

# Compendium of Abstracts in Spinal Cord Medicine

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Prepared by the Tri-Association SCI Compendium Workgroup



AMERICAN ASSOCIATION  
OF SPINAL CORD  
INJURY NURSES



AMERICAN ASSOCIATION  
OF SPINAL CORD INJURY  
PSYCHOLOGISTS AND  
SOCIAL WORKERS



AMERICAN  
PARAPLEGIA  
SOCIETY



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## PREFACE

The Compendium Work Group is proud to publish Volume eight of the *Compendium of Abstracts in Spinal Cord Medicine*. The *Compendium* is the result of a major project undertaken by representatives of the American Paraplegia Society (APS), the American Association of Spinal Cord Injury Psychologists and Social Workers (AASCIPSW), and the American Association of Spinal Cord Injury Nurses (AASCIN). It is through their diligence and commitment that the *Compendium* is published as a benefit of Membership in APS, AASCIPSW, and AASCIN.

The current issue spans the period from January to June 2003, and is the result of searching various databases for topics related to spinal cord injury (SCI) and spinal cord disease. The inclusion of an abstract in the *Compendium* is the result of an extensive selection process. The appropriate selection of key words, setting limits on search terms, restricting the total number of abstracts for reviewers to a number that can be handled in a relatively short turn-around time yet at the same time provide a broad-based comprehensive search of abstracts of papers published in peer-reviewed journals are all considered. Not all technical problems incurred through the electronic submission of material to reviewers have been completely resolved, although I am pleased to report significant progress in this effort.

Please feel free to contact me if you have specific recommendations for improving future issues or recommendations for the librarian.

My thanks go to Lesley Jorbin, Research Librarian at Cleveland State University in Cleveland, Ohio, the reviewers who offered their professional expertise, and to United Spinal Association, specifically to Drs. Vivian Beyda and Stephen Sofer for their continued support and encouragement to continue this project.

Barbara Gothe, MD  
Chair Tri-Association  
SCI Compendium Workgroup

The abstracts included in this publication were selected from AgeLine, Applied Social Sciences Index and Abstracts, Cinahl, MEDLINE®, PubMed, PsychINFO®, Social SciSearch®, and Sociological Abstracts, and reprinted without alteration. This publication is for the exclusive use of the members of the American Paraplegia Society (APS), American Association of Spinal Cord Injury Nurses (AASCIN), and American Association of Spinal Cord Injury Psychologists and Social Workers (AASCIPSW). It is not available for commercial use or sale.

# Assistive Technology (Includes Orthotics, Prosthetics, FES, Wheelchairs, Biomedical Engineering)

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**Title:** *Functional electrical stimulation for walking in paraplegia: 17-year follow-up of 2 cases.*

**Author:** Agarwal S; Kobetic R; Nandurkar S; Marsolais EB

**Source:** Journal of Spinal Cord Medicine, Spring 2003, Volume 26, Number 1: 86-91

**Abstract:** **OBJECTIVE:** To assess the safety and effectiveness of long-term use of functional electrical stimulation (FES) for exercise, standing, and walking in individuals with paraplegia, using percutaneous intramuscular wire electrodes.  
**DESIGN:** Case study with more than 17 years of follow-up.  
**SETTING:** Institutional rehabilitation practice.  
**STUDY PARTICIPANTS:** Two long-term (17 years) volunteer participants with paraplegia who were able to stand and walk using FES.  
**INTERVENTION:** Chronically indwelling percutaneous intramuscular wire electrodes connected to a portable microprocessor-controlled stimulator were used to exercise muscles while controlling trunk, hips, knees, and ankles and develop activation patterns to produce standing and walking.  
**MAIN OUTCOME MEASURES:** Clinical complications, electrode performance and survival probability, and functional performance.  
**RESULTS:** The most noted clinical complications included localized inflammation at the electrode site and superficial infection that responded well to topical and oral antibiotic treatment. The change from coil-wire electrodes, with a survival of 35% after 1 year, to double-helix electrodes improved electrode survival to 80% at 1 year and 48% at 5 years. Maintenance of the multichannel percutaneous FES walking system required replacement of an average of 2 electrodes every 6 months. Participants were able to use their system for independent exercise and standing and for walking with standby assistance.  
**CONCLUSION:** Although the FES system was devised as a temporary means of achieving functional activation until permanent means could be achieved, it was found to be effective and relatively safe for more than 17 years. Two long-time users of the system had no adverse effects to their skeletal system. The most common problems were daily care of electrodes at exit sites, frequent irritation of the skin around electrodes, and replacement of failed electrodes. The percutaneous system has the potential for short-term rehabilitation in individuals with incomplete paraplegia or stroke.

**Title:** *Persons with C5 or C6 tetraplegia achieve selected functional gains using a neuroprosthesis.*

**Author:** Alon G; McBride K

**Source:** Archives of Physical Medicine and Rehabilitation, January 2003, Volume 84, Number 1: 119-24

**Abstract:** **OBJECTIVE:** To test the efficacy and safety of the NESS Handmaster neuroprosthesis with subjects with C5 or C6 tetraplegia.  
**DESIGN:** Interventional, nonrandomized case series.  
**SETTING:** Subjects' residence and university research laboratory.  
**PARTICIPANTS:** Men, 3 to 17 years after C5 (n=5) and C6 (n=2) spinal cord injury (SCI).  
**INTERVENTION:** Subjects practiced with the neuroprosthesis daily to regain grasp, hold, and release ability and to restore selected functions of 1 of the 2 paralyzed hands. Subjects were observed 2 to 3 times weekly for 3 weeks.  
**MAIN OUTCOME MEASURES:** Three activities of daily living (ADL) tasks: (1) pick up a telephone, (2) eat food with a fork, and (3) perform 1 individually selected ADL task and 2 grasp, hold, and release tasks (lift a videocassette, lift a 150-g weight). Secondary outcomes were grip strength, electrically induced finger motion, and Fugl-Meyer spherical grasp. Nonparametric data were analyzed with the

Wilcoxon signed-rank test, and parametric data (grip strength and finger motion) were analyzed by analysis of variance. All tests were considered significant at P equal to .01.

RESULTS: At study completion, all 7 subjects were 100% successful at using the Handmaster in the studied ADL and grasp, hold, and release tasks. Significant improvements occurred in grip strength (from 57±9.98N at baseline to 165±44N), finger linear motion (from 0.0cm at baseline to 8.4±3.2cm), and Fugl-Meyer scores. No safety issues were encountered. Six of 7 subjects rated their overall performance as "excellent."

CONCLUSIONS: The Handmaster is a safe, noninvasive neuroprosthesis that improves hand function of selected subjects with C5 or C6 SCI.

Title: ***The effect of locomotor training combined with functional electrical stimulation in chronic spinal cord injured subjects: Walking and reflex studies.***

Author: Barbeau H; Ladouceur M; Mirbagheri M; Kearney R

Source: Brain Research Reviews, October 2002, Special Issue: Principles of Spinal Cord Function, Plasticity and Repair, Volume 40, Numbers 1-3: 274-291

Abstract: Notes that it is necessary to continue to develop new treatment long-term locomotor training with FES in subjects with SCI. Promising results are shown in all outcome measures of walking, such as functional mobility, speed, spatio-temporal parameters, and the physiological cost of walking. Furthermore, the change in the walking behavior could be associated with plasticity in the central nervous system organization, as seen by the modification of the stretch reflex and changes in the corticospinal projection to muscles of the lower leg. In conclusion, recovery of walking is an increasing possibility for a large number of people with SCI. New modalities of treatment have become available for this population but most still need to be evaluated for their efficacy. This review focuses on FES assisted walking as a therapeutic modality in subjects with chronic SCI, but it is envisaged that the care and recovery of SCI in the early phase of recovery could also be improved.

Title: ***Seat and footrest shocks and vibrations in manual wheelchairs with and without suspension.***

Author: Cooper RA; Wolf E; Fitzgerald SG; Boninger ML; Ulerich R; Ammer WA

Source: Archives of Physical Medicine and Rehabilitation, January 2003, Volume 84, Number 1: 96-102

Abstract: OBJECTIVE: To examine differences in the shock and vibration transmitted to an occupant of a manual wheelchair with and without suspension caster forks and with and without rear-suspension systems.

DESIGN: Repeated-measures engineering testing.

SETTING: Rehabilitation engineering center with a wheelchair standards test laboratory.

SPECIMENS: Six manual wheelchairs.

INTERVENTIONS: An American National Standards Institute/Rehabilitation Engineering and Assistive Technology Society of North America wheelchair test dummy and a Hybrid III test dummy were used to test shock and vibration transmission in wheelchairs equipped with original equipment manufacturer (OEM) caster forks and suspension caster forks. Ultralight wheelchairs, half of which had factory-equipped rear-suspension systems, were tested. Testing was conducted on a double-drum wheelchair test machine.

MAIN OUTCOME MEASURES: Shocks were examined by using peak acceleration and the frequency at which peak acceleration occurs for the seat and footrest. Vibration was characterized by the acceleration power per octave for the seat and footrest.

RESULTS: Significant differences were found in the peak accelerations at the seat (P=.0004) and footrest (P=.0007) between the wheelchairs with the OEM caster forks and those with the suspension casters. The wheelchairs with suspension had significantly different frequencies at which the peak accelerations occurred for both the seat (P=.01) and footrest (P=.0001). The wheelchairs with

suspension caster forks had a lower total power per octave than the wheelchairs with the OEM caster forks. For the footrest vibrations, significant differences were found between the types of caster forks for all octaves except those associated with frequencies more than 78.75Hz. There were significant differences for wheelchairs with and without rear suspension for total power per octave of seat vibrations in the octaves between 7.81 and 9.84Hz (P=.01) and 12.40 and 15.63Hz (P=.008). CONCLUSIONS: Suspension caster forks reduce the shock and vibration exposure to the user of a manual wheelchair. Rear-suspension systems reduce some of the factors related to shock and vibration exposure, but they are not clearly superior to traditional designs.

Title: ***Preliminary performance of a surgically implanted neuroprosthesis for standing and transfers —where do we stand?***

Author: Davis JA, Jr; Triolo RJ; Uhlir J; Bieri C; Rohde L; Lissy D; Kukke S

Source: Journal of Rehabilitation Research and Development, November–December 2001, Volume 38, Number 6: 609-17

Abstract: This paper describes the preliminary performance of a surgically implanted neuroprosthesis for standing and transfers after spinal cord injury (SCI) in an initial group of 12 volunteers with longstanding paralysis. The CWRU/VA standing neuroprosthesis consists of an 8-channel implanted receiver-stimulator, epimysial and surgically implanted intramuscular electrodes, and a programmable wearable external controller. After reconditioning exercise and rehabilitation with the system, most individuals with paraplegia or low tetraplegia were able to stand, transfer, and release one hand from a support device to manipulate objects in the environment, or perform swing-to ambulation in a walker. The effort and assistance required for transfers were reduced for users with mid-level tetraplegia, although the maneuvers were not independent. Neuroprosthesis users with tetraplegia and paraplegia alike benefited from the improvements in their general health derived from exercise, including reduced risk of decubiti and self reported modulation of spasticity. Stimulated responses are stable and sufficiently strong for function, and implanted components are reliable with a 90% probability of epimysial electrode survival at four years post-implant. The techniques employed are repeatable and teachable, and suitable for multicenter clinical trial.

Title: ***Standards for wheelchair prescription.***

Author: Di Marco A; Russell M; Masters M

Source: Australian Occupational Therapy Journal, March 2003, Volume 50, Number 1: 30-9

Abstract: Wheelchair prescription for individuals with a spinal cord injury is a highly complex and challenging clinical intervention. Evidence exists that successful outcomes are not always achieved for the wheelchair user and that therapists are experiencing increasing pressure to be accountable for and to justify their wheelchair prescription practice. This paper describes the process of establishing an evaluation of wheelchair prescription practices by occupational therapists in a spinal injury rehabilitation unit in South Australia. The evaluation process centred on the development of standards of practice to monitor performance and led to improvements in: (i) service delivery practices; (ii) wheelchair user participation; and (iii) accountability and justification of service delivery. Steps taken to develop the standards of practice to monitor performance and the benefits and limitations of the evaluation are described.

Title: ***Neural prostheses in the respiratory system.***

Author: DiMarco AF

Source: Journal of Rehabilitation Research and Development, November–December 2001, Volume 38, Number 6: 601-7

Abstract: Approximately 5% of spinal cord-injured individuals suffer from respiratory muscle paralysis and require chronic mechanical ventilation. Unfortunately, this form of life support is associated with a number of undesirable side effects and discomforts. The only available alternative to mechanical ventilation is diaphragm pacing via bilateral phrenic nerve stimulation. This technique can provide patients with marked improvements in life quality and offers significant advantages compared to mechanical ventilation. Many patients, however, do not have bilateral phrenic function, or are not willing to accept the risks inherent with phrenic nerve pacing and therefore are not candidates for this technique. Two alternative methods to ventilate patients with ventilator-dependent tetraplegia are reviewed in this paper. In patients with only a single functional phrenic nerve who are therefore not candidates for phrenic nerve pacing, combined intercostal muscle and unilateral phrenic nerve stimulation has recently been shown to maintain ventilatory support. In patients with bilateral phrenic nerve function, on-going studies suggest that intramuscular diaphragm pacing may be a useful alternative to direct phrenic nerve pacing. By placing the electrodes into the diaphragm laparoscopically, this method allows for the diaphragm to be activated without manipulation of the phrenic nerve, need for thoracotomy, or hospitalization. Both techniques provide benefits similar to that derived from bilateral phrenic nerve pacing and hold promise as alternative methods of ventilatory support in selected populations groups.

Title: ***Improvement in activities of daily living using the Freehand: A system designed for people with tetraplegia.***

Author: Esnouf J; Taylor P; Hobby J

Source: British Journal of Occupational Therapy, March 2003, Volume 66, Number 3: 113-7

Abstract: The Freehand system is an implanted device for people with C5/6 tetraplegia, international classification 0, 1 and 2. The implant is designed to improve hand function, particularly in those who lack voluntary muscles suitable for tendon transfer. This study investigated how the Freehand system was being used at home, work and leisure. Twelve participants, who were assessed, implanted and trained with the Freehand system, were reviewed against their preoperative goals. Prior to surgery, eight activities of daily living goals that the participant would like to perform with the Freehand system were selected by him or her. Each task was assessed in three sections: the set-up of the task, the performance and the take-down. The amount of assistance for each section was recorded. This was repeated after training had been completed and daily use established. Each participant was also asked to state a preference on how the tasks would be completed, whether with the system or by the method prior to surgery. The results of this study show an improvement in the participants' functional ability in their selected goals when using the Freehand system. The preference for using the Freehand system to complete tasks applied to 84% of the total 96 tasks chosen by the 12 participants in this study.

Title: ***Assistive technology education needs of allied health professionals in a rural tate.***

Author: Gitlow L; Sanford T

Source: Allied Health, Spring 2003, Volume 32, Number 1: 46-51

Abstract: A nonexperimental design using a mailed questionnaire was used to answer five questions regarding allied health practitioners: What (1) present skills, (2) knowledge and (3) assistive technology (AT) competence do allied health practitioners have; what are (4) the AT skills and knowledge that allied health practitioners would like to obtain; and (5) how would these practitioners like to have AT education provided. More than two thirds of the subjects reported having nonexistent or foundational knowledge in most of the AT areas. Additionally, more than 50% of the respondents had a moderate or significant need for information in most areas of AT. No clear preferences regarding training options were revealed, other than a traditional classroom approach being the least attractive option. Most respondents are not willing to travel more than 1 hour from their home for AT education. This study revealed useful information for developing the content and format of AT education for allied health practitioners in Maine. We will expand this pilot study to investigate the AT educational needs of a wider variety of practitioners and consumers.

