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

Assistive Technology
Canadian Journal of Rehabilitation
Journal of Bone and Joint Surgery
Journal of Medical Engineering and Technology
Journal of Speech and Hearing Disorders
Journal of Speech and Hearing Research
Journal of Visual Impairment and Blindness
Prosthetics and Orthotics International

PROSTHETICS, ORTHOTICS, AND RELATED TOPICS


The acceleration in the sagittal plane of the prosthetic tube at heel strike in normal walking was measured in five health amputees with their definitive below-knee prosthesis, every subject using six different prosthetic feet, wearing sport shoes as well as leather shoes. The experiments were carried out in the rehabilitation centre “Het Roessingh,” Enschede, The Netherlands.

Maximum accelerations were extracted from the acceleration-time-signal. Mean acceleration maxima of all subjects were calculated for each foot-shoe combination to eliminate the individual influence of the subjects. In the axial direction the maximal accelerations demonstrate a clear difference among the prosthetic feet and the shoes, while in dorsoventral (tangential) direction the inter-individual variation in the acceleration extremes dominates the difference between the types of footwear. In comparison with nonamputees the magnitude of the maximal axial acceleration at heel strike does not differ significantly. [JEE]


Many severely speech-impaired individuals have a need or desire to maintain the capability for computerized speech generation while performing a variety of other computer-supported tasks such as word processing, financial analysis, or database management. Criteria are presented for augmentative communication systems that both incorporate a personal computer (PC) and provide capabilities for voice output to satisfy this requirement. Current approaches to such systems are categorized and reviewed in light of these criteria. A new method is then described in which word processing or other appropriate PC software is used for speech production, providing a natural integration of written and spoken communication. The approach separates the computer access and voice output functions to allow great flexibility in the choice of an alternative access system. This flexibility combined with appropriate exploitation of PC software features has the potential to yield a high communication rate as well as maximum compatibility with application software. [JEE]

Laser Doppler flowmetry (LDF) is now a well-established, noninvasive technique for measuring microvascular blood perfusion. However, there are a number of factors which can seriously affect the interpretation of the laser Doppler signal which are often not considered during routine use. These include: consideration of signal processing limitations, choice of processing bandwidth, problems with motion artefact and instrument calibration, the effect of probe pressure on the skin, and the type of laser used. This paper reviews many of the problems and limitations frequently encountered using the laser Doppler technique. [JEE]


It has been generally accepted that mechanical stimulation is an important factor in the promotion of formation of bone. Fracture-healing consists of periosteal bridging of the fracture, which achieves stability, and proliferation of endosteal bone to fill the defects between the ends of the bone. To evaluate the effect of weight-bearing on bone-healing, an operatively created defect in the tibial cortex was chosen as an experimental model. In one set of dogs (Group 1), a bilateral defect in the tibial cortex was created and weight-bearing was permitted on one tibia but not on the opposite one. In Group 2, a bilateral defect in the tibial cortex was made and weight-bearing was allowed on both tibiae. A third group of dogs of similar age (Group 3) had no tibial defects. Quantitative histomorphometry was used to measure formation and porosity of bone. Weight-bearing was measured with both static and dynamic techniques.

Significantly less woven bone formed in the defects in the non-weight-bearing tibiae than in the weight-bearing tibiae. This appeared to be due to a disuse response in the underloaded tibiae, in which less bone formed, rather than to the formation of more bone in the weight-bearing tibiae. The data suggest that weight-bearing is a permissive factor, not a stimulus, for formation of woven bone in a tibial defect.

