

# 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:

*Assistive Technology*  
*Clinical Orthopedics and Related Research*  
*International Journal of Rehabilitation Research*  
*New England Journal of Medicine*  
*Journal of Bone and Joint Surgery*  
*Journal of Medical Engineering and Technology*  
*Paraplegia*  
*Physiotherapy*

## PROSTHETICS, ORTHOTICS, AND RELATED TOPICS

**A Comparison of Quality of Life Before and After Arthroplasty in Patients Who Had Arthrosis of the Hip Joint.** Wiklund I, Romanus B, reprinted from *J Bone Joint Surg* 73-A:765-769, 1991.

Quality of life before and one year after total hip arthroplasty was evaluated in fifty-six patients who had arthrosis of the hip joint. There were twenty-one men and thirty-five women, and the median age was sixty-five years (range, thirty to seventy-nine years). Before and after hip arthroplasty, a functional assessment was done with the Charnley-Merle d'Aubigne scoring system. The patients assessed quality of life using the Nottingham Health Profile. In the comparison of quality of life before and after the arthroplasty, significant improvement was observed regarding pain ( $p < 0.0001$ ), energy ( $p < 0.0001$ ), sleep ( $p = 0.0001$ ), and social isolation ( $p = 0.001$ ). Similarly, there was a significant reduction in the frequency of health-related problems pertaining to housework ( $p < 0.0001$ ), holidays ( $p < 0.0001$ ), hobbies ( $p = 0.0001$ ), social life ( $p < 0.0001$ ), sexual function ( $p = 0.001$ ), and family life ( $p = 0.0005$ ), and among patients who were sixty-five years old or less and who worked at paid employment ( $p = 0.04$ ). Quality of life

after total hip arthroplasty was in close agreement with that of a healthy reference group of similar age and sex distribution. It was concluded that quality of life after total hip arthroplasty is improved considerably. The Nottingham Health Profile is a valuable tool in the evaluation of the result of, as well as the indicators for, total hip arthroplasty.

**Current Choices in Prosthetic Feet.** Edelstein JE, *Crit Rev Phys Rehabil Med* 2:213-226, 1991.

All prosthetic foot-ankle assemblies simulate the general contour of the human foot, and serve as a stable base during standing and walking, plantarflex and absorb impact during early stance, and provide metatarsophalangeal hyperextension in late stance. They can be attached to any prosthesis from below-knee to hemipelvectomy, either to the shank or, if the foot assembly has a leaf spring, to the below-knee socket or the knee unit. Feet designed for Syme's prostheses are secured to the distal portion of the socket. Limitations of all prosthetic feet include the lack of provision for standing on tiptoe or plantarflexing while seated. Designs differ according to their materials and whether they are articulated or nonarticulated. The latter include the SACH, SAFE, Dynamic, STEN, Carbon Copy, Seattle, Quantum, Sabolich, Flex-Foot, and Springlite feet. Research on limited numbers of subjects suggests that no assembly enabled the wearer to duplicate the kinematics or kinetics of the contralateral, sound limb; nevertheless, the closest values were recorded for the Flex-Foot.

Articulated assemblies have a cleft between the proximal foot and the distal shank. Such models include the single-axis and the multiaxial models, namely Greissinger, MULTIFLEX, Dual-Ankle Springs, and Mauch units. The single-axis assembly has been studied more extensively than the other articulated designs. Other assemblies include the Habermann multiaxial assembly and the Jaipur Foot, rarely used in North America.

**Current Evaluation of Hydraulics to Replace the Cable Force Transmission System for Body-Powered Upper-Limb Prostheses.** LeBlanc M, reprinted from *Assist Technol* 2:101-107, 1990.

Present body-powered upper-limb prostheses use a cable control system employing World War II aircraft technology to transmit force from the body to the prosthesis for operation. The cable and associated hardware are located outside the prosthesis. Because individuals with arm amputations want prostheses that are natural looking with a smooth, soft outer surface, a design and development project was undertaken to replace the cable system with hydraulics located inside the prosthesis. Three different hydraulic transmission systems were built for evaluation, and other possibilities were explored. Results indicate that a hydraulic force transmission system remains an unmet challenge as a practical replacement for the cable system. The author was unable to develop a hydraulic system that meets the necessary dynamic requirements and is acceptable in size and appearance.