Title: ***Emerging clinical applications of electrical stimulation: Opportunities for restoration of function.***

Author: Grill WM; Craggs MD; Foreman RD; Ludlow CL; Buller JL

Source: Journal of Rehabilitation Research and Development, 2001, Volume 38: 641-53

Abstract: Emerging clinical application of electrical stimulation in three systems is reviewed. In the bladder, stimulation of sacral posterior roots reduces reflex incontinence and significantly improves bladder capacity. By combining anterior and posterior root stimulation, bladder control can be achieved without the need for rhizotomy. Preliminary research demonstrates that bladder contractions may also be generated by stimulation of the urethral sensory branch of the pudendal nerve, even after acute spinal cord transection, while inhibition of the bladder and control of urge incontinence can be achieved by stimulation of the whole pudendal nerve. Spinal cord stimulation can modulate the activity of the intrinsic cardiac nervous system involved in the regulation of regional cardiac function and significantly reduce the pain associated with angina pectoris. Finally in the area of upper airway disorders, functional electrical stimulation has great potential for increasing life support as well as quality of life in chronic ailments, particularly obstructive sleep apnea and dysphagia.

Title: ***At the interface: Convergence of neural regeneration and neural prostheses for restoration of function.***

Author: Grill WM; McDonald JW; Peckham PH; Heetderks W; Kocsis J; Weinrich M

Source: Journal of Rehabilitation Research and Development, 2001, Volume 38: 633-9

Abstract: The rapid pace of recent advances in development and application of electrical stimulation of the nervous system and in neural regeneration has created opportunities to combine these two approaches to restoration of function. This manuscript relates the discussion on this topic from a workshop at the International Functional Electrical Stimulation Society. The goals of this workshop were to discuss the current state of interaction between the fields of neural regeneration and neural prostheses and to identify potential areas of future research that would have the greatest impact on achieving the common goal of restoring function after neurological damage. Identified areas include enhancement of axonal regeneration with applied electric fields, development of hybrid neural interfaces combining synthetic silicon and biologically derived elements, and investigation of the role

of patterned neural activity in regulating various neuronal processes and neurorehabilitation. Increased communication and cooperation between the two communities, and recognition by each field that the other has something to contribute to their efforts are needed to take advantage of these opportunities. In addition, creative grants combining the two approaches and more flexible funding mechanisms to support the convergence of their perspectives are necessary to achieve common objectives.

Title: ***Wheelchair configuration and postural alignment in persons with spinal cord injury.***

Author: Hastings JD; Fanucchi ER; Burns SP

Source: Archives of Physical Medicine and Rehabilitation, April 2003, Volume 84, Number 4: 528-34

Abstract: OBJECTIVE: To determine whether postural alignment and shoulder flexion range differ for persons with spinal cord injury (SCI) seated in wheelchairs with standard configurations versus wheelchairs with posterior seat inclination and a low backrest set perpendicular to the floor.  
DESIGN: Prospective repeated-measures study.  
SETTING: Outpatient SCI clinic.  
PARTICIPANTS: Fourteen subjects with C6-T10 motor-complete SCI.  
INTERVENTIONS: Subjects sat in 3 manual wheelchairs: standard setup E&J Premier (S1), standard setup Quickie Breezy (S2), and test configuration Quickie TNT (T) with posterior seat inclination and a low backrest set perpendicular to the floor.  
MAIN OUTCOME MEASURES: Shoulder and neck alignment and pelvic tilt were determined from sagittal plane digital photographs at rest and with maximal vertical reach.  
RESULTS: At rest, T produced less shoulder protraction than either standard configuration (difference between the mean values, S1: 1.6 cm, P=.048; S2: 1.2 cm, P=.013). S1 and S2 showed a greater head-forward position than T (differences between the mean values, S1: 6.5 degrees, P=.008; S2: 6.3 degrees, P=.013). T allowed greater humeral flexion than S2 (difference between the mean values: 3.7 degrees, P=.036) and greater vertical reach above the seat plane than either conventional configuration (differences between the mean values, S1: 4.7 cm, P=.005; S2: 4.1cm, P=.002). The indirect pelvic tilt measurement showed a trend (P=.06) toward greater posterior pelvic tilt with S1 and S2.  
CONCLUSION: The alternate configuration produces more vertical postural alignment and greater reach ability versus the standard factory setup wheelchairs.

Title: ***Neuroprosthesis consumers' forum: Consumer priorities for research directions.***

Author: Kilgore KL; Scherer M; Bobblitt R; Dettloff J; Dombrowski DM; Godbold N; Jatich JW; Morris R; Penko JS; Schremp ES; Cash LA

Source: Journal of Rehabilitation Research and Development, 2001, Volume 38: 655-60

Abstract: The purpose of this forum was to discuss with consumers having spinal cord injury what their research priorities would be for the field of functional electrical stimulation and to explore the impact of technology in the lives of people with disabilities. Both functional electrical stimulation (FES) users and non-users were included on the panel. The format for the discussion was primarily question and answer, with each participant giving his or her personal response to the moderator's question. Consumer research priorities depended on the individual, and his or her personal priorities, preferences, background, history, and level of injury. Common themes that emerged were independence, ease of movement, ease of control, and spontaneity. From the consumers' perspective, the focus of research to restore function ought to be based on the needs and desires of the consumer, not just on the scientifically intriguing aspects of a particular technology.

Title: ***Wheelchair skills tests: A systematic review.***

Author: Kilkens OJ; Post MW; Dallmeijer AJ; Seelen HA; van der Woude LH

Source: Clinical Rehabilitation, July 2003, Volume 17, Number 4: 418-30

Abstract: OBJECTIVE: To describe and compare the content, feasibility, outcome parameters, and clinimetric properties of the manual wheelchair skills tests reported in the literature.  
DESIGN: A systematic literature search was conducted in MEDLINE, EMBASE, PsychINFO and Current Contents. Tests were selected if they were observational tests, designed for subjects using hand-rim wheelchairs and were intended to assess wheelchair skill performance at the activity level.  
RESULTS: The search resulted in 34 papers, in which 24 different wheelchair skills tests were described. The skill most frequently included was wheelchair propulsion, consecutively followed by transferring, negotiating kerbs, ascending slopes, traversing tracks, sprinting and performing a wheelie. The three most frequently used outcome parameters were task performance time, independency of task performance, and physical strain during skill performance. Sensitivity to change was evaluated in three tests, validity in 10 tests, and reliability in nine tests.  
CONCLUSIONS: Many tests are applied to measure wheelchair skill performance using different tasks and outcome measures. This makes it difficult to compare study results. Consensus among researchers as to which skills must be included as well as to standardization of the use of measurement instruments will reduce this problem and will additionally lead to a better insight in the quality of tests.

Title: ***Model-based development of neuroprostheses for restoring proximal arm function.***

Author: Kirsch RF; Acosta AM; van der Helm FCT; Rotteveel RJJ; Cash LA

Source: Journal of Rehabilitation Research and Development, 2001, Volume 38: 619-26

Abstract: Neuroprostheses using functional neuromuscular stimulation (FNS) have the potential to restore elbow and shoulder function lost to paralysis due to spinal cord injury (SCI). The human shoulder is highly flexible and thus provides a large range of motion to the arm and hand, although at the expense of precarious stability of the articulations. The complexity of the shoulder has prevented widespread use of FNS at this joint. However, musculoskeletal modeling of the elbow and shoulder has the potential to significantly speed the development of neuroprostheses by allowing many mechanical issues to be resolved in simulation prior to implementation in human subjects. This paper describes our rationale for the use of musculoskeletal modeling, the model we are using, and several practical applications of the model to study the potential use of shoulder and elbow muscle FNS to restore function following cervical SCI.

Title: ***Treadmill walking in incomplete spinal-cord-injured subjects: 1. Adaptation to changes in speed.***

Author: Pepin A; Norman KE; Barbeau H

Source: Spinal Cord, May 2003, Volume 41, Number 5: 257-70

Abstract: Walking in spinal-cord-injured (SCI) subjects is usually achieved at a lower speed than in normal subjects.  
STUDY DESIGN/METHODS: Time and distance parameters, angular displacements of lower limbs and electromyographic (EMG) activity were measured for seven normal and seven SCI subjects at several walking speeds. Analyses of variance were used for comparing groups and speeds.  
OBJECTIVES: First, to measure the adaptability of SCI subjects' walking pattern to different speeds (0.1-1.0 m/s), and to compare it to that of normal subjects. Second, to characterize SCI subjects'

walking pattern as compared to that of normal subjects at a matched treadmill speed (0.3 m/s).  
SETTING: University-Based Human Gait Laboratory, Montreal, Canada.  
RESULTS: SCI subjects' pattern adapted to a limited range of speeds. Longer cycle duration, flexed knee at foot contact, increased hip joint flexion at foot contact and during swing, and altered coordination of hip and knee joints were found for the SCI group. At all speeds, duration of muscle activity was longer in the SCI group and the increase in amplitude of soleus EMG activity at higher speeds was not specific to push-off. The importance of matching the walking speed of SCI and normal subjects in order to differentiate the features that are a consequence of SCI subjects' reduced walking speed rather than a direct consequence of the injury is demonstrated.  
CONCLUSIONS: All SCI subjects could adapt to a narrow range of speeds and only three could reach the maximal tested speed. This limited maximal speed seems to be a consequence of SCI subjects having reached their limit in increasing stride length and not being able to increase stride frequency further. This limitation in increasing stride frequency is likely because of the altered neural drive.

Title: ***Treadmill walking in incomplete spinal-cord-injured subjects: 2. Factors limiting the maximal speed.***

Author: Pepin A; Ladouceur M; Barbeau H

Source: Spinal Cord, May 2003, Volume 41, Number 5: 271-9

Abstract: STUDY DESIGN/METHODS: Five SCI subjects referred to the laboratory and a convenience sample of five normal volunteer individuals was selected. Stride length and frequency were measured at different walking speeds under three different conditions: preferred, highest possible and lowest possible stepping frequencies.  
OBJECTIVE: To determine which factors are limiting the maximal walking speed in spinal-cord-injured (SCI) individuals.  
SETTING: University-Based Human Gait Laboratory, Montreal, Canada.  
RESULTS: It is shown that maximal stride frequency was the predominant limiting factor of the maximal treadmill-walking speed in SCI subjects. These results were explained in the light of the forced hybrid mass-spring pendulum model. At all speeds, SCI subjects spent longer time in stance, swing and double support phases. The relative time spent in single support is greater at higher walking speed and the difficulty to reduce double support time is a limiting factor.  
CONCLUSIONS: A better understanding of the factors limiting the maximal speed in SCI subjects should help developing rehabilitation interventions oriented towards increasing the control and the capacity of walking. Rehabilitation strategies should put the emphasis on improving the capacity to produce rapid alternate rhythmical stepping movements of the lower limbs.

Title: ***New algorithm to control a cycle ergometer using electrical stimulation.***

Author: Petrofsky JS

Source: Medical and Biological Engineering and Computing, January 2003, Volume 41, Number 1: 18-27

Abstract: Data were collected from four male subjects to determine the relationships between load, speed and muscle use during cycle ergometry. These data were then used to construct equations to govern the stimulation of muscle in paralysed individuals, during cycle ergometry induced by functional electrical stimulation (FES) of the quadriceps, gluteus maximus and hamstring muscles. The algorithm was tested on four subjects who were paralysed owing to a complete spinal cord injury between T4 and T11. Using the multivariate equation, the control of movement was improved, and

work was accomplished that was double (2940 Nm min<sup>-1</sup>) compared with 5880 Nm min<sup>-1</sup>) that of traditional FES cycle ergometry, when muscle stimulation was also controlled by electrical stimulation. Stress on the body, assessed by cardiac output, was increased almost two-fold during maximum work with the new algorithm (81 min<sup>-1</sup>) compared with 15 l min<sup>-1</sup>) with the new algorithm). These data support the concept that the limitation to workload that a person can achieve on FES cycle ergometry is in the control equations and not in the paralysed muscle.

Title: ***Impact of wheeled seated mobility devices on adult users' and their caregivers' occupational performance: A critical literature review.***

Author: Reid D; Laliberte-Rudman D; Hebert D

Source: Canadian Journal of Occupational Therapy, 2002, Volume 69: 261-80

Abstract: The prescription of wheeled seated mobility devices for clients with mobility impairment is a growing area in occupational therapy practice. The goal is to enhance client participation in occupation through technical intervention. This critical review examines the body of knowledge concerning the impact and effectiveness of the provision of wheeled seated mobility on the occupational performance of wheelchair users and their caregivers. The scope and gaps in the literature are defined to identify areas for future research. While the focus is on the methodological issues of the research reports, the relevance of findings to occupational therapy practice will also be reviewed. The results of the 46 studies in this review indicate that the majority of research conducted thus far have methodological limitations, which limits the extent to which this body of research can be drawn upon to provide evidence for the effectiveness of wheeled mobility systems. While most of the studies reviewed addressed constructs of relevance to occupational therapy practice, there was an emphasis on performance components and inadequate attention to engagement in occupations. This review is an important first step in building the ability of occupational therapists to demonstrate effectiveness in wheeled seating interventions.

Title: ***Onset of electrical stimulation leg cycling in individuals with paraplegia.***

Author: Raymond J; Schoneveld K; Van Kemenade CH; Davis GM

Source: Medicine and Science in Sports and Exercise, October 2002, Volume 34, Number 10: 1557-62

Abstract: PURPOSE: This study investigated cardiovascular and hemodynamic responses during the transition from rest to electrical stimulation-induced leg cycling exercise (ES-LCE) in individuals with chronic paraplegia (PARA).  
METHODS: Ten PARA (T(4)-T(9); ASIA A) participated in this study. Heart rate (HR), mean arterial pressure (MAP), stroke volume (SV), and cardiac output (Q) were measured on a beat-to-beat basis at rest and during the first 60 s of ES-LCE.  
RESULTS: PARA exhibited two discrete MAP responses during ES-LCE. Those with high thoracic lesions (HIGH: T(4) -T(6), = 5) responded to ES-LCE with a significant rise in MAP (maxdelta 8.3 +/- 3.6 mm Hg), whereas MAP did not exhibit any sustained change from resting values during ES-LCE in those subjects with lower lesions (LOW: T -T, = 5). In HIGH PARA, the immediate increase in MAP corresponded to a decrease in HR (maxdelta 6.8 +/- 3.1 b x min<sup>-1</sup>), which returned toward resting levels by the end of 60 s. In contrast, for LOW PARA there was no change in HR from resting levels during transition to ES-LCE. In both subgroups, SV and Q were not significantly increased during ES-LCE.  
CONCLUSION: These results suggest that the on-transient responses of MAP during ES-LCE in HIGH PARA elicited reflex changes in HR via the arterial baroreflex, whereas in LOW PARA, an unchanged HR from rest was likely due to a constant MAP during ES-LCE.

Title: ***Assistive technology: Providing independence for individuals with disabilities.***

Author: Berry BE; Ignash S

Source: Rehabilitation Nursing, January–February 2003, Volume 28, Number 1: 6-14

Abstract: Despite improvements in technology and health care, the number of people with disabilities, and the complexity of needs that they and their families experience, continue to increase. In response to these needs, specialized technology has been developed that helps people with disabilities to become more independent and more involved in the activities in their homes, schools, and communities. However, many individuals with disabilities, their family members, and many rehabilitation service providers are not aware of the availability, use of, and benefits afforded by assistive technology devices. Further, many providers have not received the pre-service academic preparation required to provide services and support to their clients. Preparation includes acquiring the knowledge and skills needed for evaluation of client needs, making appropriate assistive technology recommendations, and developing advocacy skills such as writing letters of necessity that justify funding for assistive technology devices. This article provides information about these issues and suggests that further information is available through continuing education courses as well as articles in the reference list and other sources cited in the accompanying tables.

Title: ***Matching person & technology (MPT) assessment process.***

Author: Scherer MJ; Craddock G

Source: Technology and Disability, 2002, Volume 14, Number 3: 125-31

Abstract: The Matching Person & Technology (MPT) assessment process is a set of person-centered measures, all of which examine the self-reported perspectives of adult consumers regarding strengths/capabilities, needs/goals, preferences and psychosocial characteristics, and expected technology benefit. There are separate measures for general, assistive, educational, workplace, and healthcare technology use; in Ireland, the measures were used to assess outcomes of assistive technology (AT) provision for (a) people throughout the country participating in a new localized AT service delivery process and (b) students transitioning from secondary education. There are companion provider forms so that consumer-provider shared perspectives can be assessed and to ensure that the matching process is a collaborative one; the Irish version assumes collaboration from the start. Each measure can be used when evaluating a person for technology use and as person-centered, ideographic, outcomes measure. The measures have been determined to have good reliability and validity.

