

## Clinical Relevance for the Veteran

### SUMMARIES OF SCIENTIFIC/TECHNICAL ARTICLES

#### **Sensitivity to changes in disability after stroke: A comparison of four scales useful in clinical trials**

Alexander W. Dromerick, MD;  
Dorothy F. Edwards, PhD; Michael N. Diringer, MD

**Purpose of the Work.** This study determined how different ways of measuring improvement in people with stroke might help design better clinical trials of new stroke treatments. **Subjects and Procedures.** Ninety-five people with stroke were studied while they received inpatient rehabilitation. As they improved, their ability to move and care for themselves was measured with the use of several different rating scales. The scales used were the Barthel Index (BI), the Modified Rankin Scale (MRS), the Functional Independence Measure (FIM), and the International Stroke Trial Measure (ISTM). **Results.** A wide variation was found in the sensitivity to change among the four measures. The two global scales (MRS and ISTM) were less sensitive to improvements in disability compared to the two activities of daily living scales (BI and FIM). **Relevance to the Veteran Population.** These findings aid researchers studying new treatments for persons with stroke, including veterans. Improving recovery measurement will allow for more efficient testing of promising new treatments.

*Alexander W. Dromerick, MD*

#### **Transverse rotation and longitudinal translation during prosthetic gait—A literature review**

Martin Twiste, MSc; Shyam Rithalia, PhD

**Purpose of the Work.** This study reviewed the literature on investigations into torque and shock-absorbing devices for prosthetic gait. Such devices allow the prosthetic socket, when seen from above, to rotate clockwise and anticlockwise and to move up and down with respect to the prosthetic foot. **Procedures.** A large range of literature is used to extract useful information on these motions and their effect on prosthetic gait as well as to establish design characteristics of current, commercially available devices that allow these types of motions. **Results.** Despite implementation of torque and shock absorption in prostheses for several decades, the amount of research conducted in this field is little and benefits from such

motions still need further explorations. **Relevance to the Veteran Population.** This review identifies areas that require more in-depth research and may help to stimulate creative thinking for future investigations.

*Martin Twiste, MSc*

#### **Reliability of measures of gait performance and oxygen consumption with stroke survivors**

Inácio Teixeira da Cunha-Filho, PT, PhD;  
Helene Henson, MD; Sharmin Wankadia, PT, MS;  
Elizabeth J. Protas, PT, PhD, FACSM

**Purpose of the Work.** The work determined if measures of walking are repeatable. Many people who have difficulty walking after a major stroke receive rehabilitation for their walking problems. Leg weakness caused by the stroke slows walking and makes walking more difficult by decreasing its efficiency. Good measures of walking are needed to judge recovery following the stroke and response to rehabilitation. **Subjects and Procedures.** The subjects were nine men who had a recent history of stroke and were receiving rehabilitation. Subjects walked twice for 5 min each while wearing a device to collect and analyze oxygen used. Gait speed, distance walked, and oxygen (efficiency) were compared between the walks. **Results.** The measures were repeatable. **Relevance to the Veteran Population.** Stroke is one of the most common disabling conditions experienced by middle-aged and older veterans. Repeatable measures are critical following their recovery and response to rehabilitation.

*Inácio Teixeira da Cunha-Filho, PT, PhD*

#### **Upper-limb fatigue-related joint power shifts in experienced wheelchair users and nonwheelchair users**

Mary M. Rodgers, PhD, PT; Kevin J. McQuade, PhD, PT;  
Elizabeth K. Rasch, MS, PT; Randall E. Keyser, PhD;  
Margaret A. Finley, MA, PT

**Purpose of the Work.** This study evaluated the power transfer or shifting across the joints of the arm, resulting from fatigue-inducing wheelchair propulsion. Calculation of joint power is used to estimate how hard different parts of the arms are working. **Subjects and Procedures.** Biomechanical and physiological measures were collected during a wheelchair exercise test to exhaustion on 19 manual wheelchair users and 10 nonusers. **Results.** Results

showed that as individuals tire, joint power shifts from the shoulder joint to the elbow and wrist joints for both wheelchair users and nonusers. In other words, the muscles around the shoulder do more work when the user is fresh, but the muscles around the elbow and wrist joints do more work as the user gets tired. **Relevance to the Veteran Population.** Shifting of the workload in the arm as a person tires may help protect the arm joints from injury.