**Effectiveness of Cervical Collars in Limiting Movement.** Burl MM, reprinted from *Physiotherapy* 77:308-310, 1991.

The objective of this research was to determine the effect of rigid cervical collars on neck movements. Ten healthy young women aged 18 to 24 years had neck movements measured in all planes of movement while wearing a rigid Airflow cervical collar and with the neck unrestrained. Measurement was by the Myrin goniometer. On related t-tests the findings showed a significant decrease in movement when wearing the collar ( $p < 0.0005$ ). Flexion/extension was most restricted while side flexion was least restricted.

The results indicate that when limitation of neck movement is desired, the use of a rigid cervical collar is a valid therapeutic tool.

**Factors Influencing the Regeneration of Axons in the Central Nervous System.** Fawcett JW, reprinted from *Paraplegia* 29:287-293, 1991.

Damage to the central nervous system (CNS) causes damage to neurons. This damage can result in the complete death of neurons, or in them becoming disconnected from their inputs or target structures due to disruption of axons. The main reason why damage to the human CNS is so disastrous and disabling is that axons will not in general regenerate in the mammalian brain, and neurons once

lost are not replaced. In order, therefore, to repair the CNS, techniques will have to be developed to replace dead neurons, and induce axon regrowth. Central to the technologies necessary for brain repair is the ability to induce and control the growth of axons, since in a damaged brain both surviving and newly implanted neurons must grow axons to make or remake appropriate synaptic connections. Worthwhile treatments, however, do not necessarily require the repair of all the damaged circuits in the CNS, it may be possible to substantially improve the function of patients with relatively few reconnected axons, if those axons are ones which mediate particularly important behaviours, such as respiration, bladder control, or hand and arm movements.

**Functional Electrical Stimulation and Reciprocating Gait Orthosis for Ambulation Exercise in a Tetraplegic Patient: A Case Study.** Phillips CA, Hendershot DM, reprinted from *Paraplegia* 29:268-270, 1991.

The purpose of this paper is to report the cardiopulmonary stresses (as indicated by heart rate, blood pressure, oxygen consumption and task cost) for a tetraplegic individual when walking with electrical stimulation and a gait orthosis as opposed to walking with a gait orthosis alone. Functional electrical stimulation (FES), when interfaced with a reciprocating gait orthosis (RGO), resulted in walking exercise for a C-7 level tetraplegic subject, who was 8 years post-injury. Cardiopulmonary measurements were made and task costs calculated on this individual during progressive velocity walking with the FES-RGO and the orthosis alone (without FES). Results for the tetraplegic individual indicate that there were no significant changes in heart rate at the various walking velocities with respect to the two systems. However, systolic blood pressure was significantly reduced at the three highest walking velocities (1.2, 1.6 and 2.0 kph) when using the FES and orthosis system as compared to orthosis-alone walking ( $p < .025$ ,  $p < .005$  and  $p < .025$  respectively). Calculated oxygen consumption was significantly reduced and calculated task cost improved at the highest walking velocity (2.0 kph) when using the FES-RGO system as compared to using only the RGO ( $p < .025$ ). It is concluded that cardiopulmonary stresses are significantly less for this tetraplegic individual when ambulating at the higher velocities with electrical stimulation and a gait orthosis than when walking with a gait orthosis alone. This may result in improved endurance during each walking session and (consequently) as improved aerobic exercise effect. This might also allow some tetraplegics, who would be unable to walk with

the RGO alone, to walk with electrical stimulation and the RGO.

**A Hierarchy of Reactions to Disability.** Antonak RF, Livneh H, *Int J Rehabil Res* 14:13-24, 1991.

One hundred eighteen individuals with noncongenital physical disabilities responded to a 60-item Reactions to Impairment and Disability Inventory. The inventory gathered information on psychosocial reactions to disability, including shock, anxiety, denial, depression, internalized anger, externalized hostility, acknowledgment, and adjustment.

