

SUMMARY OF SCIENTIFIC/TECHNICAL ARTICLES IN THIS ISSUE

Intramedullary osseointegration: Development of a rodent model and study of histology and neuropeptide changes around titanium implants

Magnus Ysander, MD; Richard Brånemark, MD, PhD; Kjell Olmarker, MD, PhD; Robert R. Myers, PhD
(p. 183)

Purpose of the Work. This paper presents a rodent model of femoral osseointegration. Osseointegration is the term originally used by Professor P.-I. Brånemark to characterize the permanent attachment of pure titanium fixtures to living bone. Osseointegrated dental fixtures have become the state-of-the-art therapy for edentulism, and the concept is now being extended to orthopedic applications. An ongoing clinical study in the European Union is focused on transfemoral applications in which intramedullary osseointegrated fixtures support above-knee prostheses of patients who cannot tolerate traditional socket prostheses. The purpose of the research was to establish the experimental model in rats and to investigate the nature of the neural-immune interactions that support osseointegration. **Subjects/Procedures.** Eighteen rats were fitted with a threaded, pure titanium fixture in the intramedullary space of one femur. The fixture was left in place for variable periods of time up to 8 weeks. Histological analyses, including immunohistochemical analyses of substances associated with nerve fiber function, were evaluated at the experimental time points. **Results.** Fixtures became osseointegrated by 8 weeks without signs of rejection or pain. Microscopy showed that the density and structure of the vasculature in bone adjacent to the implants were similar to that in control femurs. There was active integration of titanium threads to remodeling bone, and temporal changes in calcitonin gene-related peptide normally associated with bone remodeling. **Relevance to the Veteran Population.** Osseointegrated limb prostheses have tremendous potential to supplement current prostheses techniques and are particularly well suited to cases where traditional techniques have failed. A forthcoming review article in this journal will summarize the clinical experience.

Magnus Ysander, MD

Long-term survival of regenerated cartilage on a large joint surface

Jennifer S. Wayne, PhD; Charles L. McDowell, MD; Mark C. Willis, MD (p. 191)

Purpose of the Work. To create an environment in which a new cartilage tissue will grow to cover an entire joint surface and will withstand the stresses of normal joint function for at least one year (the time limit of this work). **Subjects/Procedures.** An animal model was designed to produce a protective environment in which the new cartilage could grow to an early stage of maturity before exposing it to the normal stresses within a moving joint. **Results.** We observed that the new cartilage grown in a stress protected environment for 12 weeks and then exposed to normal joint stresses survived this work (one year). **Relevance to the Veteran Population.** Arthritis has many causes and constitutes one of the most disabling conditions in the Veteran population. This work will help us to design new surgical methods to treat the varied forms of arthritis.

Charles L. McDowell, MD

Measuring the effects of seating on people with profound and multiple disabilities— A preliminary study

Aileen R. Neilson, BSc, MSc; Geoff I. Bardsley, BEng, PhD; David I. Rowley, BmedBiol, MD, FRCS; James Hogg, BA, BA, PhD; Mo Malek, BSc, MSc, MSc, PhD; Gwendolyn C. Morrison, BA, MSc, DPhil; Craig A. Kirkwood, BSc, PhD (p. 201)

Purpose of the Work. The purpose of this study was to investigate a range of “tools” that may be used for measuring the effects of special seating on people with profound and multiple disabilities and their carers. **Subjects/Procedures.** The study involved nine subjects who were severely disabled, requiring custom-molded seating to maintain acceptable postures in their wheelchairs. Their carers played an essential part in the study. Questionnaires involving tools for measuring quality of life and satisfaction were administered before and after intervention with molded seating. Carers responded to these questionnaires both on behalf of themselves and their clients. Functional abilities were assessed from

video recordings of eating. **Results.** The results suggest that these tools are sensitive to this intervention, showing a general beneficial effect with good carer satisfaction. **Relevance to the Veteran Population.** This preliminary study points the way toward the use of tools to quantify the effects of Rehabilitation Technology interventions on people with disabilities. Such tools may form the basis for gaining scientific evidence to guide policies of provision and to help select the most appropriate intervention for each individual person.

Geoff I. Bardsley, BEng, PhD

Driving performance and workload assessment of drivers with tetraplegia: An adaptation evaluation framework

Björn Peters, MSc (p. 215)

Purpose of the Work. The purpose of this study was to begin the development of a method to evaluate vehicle adaptations for drivers with disabilities. **Subjects/Procedures.** Twenty-six drivers with spinal cord injuries (SCI) (tetraplegia) were studied and compared to a group of 26 able-bodied drivers in a driving simulator. The drivers with tetraplegia used two types of hand-operated controls for accelerating and braking (combined or separate controls). Able-bodied drivers drove with standard pedals. **Results.** The drivers with SCI drove in general as equally well as the control group but had a slightly longer reaction time (10%). Workload assessment revealed that they also experienced a greater time pressure and spent more effort than did the able-bodied drivers. They were also more tired from braking and accelerating. The drivers using separate controls had a greater variation (18%) in lateral position within the lane, while those using a combined control were more tired from braking and accelerating. The observed differences could be interpreted as indicators of insufficient adaptation. **Relevance to the Veteran Population.** A reliable method to evaluate vehicle adaptations would improve the possibilities of providing drivers with disabilities with better driving conditions and thus enhance mobility, independence, and well-being.

