Clinical Relevance for the Veteran

SUMMARY OF SCIENTIFIC/TECHNICAL PAPERS IN THIS ISSUE

An Analysis of Work Postures of Manual Wheelchair Users in the Office Environment.

Betty S. Troy, MS; Rory A. Cooper, PhD; Rick N. Robertson, PhD; Thomas L. Grey, MS *(p. 151)*

Purpose of the Work. The number of wheelchair users in the workforce is increasing. Along with the enactment of the Americans with Disabilities Act, there is a need for information on how to facilitate the needs of wheelchair users in the office environment. **Subjects/Procedures.** This was a two-phase study. In Phase I, a questionnaire was distributed to 140 adult wheelchair users throughout the United States, asking them about office activities that they perform on a daily basis. In Phase II, 7 subjects were chosen for further study, performing 2 of the most problematic activities indicated by subjects in Phase I. **Results.** Responses from questionnaires in Phase I revealed filing and writing at a desk to be the most problematic activities for subjects. In Phase II, low back pain appeared to be associated with the need to bend forward to access file drawers while seated in a wheelchair. Also, while writing at a desk, a poor desk-wheelchair relationship appeared to be associated with back, shoulder, and neck discomfort. **Relevance for Veteran Population.** This information can be put to use to improve workspaces utilized by wheelchair users, which in turn would help increase their work comfort and productivity.
Betty S. Troy, MS

Methods for Determining Three-Dimensional Wheelchair Pushrim Forces and Moments: A Technical Note.

Rory A. Cooper, PhD; Rick N. Robertson, PhD; David P. VanSickle, MS; Michael L. Boninger, MD; Sean D. Shimada, MS *(p. 162)*

Purpose of the Work. The purpose of this study was to examine some of the differences between techniques reported in the literature related to the study of manual wheelchair propulsion biomechanics. **Subjects.** Data are presented from a single veteran with paraplegia due to a spinal cord injury. The veteran uses a wheelchair as his primary means of mobility. **Procedures.** Data were collected with the veteran propelling an ultralight manual wheelchair on a stationary roller system. A force/moment sensing SMARTWheel was mounted to the wheelchair. Motion data were collected using three synchronized video cameras. The data were then analyzed using several methods presented in the literature for wheelchair biomechanics studies. **Results.** Discrepancies in results presented in the wheelchair biomechanics literature are in part due to the differences in the methods used to analyze the data. **Relevance to Veteran Population.** Studies such as this one represent important steps toward understanding and eventually preventing pain an secondary disability.
Rory A. Cooper, PhD

Generic, Geometric Finite Element Analysis of the Transtibial Residual Limb and Prosthetic Socket.

M. Barbara Silver-Thorn, PhD and Dudley S. Childress, PhD *(p. 171)*

Purpose of the Work. The purpose of this study was to develop a computer model of the residual limb and socket of individuals with transtibial amputation to estimate loading and improve our understanding of socket fit. **Subjects/Procedures.** Three subjects with unilateral transtibial amputation were included in this study. Data obtained included assessment of limb tissue stiffness via indentor studies and pressure measurement at select limb locations. These data were used to complete the computer model and assess how well the model was able to estimate limb loading for a variety of socket designs and alignments during quiet standing. **Results.** The pressures estimated by the computer model were of the same order of magnitude as the measured pressures. However, significant differences in the pressure distribution were observed. **Relevance to Veteran Population.** Accurate computer models of the lower residual limb may be used to further our understanding of socket fit, and ultimately improve the design of prostheses.
M. Barbara Silver-Thorn, PhD

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A Holter-Type, Microprocessor-Based Rehabilitation Instrument for Acquisition and Storage of Plantar Pressure Data.
Ziad O. Abu-Faraj, PhD; Gerald F. Harris, PhD, PE; Joseph H. Abler, PhD, PE; Jacqueline J. Wertsch, MD *(p. 187)*

Purpose of the Work. A Holter-type plantar pressure data acquisition system was developed and validated. The system provides quantitative analysis of cumulative plantar pressure and temporal gait data. **Subjects/Procedures.** An adult male subject was monitored during three successive working days. Plantar pressure data were recorded during sitting, level walking, stair climbing, stair descent, and quiet standing. **Results.** Peak plantar pressures, pressure-time integrals, and contact durations were analyzed. The results indicate that the system is appropriate for further clinical application and characterization of event-related pressure alterations. **Relevance to Veteran Population.** The VA population includes large numbers of patients at high risk for development of plantar pressure sores. This research may help define cumulative loading thresholds for better management of the insensitive foot.
Ziad O. Abu-Faraj, PhD

A Modular Six-Directional Force Sensor For Prosthetic Assessment: A Technical Note.
Joan E. Sanders, PhD; Robert A. Miller, MSME; David N. Berglund, BSME; Santosh G. Zachariah, PhD *(p. 195)*

Purpose of the Work. The purpose of this work was to design a small instrument for measuring the forces transmitted through prostheses of persons with lower limb amputation. **Subjects/Procedures.** The instrument is a thin, disk-shaped, lightweight device that is positioned immediately beneath the socket within the prosthesis. The instrument was tested on a subject with a transtibial amputation during standing and walking trials. **Results.** During standing, the device was shown to record a force of approximately half the subject's body weight. Waveform shapes during walking varied depending on the walking rate with relatively higher forces during early stance than late stance for faster walking rates. **Relevance to Veteran Population.** Such a device has several potential uses, including providing information: for enhancing the design and evaluation of prosthetic componentry (knees, ankles, feet); for computer models intended to predict interface stresses on residual limbs; and for use in prosthetic fitting and alignment.
Joan E. Sanders, PhD

An Experimental Device for Investigating the Force and Power Requirements of a Powered Gait Orthosis.
Brent J. Ruthenberg, MSME; Neil A Wasylewski, BSME; John E. Beard, PhD *(p. 203)*

Purpose of Work. The use of powered exoskeletons to provide bipedal locomotion for the physically impaired, in part, requires a device that is lightweight, easy to don and doff, simple to maintain, inexpensive, and has significant walking distance on one charge. The purpose of the project was to measure forces in the exoskeleton and to determine the importance of specific gait parameters. **Subjects/Procedures.** The data used in the project were obtained from two adult male subjects, one with C-2 imcomplete quadriplegia and an individual in the advanced stages of multiple sclerosis. Both subjects had experience using the RGO. **Results.** The results indicate power requirements of the mechanical system can be minimized by varying the heel strike to toe-off ratio without increasing the energy requirements of the user. **Relevance to Veteran Population.** The Department of Veterans Affairs can use this information to aid in the development of powered exoskeletons capable of providing realistic bipedal locomotion.
John E. Beard, PhD