Theoretic analysis showed a set of five nonadapted reactions, including depression, internalized anger, shock, anxiety, and externalized hostility, which were distinguished from the adapted reactions of acknowledgment and adjustment. The nonadapted reactions are prerequisite to the two adapted reactions. Denial is independent of either type of reaction. Acknowledgment refers to one's intellectual recognition of permanency of the condition and its future implications; adjustment involves affective and behavioral assimilation of the ramifications of the disability. The individual is fully integrated into the outside world, having mastered social, familial, and work roles required for successful, independent functioning in society.

A comparison of hierarchies derived from other studies may clarify the multidimensional structure of adaptation to disability.

**The Influence of Smoking on Complications After Primary Amputations of the Lower Extremity.**

Lind J, Kramhoft M, Bodtker S, *Clin Orthop Rel Res* 267:211-217, 1991.

One hundred and thirty-seven patients were reviewed. The group had 165 primary amputations, including 111 below-knee and 54 above-knee, and consisted of 83 men and 82 women. Sixty-four were diabetic. All amputations were performed because of peripheral vascular disease, excluding Buerger's disease. Patients treated with intraoperative prophylactic antibiotics were excluded, although most had prophylactic antibiotics. Seventy-seven patients smoked either cigarettes, cigars, or a pipe; those who chewed tobacco or used snuff were excluded. The average age of the nonsmokers was 76.4 years, as compared with an average of 72.2 years for cigar smokers, and 68.9 for those who smoked cigarettes.

Cigarette smokers had a significantly higher risk of infection and reamputation as compared with the nonsmokers and cigar smokers, possibly resulting from inhalation of

high concentrations of nicotine which compromises the cutaneous blood-flow velocity and increases the risk of forming microthrombi. Cigarette smokers should abstain from smoking one week prior to surgery so that the fibrinogen level can normalize; they should also refrain from smoking during the healing phase.

**The Krukenberg Hand.** Garst RJ, reprinted from *J Bone Joint Surg* 73-B:385-388, 1991.

Little has been published about the Krukenberg operation, which has been regarded as primarily indicated for the blind patient with bilateral hand amputations. Of the 35 Krukenberg cineplasty operations I have performed in the last 36 years, only two have been on blind patients.

The operation provides forearm amputees with pincers which allow them to perform tasks without a prosthesis, but does not preclude the use of any type of aid. The author's operative procedure is described and the results illustrate its practical application for most patients.

**Lower Limb Amputations for Vascular Insufficiency.** Ebskov LB, *Int J Rehabil Res* 14:59-64, 1991.

The Danish Amputation Register was established in 1972 to collect data on major amputations. Since 1978, information has been obtained from all patients admitted to Danish nonpsychiatric hospitals. Records include etiology according to the World Health Organization International Classification of Diseases, level and type of amputation, age, sex, dates of admission and discharge, mortality and geographical information. Between 1978 and 1984, 9061 hospital admissions were recorded, accounting for 10,373 amputations.

The mean age of the patients having amputation was 73.4; women were somewhat older than men. Ninety percent were older than 60 years, and 70 percent were at least 70 years old. The overall sex ratio of men to women was 57:43. Additional factors analyzed included hospitalization period, mortality during hospitalization, and amputation level.

**Profiles of Spinal Cord Injury and Recovery After Gunshot Injury.** Waters RL, Adkins RH, Yakura J, Sie I, *Clin Orthop Rel Res* 267:14-21, 1991.

One hundred and thirty-five patients with spinal cord injuries resulting in neuropathy had prospective motor and sensory examinations. Lesions were complete in 77 subjects, and incomplete in the remaining 58. More than four-fifths of the injuries were in the thoracic or thora-

columbar spine. In most instances, the neurologic level was at least one level higher than the vertebral level of injury. The site of bullet entry was not related to the severity of injury. Data were also gathered regarding bullet caliber, direction of bullet entry, and route of the bullet within the body.

