

SUMMARY OF SCIENTIFIC/TECHNICAL PAPERS IN THIS ISSUE

Lumbar corsets: Their effect on three-dimensional kinematics of the pelvis

L. Vogt, MS; K. Pfeifer, PhD; M Portscher;
W. Banzer, MD, PhD (p.495)

Purpose of the Work. Low back pain is a costly and often seriously disabling condition that affects people of all ages. Lumbar supports are frequently used in the management of low back pain. However, the mechanisms by which lumbar supports influence low back problems remain a subject of debate. To determine the degree of changes in the lumbar region, our purpose was to quantify three-dimensional kinematic data of the pelvis in harness-supported treadmill walking. **Subjects/Procedures.** Twelve healthy subjects walked on a treadmill with and without wearing a lumbar corset. Pelvic motions in the frontal, sagittal, and transverse planes were recorded. **Results.** Net angular displacements of the pelvis demonstrated a 40% decrease in the pelvis upward and downward movement. **Relevance to the Veteran Population.** Following the results, it is important to analyze the use of auxiliary devices in functional conditions to gain knowledge for helping to develop functional orthotic devices.
L. Vogt, MS

Functional outcome after high tibial osteotomy: A study using individual goal achievement as the primary outcome variable

Ulrika Öberg, PT, PhD and Tommy Öberg, MD, PhD
(p.501)

Purpose of the Work. This paper focuses on goal achievement as a clinically relevant outcome variable. As an example of application, outcome after high tibial osteotomy was evaluated with respect to both improvement and goal achievement. **Subjects/Procedures.** Fifty-seven patients, 32 men and 25 women, with a mean age of 55 years were examined with the Functional Assessment System (FAS) 6 and 12 months after surgery. The FAS is an evaluation system specifically designed to monitor lower extremity dysfunction. It

shows a profile with preoperative status, individual goal, and postoperative status. **Results.** Statistically significant improvement was seen in 6 of 20 variables after 6 months, and in 10 of 20 variables after 12 months. When goal achievement was examined, the results were not as impressive. The treatment goal was not reached on a group level for almost all variables. On the individual level, only 20–40% of the patients achieved the goal as a result of surgery in most variables. Exceptions were pain and leisure time/hobbies, where there was a high degree of goal achievement. **Conclusions.** It is possible that postoperative training was inadequate. The authors recommend a new randomized study, where patients who receive specific individual training related to the individual goal and functional profile are compared with a control group. **Relevance to the Veteran Population.** Very often, improvement is reported as statistically significant changes. All changes, however, will become statistically significant, if the sample size is large enough. In this paper, we focus on goal achievement as a clinically relevant parameter in rehabilitation outcome research. We show that despite statistical significance, goal achievement was not impressive after high tibial osteotomy.

Ulrika Öberg, PT, PhD and Tommy Öberg, MD, PhD

Thermal response of skin to cyclic pressure and pressure with shear: A technical note

J.E. Sanders, PhD (p.511)

Purpose of the Work. The purpose of this study was to investigate the use of thermal recovery time (TRT) to distinguish different stress conditions applied to skin. **Subjects/Procedures.** Different pressure and shear stress combinations and different stress magnitudes were applied cyclically for up to 10 min to skin over the lower legs of three male volunteer subjects. The time for the skin to reach a stable temperature after load release was assessed. **Results.** Results demonstrated a trend of increased TRT for combined pressure and shear vs. pressure alone. TRTs were longer for high resultant stress vs. low resultant stress. **Relevance to the Veteran Population.** Results suggest an effective method to quantitatively distinguish tissue response to different interface stress conditions. Identification of the source of the TRT differ-

ences and evaluation of their clinical relevance could lead to the use of TRT to quantitatively evaluate the effects of different interface design features in lower-limb prosthetics on tissue response.

