

# ABSTRACTS OF RECENT LITERATURE

by

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

*Acta Orthopaedica Scandinavica*

*American Journal of Occupational Therapy*

*American Journal of Physical Medicine and Rehabilitation*

*Archives of Physical Medicine and Rehabilitation*

*ASHA*

*Ergonomics*

*Hearing Instruments*

*IEEE Transactions in Biomedical Engineering*

*International Journal of Rehabilitation Research*

*Journal of Medical Engineering and Technology*

*Journal of Prosthetics and Orthotics*

*Journal of Speech and Hearing Disorders*

*Journal of Speech and Hearing Research*

*Journal of Visual Impairment and Blindness*

*Paraplegia*

*Physical Therapy*

*Physiotherapy*

*Prosthetics & Orthotics International*

*Scandinavian Journal of Rehabilitation Medicine*

Specialschuh is high-laced and reinforced laterally to allow flexion and extension at the ankle, without supination, pronation, inversion, or eversion. Patients with sutured lateral ankle ligaments walked without crutches and returned to work 3 weeks earlier than those who had postoperative casting. The patient group included 12 men; mean age was 33 years. All patients were initially treated in a pressure bandage and splint for one week. Then the shoe was applied over an elastic sock. In bed the sock, but not the shoe, was worn. All patients bore weight progressively, using crutches as needed. The shoe was removed at 6 weeks. There were no complications or increase of dislocation. Twenty-three patients had healing in the initial fracture position. Patients rated pain as moderate 2 weeks after injury. After 6 weeks, pain was minimal, only one patient was still using a crutch, and 16 had returned to work. Of 13 active athletes, 11 resumed pre-accident activities. Few had decrease of ankle motion. Treatment was based on preventing the mechanism of injury, namely supination and eversion, leaving ankle motion free. The shoe should be used only by patients able to cooperate. The single failure occurred in a woman with epilepsy and severe mental retardation who developed asymptomatic pseudoarthrosis, subsequently operated on.—[JEE]

## PROSTHETICS, ORTHOTICS, AND RELATED TOPICS

### **Ankle Fractures Treated with a Stabilizing Shoe.**

Zeegers AVCM, Van Raay JJAM, van der Werken C, *Acta Orthop Scand* 60:597-599, 1989.

Twenty-four patients with fresh Type SE-II fracture of the lateral malleolus between 15 and 60 years of age with dislocation less than 2 mm and no ligamentous rupture were fitted with a stabilizing shoe. The Adidas Adimen

### **Bacteria on Stumps of Amputees and the Effects of Antiseptics.** Kohler, P, Lindh L, Bjorklind A, reprinted from *Prosthet Orthot Int* 13:149-151, 1989.

Amputees get stump infections usually from the natural inhabitants of the healthy skin and probably due to the unnatural environment of tight fitting sockets. The aim of the present study was to investigate the natural stump bacteria and the effect of antiseptics as well as the amputees' evalua-

tion of such treatment. Fifteen amputees using their prostheses all day were investigated. Bacterial samplings were taken by swab technique with respect to bacteria and fungi from the stumps in the morning before prosthetic application and in the evening after a whole day's prosthetic use without antiseptic cleaning; after antiseptic cleaning with a combination of Isopropanol 45 percent, N-propanol 30 percent and N-cetylpyridiniumchloride 0.2 percent for one day; after fourteen days continuous use. The patients were asked if they like the antiseptic and if they would like to continue to use it. Two patients did not submit bacteriological samples after the cleaning period. Before cleaning *S. epidermidis*, *S. aureus* and alpha-hemolytic streptococci were commonly found. In two instances gram negative rods were found. After the cleaning period there was a reduction of bacteria in 11 out of 13 patients. All patients liked the antiseptic and the simplicity by which the stumps and the sockets could be kept clean. The authors feel that the use of antiseptics to increase stump and socket hygiene is justified.—[JEE]

**Clinical Biomechanics of the Subtalar Joint.** Evans P, reprinted from *Physiotherapy* 76:47-51, 1990.

The purpose of this paper is to show how the effects of subtalar workings produce clinical symptoms. A musculo-skeletal symptom at any level in the limb may be mediated by the subtalar joint, with the original cause being at some distance from the symptom. Here the effects of subtalar motion are linked to functional anatomy, starting from the presenting problem. Clinical examples are used to show the way that problems present, and some examination methods used to find the causes are explained. A short section describes the problems of deciding what is 'normal.' The main sources of material are the 'sport-mad,' but the paper has an application wider than the narrow field of sports medicine.—[JEE]

**The Contribution of the Three Columns of the Spine to Spinal Stability: A Biomechanical Model.** Haher TR, Tozzi JM, Lospinuso MF, et al., reprinted from *Paraplegia* 27:432-439, 1989.

The load carrying capacity (LCC) of the human spine was evaluated in 10 human cadaver spines. The specimens consisted of segments from T11 to S1 with markers placed on the specimens at each vertebral level in both Ap and lateral planes. The specimens were loaded to 1250 N and spinal deflections were recorded and photographed at 125 N intervals during the loading cycle. In 5 specimens, axial

and flexion loads were applied to the intact spine. The anterior and middle columns were destroyed in sequence at L2 and the loading process repeated. In the remaining 5 specimens, axial and extension loads were applied with the spine intact and after the posterior and middle columns were destroyed in sequence at L2. Load deflection curves were generated for each test and comparisons were made between intact spines and spines with single and double column destruction. Results: When the axis of loading was anterior to the posterior longitudinal ligament (PLL), destruction of the anterior and middle columns reduced the LCC by 46 percent and 68 percent respectively and destruction of the posterior and middle columns reduced the LCC by 30 percent and 63 percent respectively. There was minimal change in the LCC when the axis of loading was posterior to the PLL and the anterior and middle columns were destroyed.

Two column destruction of the spine reduced its load carrying capacity for flexion loads by 70 percent. In thoracolumbar spinal fractures where flexion loads are predominant and anticipated, the authors conclude that surgical stabilization is indicated with double column failure.—[JEE]

**A Controlled Study of Neuropsychological Deficits in Acute Spinal Cord Injury Patients.** Roth E, Davidoff G, Thomas P, et al., reprinted from *Paraplegia* 27:480-489, 1989.