Clinical Relevance: This animal model supports the concept that lack of weight-bearing decreases the amount of woven bone that is formed in a healing tibial defect. The results of this study indicate that weight-bearing increases the formation of bone fracture-healing. Therefore, it is possible that, in the clinical situation, weight-bearing has a positive effect on bone-healing. [JEE]


A three-dimensional cervical spine range-of-motion system was developed using an electromagnetic tracking system for data collection and a personal computer for analysis and graphic representation of the data. A test was designed to investigate the sensitivity of the electromagnetic device to the proximity of metal. It was found that position errors could be kept below 0.5 cm, and rotation errors could be kept below 1.3 degrees, if all metal was at least 33 cm from the source and sensor. The sensitivity of the system to metal should not cause serious problems in the typical clinical environment if simple precautions are taken. [JEE]


During the 1987 Boston Marathon, 14 of the 46 wheelchair participants tipped over in their chairs during a 13-s chain reaction of accidents near the bottom of the first hill. An analysis of the available documentation revealed factors that may have contributed to the accidents—the tight grouping at the start, the wetness of the road, the steepness of the hill, and speeds that were well in excess of the average for the course. Nine of the 14 tipping accidents were lateral in direction; 5 of the 14 subjects did somersaults in their chairs. Although there were no serious injuries, four of those involved were unable to complete the course, some due to mechanical failure. In 1988 and 1989, a pace car was used at the start, and there were no accidents, although the number of participants and the conditions were similar. This analysis provides insights into how the likelihood of serious injury might be further reduced. [JEE]


The aim of this study was to determine the rate at which gait recovery as measured by temporal distance factors (velocity and symmetry) occurs in unilateral lower limb

The effect of one year's general use on the performance of four shock attenuating insoles is reported. Testing was carried out using the JP Biomechanics Shock Meter on twelve volunteers on a timed oval course at eight intervals during the year. The results show that two of insoles perform well (Viscolas and PPT) although deterioration does occur after 6 to 9 months use; the other two insoles (Plastazote and Gait Aid) perform poorly. It is suggested that manufacturers provide some information to the user or supplier regarding the effective life of their products. [JEE]


In retrospective study of critical ischemia of the lower limb, sympathectomy appeared to be of value in the majority of patients. We therefore assessed sympathectomy by measuring skin blood flow before and after the procedure using laser Doppler flowmetry (LDF) and transcutaneous oxygen tension (TcPO₂) techniques. Twenty patients underwent chemical sympathectomy and there was one surgical procedure. Measurements were performed before and 1 week after sympathectomy below the knee and on the forefoot. Symptomatic improvement occurred in 20 of 21 patients. This study demonstrates that skin blood flow in the leg and foot is improved by sympathectomy and confirms objectively our clinical impression. [JEE]


Major advances in the techniques of discography since 1968, in conjunction with major strides in the evaluation of pain in recent years, prompted a study in which Holt's work on the specificity of discography was replicated and extended. For the present study, seven patients who had low-back pain and ten volunteers who had been carefully screened, with a questionnaire and a physical examination, to ensure that they had no history of problems with the back, had an injection at three levels, and all sessions were videotaped. After each injection, the participant was interviewed about the pattern and intensity of the pain, and then the discs were imaged with computed tomography. Five raters, who were blind to the condition of the participant, graded each disc as normal or abnormal on the basis of findings on magnetic resonance images that had been made before the injection and computed tomography (discography) were done. There was only one disagreement between the ratings that were made on the basis of the magnetic resonance images and those that were made on the basis of the discograms.

Each participant's pain-related response was evaluated independently by two raters who viewed the videotapes of the discography. Inter-rater reliability was 0.99, 0.93, and 0.88 for the evaluation of intensity of the pain, pain-related behavior, and similarity of the pain to pain that the subject had before the injection. In the asymptomatic individuals, the discogram was interpreted as abnormal for 17 percent (5) of the 30 discs and for 5 of the 10 subjects. However, when the discogram was defined as positive only when substantial pain had been associated with the injection, there were no positive interpretations for the asymptomatic individuals (a false-positive rate of 0 and a specificity of 100 percent). Thus, although the prevalence of abnormal discograms in the asymptomatic participants in the present study was generally consistent with Holt's results, the false-positive rate in this study (0 percent) was significantly lower than in Holt's study (26 percent).

