Bionic leg undergoing clinical trials

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(Medical Xpress) -- A "bionic" leg designed for people who have lost a lower leg is undergoing clinical trials sponsored by the US Army. The researchers hope the leg will be able to learn the patient's nerve signal patterns and be able to move in response to the patient's own muscles and nerves.

Lead researcher, Dr Levi Hargrove of the Rehabilitation Institute of Chicago (RIC) Center for Bionic Medicine, said the research aims to integrate the machine with the person, replacing the mechanical sensors used by traditional prostheses with sensors that can "measure the actual neural intent" to tell the motors what to do. Prosthetic arms using the same technology have already been developed.

The system uses electromyography (EMG), or electrical signals produced by the muscles, along with pattern recognition computer software to control the robotic leg. Electrodes are attached to nine muscles in the thigh to detect the patterns in which the nerve signals are fired. Different patterns correspond to different intended movements.

In the current stages of training, the volunteers are wired up to the electrodes and learn how to use the muscles to make a computer avatar move on screen.

The clinical trials are using four lower leg amputee patients and four non-amputee controls. They aim to find out if they will need to have extra nerve endings implanted in a process known as "targeted muscle innervations" to control the robotic limb. The researchers have been

surprised with the preliminary findings that show the patients are able to control the ankle joint, which they expected would require surgical implants.

Results showed that all the volunteers could control the avatar's knee and ankle movements from neural information from the thigh, with amputees achieving 91 percent accuracy of movement and the non-amputees achieving 89 percent.

The paper was published on April 20 in the Journal of the American Medical Association. There are currently around two million people globally with lower leg amputations, but this figure is rising steadily as the number of people with type 2 diabetes continues to increase.

A robotic leg controlled by tiny movements in the remaining muscles would give amputees more freedom and more natural movements, and it would enable them to make complicated movements such as climbing stairs with much more safety. With current prostheses they must swing the leg to make it move.

Other companies are working on motorized ankles and knees, but no other group is working on a prosthetic leg with both or with a prosthesis controlled by the patient's own nerve signals. Dr Hargrove said there was much work remaining to be done, but the future of more advanced prosthetic control looks bright.

More information: Real-Time Myoelectric Control of Knee and Ankle Motions for Transfemoral Amputees, Levi J. Hargrove, PhD, l-hargrove@northwestern.edu; Ann M. Simon, PhD; Robert D. Lipschutz, CP; Suzanne B. Finucane, MS, PTA; Todd A. Kuiken, MD, PhD, Center for Bionic Medicine, Rehabilitation Institute of Chicago, Chicago, Illinois, *JAMA*. 2011; 305 (15): 1542-1544. doi:10.1001/jama.2011.465

Abstract

We recently investigated real-time neural control of artificial arms using targeted muscle reinnervation and pattern recognition algorithms. However, lower limb amputees outnumber upper limb amputees. There has been increased interest in neurally controlled powered lower limb prosthetics because they can restore activities that require joint power to be generated. We have extended our research to lower limb amputees.