

Mechanical design and performance specifications of anthropomorphic prosthetic hands: A review

Joseph T. Belter, MS, BS, et al.

This article discusses the mechanical design characteristics of anthropomorphic prosthetic hands. The mechanical design of the hand determines the functions (grasping, pushing, pointing, etc) the hand can perform and therefore the ability the user will gain. The many tradeoffs when engineering a complex, multifunctional electromechanical device are discussed. Hopefully, engineers, prosthetists, and users of prosthetic limbs will gain insight from this article. The likely benefits of this work include a broader understanding of the mechanical design of prosthetic hands, a resource to use when making rehabilitation decisions, and a review of the current state-of-the-art anthropomorphic prosthetic hands.

<http://dx.doi.org/10.1682/JRRD.2011.10.0188>

**Load applied on bone-anchored transfemoral prosthesis: Characterization of a prosthesis—
A pilot study**

Laurent Frossard, PhD, et al.

This study explored the potential of portable kinetic recording systems to determine the effect of prostheses on the load applied on the residuum. In this case, this load was measured during several activities of daily living performed by an individual with unilateral transfemoral amputation fitted with a bone-anchored prosthesis. This work confirmed that the proposed apparatus can reveal how changes in prosthetic components (e.g., mechanical vs microprocessor-controlled knee) are translated into inner-prosthetic loading. This indicates that such an apparatus might have the ability to support evidence-based fitting, and therefore, to address issues related to under- or over-prescription of components.

<http://dx.doi.org/10.1682/JRRD.2012.04.0062>

Cardiometabolic risk factors in Iranians with spinal cord injury: Analysis by injury-related variables

Hadis Sabour, MD, PhD, et al.

Persons with spinal cord injury (SCI) have increased prevalence of abnormalities in carbohydrate and lipid metabolism. The objective of this study was to determine the prevalence of cardiometabolic risk factors in people with SCI based on injury-related variables. Waist circumference, level of injury, cholesterol intake, and polyunsaturated fatty acid intake were positive predictor factors. Conventional risk factors for coronary heart disease should be identified and treated in individuals with SCI.

<http://dx.doi.org/10.1682/JRRD.2012.01.0020>

Internet-based physical assessment of people with Parkinson disease is accurate and reliable: A pilot study

Trevor G. Russell, PhD, et al.

This study aimed to determine the accuracy and reliability of performing physical assessments of people with Parkinson disease (PD) via the Internet. People with PD who live in areas where traditional rehabilitation services are not readily accessible could benefit from this technology through increased access to healthcare. Balance and mobility outcome measures were investigated in 12 subjects via the Internet using the eHAB telerehabilitation system. Results showed that telerehabilitation assessments are accurate and reliable. This study indicates that it is possible to assess the physical ability of people with PD via telerehabilitation systems and provides support for further development of telerehabilitation applications.

<http://dx.doi.org/10.1682/JRRD.2012.08.0148>

Coordination patterns of shoulder muscles during level-ground and incline wheelchair propulsion

Liping Qi, PhD, et al.

People with spinal cord injury usually rely on their ability to propel a manual wheelchair for independent mobility. Achieving the highest degree of independence in a manual wheelchair often depends on the user's ability to negotiate a range of environments and overcome indoor and outdoor obstacles. Ramps of varying degrees are frequent both outdoors and indoors. Wheelchair users adopt different postures and employ different stroke techniques to suit different locomotion tasks. We developed a method for identifying shoulder muscle coordination patterns during level-ground versus incline wheelchair propulsion. This approach allows for patterns and trends in electromyography characteristics to effectively and consistently map out patterns of physical activity.

<http://dx.doi.org/10.1682/JRRD.2012.06.0109>

Veterans Health Administration vocational services for Operation Iraqi Freedom/Operation Enduring Freedom Veterans with mental health conditions

Elizabeth W. Twamley, PhD, et al.

By studying Veterans Health Administration appointments in 75,607 Operation Iraqi Freedom/Operation Enduring Freedom (OIF/OEF) Veterans with posttraumatic stress disorder, depression, substance use disorders, or traumatic brain injury (TBI)-related problems in fiscal years 2008 and 2009, we found that only 8.4 percent accessed vocational services. Most Veterans who did so attended only one or two appointments. Veterans with TBI and with more mental health conditions overall were more likely to access vocational services. Only 2.2 percent of Veterans received evidence-based supported employment. However, supported employment was effective, with 243 out of 479 Veterans who received it obtaining competitive work, with an average hourly wage of \$11.60 and longer-lasting jobs. More supported employment spe-

cialists are needed to serve OIF/OEF Veterans.
<http://dx.doi.org/10.1682/JRRD.2012.08.0137>

Prosthesis preference is related to stride-to-stride fluctuations at the prosthetic ankle

Shane R. Wurdeman, CP, MSPO, et al.