According to a number of studies, between 40 percent and 60 percent of acute traumatic spinal cord injury (SCI) patients demonstrate cognitive dysfunction resulting from various forms of cerebral damage, including concurrent or premorbid closed head injury, chronic alcohol or substance abuse, and other causes. However, applicability of findings from these reports has been limited due to the use of inadequate neuropsychological testing techniques and the lack of control data. In a collaborative investigation, 81 acute SCI patients and 61 non-injured control subjects between 18 and 55 years of age completed a comprehensive motor-free neuropsychological test battery, including: Halstead Category Test (HCT), Vocabulary Subtest (VOCAB) of the Wechsler Adult Intelligence Scale - Revised; Mental Control (MC) Subtest, and Initial and Recall trials of Logical Memory (LM) and Paired Associates (PA) Subtests of the Wechsler Memory Scale; and the 8 trials of the Rey Auditory Verbal Learning Test (RAVLT). Percentages of retained information on the LM and PA were also calculated. Impairment levels for each test were defined as values which exceeded two standard deviations (one-

tailed) from the control mean. Based on this definition, the prevalence of neuropsychological abnormality on each test ranged between 10 percent and 40 percent. Mean performance levels of patients were significantly more impaired than those of control subjects for all tests except for the Interference trial of the RAVLT and for the percentages of retained information on the LM and PA subtests. Comparison of test results of SCI patients with those of control subjects demonstrates that poor attention span and limited initial learning ability are frequent problems among SCI patients. Other common neuropsychological deficits among these patients include poor concentration ability, impaired memory function, and altered problem solving ability. These deficits may interfere with rehabilitation following SCI.—[JEE]

**Does Socket Configuration Influence the Position of the Femur in Above-Knee Amputation?** Gottschalk FA, Kourosh S, Stills M, et al., *J Prosthet Orthot* 2:94-102, 1989.

Fifty above-knee amputees were divided into two groups according to the type of socket worn, either quadrilateral or ischial containment. Groups were comparable for age, sex, and cause of amputation. All had mature amputation limbs and were daily prosthesis users. Thigh position was checked out of the prosthesis to see if it was abducted or adducted. The femur was palpated to determine its distal end and position within the thigh. Anteroposterior radiographs were taken with the patient wearing the prosthesis while standing with weight equally distributed on both legs and the feet 2 inches apart and the pelvis level. Alignment of the normal and amputated femurs were measured on the radiograph; length was measured from the middle of the lesser trochanter. Socket alignment was measured by taking the midportion of the socket on the radiograph at three levels, drawing a straight line through the points and measuring the angle to the perpendicular.

Femoral angle on the sound side was the same in both groups, averaging from 80 to 100 degrees of adduction. The axis of the amputated femurs averaged 2 degrees abduction in both types of socket. In neither socket type was the femur consistently in any one position. Angles varied from 8 degrees adduction to 12 degrees abduction in the quadrilateral socket, and from 8 degrees adduction to 14 degrees abduction in the ischial containment ones. The average length was the same in both groups. Socket axis was neutral with the quadrilateral group, and from neutral to 9 degrees adducted in the ischial containment group. There was no statistically significant difference in abduc-

tion angles of femurs between the groups. Unlike normal skeletal alignment, most above-knee amputees have the femoral shaft abducted, which disturbs function of the hip abductors which ordinarily reduce lateral trunk motion. Persistence of abduction, regardless of socket design, suggests that the problem is not amenable to a purely prosthetic solution. During amputation the adductors should be sutured to the femur which is held adducted.—[JEE]

**The Effect of Footwear Mass on the Gait Patterns of Unilateral Below-Knee Amputees.** Donn JM, Porter D, Roberts VC, reprinted from *Prosthet Orthot Int* 13:140-144, 1989.

This study reports an investigation into the effect of shoe mass on the gait patterns of below-knee (BK) amputees. Ten established unilateral BK, patellar-tendon-bearing prosthesis wearers were assessed using a VICON system of gait analysis. Incremental masses of 50g (up to 200g) were added to the subjects' shoes and data captured as they walked along a 15m measurement field. Coefficients of symmetry of various parameters of the swing phase (knee frequency symmetry, swing time symmetry, maximum flexion to heel strike time symmetry) were measured and their correlation was tested with the patient's preferred shoe mass and also their own shoe mass, all expressed as a proportion of body mass.

The subjects' 'preferred' shoe mass (139-318g) showed the greatest symmetry in all the parameters examined (correlations 0.78-0.81  $p < 0.01$  and  $> 0.005$ ), whereas there was no correlation between the subjects' own shoe mass (121-325g) and the symmetry coefficients measured.—[JEE]

**Electrode Characterization for Functional Application to Upper Extremity FNS.** Kilgore KL, Peckham PH, Keith MW, et al., reprinted from *IEEE Trans Biomed Eng* 37:12-15, 1990.

A quantitative method has been developed to characterize the isometric force vectors of electrically stimulated paralyzed muscles of the thumb. The vectorial force output as a function of the stimulus level was measured for individual electrode/muscle combinations in a number of intramuscular and epimysial electrodes implanted in paralyzed thenar muscles of cervical level spinal cord injury subjects. Vectors are used to determine the output characteristics of each electrode/muscle combination. The characteristics studied include: the strength of the contraction, the stimulus level at which fibers from other muscles

are stimulated, the recruitment gain of force, dependency of the output on the skeletal position, and the direction of force produced. These characteristics can then be used to select stimulus parameters to produce coordinated hand motion and force generation by functional neuromuscular stimulation (FNS).