Title: ***Expectations of wheelchair-dependency in recently diagnosed patients with multiple sclerosis and their partners.***

Author: Janssens AC; de Boer JB; van Doorn PA; van ver Ploeg HM; van ver Meche FG; Passchier J; Hintzen RQ

Source: European Journal of Neurology, May 2003, Volume 10, Number 3: 287-93

Abstract: The aim of the present paper was to quantify expectations of wheelchair-dependency in patients recently diagnosed with MS (n = 101) and their partners (n = 78). Expectations focused on the risk and seriousness of becoming wheelchair-dependent in 2 years, 10 years or lifetime. Expectations were compared with natural history data, compared between patients and their partners, and related to clinical characteristics. Our results show that patients overestimated their 2-year and 10-year risks of wheelchair-dependency, but underestimated their lifetime risks. A large number of patients were uncertain about their 2-year risk, even those with no or only minimal disability [Expanded Disability Status Scale (EDSS) <3.0]. One-third of the patients perceived the 10-year and lifetime risk to be 50%, which, as they explained in the interviews, reflected their uncertainty: they did not know what to expect - it might happen or not. Patients with more functional limitations had higher perceptions of risk, but lower perceptions of seriousness. Concordance in perceived risk and seriousness between patients and partners was moderate. The overestimation of the short-term risks and the substantial differences in expectations within couples warrant further research on the impact of expectations on their treatment decisions and psychological well-being.

Title: ***Barriers, facilitators, and access for wheelchair users: Substantive and methodologic lessons from a pilot study of environmental effects.***

Author: Meyers AR; Anderson JJ; Miller DR; Shipp K; Hoenig H

Source: Social Science and Medicine, October 2002, Volume 55, Number 8: 1435-46

Abstract: We undertook a month-long intensive pilot study of a sample of adult wheelchair-users in Boston, Massachusetts and Durham, North Carolina, USA. The study had four objectives; to: (1) measure experiences of reaching and failing to reach specific destinations; (2) measure encounters with environmental facilitators and barriers, including both those overcome and not overcome; (3) determine the frequencies of destinations, facilitators, and barriers, and (4) test for consistency between daily reports and retrospective reports. Full participation entailed baseline and exit telephone interviews, and 28 daily telephone contacts. Participants reported reaching a wide range of destinations, most notably, banks, stores and shops, friends' and relatives' homes and health professionals' offices. There was a smaller range of destinations that they could not reach, despite trying; most notably, religious buildings, friends' and relatives' homes and work-places. They encountered an array of barriers, some of which they were able to overcome and others they could not overcome. Reported barriers included personal, interpersonal, and environmental barriers. The 25 subjects completing the study reported a wide range of human, environmental, and technologic support. In general, the consistency among daily, baseline, and exit interviews was high. This study has both substantive and methodologic implications. It suggests that efforts to facilitate social participation by wheelchair-users should focus not only on the built environment, but also on interventions in personal assistance and assistive technology, health promotion and fitness, and programs that improve civility. Methodologically, the data suggest that it is possible to make reliable measures of environmental encounters without the administrative and respondent burden associated with daily interviews.

Title: ***Measurement reliability of functional tasks for persons who self-propel a manual wheelchair.***

Author: May LA; Butt C; Minor L; Kolbinson K; Tulloch K

Source: Archives of Physical Medicine and Rehabilitation, April 2003, Volume 84, Number 4: 578-83

Abstract: OBJECTIVE: To evaluate the reliability of 4 functional tasks relevant to wheelchair seating.  
DESIGN: Within-subject and between-rater comparisons.  
SETTING: Rehabilitation center in Canada.  
PARTICIPANTS: Two separate convenience samples of 10 male wheelchair users.  
INTERVENTIONS: Not applicable.  
MAIN OUTCOME MEASURES: The 4 functional tasks were timed forward wheeling, ramp ascent, forward vertical reach distance, and ramp descent, scored by an ordinal performance scale. To determine test-retest reliability, the participants performed each task twice on the same day. To determine interrater reliability, 5 experienced therapists independently scored each participant. The ramp descent task was replaced with a 1-stroke push distance task due to difficulties with the interpretation of the ordinal performance scale.  
RESULTS: Testing of all tasks was completed within 45 minutes, allowing for rest periods. There were no adverse incidents. One individual with C6 quadriplegia 4 months after spinal cord injury was unable to complete the ramp ascent. Estimates for test-retest reliability of all 4 functional tasks were excellent ( $r=.99$ ). Interrater reliability was calculated for all tasks except the 1-stroke push and found to be excellent (intraclass correlation coefficient $=.99$ ).  
CONCLUSIONS: The final 4 functional tasks are practical, safe, and reliable tests that may be used for clinical evaluation of wheelchair seating. Further research involving comparative assessments of wheelchair seating options is required to determine the discriminative ability of the tests.

## Basic Science (Includes Animal Studies, Molecular Biology, Regeneration, Immunology)

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**Title:** *Induced adaptive resistance to oxidative stress in the CNS: A discussion on possible mechanisms and their therapeutic potential.*

**Author:** Bishop A; Cashman NR

**Source:** Current Drug Metabolism, April 2003, Volume 4, Number 2: 171-84

**Abstract:** The free radical, nitric oxide (NO), is synthesized by mammalian cells and is utilized for normal cellular functions. High levels of NO are released during disease, injury and inflammation. NO at high concentrations more readily combines with other oxidants to form reactive nitrogenous species (RNS), which can wreak havoc on the cell by damaging a variety of cellular targets, such as DNA and proteins, ultimately leading to apoptosis, mutagenesis or carcinogenesis. Cells have natural resistance mechanisms to nitrooxidative stress that are either defective (as can occur in disease), or overwhelmed (as can occur in injury and inflammation). It has been found recently in the CNS that resistance to normally toxic levels of NO can be induced by nontoxic levels of NO and that this induction is correlated with and dependent upon increased levels and activity of the heme-metabolizing enzyme, heme oxygenase-1 (HO-1). HO1-mediated metabolism of heme groups released from NO-damaged proteins leads to a change in the levels of redox-active iron and a release of carbon monoxide (CO) and bilirubin, all of which have been implicated in cellular resistance to oxidative stress. Perhaps one or more of the products of HO1 heme metabolism is involved in induced adaptive resistance or perhaps a heme-independent mechanism is involved. In fact, a variety of possible mechanisms may be involved in induced resistance to NO in the CNS. Ultimately elucidating these mechanisms will enable us to modulate them for therapeutic potential.

**Title:** *Repair of spinal cord injuries: Where are we, where are we going?*

**Author:** Fawcett J

**Source:** Spinal Cord, 2002, Volume 40: 615-23

**Abstract:** Repairing the spinal cord has for a long time been a 'holy grail' for neuroscientists. No achievement in neuroscience is more difficult to achieve, and none would have the same impact amongst the medical profession and the public. Yet no patient has yet benefited from a regeneration therapy. At last sufficient progress has been made in the basic science of axon regeneration that treatments that would partially repair a spinal injury are imminent. A full repair of spinal injury still remains elusive. This review summarises progress to date, and suggests ways in which progress towards treatment of spinal injury patients might be made.

**Title:** *Cell transplantation of peripheral-myelin-forming cells to repair the injured spinal cord.*

**Author:** Kocsis JD; Akiyama Y; Lankford KL; Radtke C

**Source:** Journal of Rehabilitation Research and Development, 2002, Volume 39: 287-98

**Abstract:** Much excitement has been generated by recent work showing that a variety of myelin-forming cell types can elicit remyelination and facilitate axonal regeneration in animal models of demyelination and axonal transection. These cells include peripheral-myelin-forming cells, such as Schwann cells and olfactory ensheathing cells. In addition, progenitor cells derived from the subventricular zone of the brain and from bone marrow (BM) can form myelin when transplanted into demyelinated lesions

in rodents. Here, we discuss recent findings that examine the remyelination potential of transplantation of peripheral-myelin-forming cells and progenitor cells derived from brain and bone marrow. Better understanding of the repair potential of these cells in animal models may offer exciting opportunities to develop cells that may be used in future clinical studies.

Title: ***Transplantation of olfactory ensheathing cells into spinal cord lesions restores breathing and climbing.***

Author: Li Y; Decherchi P; Raisman G

Source: Journal of Neuroscience, February 2003, Volume 23, Number 3: 727-31

Abstract: One of the most devastating effects of damage to the upper spinal cord is the loss of the ability to breathe; patients suffering these injuries can be kept alive only with assisted ventilation. No known method for repairing these injuries exists. We report here the return of supraspinal control of breathing and major improvements in climbing after the application of a novel endogenous matrix transfer method. This method permits efficient transfer and retention of cultured adult rat olfactory ensheathing cells when transplanted into large lesions that destroy all tracts on one side at the upper cervical level of the adult rat spinal cord. This demonstrates that transplantation can produce simultaneous repair of two independent spinal functions.

Title: ***Manipulating neuroinflammatory reactions in the injured spinal cord: Back to basics.***

Author: Popovich PG; Jones TB

Source: Trends in Pharmacological Sciences, January 2003, Volume 24, Number 1: 13-17

Abstract: Recruitment of inflammatory leukocytes to the injured spinal cord is a physiological response that is associated with the production of cytokines and proteinases that are involved in host defense and wound repair. Cells in the spinal cord are mainly post-mitotic and tissue regeneration is poor; thus, these inflammatory mediators can exacerbate the damage to spared tissue and thereby impair spontaneous functional recovery. Although several aspects of immune function might benefit the CNS, experimental studies indicate that acute neuroinflammation aggravates tissue injury. Until the timing and nature of the molecular signals that govern leukocyte recruitment and activation after spinal injury are defined, clinical therapies designed to boost immune cell function should be avoided.

Title: ***Increases in the phosphorylation of cyclic AMP response element binding protein (CREB) and decreases in the content of calcineurin accompany thermal hyperalgesia following chronic constriction injury in rats.***

Author: Miletic G; Pankratz MT; Miletic V

Source: Pain, 2002, Volume 99, Number 3: 493-500

Abstract: Plasticity in the spinal dorsal horn may underlie the development of chronic pain following peripheral nerve injury or inflammation. In this study, we examined whether chronic constriction injury (CCI) of the sciatic nerve was associated with changes in the immunoreactive content of cyclic AMP response element binding protein (CREB), protein kinase A (PKA), and calcineurin Aalpha and Abeta in the spinal dorsal horn. Male rats were examined 7 and 28 days after surgery (loose ligation of the sciatic nerve, or CCI); those animals exhibiting thermal hyperalgesia as a behavioral sign of neuropathic pain were evaluated as to the content of phosphorylated (activated) CREB (pCREB),

calcineurin Aalpha and Abeta, and non-phosphorylated PKA. Differences were noted between control and sciatic ligation animals 7 and 28 days after surgery. The data establish a close association in the expression of thermal hyperalgesia with CREB activation and decreased calcineurin content in the spinal dorsal horn. The data reveal a significant but reversible shift in the manner in which spinal neurons processed sensory information following peripheral nerve injury, and lend further support to the notion that plasticity in the spinal dorsal horn may have contributed to the development of chronic pain.

Title: ***Ependymal cell reactions in spinal cord segments after compression injury in adult rat.***

Author: Takahashi M; Arai Y; Kurosawa H; Sueyoshi N; Shirai S

Source: Journal of Neuropathology and Experimental Neurology, February 2003, Volume 62, Number 2: 185-94

Abstract: Recently, it has been suggested that neural stem cells and neural progenitor cells exist in the ependyma that forms the central canal of the spinal cord. In this study, we produced various degrees of thoracic cord injury in adult rats using an NYU-weight-drop device, assessed the degree of recovery of lower limb motor function based on a locomotor rating scale, and analyzed the kinetics of ependymal cell proliferation and differentiation by proliferating cell nuclear antigen (PCNA), nestin, glial fibrillary acidic protein (GFAP), or GAP-43 immunostaining. The results showed that the time course of the ependymal cell proliferation and differentiation reactions differed according to the severity of injury, and that the responses occurred not only in the neighborhood of the injury but in the entire spinal cord. An increase in the locomotor rating score was related to an increase in the number of PCNA-positive cells, and the differentiation of ependymal cells into reactive astrocytes was involved in injury repair. No apoptotic cells in the ependyma were detectable by the TUNEL method. These results indicate that the ependymal cells of the spinal central canal are themselves multipotent, can divide and proliferate according to the severity of injury, and differentiate into reactive astrocytes within the ependyma without undergoing apoptosis or cell death.

## Clinical Research (Case Studies; Drug Studies; Clinical Physiology, Including Neurophysiology and Exercise Physiology)

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**Title:** *Chordoma: Natural history and results in 28 patients treated at a single institution.*

**Author:** Baratti D; Gronchi A; Pennacchioli E; Lozza L; Colecchia M; Fiore M; Santinami M

**Source:** Annals of Surgical Oncology: The Official Journal of the Society of Surgical Oncology, April 2003, Volume 10, Number 3: 291-6

**Abstract:** **BACKGROUND:** The natural history of chordoma is characterized by a high failure rate and a poor functional outcome. The purpose of this study was to review the long-term outcome of our institutional experience.  
**METHODS:** The clinical features, type of treatment, pathologic assessment, and follow-up of 56 consecutive patients with chordoma were reviewed.  
**RESULTS:** Fifty sacral and six mobile spine chordomas (median size, 13 cm; range, 2-30 cm) were treated at our center between January 1933 and December 2000. Twenty-eight patients affected by sacrococcygeal chordoma and operated on after 1977 form the basis of our study. Surgical margins were rated as wide in 11 cases, marginal in 13 cases, and intralesional in 4 cases. The median follow-up was 71 months (range, 15-200 months). Seventeen patients' disease recurred. Ten patients died as a result of disease. Nine patients remained continuously free of disease. The estimated 5- and 10-year overall survival was, respectively, 87.8% and 48.9%; disease-free survival was 60.6% and 24.2%. Radiotherapy was considered for marginal and intralesional resections.  
**CONCLUSIONS:** High sacral amputation can achieve a good rate of wide-margin resections for sacrococcygeal chordomas. Adjuvant radiotherapy may offset the negative effect in the prognosis of marginal resections.

**Title:** *Aerophagia as a cause of ineffective phrenic nerve pacing in high tetraplegia: A case report.*

**Author:** Colachis SC; Kadyan V

**Source:** Archives of Physical Medicine and Rehabilitation, May 2003, Volume 84, Number 5: 768-9

**Abstract:** We report an unusual case of aerophagia after traumatic spinal cord injury (SCI), which shows the profound effects of abdominal distension on respiratory ability in such individuals. In this case, abdominal distension resulting from aerophagia reduced the effectiveness of phrenic nerve pacing on diaphragm function necessitating greater use of positive-pressure ventilatory (PPV) support. Reduction of postprandial gastric air and abdominal distension with insertion of a percutaneous endoscopic gastrostomy tube ameliorated the condition and allowed for more effective phrenic nerve pacing and greater PPV-free breathing. We are unaware of a similar case involving an individual with an SCI.

Title: ***Functional reorganization and stability of somatosensory-motor cortical topography in a tetraplegic subject with late recovery.***

Author: Corbetta M; Burton H; Sinclair RJ; Conturo TE; Akbudak E; McDonald JW

Source: Proceedings of the National Academy of Sciences of the United States of America, December 2002, Volume 99, Number 26: 17066-71

Abstract: The functional organization of somatosensory and motor cortex was investigated in an individual with a high cervical spinal cord injury, a 5-year absence of nearly all sensorymotor function at and below the shoulders, and rare recovery of some function in years 6-8 after intense and sustained rehabilitation therapies. We used functional magnetic resonance imaging to study brain activity to vibratory stimulation and voluntary movements of body parts above and below the lesion. No response to vibratory stimulation of the hand was observed in the primary somatosensory cortex (SI) hand area, which was conversely recruited during tongue movements that normally evoke responses only in the more lateral face area. This result suggests SI reorganization analogous to previously reported neuroplasticity changes after peripheral lesions in animals and humans. In striking contradistinction, vibratory stimulation of the foot evoked topographically appropriate responses in SI and second somatosensory cortex (SII). Motor cortex responses, tied to a visuomotor tracking task, displayed a near-typical topography, although they were more widespread in premotor regions. These findings suggest possible preservation of motor and some somatosensory cortical representations in the absence of overt movements or conscious sensations for several years after spinal cord injury and have implications for future rehabilitation and neural-repair therapies.

