Medical Xpress

Joint efforts toward treating paralysis

March 13 2017, by Hillary Sanctuary

Credit: Ecole Polytechnique Federale de Lausanne

EPFL scientists Stéphanie Lacour and Grégoire Courtine report on the status of their research and share their vision about the future of wearable neuroprosthetics at this year's edition of South by South West in Austin, Texas, on March 12th. Courtine shares some preliminary impressions about clinical trials addressing paralysis that are currently underway at the Lausanne University Hospital.

Scientists Stéphanie Lacour and Grégoire Courtine of Ecole polytechnique fédérale de Lausanne (EPFL) in Switzerland are paving the way for new, intelligent neuroprosthetics that may one day assist people with neurological dysfunction in everyday tasks. Neuroprosthetic devices are electronics that communicate with the nervous system, and the scientists are working together to translate their findings from the lab to the clinic.

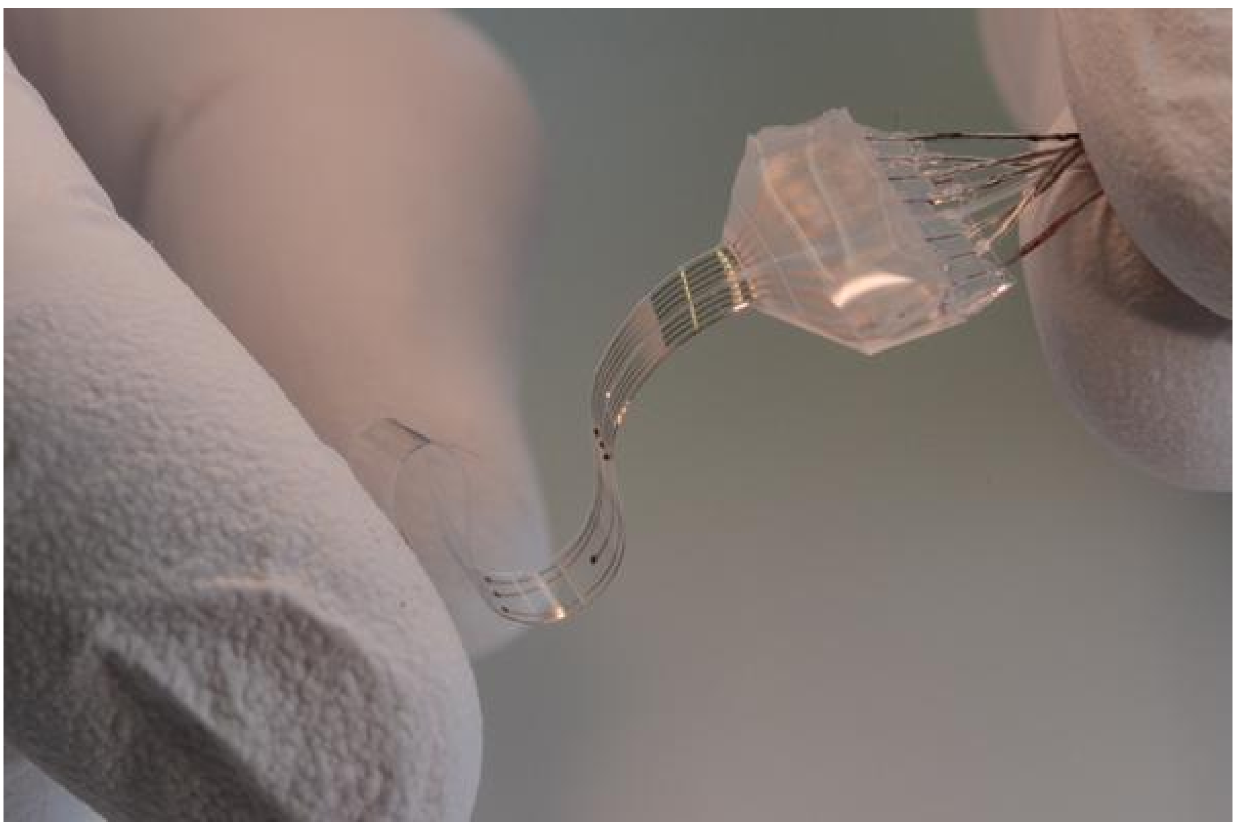
Clinical trials currently underway

In the lab, Grégoire Courtine recently showed that paralyzed primates could walk again with the assistance of a smart neuroprosthetic system he calls the "brain-spine interface". This wireless – fully wearable – neuroprosthetic interface essentially decodes brain signals about walking and stimulates the spinal cord to contract the correct group of leg muscles to enact the intended walking movements – without any therapeutic training. He also showed in 2012 that paralyzed rats could recover after spinal cord injury after a few weeks of rehabilitation, combining electro-chemical stimulation and physiotherapy that uses a robotic harness.

At this year's edition of South by South West (SXSW), Courtine describes this research in detail and his roadmap to transforming this technology into therapy for people suffering from paralysis. In particular, clinical trials are currently underway to test the feasibility of the spine-part of the brain-spine interface on patients with partial paralysis, in a collaboration with neurosurgeon Jocelyne Bloch at the Lausanne University Hospital (CHUV).

"This is the culmination of years of work," says Courtine about the current clinical trials. "The results are so far promising, but the final outcomes must be carefully analyzed and no conclusions can be made yet."

His approach to paralysis research is highly unconventional. Instead of focusing his energy on generating neural regrowth across spinal cord lesions that lead to paralysis, his approach relies on the plasticity of the nervous system, this incredible ability of the nervous system to adapt to damage. Based on his research, he is driven by the conviction that his neurorehabilitation protocol (electro-chemical stimulation and physiotherapy) drives the nervous system to reestablish connections across the lesion.



Credit: Ecole Polytechnique Federale de Lausanne

Elastic electrodes interfacing the body

At the interface of these innovative neuroprosthetic protocols are implantable electrodes that can read neural activity, stimulate nerves, and bypass nerve injury to reactivate biological function. Electrodes are surgically implanted into or on top of target nerve fibres, ready to sense electrical signals from neural activity or to deliver electric current that mimics the language of the nervous system.

There is a caveat. Conventional electrodes are rigid. Implanted in the human body, they aggravate surrounding tissue, leading to inflammation and tissue build-up that precipitate electrode dysfunction and necessite surgical removal.

But Lacour, who holds the Bertarelli Chair in Neuroprosthetic Technology, may have a solution. At SXSW, she presents flexible and stretchable electrodes that conform to the dynamics of the body in the hopes that these new electrodes will provoke less inflammation in the body, leading to longer-lasting – and more wearable – interfaces.

Her e-Dura implant is designed specifically for implantation on the surface of the brain or spinal cord. The small device closely imitates the mechanical properties of living tissue, and can simultaneously deliver electric impulses and pharmacological substances. The risks of rejection and/or damage to the spinal cord have been drastically reduced. Results so far in rodents have been encouraging.

"These electrodes are not yet clinically available," warns Lacour. "Nevertheless, what we are learning can already be applied in a clinical context with my colleague Grégoire."

Provided by Ecole Polytechnique Federale de Lausanne