The range of muscle force and direction for each electrode/muscle combination showed considerable variation between subjects and between electrodes in the same subject. This variation is primarily due to differences in electrode placement within the muscle. Comparison between intramuscular and epimysial electrodes demonstrated similar characteristics in the force vector output. Preliminary results show the potential for using the force vector output to predict the co-contracted output of two muscles.—[JEE]

**Electromyographic Changes of Leg Muscles with Heel Lifts in Women: Therapeutic Implications.** Lee KH, Shieh JC, Matteliano A, et al., *Arch Phys Med Rehabil* 71:31-33, 1990.

Six young healthy women, all regular wearers of high-heeled shoes, were examined while wearing flat-, medium-, and high-heeled shoes. Muscle activity was determined with surface electrodes affixed over the anterior tibialis and medial gastrocnemius as each subject walked on a level floor at a rate of 88 steps per minute, timed by metronome.

There were no significant differences between steps or trips in activity of the two muscles. Peak activity, however, showed progressive linear decrements with increasing heel height. Decrements were significant, except for comparison of 2.5 and 5.0 cm heel heights with gastrocnemius, and for comparison between 5.0 cm and 7.5 cm heel heights for anterior tibialis. Muscle response may be due to the fact that gastrocnemius is at resting length without heel lifts; lifts shorten muscle fibers and thus active tension generated upon contraction is less. In addition, muscle contraction to move the ankle from 15 to 30 degrees of plantar flexion in push-off is less than that needed to move from neutral to 30 degrees plantar flexion. Unlike other studies with men, the women in this study had decreased anterior tibialis activity with increased heel lifts. Perhaps this is because the muscle is an ankle stabilizer unneeded by habitual wearers of high heels.—[JEE]

**Energy Cost of Paraplegic Locomotion with the ORLAU ParaWalker.** Nane AV, Patrick JH, reprinted from *Paraplegia* 27:5-18, 1989.

Ten subjects with neurological lesion levels between T4 and T9 have been evaluated in the laboratory at ORLAU using their orthosis in its mechanical form alone (without FES assist). Initially the oxygen consumption at rest was measured. Then the patients were asked to walk (orthotic gait) at their preferred constant steady speed for a period of 5 minutes. Min.  $\text{VO}_2$  was measured during the exercise. From these readings the energy cost and consumption of the patients' gait was calculated.

Our results show that the ParaWalker allows more efficient walking than do bilateral long leg braces and a paraplegic 3 point gait. It also shows that higher speeds with lower energy cost walking is possible with a different orthotic approach for high or mid thoracic lesion paraplegics. We believe that the energy demands to walk with the ParaWalker are within sustainable limits.—[JEE]

**Energy Expenditure of Ambulation Using the Sure-Gait Crutch and the Standard Axillary Crutch.** Annesley AL, Almada-Norfleet M, Arnall DA, et al., reprinted from *Phys Ther* 70:18-23, 1990.

Energy expenditure is increased for ambulation with various assistive devices such as canes, walkers, and crutches compared with unassisted ambulation. The purpose of the present investigation was to determine whether a significant difference in oxygen consumption and heart rate existed during ambulation with two different types of crutches. Ten healthy male subjects between the ages of 40 and 60 years participated in this study. Each subject ambulated at 1.5 mph on a treadmill using two different types of crutches—the standard axillary crutch and the Sure-Gait® crutch. After walking on the treadmill without an assistive device, subjects ambulated a three-point, swing-to gait pattern with one of the two types of crutches. This procedure was repeated using the other type of crutch. Oxygen consumption and heart rate were analyzed using an analysis of variance for repeated measures design. The results of the study showed a significant difference ( $p < .01$ ) between ambulation with crutches and unassisted ambulation for oxygen consumption and heart rate. No difference, however, was found between the two crutch types.—[JEE]

**Falls Resulting in Spinal Cord Injury: Patterns and Outcomes in an Older Population.** Weingarden SI, Graham PM, reprinted from *Paraplegia* 27:423-427, 1989.

Falls are the major cause of spinal cord injuries in older people. The pattern of injury seen most frequently is that

of a central cord syndrome due to cervical hyperextension. The medical records of 58 patients over 50 years of age who sustained a spinal cord injury in a fall were reviewed for circumstances of onset, length of stay and outcomes of rehabilitation.

The study identified elderly single or widowed men, and those who use alcohol, as high risk groups.—[JEE]

**Instrumentation Used in Clinical Gait Studies: A Review.** Begg RK, Wytch R, Major RE, reprinted from *J Med Eng Tech* 13:290-295, 1989.

This paper reviews the currently available instrumentation used for gait studies and discusses the clinical suitability of the various methods of recording gait parameters. Most of the presently available motion analysis systems appear to be more suited to research than to the routine clinical situation. However, the video vector visualization technique appears to be the most useful clinically since it produces a real time display, is simple to operate and interpretation of the data is easier than other systems available. Some further development of the video vector visualization system is necessary to improve its accuracy and to produce quantitative information.—[JEE]

**Lightweight Modular Orthosis.** Engen T, reprinted from *Prosthet Orthot Int* 13:125-129, 1989.

Background and highlights are presented concerning the development of a new orthotic system judged to be "the most outstanding innovation in prosthetics and/or orthotics practice" during the 1986-1989 period. The first Brian Blatchford Prize was awarded at the Sixth World Congress of ISPO held in Kobe, Japan, November 12-17, 1989. The new development selected as most deserving of this award consists of a system utilizing inexpensive, lightweight, modular components which can be quickly assembled with a few hand tools to provide custom-fitted knee-ankle-foot orthoses for persons with paraplegia and quadriplegia. These leg frames support standing and permit the patient to begin receiving the physical and psychological benefits of weightbearing as soon as medically feasible after injury. Later, if desired, specially designed knee-joints, with a variety of possible locking features, can be installed on the existing leg frames at a reasonable cost.—[JEE]

**Predicting Falls Among Patients in a Rehabilitation Hospital.** Mayo NE, et al., reprinted from *Am J Phys Med Rehabil* 68:139-142, 1989.