Title: ***Cardiovascular control during exercise: Insights from spinal cord-injured humans.***

Author: Dela F; Mohr T; Jensen CM; Haahr HL; Secher NH; Biering-Sorensen F; Kjaer M

Source: Circulation, April 2003, Volume 107, Number 16: 2127-33. Epub April 14, 2003.

Abstract: BACKGROUND: We studied the role of the central nervous system, neural feedback from contracting skeletal muscles, and sympathetic activity to the heart in the control of heart rate and blood pressure during 2 levels of dynamic exercise.

METHODS AND RESULTS: Spinal cord-injured individuals (SCI) with (paraplegia, n=4) or without (tetraplegia, n=6) sympathetic innervation to the heart performed electrically induced exercise. Responses were compared with those established by able-bodied individuals (control, n=6) performing voluntary exercise at a similar pulmonary oxygen uptake. In all subjects, cardiac output and leg blood flow increased, but in SCI they reached a maximal value. The increase in cardiac output was mainly elicited by an increase in stroke volume in individuals with tetraplegia, whereas in individuals with paraplegia it was by heart rate. The increase in SCI was slow compared with that in controls. During exercise, blood pressure was stable in controls, whereas it decreased over time in SCI and especially in individuals with tetraplegia.

CONCLUSIONS: The autonomic nervous system provides for acceleration of the heart at the onset of exercise, but a slow increase in heart rate is established even without central command, neural feedback from working muscles, or autonomic influence on the heart. Yet an intact autonomic nervous system is a prerequisite for a large rise in cardiac output and in turn leg blood flow during exercise. Thus, when the sympathetic nervous system is injured at a level where it influences the heart, vasodilatation in working muscles challenges blood pressure.

Title: ***Locomotor activity in spinal man: Significance of afferent input from joint and load receptors.***

Author: Dietz V; Muller R; Colombo G

Source: Brain, 2002: 2626-34

Abstract: The aim of this study was to differentiate the effects of body load and joint movements on the leg muscle activation pattern during assisted locomotion in spinal man. Stepping movements were induced by a driven gait orthosis (DGO) on a treadmill in patients with complete para-/tetraplegia and, for comparison, in healthy subjects. All subjects were unloaded by 70% of their body weight. EMG of upper and lower leg muscles and joint movements of the DGO of both legs were recorded. In the patients, normal stepping movements and those mainly restricted to the hips (blocked knees) were associated with a pattern of leg muscle EMG activity that corresponded to that of the healthy subjects, but the amplitude was smaller. Locomotor movements restricted to imposed ankle joint movements were followed by no, or only focal EMG responses in the stretched muscles. Unilateral locomotion in the patients was associated with a normal pattern of leg muscle EMG activity restricted to the moving side, while in the healthy subjects a bilateral activation occurred. This indicates that interlimb coordination depends on a supraspinal input. During locomotion with 100% body unloading in healthy subjects and patients, no EMG activity was present. Thus, it can be concluded that afferent input from hip joints, in combination with that from load receptors, plays a crucial role in the generation of locomotor activity in the isolated human spinal cord. This is in line with observations from infant stepping experiments and experiments in cats. Afferent feedback from knee and ankle joints may be involved largely in the control of focal movements.

Title: ***Importance of access to research information among individuals with spinal cord injury: Results of an evidenced-based questionnaire.***

Author: Edwards L; Krassioukov A; Fehlings MG

Source: Spinal Cord, 2002: 529-35

Abstract: OBJECTIVE: To assess the interests and accessibility of patients with a spinal cord injury (SCI) to information in different areas of SCI.  
SETTING: Spinal Program, Toronto Western Hospital, University Health Network.  
METHODS: An interest assessment survey and the SF-36 (short form-36) questionnaire were mailed to SCI patients living in the community. The interest assessment examined patients' interest in information in many areas related to SCI, their current knowledge in these areas and the accessibility of different information formats.  
RESULTS: Fourteen patients (45%) completed the questionnaires. Regardless of physical or mental health status, all patients expressed a high level of interest in SCI research and clinical trials. An Internet website proved to be the most preferred, accessible and comfortable information format for these patients. Patients expressed a lower interest in support groups and organizations. Results from the SF-36 showed poor social functioning was related to interest in support groups, and poor general health perception was related to interest in occupational and physical therapy.  
CONCLUSION: The majority of SCI patients have a high interest in accessing SCI research information. The Internet is a favorable, comfortable and accessible tool for providing this information and will benefit all SCI patients. These results suggest that a significant number of patients with SCI would benefit from an accessible Internet-based information database that is relevant to the SCI patients population.

Title: ***Kinetics and steady-state of VO<sub>2</sub> responses to arm exercise in trained spinal cord injury humans.***

Author: Fukuoka Y; Endo M; Kagawa H; Itoh M

Source: Spinal Cord, 2002: 631-8

Abstract: STUDY DESIGN: Cross-sectional study comparing trained spinal cord injured (SCI) subjects (lesion level: L1 - T6) with healthy young subjects (CONT).  
OBJECTIVE: To investigate the kinetics of response in oxygen uptake (VO<sub>2</sub>) in human upper-body skeletal muscles, nine trained SCI subjects underwent submaximal supine arm exercises.  
METHOD: The SCI subjects underwent an incremental arm exercise test until exhaustion. The days after this first round of testing, breath-by-breath VO<sub>2</sub> and beat-by-beat heart rate (HR) on- and off-kinetics were determined during three repetitions of constant exercise at 50% of VO<sub>2peak</sub>. The overall time course of response was determined from the half time (t<sub>1/2</sub>). Increased capillary blood lactate production (delta[La]b) at the onset of exercise was defined as the difference between at rest and at the end of exercise. Cardiac output (Q) was measured using the acetylene rebreathing method during the steady state of exercise. In accordance with the Fick principle, the difference in arterial-venous O<sub>2</sub> content (Ca-vO<sub>2</sub>) was defined as VO<sub>2</sub>/Q.  
RESULTS: During the steady state of the submaximal arm exercise, a more significant increase in the steady state of Q was obtained in the CONT subjects than in the trained SCI subjects: respectively, 14.9+/-1.4 l/min versus (12.7+/-0.8 l/min). There was no difference in the steady state of VO<sub>2</sub> between the two groups; as a result, SCI subjects had the greater Ca-v<sub>2</sub>. Meanwhile, VO<sub>2</sub> on- and off-kinetics became much faster in the trained SCI subjects than in the CONT subjects. In addition, t<sub>1/2</sub> HR on-kinetics was not significantly different between the SCI and CONT groups. Increased Delta[La]b was closely related to larger t<sub>1/2</sub> VO<sub>2</sub> on-kinetics (r = 0.624, P < 0.05).  
CONCLUSION: It is concluded that the acceleration of VO<sub>2</sub> on- and off-kinetics in the trained SCI subjects was observed even though there was no difference in HR on- and off-kinetics between the SCI and CONT groups and a lower steady state of Q in the trained SCI subjects. VO<sub>2</sub> kinetics would therefore be the limiting factor in oxidative phosphorylation in the upper skeletal muscles, thereby providing a lower lactic O<sub>2</sub>-deficit (ie delta[La]b).

Title: ***Recovery of spinal cord conduction after surgical decompression for cervical spondylotic myelopathy: Serial somatosensory evoked potential studies.***

Author: Ishida K; Tani T; Ushida T; Zinchk V; Yamamoto H

Source: American Journal of Physical Medicine and Rehabilitation, February 2003, Volume 82, Number 2: 130-6

Abstract: OBJECTIVE: We tested the utility of scalp-recorded median and tibial somatosensory evoked potentials (SEPs) as a measure of delineating the time course of postoperative recovery from cervical spondylotic myelopathy.  
DESIGN: We evaluated serial median and tibial SEP studies for 20 hands and 22 feet in 13 cervical spondylotic myelopathy patients during the first 6 mo postoperatively or longer. Serial sensory assessment of the hands and feet served to evaluate clinical correlation with the SEPs.  
RESULTS: The studies distinguished three recovery patterns of the SEPs based on the time course of the latencies of the N20 component for the median SEP and the P40 component for the tibial SEP. The latency started to decrease by 0.5 msec or more within 2 wk (seven hands and eight feet) or later than 2 wk (six hands and eight feet) postoperatively, or the change did not reach 0.5 msec (seven hands and six feet). In the late recovery group, the SEP improvement began as late as 10 wk postoperatively. Sensory recovery correlated with the SEP change in every group.  
CONCLUSIONS: An early onset of the SEP recovery predicts a favorable clinical course. The SEP may begin to improve later, and once it occurs, progressive return of function will follow.

Title: ***Sympathetic dysfunction of central origin in patients with ALS.***

Author: Karlsborg M; Andersen EB; Wiinberg N; Gredal O; Jorgensen L; Mehlsen J

Source: European Journal of Neurology, May 2003, Volume 10, Number 3: 229-34

Abstract: Amyotrophic lateral sclerosis (ALS) is a severe, progressive disease affecting both the central and peripheral parts of the motor nervous system. Some studies have shown unequivocal indications of a more disseminated disease also affecting the autonomic nervous system. We therefore evaluated the centrally and peripherally mediated autonomic vascular reflexes by (i) the local <sup>133</sup>Xenon washout technique, and (ii) the head-up tilt table test. The results correlated to clinical scores. We examined nine ALS patients and 15 age-matched controls. The <sup>133</sup>Xenon washout test showed a significant reduction in the centrally mediated sympathetic vasoconstrictor response, but a preserved locally mediated response in the patients. In the head-up tilt table test, the patients had a significantly higher mean arterial blood pressure (MAP) compared with controls, probably due to a general increase in vascular resistance. There were no correlations between the ALS Severity Scores and blood flow changes, diastolic blood pressure or MAP. Our study supports previous results, but indicates abnormalities consistent with a solely centrally located sympathetic dysfunction in ALS, independent of the stage of the disease.

Title: ***Nutritional and immune status following spinal cord injury: A case controlled study.***

Author: Lynch AC; Palmer C; Lynch AC; Anthony A; Roake JA; Frye J; Frizelle FA

Source: Spinal Cord, 2002: 627-30

Abstract: STUDY DESIGN: Case controlled study.  
OBJECTIVE: To compare nutritional status and immune response in a group of spinal cord injured (SCI) patients with age and gender matched non SCI control subjects.  
METHOD: Thirty past patients of the Burwood Hospital Spinal Injuries Unit living locally were enrolled in the study. Age and gender matched non SCI control subjects were selected volunteers from hospital staff. Nutritional status was assessed by generating a Nutritional Risk Score (NRS, Appendix 1) and drawing blood for full blood count, iron studies, red blood cell folate, vitamin B12, ferritin, magnesium, and zinc. Immune status was assessed by vaccination response index (VRI) to Pneumovax 23 vaccine.  
RESULTS: Full blood count, iron studies, and testing for red blood cell folate, albumin, prealbumin, vitamin B12, ferritin, magnesium and zinc were normal range for both groups. The SCI group had significantly different median values than controls ( $P < 0.01$ ) for haemoglobin concentration, white blood cell count, albumin, prealbumin, serum iron and % saturation. Body Mass Index (weight kg/(height cm<sup>2</sup>)) was 22.2 (range 15-30) for the SCI group, significantly less than the paired control group index of 26 (range 20-32,  $P = 0.0004$ ). Median NRS for SCI patients was 2 (range 0-6), compared to 0 (range 2-4) for paired controls ( $P < 0.0001$ ). Scores ranged from 0 to 2 for each of the five NRS components for the SCI patients and 0 to 3 for the control group. There was no significant difference in the pre- and post-vaccination ratio for IgG, IgA, and IgM response to Pneumovax 23 vaccine.  
CONCLUSION: We have not identified any nutritional or immune status abnormality in SCI patients, however the SCI patients have a lower value for certain nutritional parameters and BMI. SCI patients however are at only slight risk of nutritional problems given their NRS and their lower normal values for certain nutritional factors.

Title: ***Cardiovascular and endocrine responses during the cold pressor test in subjects with cervical spinal cord injuries.***

Author: Mizushima T; Tajima F; Okawa H; Umezu Y; Furusawa K; Ogata H

Source: Archives of Physical Medicine and Rehabilitation, January 2003, Volume 84, Number 1: 112-8

Abstract: OBJECTIVE: To investigate cardiovascular regulation and endocrine responses during the cold pressor test in patients with chronic spinal cord injury (SCI).  
DESIGN: Experimental and control study.  
SETTING: University laboratory, department of rehabilitation medicine, in Japan.  
PARTICIPANTS: Eight quadriplegic subjects with complete spinal cord transection at the C6 to C8 level and 6 age-matched healthy subjects.  
INTERVENTIONS: Cardiovascular and endocrine responses were examined during 2 minutes of control, 3 minutes of ice-water immersion of the foot, followed by a 3-minute recovery.  
MAIN OUTCOME MEASURES: Blood pressure, heart rate, the Borg 15-point Rating of Perceived Pain Scale, and blood samples for measurement of plasma norepinephrine, epinephrine, plasma renin activity, plasma aldosterone, and arginine vasopressin.  
RESULTS: The rise in the mean arterial blood pressure during the cold pressor test in patients with SCI (baseline, 81.6+/-3.7mmHg; increased by 30%+/-6.1%) was significantly ( $P<.05$ ) higher than that in healthy subjects (baseline, 101.2+/-4.5mmHg; increased by 20%+/-4.5%). The SCI subjects had no change in heart rate throughout the test, in contrast to the tachycardia noted in normal subjects. Baseline plasma norepinephrine in SCI subjects (63.0+/-18.3pg/mL) was significantly lower than in normal subjects (162.3+/-19.6pg/mL) and plasma norepinephrine increased significantly during the cold pressor test in both groups.  
CONCLUSIONS: In the SCI subjects, a reflex sympathetic discharge through the isolated spinal cord results in a more profound rise in mean blood pressure during ice-water immersion. This response was free of inhibitory impulses from supraspinal center and baroreceptor reflexes, either of which might restrain the increase in blood pressure.

Title: ***Blood flow response in individuals with incomplete spinal cord injuries.***

Author: Olive JL; McCully KK; Dudley GA

Source: Spinal Cord, 2002: 639-45

Abstract: STUDY DESIGN: Cross sectional comparison, control group.  
OBJECTIVE: To determine if incomplete spinal cord injured patients (SCI) have an abnormal blood flow response to cuff ischemia compared to able-bodied individuals (AB). SETTING: Academic institution.  
METHODS: Blood flow in five chronic incomplete SCI patients (C4-C5) and 17 able bodied individuals was measured in the common femoral artery using quantitative Doppler ultrasound (GE LogiQ 400CL) at rest and after distal thigh cuff occlusion of 2, 4 and 10 min to investigate whether blood flow or vascular control were different in SCI's and AB.  
RESULTS: Blood flow and the diameter of the common femoral artery at rest were similar in incomplete SCI and AB. Peak flow after 10 min of cuff ischemia (the highest found) was also comparable between incomplete SCI and AB. The half-time for recovery of blood flow to baseline after 2, 4 or 10 min of ischemia was 50% longer for incomplete SCI compared to the AB ( $P = 0.023$ ). In addition, peak blood flow after 2 and 4 min of ischemia relative to the maximum, 10 min value (2/10 and 4/10 ratios) was lower in incomplete SCI compared to AB (0.65 +/- 0.06 vs 0.76 +/- 0.15,  $P = 0.029$  and 0.75 +/- 0.10 vs 0.89 +/- 0.11,  $P = 0.014$ , respectively).  
CONCLUSION: This study demonstrated that incomplete spinal cord injured patients have impaired vascular control seen as a slower return to resting flow after cuff ischemia and reduced sensitivity to ischemia relative to maximum flow. However, incomplete SCI patients did not demonstrate impaired

flow capacity as seen in complete SCI patients suggesting that smaller cardiovascular abnormalities are seen with incomplete versus complete SCI injury. Impaired vascular control may serve to limit exercise capacity and may contribute to increased cardiovascular disease. Impaired circulation could contribute to impaired muscle function and poor cardiovascular health in incomplete SCI's, although these findings need to be replicated in a study with more subjects.

