

# Spinal cord neurostimulation



Neurostimulation is a treatment that can potentially help improve the quality of life and mobility of patients with high paraplegia. It is an implantable system which, by producing electricity, stimulates the injured spinal nerves. Electricity comes from an implantable generator and is applied to specific areas of the spinal cord via electrodes. The patient can assess the effect of neurostimulation as a test stimulation is performed. It is a completely reversible treatment, meaning the patient can at any time turn off or remove the neurostimulation system without any side effects.

## **Application of neurostimulation**

Neurostimulation therapy is applied in two stages: first the trial stimulation takes place, during which the patient evaluates the effect of the neurostimulation, and then, if the patient chooses, the permanent implantation of the neurostimulation system takes place.

### **Test stimulation**

A thin electrode is placed under anesthesia at an appropriate site and connected to a temporary external stimulator. The goal during experimental neurostimulation is the recording of stimuli through intraoperative neuromonitoring, as well as the effect on phenomena such as spasticity. Then either the system is removed, or the permanent implantation is performed.

### **Permanent implantation**

Depending on the type and complexity of the paraplegia, the attending physician selects the appropriate system for implantation. With anesthesia, a small incision is made in the buttock or elsewhere (eg abdomen) and the stimulator is placed under the skin, which is connected to the electrode. The patient has his own programmer with which he can easily change the settings for optimal performance. It is usually rechargeable, for better performance and long-term use.

Neurostimulation is a minimally invasive method, which has a low rate of complications. Most of these can be avoided by following the guidelines of both the treating physician and the patient.

## **Deep Brain Stimulation (DBS)**

Deep brain stimulation (DBS) is a neurosurgical operation on the head for treating specific neurological and psychiatric conditions. In this particular case, the stimulation of areas of the brain responsible for body movement is achieved, in order to reduce unwanted symptoms and medication intake as well as improve the patient's quality of life.

DBS is applied to selected patients who suffer from conditions that cannot be adequately controlled with medication or cannot receive appropriate medication for other reasons.

### **These diseases are:**

Idiopathic tremor : Involuntary movements and prolonged muscle spasm cause distortion of the movements of the whole body or part of it and tremor. Deep

stimulation reduces hand tremor by 60-90% and manages to limit head and voice tremor

Parkinson's: A 70% reduction in dyskinesia is achieved with a parallel reduction in medication

Dystonia

Neuropathic pain

Disorders of the level of consciousness (minimal conscious state, vegetative state)

Obsessive compulsive disorder and other psychiatric syndromes (OCD, Tourette's)

Addiction

The patient suffering from the above diseases will be evaluated as a whole, based on the existing international scales, by the neurosurgeon, the neurologist and the psychiatrist in order to check if he is a suitable candidate for the operation. He will then be informed in detail about the plan and the results of using the stimulator, as well as how he will handle it after the operation.

## **What is deep brain stimulation (DBS)**

In deep brain stimulation, electrodes are implanted in a specific area of the brain.

Depending on the disease and the motor disorders to be controlled, the implantation is done in the thalamus of the brain, the globus pallidum and the

hypothalamic nucleus, while new studies are constantly emerging, indicating more target areas.

Implantation is done through small holes at the top of the skull.

The electrodes are connected to individual wires that pass under the skin, behind the ear, down the neck and up to the chest. There they are connected to a

neurostimulator that is also implanted under the skin of the chest, in the subclavian area.

A neurostimulator is an electronic pacemaker that produces electrical impulses. The wires carry electrical impulses to electrodes located in the brain parenchyma,

thereby altering problematic nerve signals that cause tremor, dystonia, stiffness, or pain.

After surgery and activation of the neurostimulator, the skilled neurosurgeon programs and adjusts the parameters of the stimulator via a wireless device. These parameters can be changed to follow the needs of the patient. The patient can activate and deactivate the system, e.g. during sleep, with a control.

## **The operation**

The neurostimulation operation includes two phases. First, a thin-slice MRI scan is performed, and then the stereotactic crown is placed on the patient's head to perform the CT targeting scan in order to accurately three-dimensionally locate the area of the brain where the electrodes will be placed and their path is planned.

During the placement the patient is under mild sedation without feeling pain, because he has to cooperate with the doctor and answer his questions. The electrodes are placed through two small holes created by cranial drilling.

After placing the electrodes and testing their proper function, the patient is put under general anesthesia in order to place the neurostimulator under the skin of the subclavian region and connect the electrodes to the extensions. After the operation, minor postoperative pain is treated with analgesics. The patient leaves the clinic a few days after the operation, after the initial settings of the stimulator have been completed.

Complications from surgery to place the neurostimulator are minimal and usually reversible. In a well-planned case, in the hands of a specialist neurosurgeon with experience and in a clinic with the required modern equipment, they are very small. However, as in any surgery, symptomatic bleeding at the lead's target site is a small possibility. It can also cause infection, allergic reaction to anesthesia, seizure, skin infection, and a less than 1% chance of intracerebral hemorrhage.

## **Post surgery**

The stimulator is programmed in the immediate post-operative period, which depending on the condition can be a week or so after the operation, while in collaboration with the neurologist, the medication is adjusted - and usually reduced.

The therapist monitors the patient for changes in parameters depending on their condition, especially in Parkinson's patients where gradual deterioration is a given.

The patient learns to use the neurostimulator correctly with the portable device he has and is informed by the doctor in detail about what he should pay attention to.