A retrospective case-control study within a cohort was carried out to identify factors associated with falling by patients in a rehabilitation hospital. The cohort comprised all patients admitted during a 2-year period from 1984 to 1986. Cases were those who fell one or more times during their hospitalization. For each case, one control matched on sex and date of admission, was chosen. Material from the first year of the cohort (201 cases and 201 controls) was used to define a model to estimate the risk of falling. Of the more than 100 variables considered in the conditional logistic regression models, stroke, incontinence, anticonvulsant medications, and topical eye preparations were significantly associated with the risk of falling. Analyses carried out on the second year of the cohort (155 cases and 155 controls) confirmed the predictive ability of these four variables. By combining the material from both subcohorts we were able to determine that a program to reduce falls directed towards stroke patients and incontinent patients alone could, theoretically, prevent 44 percent of first falls.—[JEE]

**A Reference Shape Library for Computer Aided Socket Design in Above-Knee Prostheses.** Torres-Moreno R, et al., reprinted from *Prosthet Orthot Int* 13:130-139, 1989.

A Reference Library of socket shapes for an Above-Knee Computer Aided Socket Design (CASD) System has been created. This library forms part of a more general CASD System (Dean & Saunders, 1985; Novicov & Foort, 1982). It consists of a matrix of reference shapes representing above-knee socket characteristics and is based upon skeletal structure, residuum length and tissue mass. A set of 27 biomechanical reference shapes in the form of male plaster casts were produced by a combination of CNC milling and traditional artisan techniques. Each reference shape was digitized to obtain its cylindrical coordinates. Cross-sectional areas and tissue distributions within each shape and between the shapes were analyzed, modified and then stored numerically within the computer for further implementation of the CASD System for the above-knee amputees. The creation and the analysis of the reference shape data is described.—[JEE]

**Rehabilitation Technology for Standing and Walking after Spinal Cord Injury.** Jaeger RJ, Yarkony GM, Roth EJ, reprinted from *Am J Phys Med Rehabil* 68:128-133, 1989.

The purpose of this paper is to review the rehabilitation

technology available for standing and walking by the spinal-cord injured. Existing aids for standing and walking and those aids under development in research laboratories are discussed. One conclusion is that therapeutic and perhaps functional standing could be achieved in a greater number of individuals using existing technology; however it must also be realized that some barriers still exist which prevent various technologies from being more widely used. Studies which measure the benefits of standing, and more fully establish minimum standing times to achieve these benefits, are needed. Standing is a necessary component of many tasks, and it is unlikely single type of standing aid is likely to perform adequately in every situation that requires standing. Therefore it may be prudent to have a variety of standing aids available to patients.—[JEE]

**The Relationship Between Sponsorship and Rehabilitation Outcome Following Spinal Cord Injury.** DeVivo MJ, Stover SL, Fine PR, reprinted from *Paraplegia* 27:470-479, 1989.

The effect of sources of support on rehabilitation outcomes of 866 patients treated at the University of Alabama at Birmingham Spinal Cord Injury Care System since 1973 was assessed using multiple linear and logistic regression. System admission was delayed for Medicaid beneficiaries, while patients who were responsible for at least a portion of their incurred charges were admitted sooner than other patients. Increased lengths of stay were noted among vocational rehabilitation clients and patients with either Workers' Compensation or private insurance coverage. Patients with Workers' Compensation also had significantly higher average hospital charges. Medicaid patients were more likely to be rehospitalised after discharge from rehabilitation. Vocational rehabilitation clients averaged fewer days in nursing homes after injury while Medicaid and Medicare patients experienced longer stays in nursing homes. We conclude that source of support has a significant impact on numerous measures of outcome.—[JEE]

**The Role of the Abdominal Musculature in the Elevation of the Intra-Abdominal Pressure During Specified Tasks.** Cresswell AG, Thorstensson A, reprinted from *Ergonomics* 32:1237-1246, 1989.

A series of standardized tasks, isometric trunk flexion and extension and maximal Valsalva manoeuvres, were used to evaluate the role of the abdominal musculature in developing an increased intra-abdominal pressure (IAP). Seven male subjects were measured for IAP, myoelectric

activity of rectus abdominis (RA), obliquus externus and internus (OE and OI respectively), erector spinae (ES) and isometric trunk torque. IAPs in all experimental conditions were markedly greater than those that occurred while relaxed. In isometric trunk flexion, IAPs were increased with accompanying high levels of activity from the abdominal muscles. In contrast, little activity from the abdominal muscles occurred during isometric trunk extension, although levels of IAP were similar to those found in the isometric flexion condition. With maximal voluntary pressurization (Valsalva manoeuvre) slightly higher levels of IAP than those found in torque conditions were recorded, this pressure being produced with abdominal activities (OE and OI) less than one fourth their recorded maximum. When isometric torque tasks were added to the Valsalva manoeuvre, patterns of muscle activity (RA, OE, OI and ES) were significantly altered. For Valsalva with isometric trunk extension, activity from OE and OI was reduced while IAPs remained fairly constant. These findings indicate that in tasks where an IAP extension moment is warranted, abdominal pressure can be increased without the development of a large counter-moment produced by the dual action of the trunk flexors. Activation of other muscles such as the diaphragm and transversus abdominis is suggested as helping provide control over the level of IAP during controlled trunk tasks.—[JEE]

**Selection of Lower Limb Amputation Level Not Aided by Transcutaneous PO<sub>2</sub> Measurements.** Falstie-Jensen N, Christensen KS, Brochner-Mortensen J, *Acta Orthop Scand* 60:483-485, 1989.

Report of the reliability of transcutaneous oxygen pressure measurement for predicting healing in a consecutive series of 71 below-knee and 24 above-knee amputations where the level selection was guided by skin perfusion pressure. In 84 patients, transcutaneous oxygen pressure was measured in the region that later was selected as the amputation level. Eleven failures of transcutaneous oxygen pressure determination were due to technical reasons, such as unstable curve or insufficient initial declude of curve, edema, and uncooperative patient. Ten amputations were excluded because the patients died before healing could be assessed. The report is thus based on 74 amputations in 72 patients. Transcutaneous oxygen pressure values were unknown to the surgeon.