Title: ***Pressor effect of water drinking in tetraplegic patients may be a spinal reflex.***

Author: Tank J; Schroeder C; Stoffels M; Diedrich A; Sharma AM; Luft FC; Jordan J

Source: Hypertension, June 2003, Volume 41, Number 6: 1234-9. Epub April 28, 2003

Abstract: Water drinking elicits a profound sympathetically mediated pressor response in patients with autonomic failure. To further elucidate the mechanism of the response, we assessed the acute effect of drinking water on supine blood pressure and heart rate in 13 tetraplegic patients (12 men, 1 woman; 39 $\pm$ 4 years of age; body mass index, 25 $\pm$ 1 kg/m<sup>2</sup>) with complete spinal cord injury (C2 to C7). Heart rate and finger blood pressure were recorded continuously. Brachial blood pressure was measured every 5 minutes. Baroreflex sensitivity was assessed by the sequence method. Stroke volume was calculated by use of transthoracic bioimpedance. Patients were placed in the supine position with the upper body elevated by 15 degrees. After 30 minutes, supine patients ingested 500 mL of water and the following 60 minutes were monitored. Finger blood pressure at baseline was 123 $\pm$ 8/65 $\pm$ 4 mm Hg. Water drinking elicited a pressor response that was apparent within 5 minutes and reached a maximum of 138 $\pm$ 8/73 $\pm$ 4 mm Hg after 35 to 40 minutes (P<0.05). Heart rate decreased from 64 $\pm$ 2 bpm at baseline to 60 $\pm$ 2 bpm (P<0.001). The mean area under the curve for brachial systolic blood pressure changes differed significantly from zero (364 $\pm$ 151 mm Hg/min). Total peripheral resistance increased by 15 $\pm$ 4% (P<0.05). Baroreflex sensitivity increased from 18 $\pm$ 5 ms/mm Hg at baseline to 23 $\pm$ 6 ms/mm Hg at 35 minutes after water drinking (P<0.01). Water drinking elicits a pressor response even if the direct connection between brain stem cardiovascular centers and spinal sympathetic neurons is interrupted. This observation might suggest that water drinking activates postganglionic sympathetic neurons either directly or through a spinal reflex mechanism.

Title: ***Fatigue of paralyzed and control thenar muscles induced by variable or constant frequency stimulation.***

Author: Thomas CK; Griffin L; Godfrey S; Ribot-Ciscar E; Butler JE

Source: Journal of Neurophysiology, April 2003, Volume 89, Number 4: 2055-64. Epub December 11, 2002

Abstract: Muscles paralyzed by chronic (>1 yr) spinal cord injury fatigue readily. Our aim was to evaluate whether the fatigability of paralyzed thenar muscles (n = 10) could be reduced by the repeated delivery of variable versus constant frequency pulse trains. Fatigue was induced in four ways. Intermittent supramaximal median nerve stimulation (300-ms-duration trains) was delivered at 1) constant high frequency (13 pulses at 40 Hz each second for 2 min); 2) variable high frequency (each second for 2 min). The first two intervals of each variable frequency train were 5 and 20 ms. The remaining pulses were evenly distributed in time across 275 ms. The number of pulses varied for each subject such that the force time integral in the unfatigued state matched that evoked by a constant 40-Hz train; 3) constant low frequency (7 pulses at 20 Hz each second for 4 min); and 4) variable low frequency (each second for 4 min). The pulse pattern was the same as that for variable high frequency except that the force-time integral was matched to that produced by the constant low-frequency stimulation. These same experiments were performed on the thenar muscles of five able-bodied control subjects. The variable high-frequency trains used to fatigue paralyzed and control muscles had an average ( $\pm$  SE) of 12  $\pm$  2 and 10  $\pm$  1 pulses, respectively. Variable low-frequency trains had 7  $\pm$  1 and 6  $\pm$  1 pulses, respectively. Significant mean force declines of comparable

magnitude (to 20-25% initial fatigue force or to 13-21% initial 50 Hz force) were seen in paralyzed muscles with all four stimulation protocols. The force reductions in paralyzed muscles were always accompanied by significant increases in half-relaxation time and decreases in force-time integral, irrespective of the stimulation protocol. Significant force decreases also occurred in control muscles during each fatigue test. Again, these force declines were similar whether constant or variable pulse patterns were used at high or low frequencies (to 40-60% initial fatigue force or to 29-36% initial 50 Hz force). The force reductions in control muscles were significantly less than those seen in paralyzed muscles, except when constant high-frequency stimulation was used. The variations in stimulation frequency, pulse pattern, and pulse number used in this study therefore had little influence on thenar muscle fatigue in control subjects or in spinal cord-injured subjects with chronic paralysis

- Title: ***Cardiac homeostasis is independent of calf venous compliance in subjects with paraplegia.***
- Author: Wecht JM; De Meersman RE; Weir JP; Spungen AM; Bauman WA
- Source: American Journal of Physiology—Heart and Circulatory Physiology, June 2003, Volume 284, Number 6: H2393-9. Epub February 27, 2003
- Abstract: The purpose of this study was to examine cardiac hemodynamics during acute head-up tilt (HUT) and calf venous function during acute head-down tilt (HDT) in subjects with paraplegia compared with sedentary nondisabled controls. Nineteen paraplegic males (below T6) and nine age-, height-, and weight-matched control subjects participated. Heart rate, stroke volume, and cardiac output were assessed using the noninvasive acetylene uptake method. Venous vascular function of the calf was assessed using venous occlusion plethysmography. After supine measurements were collected, the table was moved to 10 degrees HDT followed by the three levels of HUT (10, 35, and 75 degrees ) in random order. Cardiac hemodynamics were similar between the groups at all positions. Calf circumference was significantly reduced in the paraplegic group compared with the control group ( $P < 0.001$ ). Venous capacitance and compliance were significantly reduced in the paraplegic compared with control group at supine and HDT. Neither venous capacitance ( $P = 0.37$ ) nor compliance ( $P = 0.19$ ) increased from supine with 10 degrees HDT in the paraplegic group. A significant linear relationship was established between supine venous compliance and supine cardiac output in the control group ( $r = 0.80$ ,  $P < 0.02$ ) but not in the paraplegic group. The findings of reduced calf circumference and similar venous capacitance at supine rest and 10 degrees HDT in the paraplegic group imply that structural changes may have limited venous dispensability in individuals with chronic paraplegia. Furthermore, the lack of a relationship between supine venous compliance and supine cardiac output suggests that cardiac homeostasis does not rely on venous compliance in subjects with paraplegia.

- Title: ***Motor unit firing during and after voluntary contractions of human thenar muscles weakened by spinal cord injury.***
- Author: Zijdwind I; Thomas CK
- Source: Journal of Neurophysiology, April 2003, Volume 89, Number 4: 2065-71. Epub December 11, 2002
- Abstract: Spinal cord injury may change both the distribution and the strength of the synaptic input within a motoneuron pool and therefore alter force gradation. Here, we have studied the relative contributions of motor unit recruitment and rate modulation to force gradation during voluntary contractions of thenar muscles performed by five individuals with chronic ( $>1$  yr) cervical spinal cord injury. Mean  $\pm$  SD thenar unit firing rates were low during both steady-level 25% ( $8.3 \pm 2.2$  Hz,  $n = 27$  units) and 100% maximal voluntary contractions (MVCs,  $9.2 \pm 3.1$  Hz,  $n = 23$  units). Thus modest rate modulation, or a lack of it in some units, was seen despite an average fourfold increase in integrated surface electromyographic activity and force. During ramp contractions, units were recruited at  $5.7 \pm 2.5$  Hz, but still only reached maximal firing rates of  $12.8 \pm 4.9$  Hz. Motor units were recruited

up to 85% of the maximal force achieved (14.6 +/- 5.6 N). In contrast, unit recruitment in control hand muscles is largely complete by 30% MVC. Thus, during voluntary contractions of thenar muscles weakened by cervical spinal cord injury, motor unit rate modulation was limited and recruitment occurred over a wider than usual force range. Those motor units that were stopped voluntarily had significantly lower derecruitment versus recruitment thresholds. However, 8 units (24%) continued to fire long after the signal to end the voluntary contraction at a mean frequency of 5.9 +/- 0.8 Hz. The forces generated by this prolonged unit activity ranged from 0.3 to 7.2% maximum. Subjects were unable to stop this involuntary unit activity even with the help of feedback. The mechanisms that underlie this prolonged motor unit firing need to be explored further.

# Diagnostic Technology

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- Title: ***The use of bioelectric impedance analysis to measure fluid compartments in subjects with chronic paraplegia.***
- Author: Buchholz AC; McGillivray CF; Pencharz PB
- Source: Archives of Physical Medicine and Rehabilitation, June 2003, Volume 84, Number 6: 854-61
- Abstract: OBJECTIVES: To determine the sensitivity and specificity of body mass index (BMI) as a surrogate marker of obesity in individuals with chronic paraplegia and to validate bioelectric impedance analysis (BIA) as a method of measuring body composition in this group.  
DESIGN: Cross-sectional study.  
SETTING: University hospital.  
PARTICIPANTS: Convenience sample of 31 subjects with paraplegia (19 men, 12 women; mean age, 34.2+/-8.8y) and 62 able-bodied control subjects (30 men, 32 women; mean age, 28.6+/-7.2y).  
INTERVENTIONS: Not applicable.  
MAIN OUTCOME MEASURES: Total-body water (TBW) by deuterium dilution; extracellular water (ECW) by corrected bromide space. Fat-free mass (FFM)=TBW/.732; fat mass (FM)=weight-FFM. Single-frequency whole-body and segmental BIA, and multifrequency whole-body BIA.  
RESULTS: BMI had 100% specificity and 20% sensitivity in distinguishing obese from nonobese subjects with paraplegia. TBW was predicted by using the equation: TBW (inL)=2.11-0.1age+3.45sex+.34wt+.28(ht(2)/R)-.086sex x wt(r(2)=.95, standard error of the estimate [SEE]=1.86L, P<.0001). This equation had 81.8% specificity and 68.4% sensitivity. ECW was predicted by using the equation: ECW (in L)=-.025+1.03sex+.187wt+.0041(ht(2)/X(c)) -.033sex x wt (r(2)=.75, SEE=1.62L, P<.0001). Multifrequency BIA offered no greater prediction of TBW or ECW than single-frequency BIA.  
CONCLUSIONS: BMI has excellent specificity but poor sensitivity in distinguishing obese from nonobese individuals with paraplegia. TBW (and therefore FFM and FM) and ECW can be reasonably well predicted by using single-frequency BIA.

# Epidemiology

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Title: ***Military gunshot wound-induced spinal cord injuries.***

Author: Alaca R; Yilmaz B; Goktepe AS; Yazicioglu K; Gunduz S

Source: Military Medicine, November 2002, Volume 167, Number 11: 926-8

Abstract: Gunshot wounds are the second leading cause of spinal cord injuries in developed countries, whereas in undeveloped and developing countries, this likelihood is much more. However, the weapon and injury characteristics are very different between those two groups of countries. The aim of this study was to review our experience with gunshot wound-caused spinal cord injury during our struggle with terrorism, to examine surgical and medical complications, and to determine the difference between civilian and military gunshot wounds. One hundred five male patients (mean, 25 years of age) were examined according to completeness, spinal and nonspinal injuries, American Spinal Injury Association classification, motor and pinprick scores, surgical and nonsurgical interventions, surgical complications, and spinal cord injury-related medical complications. This study has shown that the likelihood of completeness was higher in gunshot wounds with high velocity weapons. Because of their higher wounding capacity, the difference between vertebral and neurological levels was not very different as it was on the other etiologies. Fortunately, spinal cord injury-related medical complications were less than expected.

Title: ***Functional outcome in trauma patients with spinal injury.***

Author: Akmal M; Trivedi R; Sutcliffe J

Source: Spine, January 15, 2003, Volume 28, Number 2: 180-5

Abstract: **STUDY DESIGN:** A retrospective data analysis of all trauma patients admitted the Helicopter Emergency Medical Service was performed.  
**OBJECTIVE:** To assess the long-term outcome of trauma patients with spinal injuries using Functional Independence Measure scores.  
**SUMMARY OF BACKGROUND DATA:** Mortality after severe multiple trauma is well documented. However, evaluating morbidity in survivors of multiple trauma is complex, and less information is available regarding functional outcome. There are very few systems that can effectively predict the outcome for patients sustaining multiple trauma with spinal injuries. The Functional Independence Measure scoring system, which is easy to use, can be used to assess disability after hospital discharge, and may also be used to predict the long-term outcome for patients after spinal injuries.  
**METHODS:** The records of 1500 trauma patients admitted over a 6-year period by the Helicopter Emergency Medical Service were examined. All patients with documented injuries to the spinal column were selected for study. The distribution and pattern of spinal injury, the injury severity score, and the radiologic findings were determined for each patient, along with clinical outcome measures at 1 year using Functional Independence Measure scores.  
**RESULTS:** Among the 1500 trauma patients, 263 patients (17.5%) (195 men and 68 women; mean age, 37 years; range, 3-92 years) had sustained an injury to the spinal column. Mortality (70/263; 27%) was significantly higher ( $P < 0.02$ ) in these patients than in those without spinal injury (247/1237; 20%). Injury severity scores higher than 16 were found in 96 patients (55%). The median Functional Independence Measure score was 40 on admission, 86 at discharge from the hospital, 113 at 3 months, 119 at 6 months, and 124 at 12 months. There was significant correlation between discharge Functional Independence Measure (FIM) scores (FIM = 86) and 12-month FIM scores (FIM = 124) ( $P < 0.01$ ).  
**CONCLUSIONS:** Most of the patients had poor initial Functional Independence Measure scores, but there was significant improvement by 12 months. Discharge FIM scores were a good indicator for functional outcome at one year.

Title: ***Functional performance, depression, anxiety, and stress in people with spinal cord injuries in Thailand: a transition from hospital to home.***

Author: Chinchai P; Marquis R; Passmore A

Source: Asia Pacific Disability Rehabilitation Journal, 2003, Volume 14, Number 1: 30-40

Abstract: The numbers of people with spinal cord injuries (SCI) in Thailand are on the increase. Thai traditional rehabilitation focuses its treatment in acute care with little attention to the lives of clients after their discharge from institutions. In addition to functional disability, emotional states of depression, anxiety, and stress are often involved in SCI. The purpose of this study is to identify and compare the outcomes of functional performance, depression, anxiety and stress of people with SCI, both at discharge and at post-discharge from hospital. It also identifies factors influencing these issues, for this group. The study participants were 121 people with SCI, recruited from ten major hospitals in Thailand. Data was collected at 48 hours pre-discharge and again at three months post-discharge, using the Functional Independence Measure (FIM) and the Depression, Anxiety, and Stress Scale (DASS). The results demonstrated that functional performance at discharge was significantly higher, than at three months post-discharge. Depression and anxiety at discharge were significantly lower than depression and anxiety at three months post-discharge. However, stress had not significantly changed from discharge to post-discharge. Factors influencing functional performance were marital status, number of architectural barriers, fulfilment of occupational therapy (OT) needs, and the number of service needs remaining unmet. Factors influencing depression, anxiety and stress were marital and economic status, education level, fulfilment of OT needs, and numbers of service needs remaining unmet. Rehabilitation professionals can eliminate these problems by bridging the gap of transition from hospital to home, for people with SCI.

