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NEURAL REPAIR AND REHABILITATION

Man with quadriplegia uses brainwaves to control his forearm muscles

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According to a new report in *Nature*, researchers in Columbus, Ohio have demonstrated that neural signals recorded from the motor cortex can be harnessed to restore meaningful movement to the paralysed arm of an individual with quadriplegia. The research builds on findings that brain activity can be decoded and used to control a computer or prosthetic limb. The control of muscles via this approach had already been demonstrated in nonhuman primates, but had not previously been attempted in humans.

Chad Bouton, Gaurav Sharma and their colleagues at Battelle Memorial Institute and the Ohio State University developed a neural bypass system (NBS), which consisted of an implantable microelectrode array connected to a high-resolution neuromuscular electrical stimulator (NMES). The NMES contained 130 electrodes, and was designed to be worn around the forearm.

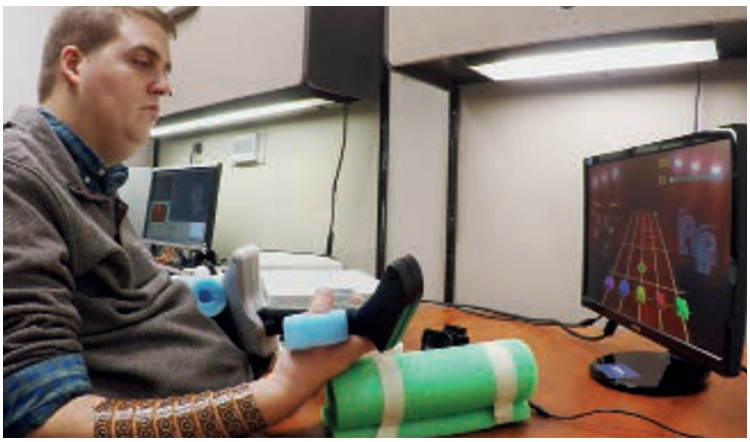
The microelectrode array was surgically implanted into the primary motor cortex of Ian Burkhart, a 24-year-old man who had been rendered quadriplegic by a cervical spinal cord injury sustained in a diving accident. The array recorded neuronal activity while Burkhart attempted to mimic various wrist and hand movements. This activity was then decoded and translated into patterns of electrical stimulation, which were delivered to the forearm muscles by the NMES to generate the desired movement.

"Our goal was to design an intracortically controlled noninvasive stimulation system that can be easily wrapped around a patient's arm and does not require any additional surgeries," explains Sharma. "Our stimulation system also provides a wide coverage of forearm muscles, and can stimulate deeper muscles due to current-field-steering capabilities."

Through use of the NBS, Burkhart was able to perform complex motor tasks, such as grasping a bottle and pouring out its contents. "He can also move individual fingers, allowing a 'pinch' grasp, for example, so that he can pick up small objects and perform finer motions," adds Bouton. "This was a key finding and a significant step forward for restoring hand movement in quadriplegic patients."

The next challenge will be to adapt the NBS for use outside the laboratory environment. "We are working on shrinking down the whole system into a portable belt-worn stimulator," says Sharma. "The goal is to develop this technology further so that the patients can take it home with them to assist with their activities of daily living or even rehabilitation."

Heather Wood



Ian Burkhart plays a guitar video game as part of a study into neural bypass technology. Image courtesy of C. E. Bouton and G. Sharma.

ORIGINAL ARTICLE Bouton, C. E. *et al.* Restoring cortical control of functional movement in a human with quadriplegia. *Nature* http://dx.doi.org/10.1038/nature17435 (2016)

FURTHER READING Ethier, C. *et al.* Restoration of grasp following paralysis through brain-controlled stimulation of muscles. *Nature* **485**, 368–371 (2012) | Jackson, A. & Zimmermann, J. B. Neural interfaces for the brain and spinal cord — restoring motor function. *Nat. Rev. Neurol.* **8**, 690–699 (2012)