilitation. Currently around 50% of stroke survivors are left with severe impairments in motor functions after regular rehabilitation treatments. With an implantable device that offers a better and even faster treatment option, the CorTec Brain Interchange System will help those patients regain quality of life.

Beyond stroke, we anticipate addressing various other indications that can benefit from a closed-loop-capable device. Being able to read from the brain, analysing the state of the brain and the current status of the specific impairment or disease, followed by a patient-individual electrical stimulation to rewire the brain and alter the state of the brain, opens up multiple use cases for this device.

Potential indications for this device are neurological diseases of the brain, as well as brain dysfunctions such as epilepsy, Alzheimer's disease and mood/mental disorders such as schizophrenia and depression.

References

1. https://www.world-stroke.org; Daniel Kahneman
2. Grefkes, C., & Fink, G. R. (2020). Recovery from stroke: current concepts and future perspectives. Neurological research and practice, 2(1), 1-10
3. Caria, A., Weber, C., et al (2011). Chronic stroke recovery after combined BCI training and physiotherapy: A case report. Psychophysiology, 48, 578-582

Please Note: This is a Commercial Profile

More About Stakeholder

CorTec, neurotechnology and the Brain Interchange System

CorTec's mission is "communicating with the brain – for the cure of disease". By using their Brain Interchange System, they hope to develop stroke rehabilitation.