Among the below-knee amputations, there were 10 failures in 58 procedures; the failure rate was unrelated to the level of transcutaneous oxygen pressure, and was equal in diabetics and nondiabetics. Failures in above-knee,

five of 16 amputations, were unrelated to the level of transcutaneous oxygen pressure.

The study confirms others where healing occurred at very low transcutaneous oxygen pressures. The investigators could not identify a pressure above which healing occurs in all cases; failure may not be due to insufficient microcirculation, but to other risk factors such as poor nutritional status, infection, suboptimal surgical technique, and poor postoperative limb handling.—[JEE]

#### **Standing Balance in Healthy Subjects: Evaluation of a Quantitative Test Battery on a Force Platform.**

Ekdahl C, Jarnlo GB, Andersson SI, *Scand J Rehabil Med* 21:187-195, 1989.

One hundred fifty-two healthy adults, including 78 women, performed several functional tests, including walking with ordinary shoes as fast as possible, standing with one leg with the other slightly flexed without shoes, and standing blindfolded on one leg for as long as possible, and executing a coordination test while standing. Ten other healthy volunteers were studied to evaluate retest reliability for the measurements included in the study. Subjects also were tested on a force platform while standing with feet close together, standing blindfolded, standing on one leg, and standing blindfolded on one leg. Subjects also completed a questionnaire concerned with vision, hearing, leisure activities, and alcohol use.

Results on the force platform correlated significantly with results of most of the functional tests. The results suggest the importance of relating test data to age and sex.—[JEE]

#### **Upper Extremity Assistive Devices: Assessment of Use by Spinal Cord-Injured Patients with Quadriplegia.**

Garber SA, Gregorio L, *Am J Occup Ther* 44:126-131, 1990.

Fifty-six adults, including six women, participated in a longitudinal prospective investigation involving an oral questionnaire administered one and two years after their first rehabilitation experience. They were questioned regarding use and satisfaction with feeding devices, splints and slings, dressing aids, hygiene and grooming appliances, communication devices, and miscellaneous ones. Two-thirds had lesions between C5 and C6; levels ranged from C2 to T1. Of the 250 devices prescribed, a quarter were for feeding, 45 percent were splints and slings, and 11 percent were communication aids. Most subjects (60.7 percent) were between 14 and 29 years of age. Two-thirds were neither in school nor employed 2 years after rehabilita-

tion. Patterns of device use were similar for all subgroups, although use decreased significantly over time. Seventy-one percent of subjects had feeding devices prescribed, but 30 percent of devices were still used at the end of the second year. Seventy-nine percent had splints and slings, but only 39 percent were used 2 years later. A third of the dressing devices were used 2 years after prescription, while a quarter of hygiene appliances were used 2 years later, as were 37 percent of communication aids. The most frequently cited reason for device discontinuance was improved physical function (45 percent) and alternative solutions found (45 percent), which may indicate a positive rehabilitation outcome. Devices discarded within the first or second year represent an average cost of \$8,240.—[JEE]

#### **Use and Usefulness of Lower Limb Prostheses.** Buijk CA, *Int J Rehabil Res* 11:361-367, 1988.

Two hundred ninety-one users of lower-limb prostheses were sent a questionnaire to which 78 percent responded. Respondents were 16 years of age and older; 56 percent were between 25 and 65. The ratio of men to women in the sample was 3:1, as compared with the national ratio of 3:2. Etiologies of amputations were 51 percent trauma, 46 percent disease, and 3 percent congenital. Levels were 56 percent below-knee, 38 percent above-knee and 12 percent knee and hip disarticulations. Those with soft sockets stated they could walk farthest. Two-thirds had modular prostheses. The SACH foot was worn by 44 percent, 39 percent had a single-axis foot, and 10 percent a polycentric one. Thirty-two percent of below-knee amputees used supracondylar suspension, 31 percent had patellar-tendon bearing, and 27 percent had a pelvic belt. Forty-six percent of above-knee amputees did not have a knee lock, 30 percent had a brake, and 22 percent a lock.

The prosthesis is used an average of 3 years, although substantial differences exist among subgroups. The average duration of continuous walking was 142 minutes for knee disarticulates, 81 minutes for below-knee amputees, 38 minutes for above-knee amputees, and 27 minutes for hip disarticulates. The average numbers of minutes of continuous standing were 142 for knee disarticulation, 103 for hip disarticulation, 85 for below-knee, and 81 for above-knee. Prosthetic fit is most important to satisfaction; factors pertinent to fitting were skillfulness in fitting and fabrication, degree to which authorities paid attention to patient, quality of material, condition of amputation limb, weight fluctuation, and perspiration and edema. Fifty-eight percent required repairs to the prosthesis during the previous 2 years. Respondents stated they wanted more and better

information, counseling, gait training, regular check-up facilities, social benefits, and adaptations to the living environment. Future problems to be addressed include counseling for relatives, prosthesis-oriented amputation, problems with the amputation limb, and fostering of new techniques and developments. Users' concerns regarding the prosthesis focused on fit, materials, appearance, and durability.—[JEE]

**Weight-Bearing KAFO Utilizing Modern Prosthetic Above-Knee Socket Design.** Hoehne JA, *J Prosthet Orthot* 2:82-93, 1989.

Difficulties fitting patients with a quadrilateral brim for the purpose of relieving the skeleton of weight led to the adaptation of the ischial containment socket for orthotic purposes. Characteristics of the ischial containment socket which are pertinent for bracing include the narrower medio-lateral diameter, containment of the ischium, increased control of the femur, increased comfort and more weight-bearing areas, and accommodation of the patient's anatomy. The quadrilateral brim has been effective for many years, but a fresh consideration of weight-bearing is necessary because pressures applied to Scarpa's triangle can impinge on the neurovascular bundle and the flat medial wall parallel to the line of progression does not reflect the tendinous arrangement of the adductor muscles. The traditional brim imposes pressure on the ischial ramus and tuberosity. Orthotic adaptation of prosthetic techniques require resolution of problems of donning, accommodating the distal leg, supporting unstable femoral fractures, and adjusting circumferential tension, as well as devising casting techniques and selecting materials and altering fabrication procedures. The indication of the new design is the same as for its predecessor, namely to unload the axial skeleton. A fabrication manual is available. Fabrication procedures are highlighted and illustrated.