*Mary M. Rodgers, PhD, PT*

### **Kinematic and dynamic performance of prosthetic knee joint using six-bar mechanism**

Dewen Jin, Professor;

Ruihong Zhang, PhD; H.O. Dimeo, PhD;

Master Rencheng Wang, PhD, Associate Professor;

Jichuan Zhang, Professor

**Purpose of the Work.** A four-bar linkage has been used in knee prostheses for many years, and many publications have dealt with the properties, design, and alignment in fitting of the mechanism. In recent years, applications of the six-bar mechanism in the prosthetic knee joint have increased, but only a few papers deal with the function of this kind of mechanism applied to the knee joint. This study explored the properties of the six-bar mechanism used in the prosthetic knee joint from the kinematic and dynamic point of view. To exploit the advantages of the mechanism, one must recognize the importance of proper design of the mechanism. Thus, the methods used in the mechanism design were proposed in this study. In addition, to better understand differences between six-bar and four-bar linkage knee joints, we made some comparisons between them as well. **Procedures.** Both analytical and experimental methods were used in this study. First, because the six-bar mechanisms have more design parameters than the four-bar mechanisms, improving the trajectories of the ankle joint of the users in the swing phase is possible. Thus, the optimum design procedure was adopted by which the dimensions of the mechanism were obtained. For the symmetry of the gait pattern to be increased in the transfemoral amputee, the expected trajectories of the ankle joint in the design had been determined based on the data from the sound side of an amputee. Second, the analysis of the stability of the knee mechanism was made by using instant inactive joints (IIJs) in multibar linkage. The IIJ is the joint that cannot move in a certain position or instant. Thus, the more IIJs exist in the standing position, the higher stability will be. By proper design, the mechanism

provides four IIJs in the standing position while only one IIJ can exist in the four-bar mechanism. Third, to realize the expected gait pattern, one should consider knee moment control, which was made by employing the dynamic force analyzing procedure. Because as many as four joints can be used for moment control, we performed the analyses one by one to determine the most suitable one. The final decision was considered not only on the values of the moments but also on the structure. Finally, the experiments were made to verify the design and analyses of the study. A knee joint was manufactured for experimental use according to the results obtained from the kinematic and dynamic studies. The knee joint consists of a six-bar mechanism and a moment control device whose friction moment can be controlled by computer through a step motor. Because the motion of the leg and consequently the trajectory of ankle joint are affected by the motion of the thigh (to make the thigh move as close as possible to normal gait in the experiments), the prosthetic thigh was strapped to the thigh of a nonamputee subject. It was dragged along in normal walking speed. The movement of the shank and the trajectory of ankle joint were recorded with a CCD-based human motion-detecting and analysis system. **Results.** The effectiveness of the analyses and design presented in this paper has been verified by comparing the expected motion of the leg and the trajectory of the ankle joint with experimental data. The mean square errors were used to make a quantitative evaluation. The results show the feasibility of the optimum design together with the moment control system proposed in the study. To compare the six-bar linkage with four-bar mechanism, the computer simulating results of a four-bar linkage designed by using the same procedure are also given in the paper. The data show that the trajectory of the ankle joint and the movement of the shank generated by the six-bar knee are closer to that expected than that of the four-bar linkage knee. Moreover, when the user walked on different terrain, e.g., on a slope or in different speed, the six-bar knee mechanism also showed its advantage over four-bar linkage. **Relevance to the Veteran Population.** The function of prosthetic knee joint is essential to improving the gait pattern of transfemoral amputees. Note that to avoid the foot from knocking the ground in swing phase, the users always inclined their bodies to the sound side, which greatly reduced the level of symmetry of gait pattern. The gait pattern may be improved by properly designing the knee mechanism so the trajectory of the ankle joint is as close to the trajectory of the sound side of the user. The study on the functional analysis of the six-bar

linkage knee and its design consideration may be helpful in developing a more functional and advanced prosthetic knee joint.