Björn Peters, MSc

Dietary and serum lipids in individuals with spinal cord injury living in the community

Robabeh M. Moussavi, PhD; Francisca Ribas-Cardus, MS; Diana H. Rintala, PhD; Gladys P. Rodriguez, PhD (p. 225)

Purpose of the Work. The purpose of this study was to measure the cholesterol and fat in the diet and blood of persons with spinal cord injuries (SCI) and compare the results with the recommended/desired range. **Subjects/Procedures.** Participants were 189 adults with SCI. Dietary fat and cholesterol were assessed based on a three-day food diary. Blood samples were obtained after an overnight fast. **Results.** Intake of fat was above the recommended levels for 80% of the participants and their intake of cholesterol was also high, particularly in men. Over 40% had high cholesterol levels in their blood. Older persons had higher cholesterol and triglycerides. Caucasians and Hispanic-Americans tended to have higher triglycerides than African-Americans. **Relevance to the Veteran Population.** These results suggest that a large proportion of persons with SCI may be at risk for coronary heart disease. Long-term studies are needed to determine the relationship between fats in the blood and the onset of heart disease in persons with SCI.

Robabeh M. Moussavi, PhD

Assistive technology to improve PC interaction for people with intention tremor

Peter Feys; Anders Romberg; Juhani Ruutiainen, MD; Angela Davies-Smith; Rosemary Jones, PhD; Carlo Alberto Avizzano, PhD; Massimo Bergamasco, PhD; Pierre Ketelaer, MD (p. 235)

Purpose of the Work. A motion-filtering software program was developed to improve the use of the PC mouse or other cursor control devices during PC interaction in patients with tremor. The purpose of this study was to validate this Tremor Control System. **Subjects/Procedures.** Thirty-six persons with multiple sclerosis and intention tremor in the upper limb participated in the trials. Several interfaces and options in the Tremor Control System were tested. The performance of the standard PC mouse on

functional PC tests was compared with the performance of an individual optimal interface and configuration of parameters. **Results.** The Tremor Control System extended the number of patients able to interact with the PC and enhanced the quality of operating the cursor, especially in subjects with marked intention tremor. **Relevance to the Veteran Population.** The successful use of cursor control devices is crucial for each subject to gain functional independence in man-machine interaction.

Peter Feyes

A comparison of regular rehabilitation and regular rehabilitation with supported treadmill ambulation training for acute stroke patients

Inácio Teixeira da Cunha Filho, PT, PhD;
Peter A.C. Lim, MD; Huma Qureshy, PT, MS;
Helene Henson, MD; Trilok Monga, MD;
Elizabeth J. Protas, PT, PhD (*p. 245*)

Purpose of the Work. Compare outcomes after evaluating two forms of walk training with acute stroke survivors. One group received regular therapy with walk training, and the other group received regular therapy with supported treadmill training. **Subjects/Procedures.** Six patients received regular walk training and six patients received walk training on a treadmill while their weight was supported in a harness, for a period of 2 to 3 weeks. **Results.** The treadmill group did more work pedaling on a bike than the group who received regular walk training. **Relevance to the Veteran Population.** Supported walk training was a feasible technique, allowing earlier walking after a stroke. This study suggests that this training is promising for patients who cannot walk after a stroke.

Inácio Teixeira da Cunha Filho, PT, PhD

Vibratory-coded directional analysis: Evaluation of a three-microphone/four-vibrator DSP system

Erik Borg, MD, PhD; Jerker Rönnerberg, PhD;
Lennart Neovius, MSc, Techn. Lic. (*p. 257*)

Purpose of the Work. To develop and evaluate a system that supports detection and localization of sound-emitting events in the surroundings. **Subjects/Procedures.** Deaf and deaf-blind subjects tested a prototype of a technical

aid for sound localization in a specially designed laboratory and in conventional rooms. **Results.** Both the deaf and the deaf-blind subjects rapidly learned the vibratory code used to indicate eight directions. Typically, 80% of events were correctly localized by the deaf and the deaf-blind subjects. The vast majority of the subjects were interested in testing a portable version of the equipment, which could assist environmental control and improve their feeling of security. **Relevance to the Veteran Population.** The combined effect of blindness and deafness on daily life activities is profound, and a technical aid facilitating interaction with events in the environment could certainly improve the subjects' quality of life and increase their feeling of security.

Erik Borg, MD, PhD

A three-microphone system for real-time directional analysis: toward a device for environmental monitoring in deaf-blind

Erik Borg, MD, PhD; Lennart Neovius, MSc, Techn. Lic.;
Magnus Kjellander, MSc (*p. 265*)

Purpose of the Work. To initiate development of a technical aid for immediate localization of sound sources in the proximate environment. The present first phase should lead to a laboratory prototype testable in an acoustic laboratory. **Subjects/Procedures.** A pair of eyeglasses was designed and fitted with three microphones and four vibrators. The three microphone signals were analyzed in real time with digital signal processing. The paired cross-correlation of the three signals is the basis for an automatic decision as to the direction of the sound source. The signals were finally coded to represent one of eight directions and fed to the vibrators. **Results.** Precision of the analysis was within $\pm 10^\circ$, adequate for coding in eight directions. The system was fairly robust in noisy environments with signal-to-noise ratios between 0 and -8 dB for different signals. **Relevance to the Veteran Population.** For subjects with severely deteriorated vision and hearing, problems include not only communication and mobility but also lack of information on events in the environment, which can cause anxiety. An improved ability to monitor ongoing events in the environment is likely to improve quality of life for those with severe multisensory deficits.

Erik Borg, MD, PhD