Title: ***Longitudinal outcome 6 years after spinal cord injury.***

Author: Franceschini M; Di Clemente B; Rampello A; Nora M; Spizzichino L

Source: Spinal Cord, May 2003, Volume 41, Number 5: 280-5

Abstract: STUDY DESIGN: Multicentered follow-up with centralized data collection based on retrospective study.  
OBJECTIVES: To assess the outcome in a population of patients with spinal cord injury (SCI). The assessed outcomes are mortality, state of health, occupation, mobility, autonomy, social and partner relationships, quality of life (QoL), with the identification of any relation between results and demographic-clinical data.  
SETTING: Two rehabilitation centers (Udine and Trevis) and a Spinal Injuries Unit (Torino).  
METHODS: A total of 251 patients with SCI discharged after first hospitalization from rehabilitation facilities between 1989 and 1994 were enrolled. A questionnaire was administered by telephone.  
RESULTS: During the time between discharge and follow-up, 25 out of the 251 patients had died, yielding a mortality rate of 9.96%. A total of 80 patients did not give their consent. The 146 patients' mean interval from discharge from the rehabilitation facility was 6 years. At least 25% has been hospitalized again. The descriptive analysis also shows that 29.5% of patients were working, 48.6% were able to drive, 63.7% would leave their home alone, 61% would leave home every day, 63% reported of a change in their relationships, 48.6% were happy with their love lives. Significant correlations have emerged between certain items and age: those who had a job, who could drive, were more autonomous and had a higher QoL are generally younger. Level of injury appear to be only associated with the degree of autonomy, which seems to be inferior for tetraplegic subjects. The injury's completeness and etiology do not exhibit any correlation. QoL is associated with a number of items: a higher QoL is linked to the possibility to work, especially if it is a paid job, to the ability to drive, to a good degree of autonomy, to a lack of change in the social and partner relationships, and to a satisfactory love life.

CONCLUSION: At 6 years after discharge from rehabilitations, the effects of trauma on work and social and partner relationships, domains correlated with autonomy and QoL, are evident. Further investigation by means of a prospective study over the years are therefore necessary.

Title: ***The health condition of spinal cord injuries in two Afghan towns.***

Author: Deconinck H

Source: Spinal Cord, May 2003, Volume 41, Number 5: 303-9

Abstract: STUDY DESIGN: Cross-sectional.  
OBJECTIVES: To describe the population with spinal cord injury (SCI) in two major towns of Afghanistan.  
SETTING: Kabul and Herat, Afghanistan, March-July 2001.  
METHODS: The residents of Kabul and Herat (N=311) with traumatic SCI were retrieved and investigated. They underwent standardised interviews and clinical examinations assessing socio-demographic characteristics and information on health condition, injury, quality of life and rehabilitation outcome.  
RESULTS: The study population could be considered as the survivors in the harsh living conditions in Afghanistan of a supposedly much larger group, counting proportionately fewer females and fewer cervical lesions than expected. Acute care was practically nonexistent. Prevalences of urinary tract infections and pressure sores were high as no good management was available. Basic rehabilitation helped persons with SCI to attain a fairly good level of independence (total functional independence measure score mean=95, SD=19). Their quality of life was significantly lower than their neighbours of same age and sex ( $P < 0.0001$ ). Along with the economic security and good access to the home, the use of the orthopaedic centre of the International Committee of the Red Cross (ICRC) contributed to a better quality of life.  
CONCLUSION: Thanks to the rehabilitation programme of the ICRC providing a basic but comprehensive rehabilitation, persons with SCI in Afghanistan are coping rather well. This result is remarkable considering the difficult economic and sanitary circumstances in the poorest country in the world.

Title: ***Epidemiology of spine tumors presenting to musculoskeletal physiatrists.***

Author: Slipman CW; Patel RK; Botwin K; Huston C; Zhang L; Lenrow D; Garvan C

Source: Archives of Physical Medicine and Rehabilitation, April 2003, Volume 84, Number 4: 492-5

Abstract: OBJECTIVE: To report the incidence and epidemiologic formation of previously undetected primary and secondary spine tumors presenting as spinal and/or extremity pain to a physiatrist practicing in an academic or private practice multidisciplinary spine center.  
DESIGN: Multicenter retrospective chart review.  
SETTING: Three multidisciplinary spine settings (1 academic, 2 private).  
PARTICIPANTS: Charts of patients from 33 academic and 18 private practice settings.  
INTERVENTIONS: Not applicable.  
MAIN OUTCOME MEASURES: Epidemiologic data collected included incidence, age, gender, race, and duration of symptoms before initial presentation. Symptom presentation data collected included intensity of pain when supine, sitting, standing, or walking; character of the pain; pain intensity as measured on the visual analog scale (VAS); spontaneous versus traumatic etiology; unexplained weight loss; presence of night pain; and fever. In addition, the results of radiographic studies including plain films, imaging, bone scan, and magnetic resonance imaging were recorded. The type of neoplastic disease was also assessed, primary versus metastatic, as well as the metastatic source.  
RESULTS: The incidence of spine tumors was 69% in academic multidisciplinary spine centers and 12% in private practice multidisciplinary spine centers. Patients with spinal pain because of

neoplastic disease who presented to musculoskeletal physiatrists were an average age of 65.3 years and reported a relatively high likelihood of night pain, aching character of symptom manifestation, spontaneous onset of symptoms, history of cancer, standing and walking provoking symptoms, and unexplained weight loss. In addition, the pain intensity level ranged widely, with an average VAS score of 6.8.

CONCLUSIONS: There are many similarities and differences in the clinical presentation of patients with spinal pain from spine tumors who present to musculoskeletal physiatrists practicing in multidisciplinary spine centers when compared with those presenting to a primary care setting.

Title: ***An evaluation of Think First Saskatchewan: A head and spinal cord injury prevention program.***

Author: Wesner ML

Source: Canadian Journal of Public Health, March–April 2003, Volume 94, Number 2: 115-20

Abstract: OBJECTIVES: To identify youth behaviour with regards to injury prevention, to assess the awareness of severity and susceptibility to brain and spinal cord injury, and to evaluate the impact of the Think First Saskatchewan school visit program on students' knowledge of brain and spinal cord injury prevention.

METHODS: A controlled, pre- and post-test design, self-report questionnaire was administered to 1,257 grade 6 and 7 students. Descriptive statistics and chi-square were used for data analysis. P-values less than 0.05 were considered significant.

RESULTS: Saskatchewan youth participate in activities that put them at risk for brain and spinal cord injury. The Think First Saskatchewan school visit program statistically improved self-reported knowledge of the students receiving the Think First message.

DISCUSSION: Think First Saskatchewan is a brain and spinal cord injury prevention program that significantly improves youth knowledge pertaining to injury prevention. Further evaluation of the program to include a more delayed survey of retention of knowledge, changes to behaviour, and reduction of brain and spinal cord injury are necessary.

## Health Care Policy (Access to Care, Legal Issues, Practice Guidelines, Outcome, Managed Care, Advocacy Issues, Limitations of Care)

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**Title:** *Threats to "informed" advance directives for the severely physically challenged?*

**Author:** Bach JR

**Source:** Archives of Physical Medicine and Rehabilitation, April 2003, Volume 84, Number 4, Supplement 2: S23-28

**Abstract:** The neuromuscular diseases, such as infantile spinal muscular atrophy, Duchenne's muscular dystrophy, and amyotrophic lateral sclerosis, are widely considered to be terminal illnesses. However, as with many neuromuscular and neurologic diseases, morbidity and mortality are caused by dysfunction of inspiratory, expiratory, and bulbar musculature. This article will discuss how inspiratory and expiratory musculature can be supported by simple, noninvasive means that are rarely considered when, as with the general population, individuals with disabilities are counseled about advance directives. Failure to use noninvasive aids almost invariably results in respiratory failure, intubation, and tracheostomy or death. When noninvasive aids are available, invasive measures referred to in advance directives (eg, intubation) are often needed only temporarily. Yet, ill-informed patients are often advised to refuse intubation and die or to be intubated and left to decide whether to undergo tracheostomy for long-term ventilatory support. Further, despite severe disability, ventilator users with neuromuscular disease report normal life satisfaction. Health care professionals, on the other hand, tend to ignore the patient's life satisfaction and consider quality of life measures not designed for the disabled to justify withholding life-saving interventions. Advance directives, although sometimes appropriate for patients with irretractable pain and advanced cancer, are inappropriate for patients with severe disability because of muscle weakness, and virtually no patients are appropriately counseled about all therapeutic options.

**Title:** *Impact of minority status following traumatic spinal cord injury.*

**Author:** Burnett DM; Kolakowsky-Hayner SA; White JM; Cifu DX

**Source:** NeuroRehabilitation, 2002, Volume 17, Number 3: 187-94

**Abstract:** **OBJECTIVE:** To interpret the data from the Spinal Cord Injury-Model Systems as it applies to demographics, incidence and functional outcomes of minority patients with spinal cord injury. **DESIGN:** Retrospective analysis of patients admitted to acute inpatient rehabilitation Spinal Cord Injury Model Systems Centers. **RESULTS:** Descriptive statistics including means, standard deviations, and proportions were computed for all relevant variables. Participants were grouped into two categories for purposes of analysis, non-minorities (white) and minorities, who were >90% African American. Differential statistics were used for comparisons with regard to demographics, etiology, sponsor of care, length of stay, charges, ASIA Motor Index scores, and FIM scores. Categorical data was analyzed using chi-square analyses while continuous data were analyzed using ANOVA procedures. Analyses revealed significant differences between minorities and non-minorities in terms of age at injury, gender, marital status, employment status, education level, health insurance provider, injury severity, etiology, and discharge disposition. **CONCLUSION:** Analysis of the data indicates that violence is the leading single cause of spinal cord injury in minority patients admitted to the model systems centers. The majority of patients who sustained spinal cord injury secondary to violence were minorities with the following demographics: young, single, unemployed males, with less than a high school education, residing in an urban area.

Title: ***Estimating life expectancy for use in determining lifetime costs of care.***

Author: DeVivo MJ

Source: Topics in Spinal Cord Injury Rehabilitation, Spring, 2002, Volume 7, Number 4: 49-58

Abstract: An accurate estimate of life expectancy is an essential component of any estimation of anticipated lifetime costs of care after spinal cord injury. Estimates of life expectancy based on age at injury, neurologic level of lesion, completeness of injury, ventilator dependency, and the amount of time since injury have been published by the National Spinal Cord Injury Statistical Center (NSCISC) and are updated annually on its web site. More precise estimates that include consideration of other factors such as gender, race, and the presence of preexisting major medical conditions can also be obtained from the NSCISC. This article describes the common analytical approaches used in estimating life expectancy, the strengths and limitations of these approaches, and the dangers of attempting to extrapolate from these results without a sound scientific basis.

Title: ***Women with disabilities: The long road to equality.***

Author: Fairchild SR

Source: Journal of Human Behavior in the Social Environment, 2002, Volume 6, Number 2: 13-28

Abstract: Although the passage of the Americans with Disabilities Act (ADA) was instrumental in raising societal conscious awareness of the issues and discriminatory practices towards people with disabilities, the evidence points to a lack of full inclusion in the mainstream of American society. Due to the double discrimination of gender and disability status, women with disabilities confront major obstacles even more boldly to achieve equality and full participation in society. This article examines some of the current meanings of disability, vital statistics, and current discriminatory practices in specific areas for women with disabilities such as, human rights and abuse, relationships and sexual functioning, health maintenance issues, employment, and environmental barriers. Positive strategies for social workers to become involved at both the macro and micro levels of practice as well as social policy level are identified.

Title: ***Interview and data collection process for the life care plan.***

Author: Kitchen JA

Source: Topics in Spinal Cord Injury Rehabilitation, Spring 2002, Volume 7, Number 4: 69-87

Abstract: The first step in developing a comprehensive life care plan is to collect and analyze pertinent data associated with the injury. The life care plan is an outline for future care recommendations that are unique to a specific individual and are designed to outline their needs for the remainder of their life expectancy.

Title: ***Accuracy of life expectancy estimates in life care plans: Consideration of nonbiographical and noninjury factors.***

Author: Krause JS

Source: Topics in Spinal Cord Injury Rehabilitation, Spring 2002, Volume 7, Number 4: 59-68

Abstract: Life care planning is a process by which lifetime costs are estimated by a careful projection of needs for items such as attendant care, durable equipment, transportation, and hospitalizations. The estimation of life expectancy is a critical component of a life care plan, because each year of life after the onset of a spinal cord injury (SCI) adds incrementally to the projected lifetime costs. Several types of procedures are used to estimate life expectancy in litigation, including statistical methods that use biographic and injury characteristics to modify estimates from standard life tables, estimates based on clinical experience, and use of standard life tables without any consideration of the SCI. Although the statistical approach is more objective than other methods, it does not account for a host of important variables that impact life expectancy, including income, access to health care, health behaviors, and psychosocial adaptation. This article explores factors that must be taken into account given the limitations of current approaches and emphasizes that, until statistical procedures take into account more relevant factors, the estimation of life expectancy will continue to be both art and science.

Title: ***Employment of people with disabilities following the ADA.***

Author: Kruse D; Schur L

Source: Industrial Relations: A Journal of Economy and Society, January 2003, Volume, 42, Number 1: 31-64

Abstract: Studies finding a negative effect of the Americans with Disabilities Act (ADA) on the employment of people with disabilities have used the work disability measure, which has several potential problems in measuring employment trends. Using Survey of Income and Program Participation (SIPP) data that permit alternative measures of disability, this study finds decreased employment among those reporting work disabilities in the first few years after the ADA was passed but increased employment when using a more probably appropriate measure of ADA coverage (functional and activity limitations that do not prevent work). State-by-state variation in labor market tightness is used to find that people with disabilities may have especially procyclical employment, but the contrary results in overall employment trends remain after accounting for labor market tightness. Given the problems in measuring who is covered by the ADA, there is reason to be cautious of both positive and negative findings.

Title: ***A decade of the Americans with Disabilities Act: Judicial outcomes and unresolved problems.***

Author: Lee BA

Source: Industrial Relations: A Journal of Economy and Society, January 2003, Volume 42, Number 1: 11-30

Abstract: A decade after its enactment, the Americans with Disabilities Act (ADA) has not resulted in the substantial employment gains for individuals with disabilities that its proponents had predicted. It also has not resulted in many legal victories for disabled individuals who have challenged alleged discriminatory actions by their employers. This article briefly reviews literature on disability and work and summarizes the data on the employment of individuals with disabilities. It addresses litigation trends prior to several significant US Supreme Court rulings the ADA made in 1999 and compares them with litigation trends following the issuance of these rulings. The article concludes that the law needs to be amended if it is to serve those individuals with disabilities who are capable of productive employment but whose impairments do not fit the judicially narrowed definition of disability in the ADA.

Title: ***Barriers to employment experienced by individuals with mobility impairments.***

Author: Liese H; MacLeod L; Drews JR

Source: Psychosocial Process, Fall 2002, Volume 15, Number 3: 151-7

Abstract: The Americans with Disabilities Act notwithstanding, many individuals with disabilities who want to work face a number of barriers entering today's workforce, including discrimination in the workplace. Psychologists, social workers, and other professionals working with individuals with disabilities must be able to identify and address these barriers to stable, competitive employment. The present study, utilizing both quantitative and qualitative methods, confirmed the existence of specific employment barriers for a sample of Utah residents, including individuals with spinal cord injury and other mobility impairments. Overcoming employment barriers and creating a level playing field for individuals with disabilities who wish to work will require active intervention and advocacy on the part of professionals serving this population.

Title: ***Americans with Disabilities Act: Physician-shareholder practice groups and ADA compliance.***

Author: Odem N; Blanck P

Source: Spine, February 2003, Volume 28, Number 3: 309-13

Abstract: This article examines the application of Americans with Disabilities Act requirements to professional associations like physician practice groups. In general, employers with 15 or more full-time employees must comply with the Act. However, the definition of an employee is sometimes unclear, especially as applied to business entities commonly used by physician practice groups. A recent case decided by the United States Court of Appeals for the Ninth Circuit held that physician-shareholders of a professional corporation are employees for Americans with Disabilities Act coverage purposes. Analogous cases in other federal circuits have held differently, likening the "owners" of professional corporations to partners in a partnership, who are not considered employees. Similar questions arise for popular business entities, such as Limited Liability Companies and Limited Liability Partnerships. This article discusses the nature of the business forms commonly used by physician practice groups and how their characteristics impact employee status for Americans with Disabilities Act coverage. It then suggests that examination is useful beyond business formation characteristics to the purpose of the Americans with Disabilities Act and other employment antidiscrimination statutes.

