

## ABSTRACTS OF RECENT LITERATURE

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Abstracts are drawn primarily from the orthotics, prosthetics, and communication aids literature. Selections of articles were made from these journals:

*Archives of Physical Medicine and Rehabilitation*

*Journal of Orthopaedic and Sports Physical Therapy*

*Medizinisch-Orthopädische Technik*

*Physical Therapy*

*Prosthetics and Orthotics International*

**Accuracy of Reconstructed Angular Estimates Obtained with the Ariel Performance Analysis System.** Wilson DJ, Smith BK, Gibson JK. Reprinted from *Phys Ther* 1997;77:1741-6.

**Background and Purpose.** Three-dimensional computerized gait analysis continues to grow in use among physical therapists and other clinical specialists interested in quantitative data regarding human ambulation. This study documented the accuracy of reconstructed angular estimates under static and dynamic conditions using the Ariel Performance Analysis System. **Methods.** Angular velocity was systematically increased by raising the release position of a T-shaped pendulum. Angular velocities were examined by releasing the pendulum from four angles (0°-static, 45°, 90°, and 120°). Twelve reference angles were estimated over 20 autodigitized frames for 10 trials at each release position. Intraclass correlation coefficients (ICCs) and analysis-of-variance (ANOVA) procedures were used to test the hypothesis that the error of angular estimates grows with increasing angular velocity. **Results.** Mean errors of the reconstructed angles were consistently within  $\pm 1.0$  degree, regardless of angular velocity. An ANOVA revealed a statistically significant angular velocity effect, characterized by release position. The 90-degree release position produced the greatest error, followed by the 120-, 45-, and 0-degree release positions. The error was not significantly different between the 120- and 45-degree release positions. Intraclass correlation coefficients greater than .90 were

found for all frame-to-frame angular velocities, except for the 90-degree release position. The angle estimates consistently underestimated the reference angles, regardless of release position. **Conclusion and Discussion.** The results suggest that clinically accurate angular estimates can be obtained across the range of angular velocities used in this study.

**Cognitive and Functional Assessments of Stroke Patients; An Analysis of Their Relation.** Hajek VE, Gagnon S, Ruderman JE. Reprinted from *Arch Phys Med Rehabil* 1997;78:1331-7 (©1997 by the American Congress on Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation).

**Objectives:** To improve the assessment of stroke patients for the purpose of designing rehabilitation treatments and predicting rehabilitation outcomes. Specific objectives included the evaluation of the power of functional scales to properly assess both physical and cognitive disabilities, and the evaluation of the relations between functional, neurological, physical, and cognitive assessments. The hypothesis was that the relations between different assessment types (eg, functional, neurological, etc) can be assessed by the relations between the results of these assessments when administered to stroke patients.

**Design:** Sixty-six stroke patients were administered a series of tests including functional assessments (Functional Independence Measure, Barthel Index, Rankin Functional Scale), neurological assessments (Canadian Neurological Scale, National Institute of Health Stroke Scale), physical assessments (Stages of Motor Recovery, Clinical Outcome Variables Scale), and cognitive assessments (Stroke Unit Mental Status Examination, Mini Mental State, Raven Matrices, Boston Naming Test).

**Results:** Analysis of correlation coefficients revealed that the stronger relationships were observed between

functional assessments and physical assessments, and between functional assessments and neurological assessments. Cognitive tests did not correlate highly with any of the functional tests used in this study. Three factors were extracted using factor analysis. They were interpreted as being a physical disability factor (50% of the variance), a cognitive disability factor (23% of the variance), a dementia factor (12% of variance). Functional scales obtained higher loads on the physical disability factor only.

**Conclusions:** Considering that cognitive functions are frequently affected in stroke patients, cognitive impairment needs to be more seriously considered when describing and/or predicting a patient's level of independence. In brain injured patients, such as stroke patients, we suggest that the total score provided by standardized functional scales should be interpreted with care. We believe that rehabilitation outcome could be better predicted if the results of functional assessment were coupled with in-depth cognitive assessment.

**Determinants of Four Functional Tasks among Older Adults: An Exploratory Regression Analysis.** Topp RM, Mikesky A, Thompson K. Reprinted from *J Orthop Sports Phys Ther* 1998;27:144-53.