J.E. Sanders, PhD

Effect of exercise on perceived quality of life of individual's with Parkinson's disease

J. Baatile, BS; W.E. Langbein, PhD; F. Weaver, PhD;
C. Maloney, MS; M.B. Jost, MD (*p.529*)

Purpose of the Work. This study was designed to determine if individuals with Parkinson's disease who completed an eight-week, supervised PoleStriding exercise program would undergo significant improvements in memory skills, activities of daily living, motor ability, and quality of life. **Subjects/Procedures.** Six male volunteers (72.7 ± 3.7 yrs. of age) performed PoleStriding exercise three times per week for 37 ± 3 min. The Unified Parkinson's Disease Rating Scale (UPDRS) and the Parkinson's Disease Questionnaire (PDQ-39) were used to measure functional independence and quality of life. **Results.** A statistically significant improvement occurred in the UPDRS and PDQ-39 scores after completing the moderate intensity exercise program. **Relevance to the Veteran Population.** The results of this clinical trial indicate that an eight-week individualized PoleStriding exercise program increases perceived functional independence and quality of life in individuals with Parkinson's disease.

J. Baatile, BS

Effect of functional neuromuscular stimulation on postural related orthostatic stress in individuals with acute spinal cord injury

Ahmed S. Elokda, MA, PT, PhD Candidate; David H. Nielsen, PhD, PT; Richard K. Shields PhD, PT (*p.535*)

Purpose of the Work. Orthostatic hypotension hinders the ability of individuals with acute spinal cord injury to achieve upright posture. The purpose of this study was to evaluate whether electrically stimulating acutely paralyzed muscles will attenuate the orthostatic hypotension. **Subjects/Procedures.** Five individuals who experienced a complete spinal cord injury within one to six weeks underwent graded upright tilting with and without elec-

trical stimulation. **Results.** Electrical stimulation of the thigh and calf muscles was effective at maintaining blood pressure at the extreme positions during upright test maneuvers. **Relevance to the Veteran Population.** Achieving upright posture by preventing orthostatic hypotension early after spinal cord injury is a cornerstone of rehabilitation programs. Upright standing encourages early weight bearing on the lower extremities and facilitates the transition to wheelchair mobilization. Also, early upright standing may assist in counteracting several pathological processes including bone loss, renal stones, and altered health-related quality of life.

Richard K. Shields PhD, PT

Proposed test method and evaluation of wheelchair seating system (WCSS) crashworthiness

Linda van Roosmalen, MS; Gina Bertocci, PhD;
DongRan Ha, BS; Patricia Karg, MS;
Stephanie Szobota, BS (*p.543*)

Purpose of the Work. Test methods are needed to evaluate the crashworthiness of add-on or after-market wheelchair seating systems when used as motor vehicle seats during transportation. The test method used in this study is adapted from the Federal Motor Vehicle Safety Standard (FMVSS) protocol 207, which tests the strength of motor vehicle seats. **Procedures.** Three wheelchair seating systems (WCSS) were tested according to the FMVSS 207 test protocol. Forward and rearward directed loads, ($20 \times$ the weight of the WCSS) simulating frontal and rear impacts, were applied at the center of gravity and at the uppermost part of the seat back. Test loads are intended to evaluate the strength of the seat back as well as the seat-to-back joint. **Results.** All three WCSS were able to withstand the loads and moments as required by the FMVSS 207 test protocol. **Relevance to the Veteran Population.** Currently, after-market WCSS are not subjected to standard tests for evaluating seating system crashworthiness independent of the wheelchair frame. This study represents the first step in the development of crashworthiness test methods to evaluate seating systems independent of the wheelchair. Such test methods are necessary in development of industry standards that will ultimately guide manufacturers in the design of transport-safe wheelchair products.

Linda van Roosmalen, MS

Evaluation of wheelchair back support crashworthiness: Combination wheelchair back support surfaces and attachment hardware

DongRan Ha, BS; Gina Bertocci, PhD;
Ernest Deemer, BS; Linda van Roosmalen, MS;
Patricia Karg, MS (p.555)

Purpose of the Work. Motor vehicle seats are required to be tested under government standards to assure occupant protection during a crash. Wheelchairs used as vehicle seats should provide a similar level of occupant protection under crash conditions. This preliminary study attempts to evaluate the crashworthiness of five commercial wheelchair back support surfaces and their associated attachment hardware.