Discography revealed abnormal findings in 13 of the 20 discs in the symptomatic individuals and in all 7 patients.
at one or more levels. Six patients had positive discograms on the basis of the study criteria. It was concluded that, with current techniques and in conjunction with standardized methods for assessment of pain, lumbar discography is a highly reliable and specific diagnostic test. This study did not address the validity or sensitivity or provide guidelines for choosing patients for discography. Certainly, discography is not the best diagnostic test for all patients who have low-back pain. [JEE]


Myoelectric pickups (electrodes and processors for detecting the signal that is recorded as an electromyogram) are the most important human-machine interface for controlling powered upper-extremity prostheses. This article presents a simple explanation of myoelectric signal acquisition and then discusses how these signals are used to control the small motors in electric hands, elbows, wrist rotators, and other similar equipment. The less-familiar switch-based and proportional position-sensing controls are also explained. A complete listing of the major suppliers and products available will aid in understanding a discussion of the criteria for using external power instead of, or along with, body power to control and activate prosthetic function. [JEE]


A total of 175 consecutive below and above-knee amputees sent to the prosthetic workshop in Helsinki for prosthetic fitting from 32 hospitals were reviewed to determine their functional ambulation and social adaptation. The average age of patients was 62.2 years at the time of the prosthetic fitting. The mortality was 11 percent (19) during the first postoperative year. One-year postoperative information was obtained for 141 of the surviving patients (90 percent) by personal contact. At the time of the review, 68 percent of the amputees (96 patients) who had been fitted with a prosthesis made extensive and regular use of it. Half of all the above-knee amputees and 79 percent of the below-knee used their prosthesis throughout the day or over seven hours a day. A total of 72 percent of the above-knee amputees (33/46) and 85 percent of the below-knee amputees (67/79) had useful ambulation, at least indoors. Of the 141 patients contacted, 124 (88 percent) lived in their own homes. The remaining 16 patients (11 percent) lived in apartment houses for the aged or old people’s homes. A total of 48 amputees (34 percent) needed a regular home help. [JEE]


We successfully replanted five amputated legs in five patients and followed the patients for two years or more (average, six years and three months). Although some patients found it impossible to squat and to run because of joint contractures, muscle weakness, or deformities of the foot, all patients could perform other activities without difficulty. None had important pain or any intolerance to cold, and all were satisfied with the results of the replantation. [JEE]


Very little quantitative biomechanical research has been carried out evaluating issues relevant to prosthetic management. The literature available suggests that amputees may demonstrate an asymmetrical gait pattern. Furthermore, studies suggest that the forces occurring during amputee gait may be unequally distributed between the contralateral and prosthetic lower limbs. This study investigates the role of the contralateral limb in amputee gait by determining lower limb joint reaction forces and symmetry of motion in an amputee and nonamputee population. Seven adult below-knee amputees and four nonamputees participated in the study. Testing involved collection of kinematic coordinate data employing a WATSMART video system and ground reaction force data using a Kistler force plate. The degree of lower limb symmetry was determined using bilateral angle-angle diagrams and a chain encoding technique. Ankle, knee and hip joint reaction forces were estimated in order to evaluate the forces acting across the joints of the amputee’s contralateral limb. The amputees demonstrated a lesser degree of lower limb symmetry than the nonamputees. This asymmetrical movement was attributed to the inherent variability of the actions of the prosthetic lower limb. The forces acting across the joints of the contralateral limb were not significantly higher than that of the nonamputee. This suggests that, providing the adult amputee has a good prosthetic fit, there will not be
increased forces across the joints of contralateral limb and consequently no predisposition for the long-term wearer to develop premature degenerative arthritis. [JEE]


