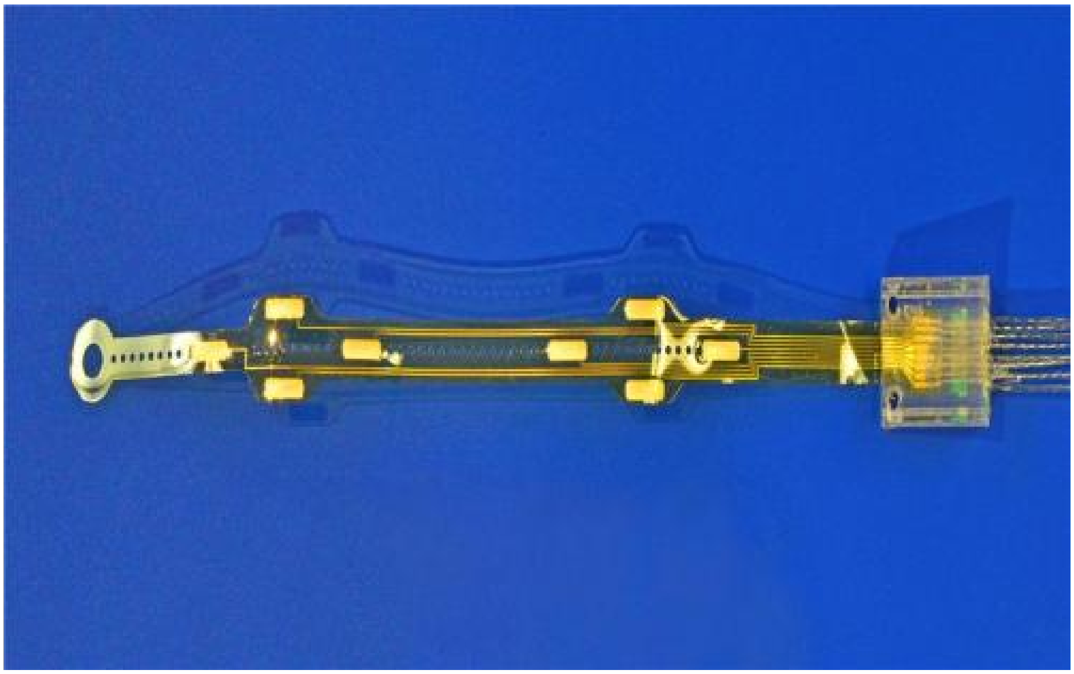
Hope for paraplegic patients

May 16 2014



The implantable microelectrode sensors are flexible and wafer-thin. Credit: Fraunhofer IMM

People with severe injuries to their spinal cord currently have no prospect of recovery and remain confined to their wheelchairs. Now, all that could change with a new treatment that stimulates the spinal cord using electric impulses. The hope is that the technique will help paraplegic patients learn to walk again. From June 3 – 5, Fraunhofer researchers will be at the Sensor + Test measurement fair in Nürnberg to showcase the implantable microelectrode sensors they have developed in the course of pre-clinical development work.

Thomas T. was just 25 years old when a severe motorcycle accident changed his life in an instant. Doctors diagnosed him with paraplegia following an injury to his spinal cord in the lumbar region. The young man has been confined to a wheelchair ever since. The diagnosis of paraplegia came as a shock, and it was only in the course of a month-long period of rehabilitation that Thomas T. was able to come to terms with his condition. Patients like him currently have no prospect of recovery, as there is still no effective course of treatment available for improving motor function among the severely disabled.

Now a consortium of European research institutions and companies want to get affected patients quite literally back on their feet. In the EU's NEUWalk project, which has been awarded funding of some nine million euros, researchers are working on a new method of treatment designed to restore motor function in patients who have suffered severe injuries to their spinal cord. The technique relies on electrically stimulating the nerve pathways in the spinal cord. "In the injured area, the nerve cells have been damaged to such an extent that they no longer receive usable information from the brain, so the stimulation needs to be delivered beneath that," explains Dr. Peter Detemple, head of department at the Fraunhofer Institute for Chemical Technology's Mainz branch (IMM) and NEUWalk project coordinator. To do this, Detemple and his team are developing flexible, wafer-thin microelectrodes that are implanted within the spinal canal on the spinal cord. These multichannel electrode arrays stimulate the nerve pathways with electric impulses that are generated by the accompanying by microprocessor-controlled neurostimulator. "The various electrodes of the array are located around the nerve roots responsible for locomotion. By delivering a series of pulses, we can trigger those nerve roots in the correct order to provoke motion sequences of movements and support the motor function," says Detemple.

Researchers from the consortium have already successfully conducted tests on rats in which the spinal cord had not been completely severed. As well as stimulating the spinal cord, the rats were given a combination of medicine and rehabilitation training. Afterwards the animals were able not only to walk but also to run, climb stairs and surmount obstacles. "We were able to trigger specific movements by delivering certain sequences of pulses to the various electrodes implanted on the spinal cord," says Detemple. The research scientist and his team believe that the same approach could help people to walk again, too. "We hope that we will be able to transfer the results of our animal testing to people. Of course, people who have suffered injuries to their spinal cord will still be limited when it comes to sport or walking long distances. The first priority is to give them a certain level of independence so that they can move around their apartment and look after themselves, for instance, or walk for short distances without requiring assistance," says Detemple.

Researchers from the NEUWalk project intend to try out their system on two patients this summer. In this case, the patients are not completely paraplegic, which means there is still some limited communication between the brain and the legs. The scientists are currently working on tailored implants for the intervention. "However, even if both trials are a success, it will still be a few years before the system is ready for the general market. First, the method has to undergo clinical studies and demonstrate its effectiveness among a wider group of patients," says Detemple.

Electric spinal cord stimulation to offer relief for Parkinson's disease

Patients with Parkinson's disease could also benefit from the neural prostheses. The most well-known symptoms of the disease are trembling, extreme muscle tremors and a short, stooped gait that has a profound effect on patients' mobility. Until now this neurodegenerative disorder has mostly been treated with dopamine agonists – drugs that chemically imitate the effects of dopamine but that often lead to severe side effects when taken over a longer period of time. Once the disease has reached an advanced stage, doctors often turn to deep brain stimulation. This involves a complex operation to implant electrodes in specific parts of the brain so that the nerve cells in the region can be stimulated or suppressed as required. In the NEUWalk project, researchers are working on electric spinal cord simulation – an altogether less dangerous intervention that should however ease the symptoms of Parkinson's disease just as effectively. "Initial animal testing has yielded some very promising results," says Detemple.

The researchers from Mainz will be at the Sensor + Test 2014 measurement fair in Nürnberg to showcase their neural prostheses. These include implantable microelectrode sensors controlled by microprocessors as well as rigid multi-channel sensors that can be used to record electrophysiological signals and to stimulate neural structures.

Provided by Fraunhofer-Gesellschaft