Typical walking measures average multiple steps together to get a single representative step. This, however, removes the effect that one step has on the next. The small changes from step-to-step are considered to be an important part of how the neuromuscular system controls walking. While previous walking measures have not related to an amputee's prosthesis preference, it is possible that this is because the typical walking measures failed to consider this other aspect of how walking is controlled. We found a strong relationship between the small changes that occur from step-to-step at the prosthetic ankle and how strongly the amputee preferred the prosthesis.

<http://dx.doi.org/10.1682/JRRD.2012.06.0104>

Motor control and learning with lower-limb myoelectric control in amputees

Ramses E. Alcaide-Aguirre, BS, et al.

We studied subjects with lower-limb amputation and nondisabled subjects while they used their muscle electrical activity to control a virtual object on a computer screen. The subjects changed the acceleration of the virtual object based on the relative amplitude of their muscle activity. We wanted to know whether the subjects with amputation could learn to change the activity level of their residual-limb muscles. We found that the subjects with amputation only needed a very short amount of practice to quickly improve their residual-limb muscle control and even match the level of the nondisabled subjects. These results suggest that a similar control strategy could be used for robotic lower-limb ankle prostheses.

<http://dx.doi.org/10.1682/JRRD.2012.06.0115>

Effects of cognitive task on gait initiation in Parkinson disease: Evidence of motor prioritization?

Joe R. Nocera, PhD, et al.

As the U.S. population ages, more Veterans may develop Parkinson disease. Unfortunately, those Veterans diagnosed with Parkinson disease may develop problems walking, particularly walking while doing another task (talking, for example). In addition to difficulty walking while talking, our study showed that patients with Parkinson disease have trouble initiating walking from a standing position while doing another task. On the basis of these results, Veterans with Parkinson disease should participate in interventions (exercise and cognitive stimulation) that could improve their ability to perform more than one task at the same time.

<http://dx.doi.org/10.1682/JRRD.2012.06.0114>

New method of fixation of in-bone implanted prosthesis

Mark Pitkin, PhD, et al.

We aimed to develop a strong porous pylon that could integrate with the surrounding skin and create a natural barrier against the infection associated with direct skeletal attachment of limb prostheses. This article presents the results on the effectiveness of a new version of the titanium porous composite skin and bone integrated pylon with side fins (SBIP-3). The side fins are designed to improve the bond between the bone and pylon. We found that the space between the fins and the bone into which they were fit was filled with fibrovascular tissue and woven bone. No substantial inflammation was found. We suggest that the proposed method may become an alternative to the established technique of implanting prostheses into the medullary canal of the hosting bone.

<http://dx.doi.org/10.1682/JRRD.2012.11.0202>

Comparison of mechanical properties of silicone and PVC (polyvinylchloride) cosmetic gloves for articulating hand prostheses

Gerwin Smit, MSc; Dick H. Plettenburg, MSc, PhD

Although polyvinylchloride (PVC) and silicone cosmetic gloves have been used in upper-limb prosthetics for decades, almost nothing is known about their mechanical properties. In this study, two types of cosmetic gloves of the same hand size were objectively measured and compared (three PVC and three silicone). The amount of required energy, energy loss, and the stiffness of the different finger joints of each glove were measured. The outcomes showed that the silicone glove was much more flexible than the PVC glove, required less energy when flexing the finger joints, and dissipated less energy. These outcomes, considered with other significant features, may help when comparing the optimal materials for a cosmetic glove that is to be fitted to an active hand. The mechanical properties of these materials and the detailed design and structure of the glove are of increasing importance as more joints are included in the hand's motion.

<http://dx.doi.org/10.1682/JRRD.2011.12.0238>

Healthcare provider beliefs about exercise and fatigue in people with multiple sclerosis

Catherine M. Smith, PhD, et al.

Fatigue is an extreme sense of tiredness that people with multiple sclerosis often feel. Healthcare providers such as doctors, physiotherapists/physical therapists, and occupational therapists do not fully understand what causes fatigue but they do know that regular exercise is good for everybody, including people with multiple sclerosis. This research will help people with multiple sclerosis talk to their healthcare providers more confidently about what form of exercise might be best for them. It will help guide healthcare providers to give exercise programs or advice that is suitable, enjoyable, and sustainable for each person with multiple sclerosis.

<http://dx.doi.org/10.1682/JRRD.2012.01.0012>