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'Smart' prosthetics: restoring independence to people with disabilities

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People with paralysis can stand and move without a wheelchair. They can operate computers to read email and play video games. Brown University neuroscientist John Donoghue said these recent achievements are previews of a major promise of neurotechnology – restoring movement control and communication to people immobilized by injury or disease.

“We’re at the dawn of a new age of neurotechnology,” Donoghue said. “Thanks to advances in biology, medicine, computer science and engineering, we can repair the human nervous system – not with tissue but with technology. Nearly 100,000 people have cochlear implants that provide a sense of sound to the deaf. Retinal implants are in development to restore sight to the blind. And there several systems being created that will help people living with paralysis. Someday, using their own muscles, people with paralysis will be able to feed themselves or perhaps even walk. These electronic devices will allow them to lead more independent lives.”

Donoghue will discuss the fast-growing field of neuroprosthetics at a Feb. 15, 2007, press briefing at the annual meeting of the American Association for the Advancement of Science (AAAS), the world’s largest general scientific society. At the meeting, held in San Francisco, Donoghue will take part in a symposium titled “Smart Prosthetics: Interfaces to the Nervous System Help Restore Independence.”

Donoghue, the Henry Merritt Wriston Professor at Brown and director

of the University's Brain Science Program, is a leader in neuroprosthesis research and development. At the press briefing and in the symposium, he will give an overview of brain-computer interfaces (BCIs) – systems that create a direct communication pathway between the brain and an external device such as a computer or a wheelchair.

One example of a BCI is BrainGate, the mind-to-movement system that got its start in the Donoghue laboratory at Brown. BrainGate consists of an implantable sensor and external processors that record and interpret brain signals from the motor cortex, turning the brain's electrical signals into movement commands that can control assistive devices.

The BrainGate system has allowed people with paralysis to operate a computer in order to read e-mail, control a wheelchair and operate a robotic hand in FDA-approved pilot clinical trials. Donoghue oversees the trials in his role as chief scientific officer of Cyberkinetics Neurotechnology Systems Inc., the Foxborough, Mass., company developing and testing the technology.

Donoghue is also working with symposium organizer P. Hunter Peckham, a professor of biomedical engineering and orthopaedics at Case Western Reserve University, to develop a neuroprosthetic system that can restore partial arm and hand function to people with paralysis.

The system will connect the BrainGate sensor with Peckham's functional electrical stimulation (FES) system, which uses electrical impulses to trigger muscle and limb movement. The first version will allow users to make simple movements that could be used to perform tasks such as eating or drinking – using their own arms and hands and under the natural control of their own brains. The initial version of this FES system would use arm supports. Later versions, however, won't require supports – and will allow users to do activities that require more dexterity, such as using cell phones or remote controls.

Donoghue and Peckham will complete a prototype within four years under a contract with the National Center for Medical Rehabilitation Research at the National Institutes of Health.

“This system will represent a quantum leap in rehabilitation technology,” Donoghue said, “and it will fundamentally alter the lives of people with spinal cord injury.”

Source: Brown University