A study was designed to evaluate if shock absorbing material (ethyl vinyl acetate [EVA]) on the shoes of long leg braces could decrease the accelerations and consequent shock forces transmitted through the leg and brace during paraplegic walking. Six male paraplegic (26-55 years old) took part, four using a “swing-to” and two a “swing-through” technique when walking. Recordings comprised accelerometry of leg and brace, force platform measurement, and still photography of the trajectories of the leg segments. Each experimental condition was tested three times with a coefficient of variation (CV) for the measurements ranging from 5-22 percent. Compared to hard heels, shoes equipped with 20mm EVA soles decreased the acceleration amplitude in the first 10 msec as well as at maximum for shoe-to-ground contact. With the accelerometer at the malleolus reduction of the amplitude averaged 22 percent and 12 percent respectively, and 35 percent and 21 percent respectively with the accelerometer on the caliper (p < 0.03-0.1). In a second trail the two “swing-through” walkers had new shoes made with a 10mm thick EVA heel built in. After 3 months of walking with these shoes tests were carried out with the accelerometer attached to the malleolus both when the new and the former shoes were put on the calipers. CV for these measurements were 15-24 percent. It was found that the new shoes decreased the amplitudes by up to 62 percent and 26 percent on average (all p < 0.01). The experimental subjects indicated that the EVA soles/heels gave a more comfortable and silent walk, e.g., the “bump” transmitted up through the body to the head diminished. In future, shock absorbing material should be built into the heels of shoes provided to long leg braces for paraplegic walking. [JEE]

**SENsory AIDS/REHABILITATION**


Examination of 13 postoperative males with 8 acoustical measures produced variable results. Predictable trends were identified. Monitoring even minor intubation-related laryngeal traumas may be successful using three of the eight measures. [JDS]


Analysis of 528 tinnitus patients’ responses to a questionnaire showed: 1) almost three of four patients reported it occurred 26 or more days per month; 2) for a little less than one in five patients tinnitus occurred in the presence of normal hearing or mild impairment; 3) one in four indicated their tinnitus had increased over time; 4) severity of tinnitus was greatest in those for whom it was the primary complaint and in those with Meniere’s syndrome; and, 5) patients differed with respect to whether noise or quiet exacerbated their tinnitus. [JDS]


Four patients with severe ataxic dysarthria and four with severe hypokinetic dysarthria read passages at rates controlled by the experimenters. Recordings of their productions were compared to those of four normal speakers and their own speech at their accustomed pace. Sentence intelligibility improved when rates were controlled for the
dysarthric patients. Slowing did not affect the naturalness of speech as much for the dysarthric as for normal individuals. Discrepancies occurred in measures of sentence and phoneme intelligibility. [JDS]


The devices tested were: Click-Count syringe, Dos-Aid, Inject-Aid, Meditec Insulgage, Orange Medical Instruments’ Betafect, and Squibb-Novo NovoPen. Using a single-subject design, three people evaluated each device. Two subjects preferred NovoPen and one the Insulgage. Each device has its advantages and disadvantages. Suggestions for further research are offered. [JDS]


After practice, 10 normal males, with mesomorphic body types, performed two tests of vital capacity, read the Rainbow passage, and submitted to measurements of tidal ventilation. The results indicate the problems inherent in relating chest-wall kinematics to exchanged volumes during ventilation and speech. The authors believe that “appropriateness of using respiratory kinematic devices as calibrated volume instruments obviously depends on the nature of the research or clinical questions that one is asking…” [JDS]


The article describes the use of a probe microphone to verify hearing-aid fitting in patients with sensorineural impairments. Each of 24 patients had three aids prescribed, using: 1) MSUv3; 2) MSUv3 plus 4 dB per octave; and, 3) MSUv3 minus 4 dB per octave. For over-the-ear hearing aids, prescriptions were matched with a 5 dB RMS error or less. The probe-microphone procedure yielded accurate fittings. However, it required precise control of the simulated speech stimuli and other inputs. [JDS]


As common as depression is following stroke, little is empirically known about its course over a substantial time period. In the year they were followed post-stroke, 48 patients exhibited the high amount of depression anticipated. The prevalence of depression increased for males and remained the same for females. Their functioning improved in all cases, but to a greater extent among those without accompanying depression. The authors urge aggressive treatment of the emotional concomitants of stroke. [JDS]