Title: ***Alexithymia and sense of coherence in patients with total spinal cord transection.***

Author: O'Carroll RE; Ayling R; O'Reilly SM; North NT

Source: Psychosomatic Medicine, January–February 2003, Volume 65, Number 1: 151-155

Abstract: Investigated the possibility that total spinal cord transection leading to tetraplegia would affect the ability to experience and identify emotions. The authors also examined whether the dispositional orientation of "sense of coherence" contributed to self-rated quality of life after spinal cord transection. 20 patients (mean age 31.1 yrs) with total spinal cord transection at the level of the 6th cervical vertebrae and 20 age- and sex-matched healthy control subjects completed measures of alexithymia, sense of coherence, and quality of life. There were no differences between the 2 groups on alexithymia scores. However, spinal injury patients reported significantly decreased quality of life relative to matched healthy control subjects. A strong sense of coherence was associated with better self-reported quality of life. This relationship remained after controlling for current affective status. The authors conclude that (1) loss of afferent feedback to the brain via the spinal cord

does not have a significant effect on alexithymia scores, particularly factor 1 (difficulty in identifying feelings), and (2) sense of coherence may be an important factor in determining psychological adjustment after serious injury.

Title: ***Race: Predictor versus proxy variable? Outcomes after spinal cord injury.***

Author: Putzke JD; Hicken BL; Richards JS

Source: Archives of Physical Medicine and Rehabilitation, November 2002, Volume 83, Number 11: 1603-11

Abstract: OBJECTIVE: To examine the impact of race on acute, rehabilitation, and long-term outcomes after spinal cord injury (SCI).  
DESIGN: Two case control studies (study 1: acute and rehabilitation outcomes, study 2: long-term outcomes) in which white and nonwhite individuals were matched case for case on multiple demographic, medical, and geographic characteristics with the rationale being that a case-control methodology would increase the internal validity of the design, thereby increasing confidence in the assertion that any between-group differences observed may be specifically attributed to race.  
SETTING: Data drawn from the Spinal Cord Injury Model Systems. Institutional practice and general community.  
PARTICIPANTS: Study 1: 187 pairs of individuals, study 2: 158 pairs of matched individuals.  
INTERVENTIONS: Not applicable.  
MAIN OUTCOME MEASURES: Outcome measures assessed included economic (eg, cost of care), treatment-related (eg, length of hospital stay), functional (eg, FIM instrument), and medical (eg, number of medical complications) variables, as well as self-reported life satisfaction, level of handicap, and mental and physical health.  
RESULTS: In study 1, none of the outcome measures differed significantly across racial groups. Similarly, study 2 failed to indicate significant differences in any of the outcome variables across racial groups, with the exception that nonwhites were at increased risk of greater self-reported handicap in the area of mobility. Power analyses indicated these findings were not merely the result of inadequate power.  
CONCLUSION: For the outcomes assessed in studies 1 and 2, race appeared to act primarily as a proxy for other variables (eg, injury severity, age, educational achievement), which in turn may be associated with poor outcome after SCI. Theoretical implications and recommendations are discussed.

Title: ***The social construction of "disabilities": The role of law.***

Author: Rice S

Source: Educational Studies: A Journal of the American Educational Studies Association, 2002, Volume 33, Number 2: 169-180

Abstract: Discusses ways in which disabilities may be viewed as being socially constructed, and how US law has been instrumental in this regard. Despite certain genetic and physiological realities, essential aspects of the term "disabilities" are socially constructed. The law has shaped general understanding about what it means to have a disability. Previously, the law promoted the view that individuals with disabilities were so unlike other humans that they were not capable of benefiting from education. Since 1970, federal case law has actively reconstructed the relationship between the disabled and the public education system. Previously, being identified as having a disability, particularly mental retardation, often resulted in institutionalization or exclusion from school. Presently, being identified as having a disability entails being channelled into the huge social services apparatus, whose various agencies try to provide for different perceived needs.

Title: ***Access barriers for persons with disabilities: The consumer's perspective.***

Author: Scheer J; Kroll T; Neri MT; Beatty P

Source: Journal of Disability Policy Studies, Spring 2003, Volume 13, Number 4: 221-30

Abstract: Individuals with disabilities constitute a marginalized group in health services research, and their experiences within the health-care system are not well understood. This article examines the access barriers to primary, specialist, and rehabilitative care, and their consequences for individuals' health, functioning, well-being, and health services utilization. The findings are based on an in-depth analysis of 30 qualitative interviews. Access problems are grouped into environmental, structural, and process barriers. The findings highlight the complex nature of access barriers for people with disabilities and underscore the importance of disability literacy in the health service delivery process.

Title: ***Impact of comprehensive gynecologic services on health maintenance behaviours among women with spinal cord injury.***

Author: Schopp LH; Kirkpatrick HA; Sanford TC; Hagglund KJ; Wongvatuny S

Source: Disability and Rehabilitation: An International Multidisciplinary Journal, November 2002, Volume 24, Number 17: 899-903

Abstract: Women with spinal cord injury (SCI) and other physical disabilities often lack access to appropriate gynecologic health care and may be at higher risk for preventable gynecologic diseases and other health problems. The purpose of this study was to investigate the effects of a women's health clinic that was established to meet the needs of women with SCI and other disabilities. Specifically, this study examined the effect of clinic participation on the rate of preventive gynecologic health care behaviors, and assessed the relationship between physical and emotional functioning in women with SCI and other disabilities. Participants were 28 women who completed surveys immediately prior to participation in the clinic, and at 3- and 12-mo follow-ups. Results indicate a trend towards increased frequency of breast self-exam 3 mo after initial participation in the clinic. Other rates of health promoting behaviors (exercise, diet, and mammography) did not increase. Results also indicate that, although physical functioning and life satisfaction were not related, women in this study did experience moderate to high levels of psychological distress. Results indicate that whole-woman health care may be important to increasing certain health behaviors among women with disabilities.

## Medical Issues (Clinical Management, Secondary Complications)

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Title: ***Pain characteristics in patients admitted to hospital with complications after spinal cord injury.***

Author: Barrett H; McClelland JM; Rutkowski SB; Siddall PJ

Source: Archives of Physical Medicine and Rehabilitation, June 2003, Volume 84, Number 6: 789-95

Abstract: OBJECTIVES: To determine characteristics of pain, the relation between pain and mood, the effect of pain on activities, and the perceived difficulty in coping with pain in patients hospitalized for treatment of complications associated with spinal cord injury (SCI). DESIGN: Cohort survey. SETTING: Hospital inpatient unit in Australia. PARTICIPANTS: Consecutive sample of patients (N=88) admitted to a hospital spinal injuries unit with complications after SCI. Two eligible patients declined to participate. INTERVENTION: Face-to-face interview with questionnaire. MAIN OUTCOME MEASURES: Pain severity, global self-rated health, mood (Kessler Mood Inventory), and interference with activities (Von Korff disability scale). RESULTS: Sixty-six (75%) of the 88 subjects experienced pain, described it as severe or excruciating. Subjects with pain were less likely to rate their global health as excellent or very good when compared with those who did not have pain (22% vs 44%, respectively). Patients with pain had significantly greater levels of psychological distress than did people with SCI and no pain. CONCLUSIONS: Pain is a common problem in people admitted to hospital with SCI for treatment of other complications. It has a significant impact on activities and is associated with a reduction in global self-rated health and higher levels of psychological distress.

Title: ***Breathing patterns during breathing exercises in persons with tetraplegia.***

Author: Bodin P; Kreuter M; Bake B; Olsen MF

Source: Spinal Cord, May 2003, Volume 41, Number 5: 290-5

Abstract: STUDY DESIGN: Cross-sectional, observational, controlled study. OBJECTIVES: To survey breathing patterns during breathing at rest, ordinary deep breathing (DB), positive expiratory pressure (PEP) and inspiratory resistance-positive expiratory pressure (IR-PEP) among individuals with a cervical spinal cord lesion (SCL) compared with able-bodied controls. SETTING: Sahlgrenska University Hospital, Goteborg, Sweden. METHOD: Participants consisted of 20 persons with a complete SCL at the C5-C8 level (at least 1 year postinjury) and 20 matched, able-bodied controls. Breathing patterns and static lung volumes were measured using a body plethysmograph. RESULTS: Compared to the controls, breathing patterns at rest among the people with tetraplegia were characterised by a decreased tidal volume, stable respiratory rate and total cycle duration resulting in decreased mean inspiratory and expiratory flow, and alveolar ventilation. All volume and flow parameters increased except respiratory rate, which decreased during DB and PEP. During IR-PEP, tidal volume increased less compared to PEP, and combined with a decreased respiratory rate the alveolar ventilation was lower than during breathing at rest. The functional residual capacity increased during PEP and IR-PEP in people with tetraplegia. CONCLUSION: DB exercises with or without resistance during expiration or the whole breathing cycle affect the breathing pattern in persons with tetraplegia. DB was superior in increasing volumes and flow. PEP and IR-PEP increased FRC but IR-PEP decreased volumes and flows. However, large interindividual differences in the SCL group indicate the need for caution in generalising the results. SPONSORSHIP: This work was supported in part by grants from the Memorial Foundation of the Swedish Association of registered Physiotherapists and the Association of Cancer and Road Accident Victims.

Title: ***Classification of chronic pain associated with spinal cord injuries.***

Author: Cardenas DD; Turner JA; Warms CA; Marshall HM

Source: Archives of Physical Medicine and Rehabilitation, December 2002, Volume 83, Number 12: 1708-14

Abstract: OBJECTIVES: To determine interrater reliability of a classification system for chronic pain in persons with spinal cord injury (SCI) and to determine the frequency and characteristics of various pain types as categorized by this system.  
DESIGN: Independent categorization (based on questionnaires; for 15 persons, questionnaires plus personal interviews) by 2 investigators.  
SETTING: Community.  
PARTICIPANTS: A total of 163 individuals aged  $\geq 18$  years with SCI and pain.  
INTERVENTIONS: Not applicable.  
MAIN OUTCOME MEASURES: Pain categories, Short-Form McGill Pain Questionnaire, and Chronic Pain Grade questionnaire.  
RESULTS: Among 41 (25%) questionnaires categorized independently by 2 investigators, strength of agreement in categorizing 68 pain problems was substantial ( $\kappa = .68$ ). For 15 persons whose pain was categorized in person by 2 investigators, strength of agreement was also substantial ( $\kappa = .66$ ). Among 163 survey respondents with pain, the most common worst pain was SCI pain (31.9%). Mean characteristic pain intensity  $\pm$  standard deviation for worst pain, regardless of type, was  $61.02 \pm 18.5$  on a scale from 0 to 100. On average, for worst pain, respondents reported moderate pain-related disability ( $43.70 \pm 29.4$ ; scale range, 0-100). Although certain pain descriptors were more often associated with a specific type of pain, none was pathognomonic.  
CONCLUSIONS: Substantial interrater reliability was achieved in determining pain categories by use of responses to a questionnaire with a classification system based on presumed pathology. Adding interviews with patients increased our ability to classify pain but did not improve overall interrater reliability.

Title: ***Optimum pharmacologic management of an acute spinal cord injury in the setting of a lumbar burst fracture.***

Author: Chu GKT; Fehlings MG

Source: Topics in Spinal Cord Injury Rehabilitation, Fall 2002, Volume 8, Number 2: 9-20

Abstract: Spinal cord injury is a devastating disease that has eluded successful treatment. It has been a long-held belief that most injuries are untreatable. This view is changing as new discoveries are made into the molecular mechanisms of injury and regeneration. This insight has led to the pursuit of new avenues of pharmacotherapy. Although surgical treatment varies with injuries at different levels, pharmacologic management for a lumbar spine burst fracture with spinal cord injury is no different than injuries at other levels. This review will describe some of the inroads made into spinal cord injury and discuss what treatments are now available and what may be in store for the future.

Title: ***Reduction of periodic leg movement in individuals with paraplegia following aerobic physical exercise.***

Author: De Mello MT; Silva AC; Esteves AM; Tufik S

Source: Spinal Cord, December 2002, Volume 40, Number 12: 646-9

Abstract: PURPOSE: According to the American Association of Sleep Disorders, periodic leg movements (PLM) are classified into the group of intrinsic sleep disorders. Studies on PLM in individuals with spinal cord injury are very recent. The objective of the present study was to assess the efficacy of aerobic training in reducing the index/score of PLM in individuals with complete spinal cord injury.

**METHODS:** Twelve male volunteers with complete spinal cord injury between T7 and T12 were submitted to six polysomnographies (PSG Oxford Medilog SAC system; EEG, EMG and EOG: (1) basal night, (2) 12 h after a maximum effort test, (3) 36 h after a maximum effort test, (4) after 44 days of aerobic physical training, (5) 12 h after the last training session, and (6) 36 h after the last training session. All volunteers participated in a physical training program for 44 days using an arm crank ergometer. Data were analyzed statistically by the Wilcoxon test, with the level of significance set at alpha5%. **RESULTS:** The results demonstrated a statistically significant reduction ( $P \leq 0.05$ ) in the comparison of first evaluation (35.1 PLM/h) with fifth (12.70 PLM/h) and sixth evaluation (18.5 PLM/h).

**CONCLUSION:** This study suggests that a program of regular and systematized physical activity promotes an effective reduction of PLM in individuals with spinal cord injury.

**Title:** *Phrenic nerve pacing in a tetraplegic patient via intramuscular diaphragm electrodes.*

**Author:** DiMarco AF; Onders RP; Kowalski KE; Miller ME; Ferek S; Mortimer JT

**Source:** American Journal of Respiratory and Critical Care Medicine, December 15, 2002, Volume 166, Number 12, Part 1: 1604-6

**Abstract:** In patients with ventilator-dependent tetraplegia, phrenic nerve pacing (PNP) provides significant clinical advantages compared with mechanical ventilation. This technique however generally requires a thoracotomy with its associated risks and in-patient hospital stay and carries some risk of phrenic nerve injury. We have developed a method by which the phrenic nerves can be activated via intramuscular diaphragm electrodes. In one patient with ventilator-dependent tetraplegia, two intramuscular diaphragm electrodes were implanted into each hemidiaphragm near the phrenic nerve motor points via laparoscopic surgery. The motor points were identified employing a previously devised mapping technique. Because inspired volumes were suboptimal on the right, a second laparoscopic procedure was necessary to position electrodes near the anterior and posterior branches of the right phrenic nerve. During bilateral stimulation, inspired volume was 580 ml. After a reconditioning program of progressively increasing diaphragm pacing, maximum inspired volumes on the left and right hemidiaphragms increased significantly. Maximum combined bilateral stimulation was 1120 ml. Importantly, the patient has been able to comfortably tolerate full-time pacing. If confirmed in additional patients, PNP with intramuscular diaphragm electrodes via laparoscopic surgery may provide a less invasive and less costly alternative to conventional PNP.

**Title:** *Sensory function in spinal cord injury patients with and without central pain.*

**Author:** Finnerup NB; Johannesen IL; Fuglsang-Frederiksen A; Bach FW; Jensen TS

**Source:** Brain, January 2003, Volume 126, Number Part 1: 57-70

**Abstract:** Spinal cord injury (SCI) frequently results in neuropathic pain. However, the pathophysiology underlying this pain is unclear. In this study, we compared clinical examination, quantitative sensory testing (QST) and somatosensory evoked potentials (SEPs) in SCI patients with and without pain below spinal lesion level, with a control group of 20 subjects without injury. All patients had a traumatic SCI with a lesion above T10; 20 patients presented with spontaneous central neuropathic pain below lesion level, and 20 patients had no neuropathic pain or dysaesthesia. Patients with and without pain had a similar reduction of mechanical and thermal detection and pain thresholds, and SEPs. SCI patients with central pain more frequently had sensory hypersensitivity (brush- or cold-evoked pain, dysaesthesia or pinprick hyperalgesia) in dermatomes corresponding to lesion level than SCI patients without pain. There was no difference in intensity of pain evoked by repetitive pinprick at lesion level between patient groups. There was a significant correlation between intensity

of brush-evoked dysaesthesia at lesion level and spontaneous pain below lesion level of SCI. These data suggest that lesion of the spinothalamic pathway alone cannot account for central pain in SCI patients, and that neuronal hyperexcitability at injury or higher level may be an important mechanism for pain below injury level.