Subjects/Procedures. A static test method was developed and applied to each wheelchair back support system. A commonly used tension/compression-loading device was used to apply crash-level loads to the seat backs. **Results.** All of the five tested wheelchair back supports failed to withstand the test criterion load. All failures were associated with seat-back attachment hardware. Four out of five tested back supports failed at loads less than 50% of the targeted test load of 2400 lb. Despite limitations in testing procedures, these results suggest that commonly used wheelchair seat backs may not be able to withstand crash-level loading. **Relevance to the Veteran Population.** Many veteran wheelchair users travel seated in their wheelchairs. To protect this population, wheelchair manufacturers must design and offer wheelchair components that are capable of withstanding crash loading. Development of test procedures and evaluation of products, such as that conducted in this study, will aid in standards development and ultimately in the design of crash-safe wheelchairs and components.

DongRan Ha, BS

Development of frontal impact crashworthy wheelchair seating design criteria using computer simulation

Gina E. Bertocci, PhD; Stephanie Szobota, BS;
DongRan Ha, BS; Linda van Roosmalen, MS (p.565)

Purpose of the Work. Many wheelchair users are unable to transfer to a motor vehicle seat and instead travel seated in their wheelchairs. When functioning as a motor vehicle seat, wheelchairs may be subjected to loading conditions that differ greatly from those associated with the normal mobility function. The intent of this study was to develop crashworthy wheelchair seating design criteria that will aid manufacturers in the design of crash-safe seating products.

Procedures. This study relied on computer simulations of frontal motor vehicle crashes and limited sled test data to determine wheelchair seat loading. Using computer simulations, the influence of various seating characteristics (stiffness, seat angle, etc.) on loading conditions was studied. Evaluation of the effects of seating characteristics is important since there is such a large range of commercially available seating products. **Results.** In a severe frontal crash, a 50th-percentile male (168 lb) wheelchair user could impose up to nearly 3300 lb on the seat, and as much as 2700 lb on the seat back. These loads are far greater than those associated with normal mobility. Loading levels vary depending upon seat and back stiffness, as well as seat-to-back angle.

Relevance to the Veteran Population. Many veteran wheelchair users travel seated in their wheelchairs. To assure safety of these veterans, wheelchair manufacturers must design and offer wheelchairs that are capable of withstanding crash conditions. Development of appropriate design criteria for wheelchair seating is key to promoting the design of crash-safe wheelchairs.

Gina E. Bertocci, PhD

Injury risk assessment of wheelchair occupant restraint systems in a frontal crash: A case for integrated restraints

Gina E. Bertocci, PhD, PE and Jonathan Evans, BS (p.573)

Purpose of the Work. Currently wheelchair users using their wheelchairs as motor vehicle seats only have the option of vehicle-mounted occupant restraint systems. Often these restraint systems do not provide suitable belt fit, leading to disuse or inadequate occupant protection in a crash. Integrated restraint technology found in the automotive industry provides a customized fit through integrating belts directly on the seat and has been associated with improved occupant protection. Such an approach could offer improved belt fit and occupant protection to wheelchair users. The intent of this study was to compare occupant protection effectiveness of vehicle-mounted versus wheelchair integrated restraint systems. **Procedures.** Computer crash simulations were used to evaluate occupant crash biomechanics for various vehicle-mounted restraint scenarios and for the wheelchair integrated restraint scenario. Occupant crash responses were compared across the scenarios as well as to injury criteria and standards. **Results.** Findings showed that wheelchair integrated restraint systems can offer improved occupant crash protection to wheelchair users. **Relevance to the Veteran**

Population. Many wheelchair-using veterans are unable to transfer to a vehicle seat during transport and instead travel seated in their wheelchairs. In these cases veterans must rely upon vehicle-mounted restraint systems which are often unable to provide adequate belt fit, compromising safety. This study illustrated the crash protection benefits of wheelchair integrated restraint systems over commonly used vehicle-mounted restraints, encouraging manufacturers to consider such an approach in new product design.