Functional ability declines in later life. The purpose of this project was to determine if strength, postural control, and joint pain predict performance of four functional tasks among older adults. A sample of 28 older adults completed assessments of strength, postural control, joint pain, and four functional tasks. The duration to complete the functional tasks of: 1) getting out of bed, going to a chair, and then returning to bed; 2) crossing a street and getting onto a bus; 3) exiting the passenger side of a car; and 4) climbing a flight of 27 stairs was recorded. Step-wise regression equations indicated that seated row strength and dynamic postural control were significant predictors of all of the tasks and accounted for the largest proportion of the variance in each equation. These results indicate that measures of physical fitness may be more important predictors of functional tasks among older adults than chronological age.

**Development of a New Ankle-Foot Orthosis with Dorsiflexion Assist, Part 1: Desirable Characteristics of Ankle-Foot Orthoses for Hemiplegic Pa-**

**tients.** Yamamoto S, Ebina M, Miyazaki S, et al. Reprinted from *J Prosthet Orthot* 1997;9:174-9.

The mechanical characteristics of ankle-foot orthoses that are important for hemiplegic gait are the magnitude of the assist moment and the initial ankle angle. An experimental ankle-foot orthosis that allows for easy adjustment of the magnitude of the assist moments and the initial ankle angle was developed.

The gaits of hemiplegic patients using the experimental orthosis were measured, and the plantarflexion assist moment was found to be unnecessary for the hemiplegic gait in most case. The hemiplegic gaits for various magnitudes of the dorsiflexion assist moment and initial ankle angles were examined, and the orthosis characteristics appropriate for the individual patients were selected. Based on these results, desirable characteristics of ankle-foot orthoses for hemiplegic patients were determined.

**Driving After Stroke: Driving Exposure, Advice, and Evaluations.** Fisk GD, Owsley C, Pulley LV. Reprinted from *Arch Phys Med Rehabil* 1997;78:1338-45 (©1997 by the American Congress on Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation).

**Objective:** Little is known about the extent to which stroke survivors return to driving and the advice and/or evaluations they receive about driving. This study sought to estimate the prevalence of driving after stroke and to determine whether stroke survivors receive advice and evaluation about driving.

**Design:** A convenience sample of stroke survivors was surveyed regarding driving status following stroke, driving exposure, advice received about driving, and evaluation of driving performance.

**Participants:** Two hundred ninety stroke survivors who were between 3 months to 6 years poststroke.

**Results:** Thirty percent of stroke survivors who drove before the stroke resumed driving after the stroke. Stroke survivors are often poorly informed by health care professionals about driving, with 48% reporting that they did not receive advice about driving and 87% reporting that they did not receive any type of driving evaluation. Almost one third of poststroke drivers had high exposure, driving 6 to 7 days per week and/or 100 to 200 miles per week.

**Conclusions:** These findings suggest that many stroke survivors are making decisions about their

driving capabilities without professional advice and/or evaluation. The results also suggest that rehabilitation professionals need to devote more attention and resources to driving issues when working with stroke survivors and their families.

**Functional Outcome Following Spinal Cord Injury: Significance of Motor-Evoked Potentials and ASIA Scores.** Curt A, Keck ME, Dietz V. Reprinted from *Arch Phys Med Rehabil* 1998;79:81-6 (©1998 by the American Congress on Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation).

**Objective:** Prediction of outcome of ambulatory capacity and hand function in tetraplegic patients with spinal cord injury (SCI) using neurologic examination, according to the protocol of the American Spinal Injury Association (ASIA) and motor-evoked potentials (MEP).

**Design:** Correlation study on a prospective cohort.

**Setting:** SCI center, university hospital.

**Patients:** Thirty-six patients with acute and 34 with chronic SCI.

**Outcome Measures:** (1) ASIA motor and sensory scores, (2) MEP recordings of upper and lower limb muscles, and (3) outcome of ambulatory capacity and hand function.