*Dewen Jin, Professor*

### **Psychosocial effects of an exercise program in older persons who fall**

Kevin M. Means, MD; Patricia S. O'Sullivan, EdD;  
Daniel E. Rodell, PhD

**Purpose of the Work.** This study determined if psychosocial variables differ among persons with and without falls and if those who fall can improve psychosocial status by exercise. **Subjects and Procedures.** Community-residing elders, with and without a history of falls, completed measures on psychosocial variables and balance and mobility. Those without a fall returned for postmeasures 6 weeks later and those with a history of falls completed a 6-week progressive exercise program to improve balance and mobility. **Results.** Those persons who fall have a poorer psychosocial status than those who have not fallen. Exercise benefited fallers' self-esteem, depression, mobility, social role, social activity, and anxiety. Nearly 40% of fallers were clinically depressed before exercise and 24% were depressed after exercise. **Relevance to the Veteran Population.** Enrolling veterans in progressive exercise programs can benefit both their physical and psychosocial status. Improved psychosocial status may protect against future falls.

*Kevin M. Means, MD*

### **Psychological correlates of illusory body experiences**

Malcolm MacLachlan, PhD;  
Deirdre Desmond, BA (Mod); Olga Horgan, BA (Mod)

**Purpose of the Work.** People who have had amputations frequently continue to experience sensations and pain in the amputated limb. These "phantom" experiences can be extremely distressing and sometimes prohibit effective rehabilitation. Recently, research on treating phantom phenomena has used the experimental induction of illusory body experiences, but a great variability exists in how susceptible people are to these illusions and how beneficial they are. We sought to identify psychological

characteristics associated with illusory body experiences so that such people may be identified more easily. **Subjects and Procedures.** We used an able-bodied sample of persons who completed psychometric measures of body plasticity, somatic preoccupation, and creative imagination, as well as who underwent the Rubber Hand, Mirror Box, and Extending Nose illusory induction procedures. **Results.** Each of our psychometric measures was associated significantly and differentially with the occurrence of illusory body experiences. **Relevance to the Veteran Population.** Our results suggest that a brief psychometric assessment can be used to identify those people most likely to have illusory body experiences and that this assessment could now be used to select those people with amputations who are most likely to benefit from treatments based on illusory body experiences.

*Malcolm MacLachlan, PhD*

### **Experimental study of decubitus ulcer formation in the rabbit ear lobe**

Junko Niitsuma, MS; Hideo Yano, PhD, MD;  
Tatsuo Togawa, PhD

**Purpose of the Work.** This study was conducted to develop an animal model that reproduces decubitus ulcer formation. **Subjects and Procedures.** An animal model was created in the ear lobes of Japanese white rabbits. Repeated compressions were applied to the ear lobes at different levels of strength and duration as well as the interval of compressions. **Results.** The four grades of severity of decubitus ulcer could be formed by the applications of compressions at specific strengths and durations, and the results were highly reproducible. Severe healing decubitus ulcers were formed by repeated compressions rather than by continuous compression. **Relevance to the Veteran Population.** Our results will allow the prevention of decubitus ulcers in humans, because (1) the conditions of occurrence of different grades of decubitus ulcers, found in our animal model, also will be applicable to human tissue and (2) the critical condition of the occurrence of severe decubitus ulcers will be determined from our results.

*Junko Niitsuma, MS*