Twenty-three patients have been fitted with the new design for fracture management, unstable joints, and other orthopedic problems. One user is a below-knee amputee who had extreme pain, slow healing, and could not tolerate traditional prosthetic management. All patients have been comfortable and compliant. Present efforts are directed at developing a flexible inner socket with a rigid frame; problems of donning and adjustability remain unsolved.—[JEE]

## SENSORY AIDS/REHABILITATION

**Aided and Unaided Time-Related Differences in Word Discrimination.** Stubblefield J, Nye C, *Hear Instrum* 40(9):38-43, 78, 1989.

Retesting of 60 persons with adventitious sensorineural hearing impairments 3 to 6 years after initial fitting with monaural hearing aids revealed statistically significant declines in the unaided ears' speech discrimination (10 to 15+ percent), with essentially unchanged hearing in the aided ears (less than one percent decline in PBQ scores).—[JDS]

**Analytic Study of the Tadoma Method: Effects of Hand Position on Segmental Speech Perception.** Reed CM, Durlach NI, Braida LD, Schultz MC, *J Speech Hear Res* 32:921-929, 1989.

Three experienced, deaf-blind users of Tadoma participated in experiments to determine effects of limiting hand placement and/or tactile cues on speech perception. Systematic differences were found, while some cue redundancy was demonstrated when three or more cues were available.—[JDS]

**Assessment and Training of Low Vision Clients for Mobility.** Dodds AD, Davis DP, *J Visual Impairm Blindn* 83:439-446, 1989.

Rather than existing clinical tests, the authors recommend performance measures to predict low-vision mobility achievement. In addition to the theoretical presentations, the article reports empirical research with 60 adults in a rehabilitation program.—[JDS]

**Attitudes of Visually-Impaired Persons Toward Cane Use.** Wainapel SF, *J Visual Impairm Blindn* 83:446-448, 1989.

Ten visually-impaired adults were interviewed by telephone regarding their attitudes toward cane use. The authors point to inertia, fear, and problems accessing training as reasons for delay in acquiring a cane.—[JDS]

**Audiological Assessment of Central Auditory Processing: An Annotated Bibliography.** American Speech-Language-Hearing Association. *ASHA* 32(2)(Suppl.1):13-30, 1990.

Entries are divided into Behavioral Measures (monotic: filtered and time-altered speech, pattern recognition, ipsi-

lateral competing signals; dichotic: digits, syllables, words and sentences; binaural: fusion, selective listening/rapidly alternating speech, and masking level differences; and test series), Physiologic Measures (acoustic reflexes and auditory-evoked potentials), Books and Chapters, and List of Abbreviations. The compilers note, but do not explain, the omission of items bearing on basic acoustics, language processing, localization, infant speech perception, learning disability, and educational assessment. A headnote acknowledges the difficulties in defining the topic being addressed and leaves to the reader the task of inferring from the selected material the organizing principle(s) used by the committee that assembled the bibliography.—[JDS]

**Auditory Deprivation.** Silverman C, *Hear Instrum* 40(9):26-32, 1989.

Longitudinal study of two adults with bilateral hearing impairments who were fitted monaurally. After 8 and 12 years, both showed statistically significant declines in speech perception in the unaided ears, with the aided ears remaining essentially unchanged.—[JDS]

**Aural Rehabilitation: An Annotated Bibliography.** American Speech-Language-Hearing Association. *ASHA* 32(2)(Suppl.1):1-12, 1990.

The 210 references are gathered under these headings and subheadings: Functional Communication Assessment (hearing handicap, auditory perception by children and by adults, speechreading, speech production, language of children with hearing impairment), Rehabilitation Procedures (counseling, auditory training/learning, speechreading, speech production, language), and Rehabilitative Devices (hearing-aid orientation, cochlear implants, vibrotactile aids, assistive listening devices). The compilers did not intend an exhaustive bibliography, choosing instead the criterion of clinical relevance. The brief annotations tend to be nonevaluative.—[JDS]

**The Bifrequency Binaural Interaction Component of the Auditory Brainstem Response.** Fowler CG, *J Speech Hear Res* 32:767-772, 1989.

Using three stimulus tones—1000 Hz to both ears, 3000 Hz to both ears, and 1000 Hz to the left ear and 3000 Hz to the right ear—the author tested 10 persons to determine the binaural interaction. Whether presented in quiet or broadband noise, all stimulus conditions showed a binaural interaction component indicating that a separation of 2000 Hz produces a fused image.—[JDS]

**Clinical Studies in Psychogenic Stuttering of Adult Onset.** Roth CR, Aronson AE, Davis LJ, *J Speech Hear Disord* 54:634-646, 1989.

The authors reviewed 12 case histories, from among 184 seen at the Mayo Clinic from 1961 to 1987, whose stuttering was diagnosed as either/both neurologic and/or psychogenic. Nine of 10 had abnormal MMPI profiles, all had additionally suggestive neurologic signs, and speech and psychological therapy appeared justified in all 12 cases.—[JDS]

**Comfortable Loudness Level: Stimulus Effects, Long-Term Reliability, and Predictability.** Cox RM, *J Speech Hear Res* 32:816-828, 1989.

Based upon a series of experiments, the author offers a number of hypotheses bearing on hearing-aid fitting: 1) stimulus peak levels influence comfortable loudness levels (CLL) for high frequencies more than low frequencies; hence, CLL for noise bands and warble tones tend to underestimate CLL for speech bands of equal duration; 2) duration can offset differences between CLL for speech versus warble and noise bands, and CLL for continuous speech bands could be used to estimate CLL for interrupted noise and warble; 3) long-term reliability of CLL measures should not concern audiologists fitting hearing aids; and, 4) factors other than thresholds significantly affect CLL, though not specifically investigated in this series of studies.—[JDS]

**Comparing Criteria of Hearing Impairment in the Elderly: A Functional Approach.** Bess FH, Lichtenstein MJ, Logan SA, Burger MC, *J Speech Hear Res* 32:795-802, 1989.