**Results:** In acute and chronic SCI, both the initial ASIA scores and the MEP recordings were significantly related ( $p < .0001$ ) to the outcome of ambulatory capacity and hand function. In tetraplegic patients, the MEP of the abductor digiti minimi muscle (Spearman correlation coefficient, .75;  $p < .0001$ ) and the ASIA motor score for the upper limbs (Spearman correlation coefficient, .83;  $p < .0001$ ) were most related to the outcome of hand function. Ambulatory capacity could be predicted by the ASIA motor score of the lower limbs (Spearman correlation coefficient, .78;  $p < .0001$ ) and by MEP recordings of the leg muscles (Spearman correlation coefficient, .77;  $p < .0001$ ). In patients with acute SCI, for the period 6 months posttrauma, the ASIA motor score increased significantly (ANOVA,  $p < .05$ ), whereas the ASIA sensory scores and MEP recordings were unchanged (ANOVA,  $p > 0.1$ ).

**Conclusion:** Both ASIA scores and MEP recordings are similarly related to the outcome of ambulatory capacity and hand function in patients with SCI. MEP recordings are of additional value to the clinical examination in uncooperative or incomprehensive pa-

tients. The combination of clinical examination and MEP recordings allows differentiation between the recovery of motor function (hand function, ambulatory capacity) and that of impulse transmission of descending motor tracts.

**Gait and Long Cane Kinematics: A Comparison of Sighted and Visually Impaired Subjects.** Johnson JT, Johnson BF, Blasch BB, et al. Reprinted from *J Orthop Sports Phys Ther* 1998;27:162-6.

Although visually impaired individuals have used the long cane to increase mobility for many years, few empirical studies have examined the effectiveness of this tool. The purposes of this research were to determine if these cane procedures provide adequate protection for visually impaired individuals and to compare sighted and visually impaired gait mechanics. Seven sighted (four females, three males) and five visually impaired subjects (two females, three males) were videotaped at 60 Hz by two cameras situated at opposite 45° angles to the subjects' frontal plane so that three-dimensional coordinates could be calculated via direct linear transformation. One-way analyses of variance were calculated on 17 variables to determine if there was a significant biomechanical difference between sighted and visually impaired gait at an adjusted  $\alpha = .003$ . The results showed that for both groups the cane tip touched outside where the foot landed and that the only variable significantly different between the two groups was resultant cane velocity. The major conclusion of this research was that present cane techniques may not provide adequate protection for visually impaired individuals since the purpose of mobility training is to have the person touch the ground with the cane tip at the foot contact positions.

**Hilfsmittellversorgung aus ergotherapeutischer Sicht (Technical Aids in Occupational Therapy).** Ehlemann H, von Peinen I. Reprinted from *Med Orth Tech* 1997;168-75.

Disabled persons use adaptive equipment in order to take care of their daily needs. Depending on the level of disability, technical aids may allow them to attain near or even complete independence of assistance. In this article, various aids are described which can be used in conjunction with a variety of dysfunctions. The selection of the appropriate equipment should be conducted by professional personell. Given the need of a quad-

riplegic for technical aids and supplying of such equipment, the wheelchair, its parts and functions, are explained in detail.

**Hilfinfitleversorgung nach Schlaganfall (Technical Aids for Patients with Stroke).** Kiesewetter K, Grefen J. Reprinted from *Med Orth Tech* 1997; 118:184-9.

Technical aids after stroke has to substitute impaired functions and permit more self-dependence. However, retraining and compensatory strategies without using such equipment should always be preferred. Interdisciplinary (physician, nurse, physiotherapist and ergotherapist) prescription of the devices is important and acceptance by the patient is crucial. Patient and his caregivers have to be trained in using the technical aids carefully. Some common equipment (wheelchairs, safety rails, raised toilet seats, bathing equipment) is described.

**The Influence of the Reciprocal Hip Joint Link in the Advanced Reciprocating Gait Orthosis on Standing Performance in Paraplegia.** Baardman G, Ijerman MJ, Hermens HJ. Reprinted from *Prosthet Orthot* 1997;21:210-21.

The effect of reciprocally linking the hip hinges of a hip-knee-ankle-foot orthosis on standing performance was studied in a comparative trial of the Advanced Reciprocating Gait Orthosis (ARGO) and an ARGO in which the Bowden cable was removed (A\_GO). Six male subjects with spinal cord injury (SCI) at T4 to T12 level participated in the study, which was conducted using a single case experimental design. Standing balance, the ability to handle balance disturbances (standing stability), and the performance of a functional hand task during standing were assessed in both orthosis configurations in the order A\_GO-ARGO-A\_GO-ARGO.