Assessment of 311 consecutive admissions out of 900 (exclusions based on not meeting criteria, such as age) showed that the screening test had a specificity of 0.85 and a sensitivity of 0.78. Despite the respectable validities of the test, the authors caution that “it certainly would be inappropriate to use the tongue-anchor task… as an isolated tool for assessing a patient’s ability to close off the nose from the mouth during speech.” [JDS]


On the average, 15 deafened adults’ speech perception improved over a three-year period following implantation with the Nucleus 22. The greatest comparative improvement occurred between the pre-implant and three months post-implant periods, but some patients showed improvements into the third year as measured by MAC scores. Improvement related to the processing scheme used by the patient: those that included coding F1 showed significantly greater improvement than FOF2 only. A limiting factor in generalizing these findings is the MAC’s test-retest characteristics, which are presently unknown. Thus, whether results of this research show people learn to perform the MAC more successfully over time or make better use of their implant’s information remains open to question. [JDS]

Comparing a group of nine persons with high-frequency hearing impairments to eight with high- and low-frequency impairments, authors found both groups preferred more gain when listening to other persons' voices than their own. Authors believe multimemory hearing aids may be necessary for some patients. [JDS]


Persons identified in the 1986 Canadian Census of the Population as having a limitation of activity or health condition were followed up by the Health and Activity Limitation Survey (HALS). HALS also sampled a large portion of those who responded no to the census screening questions. HALS estimated 445,875 Canadian adults have impaired vision; i.e., trouble reading ordinary newspaper print, with glasses, if normally worn, and/or trouble seeing clearly the face of someone 12 feet across a room, also with glasses, if normally worn. Among the findings: 1) as age increased, so did visual impairment; and, 2) HALS' estimated rate for legal blindness was far lower than the Canadian National Institute for the Blind's; self-assessed degree of impairment was related to reported cause. [JDS]


Describes NOMAD, an adaptation of a graphic tablet used with an IBM PC. It enables the blind person to read a figure, such as a map, by supplementing its tactile representation with speech. It has "great potential as a teaching aid for a variety of tactile and visual graphics. The technology itself is basically well designed." Details with respect to sources, prices, etc., are also provided. [JDS]


Publicity attracted 3,393 elderly persons from 39 predominantly rural counties of Missouri to visual screening. Low-vision centers were located at sites near large concentrations of older persons. The authors were surprised by the "high level of use of and the important contribution that these vision centers made to the residents and staffs of the participating nursing homes." The study concluded that visual impairments were extensive among elderly people, that low-vision aids are useful, and that rehabilitation services are scarce in the areas studied. [JDS]


The authors review the literature relating psychopathology to speech and language disorders. The importance of anxiety, conversion reactions, and depression in conditions like aphasia, apraxia, dementia, and voice disorders should be considered by speech pathologists when treating patients with communication problems. The effects of behavioral modification, drugs, and other treatments should be assessed with affective factors clearly in the pathologist's view. [JDS]


Various measures of voice characteristics of eight males and eight females who had undergone endotracheal intubation led authors to conclude that: 1) the procedure affects the acoustic characteristics of speech even after relatively short durations; and, 2) measures of waveforms are sufficiently sensitive to detect the vocal alterations. [JDS]


Three cognitive tests were administered to 23 Alzheimer's patients. They gave more repetitious, multiword, and unrelated responses to word associations than normal controls and lower ratios of paradigmatic to syntagmatic responses. Other associative tasks were similarly depressed. However, patients defined many words for which they did not give meaningful word associations. [JDS]

Author proposes a definition of stuttering that is independent of the fact that listeners cannot acceptably judge unit-by-unit occurrences of it. "My hypothesis is that what is frustrating, and can become frightening, about stuttering is that when it happens speech is either about to be or becomes temporarily disrupted for reasons the stutterer is unable to prevent. Moreover, the disruption is specific to the speech attempt." Note that four subsequent articles in this issue respond to this paper, along with a rebuttal by Perkins. [JDS]