Of the total group, 67 had annual follow-up examinations. Two-thirds of them had no improvement in neurologic status, regardless of whether the lesion was complete or incomplete. Patients did, however, demonstrate significant improvement in the American Spinal Injury Association motor index scores.

**Recovery of Motor Function After Spinal Cord Injury: A Randomized, Placebo-Controlled Trial with GM-1 Ganglioside.** Geisler FH, Dorsey FC, Coleman WP, *N Eng J Med* 324:1829-1838, 1991.

A prospective, double-blind trial of GM-1 Ganglioside (monosialotetrahexosylganglioside) was conducted in 34 patients with spinal cord injuries. Twenty-three had cervical injuries, and the remaining 11 had thoracic injury. The first dose of the drug or the placebo was administered intravenously within 72 hours of injury. Patients had a one-year follow-up. The Frankel scale and the American Spinal Injury Association motor score were used to determine neurologic recovery.

On the Frankel five category scale, those who received the drug had greater improvement than did the placebo recipients. The American Spinal Injury Association score, derived from strength tests of 20 muscles, also increased significantly in those treated with the drug, ascribed to the regaining of useful motor strength by initially paralyzed muscles, rather than to the strengthening of paretic muscles. Trauma usually does not cause spinal cord transection; neuropathy is usually due to microscopic disruption of axons traversing the injury site, or by vascular interference at the injury site that blocks neuronal impulse transmission. The initial contusion causes secondary damage within 3 days after injury, thus establishing the time when the effect of the injury may be altered.

No untoward neurologic events related to drug administration were observed in this study. A larger study must be conducted to confirm the clinical benefit and safety of the drug.

**Social Role Functioning Following Spinal Cord Injury.**

Stambrook M, MacBeath S, Moore AD, *et al.*, reprinted from *Paraplegia* 29:318-323, 1991.

The Katz Adjustment Scale—Relatives Form was completed by the wives of 27 hospital-discharged spinal cord injured (SCI) patients. Their ratings of the spouses' social

adjustment and behaviour were compared to available community and psychiatric norms. Overall, spouses rated their SCI husbands as performing significantly more socially inappropriate behaviours compared to ratings of 'normals' but as engaging in significantly less socially inappropriate behaviours compared to the ratings of psychiatric patients. SCI patients were perceived as performing the same levels of social activities as 'normals,' but engaging in less free-time activities compared to both 'normals' and psychiatric patients. These results mirror similar analyses comparing moderate and severe head injury victims with normal and psychiatric norms. The implications for rehabilitation and counselling of families of traumatically disabled patients are discussed.

**Tissue Shape and Deformation Versus Pressure as a Characterization of the Seating Interface.** Levine SP, Kett RL, Ferguson-Pell M, reprinted from *Assist Technol* 2:93-99, 1990.

A review of pressure measurements as a characterization of the seating interface is presented along with a discussion of their limitations in evaluating potentially adverse conditions that may lead to pressure sore formation. A theoretical rationale is then developed for using tissue shape and deformation, in contrast to pressure, as a conceptualization of the seating interface. Previous studies that have investigated shape and deformation as a characterization of the seating interface, as well as those that have utilized shape measurement for cushion fabrication, are reviewed in light of the theoretical rationale presented. It is concluded that although the efficacy of tissue shape and deformation as a characterization of the seating interface has not been clinically proven, they provide a more direct measure of the net effect of external load, mechanical tissue properties, and boundary conditions (cushion effects) as compared to pressure measurements.

**Upward Displacement of the Centre of Gravity in Paraplegic Patients.** Duval-Beaupere G, Robain G, reprinted from *Paraplegia* 29:309-317, 1991.

The centres of gravity of 44 complete chronic spinal cord injured patients and 24 normal subjects were measured using a gamma ray scanner (Barycentremetre). The results are expressed as a percentage of body length and as anatomical level. The mean weight of paraplegic patients was 12kg less than the controls. The centre of gravity was 5% of body length higher in the paraplegic patients than in the controls, equivalent to 3 to 4 vertebrae level. The importance of such changes in the centre of gravity for the design of stable wheelchairs is discussed.