No significant differences with respect to standing performance were found for the two orthosis configurations. However, the results indicate that the crutch force needed for maintaining balance during various tasks, especially for quiet standing with two crutches, may be much higher in the orthosis without Bowden cable. Therefore, it is very likely that the reciprocal hip joint link in the ARGO provides a substantial and clinically relevant reduction of upper body effort required for standing under functional conditions.

**Is Lower Extremity Strength Gain Associated with Improvement in Physical Performance and Disability in Frail, Community-Dwelling Elders?** Chandler JM, Duncan PW, Kochersberger G, et al. Reprinted from *Arch Phys Med Rehabil* 1998;79:24-30 (©1998 by the American Congress on Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation).

**Background:** Strength loss is strongly associated with functional decline and is reversible with exercise. The effect of increased strength on function has not been clearly established. The purpose of this study was to determine whether strength gain is associated with improvement in physical performance and disability.

**Methods:** One hundred functionally impaired community-dwelling men and women ( $77.6 \pm 7.6$  yrs) were tested at baseline and outcome for lower extremity strength, physical performance, and disability. After random group assignment, exercise participants received strengthening exercises in their homes three times a week for 10 weeks while control subjects continued their normal activities. Using multiple regression techniques, the relationship between strength gain and improvement in physical performance and disability was assessed, controlling for age, depression, and baseline strength.

**Results:** A significant impact of strength gain on mobility skills ( $p = .0009$ ) was found. The impact of strength gain on chair rise performance was significant in participants who were more impaired ( $p = .04$ ). Strength gain was associated with gain in gait speed ( $p = .02$ ) and in falls efficacy ( $p = .05$ ), but not with other balance, endurance, or disability measures.

**Conclusions:** Lower extremity strength gain is associated with gains in chair rise performance, gait speed, and in mobility tasks such as gait transfers, stooping, and stair climbing, but not with improved endurance, balance, or disability. Strength gain is also associated with improvement in confidence in mobility. Factors that may influence the ability of strength gain to affect function are initial level of frailty and specificity of exercise. These results support the idea that strength training is an intervention that can potentially improve physical health status in many frail elders.

**Physiologic Comparison of Forward and Reverse Wheelchair Propulsion.** Salvi FJ, Hoffman MD, Sabharwal S, et al. Reprinted from *Arch Phys Med Rehabil* 1998;79:36-40 (©1998 by the American

Congress on Rehabilitation Medicine and the American Academy of Physical Medicine and Rehabilitation).

**Objectives:** Conventional wheelchair propulsion is physiologically demanding because of the small muscle mass that is used and the low mechanical efficiency of the movement. Previous research has suggested that a reverse wheeling technique might be more economical than conventional forward wheeling. The present study sought to compare the physiologic demands of forward and reverse wheeling techniques.

**Design:** A repeated measures design was used to compare the dependent variables between forward and reverse wheeling techniques in the same subjects.

**Setting:** Human exercise research laboratory.

**Participants:** Ten able-bodied men.

**Intervention:** Subjects completed graded, discontinuous exercise tests on a wheelchair ergometer, using both forward and reverse wheeling techniques.

**Main Outcome Measures:** Oxygen uptake ( $\dot{V}O_2$ ) ventilation ( $\dot{V}_E$ ), and heart rate were measured during the last 30 seconds of each 3-minute exercise stage. Blood lactate concentration [La] and rating-of perceived

exertion (RPE) were determined immediately after each stage.

**Results:** Repeated measures analysis of variance demonstrated that  $\dot{V}O_2$ ,  $\dot{V}_E$ , heart rate, and RPE were all significantly greater ( $p < .05$ ) with reverse wheeling compared with forward wheeling.  $\dot{V}O_2$  values with reverse wheeling averaged 9% higher than forward wheeling at identical power outputs.

**Conclusions:** Reverse wheelchair propulsion is physiologically more demanding than conventional forward wheelchair propulsion and does not appear to offer potential for improving the economy of wheelchair propulsion.

**Praxis der Hilfsmittelleistung (Prescription of Technical Aids).** Stueken R. Reprinted from *Med Orth Tech* 1997;165-7.

Prescription of technical aids is a difficult theme. Often, difficulties between suppliers, physicians and health insurance companies arise because of misunderstandings concerning the technical aids. The article describes common problems as well as possible solutions.