Audiometric measures, like the average of the pure-tone thresholds at 1000, 2000, and 4000 Hz, do not accurately assess individuals' degrees of functional impairment. Further evidence of this point emerged from this study. Sickness Impact Profile, Hearing Handicap Inventory for the Elderly—Screening Version, and four audiometric measures were obtained on 304 patients 65 years of age and older. The measures overlapped greatly. Functional impairment increased with number of criteria failed. However, for one out of five of the persons in the study, average high-frequency thresholds in excess of 25 dB were not significantly associated with self-assessments of functional loss.—[JDS]

**The Diagnosis of Acquired Hearing Loss.** Martin FN, Krall L, O'Neal J, *ASHA* 31(11):47-50, 1989.

Reports a mail survey of SHHH members designed to determine their reactions to their first encounters with diagnoses of their hearing. Of 500 questionnaires mailed, 276 usable replies were received. Among the statistically significant results: expressed emotional reactions of females were greater than those of males; amount of fear respondents reported related to the degree of hearing impairment; more fear and shock was reported by those with earlier ages at onset. About two out of three respondents found support groups of positive benefit. Some readers will be disturbed by the authors' introductory remark, "Aging is by far the most common cause of hearing loss."—[JDS]

**Electrical Activity from the Superior Pharyngeal Constrictor During Reflexive and Nonreflexive Tasks.**

Perlman AL, Luschei ES, Du Mond CE, *J Speech Hear Res* 32:749-754, 1989.

Electromyograms of 15 healthy adults performing reflexive and voluntary tasks showed that EMG activity was related to electrode placement, with the largest response from lateral-superior placement. Applying this and other results to treating dysphagia, the researchers suggest that swallowing "may be a likely exercise for dysphagia due to weak pharyngeal constrictor function" and, for patients unable to swallow, "a gag would be the next most effective task for exercising the pharyngeal muscles."—[JDS]

**An Evaluation of the Legibility and Meaningfulness of Potential Map Symbols.** Lambert LM, Lederman SJ, *J Visual Impairm Blindn* 83:397-403, 1989.

Based on the results of two experiments with 21 blind observers, the authors offer recommendations of tactual symbols for maps.—[JDS]

**Factor Structure of the Communication Profile for the Hearing Impaired.** DeMorest ME, Erdman SA, *J Speech Hear Disord* 54:541-549, 1989.

Scores of 1,226 patients on the 23 scales of the Communication Profile for the Hearing Impaired were factor-analyzed, yielding five factors: Interaction, Reaction, Adjustment, Communication Performance, and Communication Importance.—[JDS]

**Functional Communication in Alzheimer's Disease.**

Fromm D, Holland AL, *J Speech Hear Disord* 54:535-540, 1989.

CADL scores of 48 cases provisionally diagnosed as Alzheimer's of varying severity were compared with those from 15 cases who were elderly and depressed, 26 with Wernicke's aphasia, and 26 normal age peers. The usefulness of CADL was demonstrated diagnostically and theoretically.—[JDS]

**How Much Extra Time do Visually Impaired People Need to Take Examinations: The Case of the SAT.**

Packer J, *J Visual Impairm Blindn* 83:358-360, 1989.

Analysis of the time taken (not necessarily needed) by visually-impaired persons to finish the Scholastic Aptitude Test showed an average of 6.0 hours for the braille (N=337), 5.4 for the cassette (N=200), 4.4 for the large-type (N=1,542), and 4.3 for the regular-type versions (N=572). By comparison, the standard administration time was 2.5 hours and those with hearing disabilities (N=590) took 3.7 hours, those with other physical disabilities (N=792) from 4.3 to 4.7 hours, and those with learning disabilities (N=8,564) from 4.1 to 4.4 hours—the ranges based on whether they were answering cassette, large-type, or regular forms.—[JDS]

**Individual Variation in Tactile Map Reading Skills: Some Guidelines for Research.** Hampson PJ, Daly CM, *J Visual Impairm Blindn* 83:505-509, 1989.

The authors' review of literature leads them to suggest several points of caution for those undertaking research in this area. Among the suggestions: "Remember that variations in cognitive style, affect, and learning strategy may exist as well as variations in mental abilities, and that these can interact with task structure to determine eventual performance. Beware that even simple tasks often admit several solutions."—[JDS]

**A Model for Training Vision Functioning.** Hall A, Bailey IL, *J Visual Impairm Blindn* 83:390-396, 1989.

While intended for children, the model derived by the authors has applicability to the adventitiously visually-impaired adult. A major virtue of the model is its differentiation of training programs.—[JDS]

**Neurolinguistic Programming in Orientation and Mobility.** Williams MF, Jacobson WH, *J Visual Impairm Blindn* 83:454-456, 1989.

Neurolinguistic programming is recommended as a means of determining if the training program suits the visually-impaired client being trained. The authors offer an outline to assist those interested in the concepts.—[JDS]

**A New Aspect to the Monaural versus Binaural Controversy.** Libby ER, *Hear Instrum* 40(9):34-36, 1989.

Research is reviewed that points to the effects of auditory deprivation resulting from aiding only one ear of those with bilateral hearing losses. In addition to reducing the risk of increased hearing loss in the unfitted ear, binaural amplification provides improved localization, loudness summation, and confidence in communicative ability, while eliminating the head-shadow effect.—[JDS]

**Nonvisual Alternative Display Techniques for Output from Graphics-Based Computers.** Vanderheiden GC, *J Visual Impairm Blindn* 83:383-390, 1989.

The increasingly detailed information displays on computers can be converted to outputs more accessible to visually-impaired and blind users. Those that are verbal can be made audible or brailled. Vanderheiden offers nine basic approaches, some of which are commercially available, some of which are being researched, and some of which are at a conceptual stage of development.—[JDS]

**Performance of Some of the Better Cochlear-Implant Patients.** Tyler RS, Moore BC, Kuk FK, *J Speech Hear Res* 32:887-911, 1989.