Gina E. Bertocci, PhD, PE and Jonathan Evans, BS

Factors affecting the use of a single switch with assistive technology devices

Jennifer Angelo, PhD, OTR, FAOTA, ATP (p.591)

Purpose of the Work. The ability to operate electronic equipment such as televisions, computers, and telephones using a single switch is important to individuals with very limited motor control. The purpose of this study was to identify the factors affecting the use of single switches.

Subjects/Procedures. Six occupational therapists experienced in assistive technology service delivery participated. The data was collected using a focus group. **Results.** Ten items were identified as essential to the single switch assessment. They were reliability of motor movements, ability to perform timed responses, ability to activate a switch within a given time frame, endurance, movements should be volitional, easily performed, efficient, and when possible based on previous successful movements. The environment where the switch will be used must be considered as well as safety. **Relevance to the Veteran Population.** By identifying key factors affecting the use of single switches, this study may make application of single switches more effective and thus benefit veterans with limited motor control who could use a single switch to control their environment.

Jennifer Angelo, PhD, OTR, FAOTA, ATP

The effect of filtering and inter-digit interval on the recognition of dichotic digits

Anne Strouse Carter, PhD and Richard H. Wilson, PhD (p.599)

Purpose of the work. The purpose of this study was to evaluate the effects of low-pass filtering and inter-digit interval on dichotic digit recognition. **Subjects/**

Procedures. We developed a dichotic digits test in which 1, 2, or 3 pairs of numbers are presented simultaneously to the right and left ears and the listener repeats back all numbers heard. For this experiment, the digit materials were low-pass filtered at five cutoff frequencies from 500–2000 Hz and the inter-digit interval was varied at four intervals from 125–750 ms. Older adult listeners with and without hearing loss were evaluated. **Results.** As the low-pass cutoff was increased, there was a corresponding increase in performance. Scores were below normal for only the 750- and 500-Hz conditions, indicating that the digit materials were essentially resistant to the effects of hearing loss. There was little change in performance as a function of inter-digit interval. **Relevance to Veteran Population.** The data indicate that the dichotic digit test evaluated is useful for evaluating dichotic listening in adult listeners. Results can aid in choosing appropriate amplification and rehabilitation strategies for veterans with hearing loss.

Anne Strouse, PhD and Richard H. Wilson, PhD

A curriculum for training patients with peripheral visual field loss to use bioptic amorphic lenses

Denice J. Laderman, MS; Janet P. Szlyk, PhD; Roger Kelsch, RKT; William Seiple, PhD (p.607)

Purpose of the Work. The purpose of the study was to develop and assess a curriculum for training patients with peripheral visual field loss to use a field expansion system for navigating their environment. **Subjects/Procedures.** Patients with peripheral vision loss due to either retinitis pigmentosa, choroideremia, or Usher Syndrome Type II, ranging in age from 27 to 67 years, were included in the study. The bioptic amorphic lenses were mounted on carrier lenses, and served to minify the horizontal extent of vision into a patient's healthy remaining central vision. Patients were trained to scan into the amorphic lenses to obtain visual information from the periphery, in the same way one would glance into a bifocal lens to read text. The training program was 12 weeks in duration, with the first 4 weeks focused on laboratory and mobility training, and the last 8 weeks focused on driving. The goal of training was to hone the following visual skills using the lenses: peripheral detection, recognition, scanning, tracking, visual memory, and mobility. **Results.** The patients showed a 37% overall task improvement in the visual skills that were trained.

Relevance to the Veteran Population. As the population of veterans with vision loss expands, the need for rehabilitation programs that provide training in the use of remaining vision increases. This study describes a program to train patients to use an optical adaptive device to improve their ability to perform everyday activities.

Janet P. Szlyk, PhD