Medical Xpress

New surgical technique shows promise for improving function of artificial arms

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A surgical technique known as targeted muscle reinnervation appears to enable patients with arm amputations to have improved control of functions with an artificial arm, according to a study in the February 11 issue of *JAMA*.

Currently available prostheses following upper-limb amputation do not adequately restore the function of an individual's arm and hand. The most commonly used prostheses are body-powered, which capture remaining shoulder motion with a harness and transfer this movement through a cable to operate the hand, wrist, or elbow. With this control method, only one joint can be operated at a time, according to background information in the article.

Improving the function of prosthetic arms remains a challenge, because access to the nerve-control information for the arm is lost during amputation. With the surgical procedure, targeted muscle reinnervation (TMR), remaining arm nerves are transferred to chest or upper-arm muscles that are no longer biomechanically functional due to loss of the limb. The goal of this procedure is to improve control of prostheses that use electromyogram (EMG) signals (the electrical signals generated during muscle contraction) from residual limb muscles to control motorized arm joints. Once reinnervated (restore nerve function), these muscles provide physiologically appropriate EMG signals for control of the elbow, wrist, and hand. It is unknown whether reinnervated muscles can stably and accurately provide myoelectric (electrical impulses in muscle) signals for real-time control of multifunction prostheses.

Todd A. Kuiken, M.D., Ph.D., of the Rehabilitation Institute of Chicago, and colleagues assessed the performance of five patients with upper-limb amputation who had undergone TMR surgery. The study, conducted between January 2007 and January 2008, also included 5 control participants without amputation. All participants were instructed to perform various arm movements, and their abilities to control the virtual prosthetic arm were measured.

The average motion selection times for elbow and wrist movements (elbow flexion/extension, wrist rotation, and wrist flexion/extension) were 0.22 seconds for TMR patients and 0.16 seconds for control participants. The average motion completion rate for elbow and wrist movements was high (96.3 percent for TMR patients and 100 percent for control participants). The average motion completion times for elbow and wrist movements were 1.29 seconds for TMR patients and 1.08 seconds for control participants. For both groups, hand grasps took longer to complete than arm movements; the average motion completion times for hand grasps were 1.54 seconds for TMR patients and 1.26 seconds for control participants.

Three of the patients were able to demonstrate the use of the control system in advanced prostheses, including motorized shoulders, elbows, wrists, and hands.

"These early trials demonstrate the feasibility of using TMR to control complex multifunction prostheses. Additional research and development need to be conducted before field trials can be performed," the authors write. "The prosthetic arms tested in this study performed very well as early prototypes. Further improvements are needed and have been planned, including reducing the size and weight and increasing the robustness of these advanced prostheses."

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