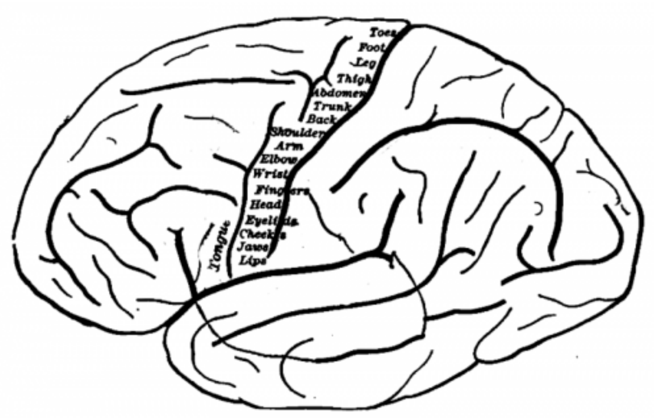
Stentrode developed for brain treatments without major surgery

3 December 2018



Topography of the primary motor cortex, on an outline drawing of the human brain. Different body parts are represented by distinct areas, lined up along a fold called the central sulcus. Credit: public domain

Australian researchers have developed a tiny device that electrically stimulates the brain and could one day be used to treat conditions such as epilepsy and Parkinson's disease without invasive surgery.

They have shown for the first time that electrical stimulation can be delivered into the brain from a 4 mm diameter Stentrode permanently implanted inside a blood vessel.

This technology opens the door for a range of potential treatments that have traditionally required open brain surgery, including deep brain stimulation for Parkinson's disease and epilepsy.

Deep brain stimulation requires open brain surgery with an electrode implanted via burr hole surgery, where one or more holes are drilled in the skull so the electrodes can penetrate the brain. The Stentrode can place electrodes in the brain via blood vessels through a vein in the neck.

The work builds on previous research that showed the Stentrode? could be used to record brain signals, with the potential to control an exoskeleton in patients with paralysis. This study now shows the Stentrode? can also deliver targeted stimulation.

The proof-of-concept study is published in *Nature Biomedical Engineering* and involved researchers from The University of Melbourne, Florey Institute of Neuroscience and Mental Health, The Royal Melbourne Hospital, Monash University and the company Synchron Australia.

The researchers implanted a 4 mm diameter Stentrode into blood vessels in sheep and achieved localised stimulation of brain tissue, all without open-brain surgery. They implanted devices into blood vessels that were adjacent to motor areas of the brain.

"Stimulation-induced responses of the facial muscles and limbs were observed, and were comparable to those obtained with electrodes implanted following invasive surgery," the researchers wrote.

"A minimally invasive endovascular surgical approach utilising a stent-electrode array is an encouraging safe and efficacious way to stimulate focal regions of brain."

Until now, it has never been proven that stimulating the brain from inside a blood vessel can achieve focal brain stimulation using a permanently implanted device. Future studies must now determine the safety of stimulation across a range of intensities.

"While additional data is required to validate chronic safety and efficacy of the Stentrode, our previous research, and literature on the success of commercially available cranial stents and vascular lead wires supports our hypothesis that a Stentrode may be a suitable alternative to invasive neural implants," the researchers said.

Lead researcher Dr. Nick Opie said the work built on previous research that showed the Stentrode could listen to the motor cortex of the brain.

"By adding the ability to speak to the brain using electrical stimulation, we have created a two-way digital communication device," Dr. Opie said. "In one application, the Stentrode could be used as a tool to record the onset of an epileptic seizure, and provide stimulation to prevent it."

Co-author Dr. Sam John said it was the first time such an implant was able to stimulate the brain without needing to perform open brain surgery. He said this work opened the way to making treatment for drug resistant neurological conditions accessible to a greater number of people.

"This offers hope of less invasive treatments for the symptoms of conditions such as Parkinson's disease, epilepsy, depression and obsessive compulsive disorder," he said.

Earlier research, released in 2016, demonstrated that Stentrodes implanted into blood vessels next to the motor cortex could pick up brain signals related to movement. The researchers plan to use the Stentrode to close the loop, making two-way communication with the brain possible.

In their upcoming clinical trial, the recording Stentrode will receive and interpret neural signals and enable a person with Motor Neurone Disease to control communication software.

Eventually it is hoped this technology will be used to help all people suffering from paralysis to control computers, wheelchairs and exoskeletons.

"From within a blood vessel in the head, the Stentrode can pick up brain signals when people think about moving", Dr. Opie said. "These can be converted into commands that enable direct-brain control of computers, vehicles or prosthetic limbs. With stimulation, sensory feedback is possible, and people may be able to feel what they are touching."

More information: Nicholas L. Opie et al, Focal stimulation of the sheep motor cortex with a chronically implanted minimally invasive electrode array mounted on an endovascular stent, *Nature Biomedical Engineering* (2018). DOI: 10.1038/s41551-018-0321-z

Provided by University of Melbourne