Three studies were conducted with 54 "super stars"—persons able to achieve some open-set word recognition—among patients implanted with six different devices (number of patients): Chorimac (6), Nucleus (10 each Hanover and US versions), 3M/Vienna (9), Duren-Cologne (10), and Symbion (9). Word recognition scores were highest for Duren-Cologne and 3M/Vienna and lowest for Chorimac, but similar for all when phoneme recognition was scored. Chorimac patients had the lowest scores for sentences, while Symbion had the highest. A Duren-Cologne patient had the highest scores on words (57 percent correct) and phonemes (85 percent correct). Five patients (3 Chorimac and 1 each Duren-Cologne and 3M/Vienna) gave no correct word responses. Word recognition was lowest for patients who had gap-detection thresholds greater than 40 ms. Symbion patients correctly identified environmental sounds most often from a closed-set test, while Chorimac patients scored lowest.—[JDS]

**Reliability and Validity of O&M Instructor Observations.** Geruschat DR, De L'Aune W, *J Visual Impairm Blindn* 83:457-460, 1989.

Five experienced O&M instructors observed 36 deaf veterans travel the same route. Interobserver judgments of what they saw correlated 0.87, and validity was assessed by pre-post gains in test scores and a correlation of 0.627 between rankings of 19 subjects.—[JDS]

**Results of a National Survey of Electronic Travel Aid Use.** Blasch BB, Long RG, Griffin-Shirley N, *J Visual Impairm Blindn* 83:449-453, 1989.

Telephone interviews with 298 of 641 possible users of electronic travel aids (ETAs) found 67 percent used the long cane, 14 percent relied on guide dogs, 10 percent on the Laser cane, and 6 percent on human guides. Respondents' first training on ETA were: Mowat Sensor, 40 percent; Sonicguide, 33 percent; and Pathsounder, 2 percent. Only 44 percent indicated that they use ETAs all of the time. Authors conclude, among other ideas, that the devices most used were those with the simplest output.—[JDS]

**Structured Solicitation: A Standardized Method for Gaining Travel Information.** LaGrow SJ, Mulder L, *J Visual Impairm Blindn* 83:469-471, 1989.

Seven specific questions have been formulated to assist visually-impaired persons to locate specific addresses by telephone. Three subjects made calls, first without knowing of the structured approach, and then using that method. Data favors structured solicitation of information.—[JDS]

**Supported Employment for Persons with Deaf-Blindness and Mental Retardation.** Griffin SL, Lowry J, *J Visual Impairm Blindn* 83:495-499, 1989.

Discusses models for providing supported employment to deaf-blind persons. While such employment may be more expensive initially, costs decrease as the worker remains on the job.—[JDS]

**The Tactile TONI, a Possible New Performance IQ Test for Blind Adults?** Duncan E, Wiedel J, Prickett H, Vernon M, Hollingsworth-Hodges T, *J Visual Impairm Blindn* 83:510-511, 1989.

The Test of Nonverbal Intelligence (TONI) was given to 11 blind adults. Its excessively long administration time

and uncertain correlation with the WAIS lead authors to recommend it not be used in its present form, if clients have orientation or tactile-discrimination deficiencies.  
—[JDS]

**Temporal-Gap Detection by Cochlear Prosthesis Users.**

Preece JP, Tyler RS, *J Speech Hear Res* 32:849-856, 1989.

Three persons implanted with the Vienna single-channel, multi-electrode, scala tympani, cochlear prosthesis were tested to determine their loudness-magnitude estimation and minimum-detectable temporal separation. The latter decreased with increases in sensation levels and in loudness to an asymptote. At equal-sensation intervals, minimum-detectable gap decreased as frequency increased. The authors discuss these findings and some intriguing interactions.—[JDS]

**Tests of Blind Pedestrians' Use of Traffic Sounds for Street-Crossing Alignment.**

Guth DA, Hill EW, Rieser JJ, *J Visual Impairm Blindn* 83:461-468, 1989.

Based on three experiments assessing blind pedestrians' use of traffic sounds, the experimenters infer that traffic sounds, while useful, do not guarantee accurate alignment of self, relative to the crossing.—[JDS]

**Toward Phonetic Intelligibility Testing in Dysarthria.**

Kent RD, Weismer G, Kent JF, Rosenbek JC, *J Speech Hear Disord* 54:482-500, 1989.

Since intelligibility is not an absolute quality, its assessment in clinical practice is complicated. Based on a review of the literature, authors believe word and/or sentence lists do not adequately control relevant factors, and the results only provide a measure of severity. Suggestions for test construction are made.—[JDS]

**The Use of a Recorded Message for Gaining Assistance with Street Crossings for Deaf-Blind Travelers.**

Florence IJ, LaGrow SJ, *J Visual Impairm Blindn* 83:471-472, 1989.

A deaf-blind lady asked 120 pedestrians to help her cross an intersection. Using a printed card, she obtained help from four persons; using a tape-recorded message, she obtained aid from 36 persons—a statistically significant difference in assistance received.—[JDS]

**Using Self-Monitoring to Reduce Disfluencies in Speakers with Mild Aphasia.**

Whitney JL, Goldstein H, *J Speech Hear Disord* 54:576-586, 1989.

Using a single-subject design, researchers observed three aphasic men who were trained to monitor their own disfluencies. All three showed improvements, and two generalized to disfluencies not in the original training.  
—[JDS]

**Visual Evoked Potentials: Relation to Adult Speech-reading and Cognitive Function.**

Ronnberg J, Arlinger S, Lyxell B, Kinnefors C, *J Speech Hear Res* 32:725-735, 1989.

The study failed to replicate an association between visual-neural speed and speechreading ability, but it did find significant correlations between some words and measures of evoked potentials, and between short-term memory and evoked potentials. The relations are complex, leading the authors to conclude that "no context-bound speechreading condition is significantly correlated with VEP latency (the VN 130 and P 200) or amplitude, but some context-free word discrimination conditions are related to VEP amplitude." They also discuss other relations they found.—[JDS]