Title: ***Prevalence of hepatitis C infection in a large urban hospital-based sample of individuals with spinal cord injury.***

Author: Fong T; Adkins RH; Govindarajan S; Post S; Waters RL

Source: Archives of Physical Medicine and Rehabilitation, November 2002, Volume 83, Number 11: 1620-3

Abstract: OBJECTIVE: To examine the prevalence and clinical characteristics of hepatitis C infection in individuals with chronic spinal cord injury (SCI).  
DESIGN: Retrospective case survey.  
SETTING: Outpatient clinic devoted to SCI follow-up care located in a county-government rehabilitation center.  
PARTICIPANTS: A total of 531 unselected individuals with chronic SCI.  
INTERVENTIONS: Patients underwent routine annual physical examinations at the outpatient clinic, and were tested for hepatitis C antibodies, antibodies to hepatitis core antigen, alanine aminotransferase (ALT), and bilirubin.  
MAIN OUTCOME MEASURES: Prevalence of hepatitis C antibodies and liver test abnormalities.  
RESULTS: Seventeen percent of the cohort was anti-hepatitis C virus (HCV) reactive (HCV positive). The prevalence of HCV infection in those who sustained SCI before 1990 was 21% compared with 7% (10/147) of those who were injured from 1990 onward (,  $P=.0002$ ). Period of injury (Wald,  $P=.0042$ ) and age (Wald,  $P=.048$ ) were the only significant factors for anti-HCV reactivity. Thirty percent of the HCV-positive individuals had abnormal ALT levels compared with only 10% of the HCV-negative individuals (,  $P<.0001$ ). Individuals who were HCV positive were more likely to be hepatitis B core antigen-reactive compared with those who were HCV negative (31% vs 9%;,  $P<.0001$ ).  
CONCLUSIONS: The prevalence of HCV infection among individuals with chronic SCI is significantly higher than the general population. The majority of those with SCI and HCV infection have normal liver tests. Clinicians should maintain a high index of suspicion for HCV infection, even in the absence of elevated aminotransferase activities.

Title: ***Anxiety and position-dependent neurologic findings due to autonomic dysreflexia.***

Author: Freudenreich O; Murray GB

Source: Psychosomatics: Journal of Consultation Liaison Psychiatry, January-February 2001, Volume 42, Number 1: 81-82

Abstract: Presents a case of anxiety due to autonomic dysreflexia to illustrate that it remains important to rule out physiological causes of anxiety, regardless of how well psychological explanations fit. The S was a 38-yr-old man whose spinal cord had been severed in a car accident, leaving him with an incomplete C4 spinal cord injury. Following hospital admission for elective correction of a urethrocutaneous fistula, the S complained of anxiety after the second of two operations. Despite the persistence of neurological findings while in the hospital, the anxiety abated over several days. Two signs made the S's anxiety "explainable" as part of autonomic dysreflexia: severe headaches and new anisokoria and position-dependent half-sided hyperhidrosis of the upper body.

Title: ***Earwax and level of paralysis.***

Author: Frisbie JH; Zahn EH

Source: Spinal Cord, April 2003, Volume 41, Number 4: 247-8

Abstract: STUDY DESIGN: Inception cohort.  
OBJECTIVES: The clinical impression that earwax is uncommonly frequent among spinal cord injury patients with high levels of paralysis was tested.  
SETTING: Veterans Administration Hospital, USA.  
METHODS: A cohort of 15 chronically paralyzed patients, motor complete, living as residents in a long-term care facility was offered monthly irrigations of the ears for removal of wax over a 6-month period. The number of requests was tabulated. All ears were examined once on a single day to determine point prevalence. The accumulated wax graded as absent or small, moderate or large.  
RESULTS: Two patients with C2 lesions, aged 37 and 52 years and paralyzed 15 and 16 years, were compared with 13 patients at C4-T6 aged 44-78 years, median 62 years, and paralyzed 2-33 years, median 24 years. Over a 6-month observation period, 10 irrigations were requested by the C2 patients and three by the C4-T6 patients. The reasons were hearing loss. Wax was found and removed, and symptoms were relieved in all instances,  $P < 0.001$ . The spot survey revealed earwax of moderate or large amounts in four of four C2 patient ears and in two of 24 C4-T6 patient ears,  $P = 0.001$ .  
CONCLUSION: Patients with C2 tetraplegia accumulate more earwax and request its removal more often than patients with lower levels of paralysis.

Title: ***Intact sympathetic nervous system is required for leptin effects on resting metabolic rate in people with spinal cord injury.***

Author: Jeon JY; Steadward RD; Wheeler GD; Bell G; McCargar L; Harber V

Source: The Journal of Clinical Endocrinology and Metabolism, January 2003, Volume 88, Number 1: 402-7

Abstract: Compared with able-bodied (AB), people with spinal cord injury (SCI) have a 3- to 5-fold higher risk of developing type 2 diabetes mellitus, which may be associated with increased fat mass. Evidence suggests that leptin regulates body adiposity through the sympathetic nervous system, which is impaired in people with high lesion SCI. The purpose of this study was to determine the relationship among leptin levels, body composition, and resting metabolic rate (RMR) in people with high lesion SCI and body mass index-, weight-, height-, and waist circumference-matched AB subjects. Fourteen subjects (seven SCI and seven AB) participated in the study. After an overnight fast, various hormones, glucose, and RMR were measured. There was no significant difference in plasma glucose, insulin, GH, cortisol, and glucagon levels between the two groups. The SCI group had 105% higher plasma leptin levels than the AB group ( $P < 0.05$ ). Plasma leptin levels correlated with body mass index (SCI:  $r = 0.80$ ;  $P = 0.028$ ; AB:  $r = 0.79$ ;  $P = 0.035$ ) and fat mass (SCI:  $r = 0.95$ ;  $P = 0.001$ ; AB:  $r = 0.78$ ;  $P = 0.038$ ) in both groups. The plasma leptin level correlated with the absolute RMR (SCI:  $r = 0.15$ ;  $P = 0.75$ ; AB:  $r = 0.99$ ;  $P < 0.006$ ) and the RMR per unit fat-free mass (SCI:  $r = -0.70$ ;  $P < 0.08$ ; AB:  $r = 0.845$ ;  $P < 0.017$ ) in the AB group, but not in the SCI group. The absolute RMR was significantly reduced in the SCI group compared with the AB group, but there was no difference in the relative RMR between the groups. In conclusion, the SCI group has a significantly higher plasma leptin level than the AB group. The absolute and relative RMR correlated with leptin only in the AB group.

Title: ***Spirometry testing standards in spinal cord injury.***

Author: Kelley A; Garshick E; Gross ER; Lieberman SL; Tun CG; Brown R

Source: Chest, March 2003, Volume 123, Number 3: 725-30

Abstract: STUDY OBJECTIVES: Because muscle paralysis makes it uncertain whether subjects with spinal cord injury (SCI) can perform spirometry in accordance with American Thoracic Society (ATS) standards, determinants of test failure were examined.  
DESIGN: Cross-sectional study.  
SETTING: Veterans Affairs (VA) medical center.  
PARTICIPANTS: Veterans with SCI at VA Boston Healthcare System and nonveterans recruited by mail and advertisement. Measurements and results: Two hundred thirty of 278 subjects (83%) were able to produce three expiratory efforts lasting  $\geq 6$  s and without excessive back-extrapolated volume (EBEV). In 217 of 230 subjects (94%), FVC and FEV(1) were each reproducible in accordance with 1994 ATS standards. In the remaining 48 subjects, efforts with smooth and continuous volume-time tracings and acceptable flow-volume loops were identified. These subjects had a lower percentage of predicted FVC, FEV(1), and maximum expiratory and inspiratory pressures compared to the others, and a greater proportion had neurologically complete cervical injury (42% compared to 16%). In 19 subjects (40%), some expiratory efforts were not sustained maximally for  $\geq 6$  s but had at least a 0.5-s plateau at residual volume (short efforts). In eight subjects (17%), some efforts were not short but had EBEV. In the remaining 21 subjects (44%), some efforts were short, some had EBEV, and some had both. If these efforts were not rejected, 262 of 278 subjects (94%) would have produced three acceptable efforts, and in 257 subjects (92%), the efforts were reproducible.  
CONCLUSIONS: Subjects with SCI with the most impaired respiratory muscles and abnormal pulmonary function are able to perform spirometry reproducibly despite not meeting usual ATS acceptability standards. Exclusion of these subjects would lead to bias in studies of respiratory function in SCI. The modification of spirometry testing standards to include efforts with EBEV and with a 0.5-s plateau if  $< 6$  s would reduce the potential for bias.

Title: ***Control of non-malignant chronic pain conditions in Japan and the possible future role of tramadol.***

Author: Itoh T

Source: European Journal of Pain, 2001, Volume 5, Supplement A: 87-89

Abstract: Discusses the management of non-malignant chronic pain in Japan. Pharmacological treatment is the most common treatment for non-malignant chronic pain diseases, such as lumbar and cervical spondylosis and osteoarthritis of the knee or hip joint. In Japan, opioid analgesics cannot be used for non-malignant chronic pain syndromes because of strict regulations for opioid use by the Ministry of Health and Welfare. Non-steroidal anti-inflammatory drugs are not sufficient for some painful conditions, and can exert serious side-effects on the gastrointestinal tract and kidneys. Controlled-release tramadol hydrochloride is among the most commonly prescribed long-lasting analgesic drugs. New drugs having stronger effects on chronic pain and less severe adverse side-effects are expected within the decade.

Title: ***Breathlessness associated with abdominal spastic contraction in a patient with C4 tetraplegia: A case report.***

Author: Laffont I; Durand MC; Rech C; De La Sotta AP; Hart N; Dizien O; Lofaso F

Source: Archives of Physical Medicine Rehabilitation, June 2003, Volume 84, Number 6: 906-8

Abstract: A tetraplegic patient with C4 cervical cord injury reported breathlessness during episodes of spastic contraction of the abdominal muscles. To determine the mechanism, we performed electrophysiologic testing of the phrenic nerves. We measured abdominal pressure, esophageal pressure, and transdiaphragmatic pressure (Pdi) during a maximal inspiratory effort (Pdi max), a maximal sniff maneuver (sniff Pdi) during resting breathing, and during the episodes of breathlessness. Electrophysiologic testing of the phrenic nerves showed axonal neuropathy on the left. Sniff Pdi and Pdi max were 38cmH(2)O and 42cmH(2)O, respectively. Transient spastic contractions of abdominal muscles were associated with an increase in abdominal pressure greater than 30cmH(2)O, with a decrease in abdominal volume; this rise in abdominal pressure was transmitted to the esophageal pressure. Inspiration became effective only when esophageal pressure fell below the resting baseline value. Achieving this decrease required an increase in inspiratory effort, characterized by swings in esophageal pressure and Pdi of 30cmH(2)O and 40cmH(2)O (approximately 100% of Pdi max), respectively. During these periods, minute ventilation was markedly reduced. This is the first report that spastic abdominal muscle contractions can impose a significant load on the diaphragm, uncovering moderate diaphragmatic weakness. This has important clinical implications; abolition of the spastic abdominal muscle contraction in this patient completely resolved her intermittent respiratory symptoms.

Title: ***Transverse myelitis in a patient with primary antiphospholipid syndrome.***

Author: Lee DM; Jeon HS; Yoo WH

Source: Yonsei Medical Journal, April 30, 2003, Volume 44, Number 2: 323-7

Abstract: The neurological manifestations of antiphospholipid syndrome (APS) are diverse. Transverse myelitis (TM) is an uncommon, but well-known neurological complication of systemic lupus erythematosus (SLE). On the other hand, the reported cases associated with primary APS are extremely rare. To our knowledge, this is the first report of TM in a patient with primary APS in Korea. A 32-year-old male patient was admitted with the sudden onset of numbness, a tingling sensation, and weakness in both lower extremities. He had a 19 months history of external iliac and femoral arterial thromboses prior to admission. The laboratory results indicated the presence of anticardiolipin antibodies of the IgG class and lupus anticoagulant. No other autoantibodies were detected and there were no apparent clinical manifestations of SLE or multiple sclerosis. A T2-weighted magnetic resonance (MR) image showed swelling and increased intensity of the cervical and thoracic spinal cord between C6 and T7 with slight enhancement by contrast medium. After steroid pulse therapy, the patient's symptoms were gradually relieved and the abnormal findings on MR imaging disappeared.

Title: ***Asymmetric flaccid paralysis: A neuromuscular presentation of West Nile virus infection.***

Author: Li J; Loeb JA; Shy ME; Shah AK; Tselis AC; Kupski WJ; Lewis RA

Source: Annals of Neurology, June 2003, Volume 53, Number 6:703-10. Comment in: Annals of Neurology, June 2003, Volume 53, Number 6: 691-2

Abstract: The neuromuscular aspects of West Nile virus (WNV) infection have not been characterized in detail. We have studied a group of six patients with proven WNV infection. All cases presented with acute, severe, asymmetric, or monolimb weakness, with minimal or no sensory disturbance after a mild flu-like prodrome. Four cases also had facial weakness. Three of our cases had no encephalitic signs or symptoms despite cerebrospinal fluid pleocytosis. Electrophysiological studies showed severe denervation in paralyzed limb muscles, suggesting either motor neuron or multiple ventral nerve root damage. This localization is supported further by the finding of abnormal signal intensity confined to the anterior horns on a lumbar spine magnetic resonance imaging. Muscle biopsies from three patients showed scattered necrotic fibers, implicating mild direct or indirect muscle damage from the WNV infection. In summary, we describe a group of patients with acute segmental flaccid paralysis with minimal or no encephalitic or sensory signs. We have localized the abnormality to either the spinal motor neurons or their ventral nerve roots. It will be important for physicians to consider WNV infection in patients with acute asymmetric paralysis with or without encephalitic symptoms.

Title: ***Cyproheptadine for intrathecal baclofen withdrawal.***

Author: Meythaler JM; Roper JF; Brunner RC

Source: Archives of Physical Medicine and Rehabilitation, May 2003, Volume 84, Number 5: 638-42

Abstract: OBJECTIVE: To evaluate the efficacy of cyproheptadine in the management of acute intrathecal baclofen (ITB) withdrawal.  
DESIGN: Descriptive case series.  
SETTING: University hospital with a comprehensive in- and outpatient rehabilitation center.  
PARTICIPANTS: Four patients (3 with spinal cord injury, 1 with cerebral palsy) with implanted ITB infusion pumps for treatment of severe spasticity, who had ITB withdrawal syndrome because of interruption of ITB infusion.  
INTERVENTIONS: Patients were treated with 4 to 8mg of cyproheptadine by mouth every 6 to 8 hours, 5 to 10mg of diazepam by mouth every 6 to 12 hours, 10 to 20mg of baclofen by mouth every 6 hours, and ITB boluses in some cases.  
MAIN OUTCOME MEASURES: Clinical signs and symptoms of ITB withdrawal of varying severity were assessed by vital signs (temperature, heart rate), physical examination (reflexes, tone, clonus), and patient report of symptoms (itching, nausea, headache, malaise).  
RESULTS: The patients in our series improved significantly when the serotonin antagonist cyproheptadine was added to their regimens. Fever dropped at least 1.5 degrees C, and heart rate dropped from rates of 120 to 140 to less than 100bpm. Reflexes, tone, and myoclonus also decreased. Patients reported dramatic reduction in itching after cyproheptadine. These changes were associated temporally with cyproheptadine dosing.  
DISCUSSION: Acute ITB withdrawal syndrome occurs frequently in cases of malfunctioning intrathecal infusion pumps or catheters. The syndrome commonly presents with pruritus and increased muscle tone. It can progress rapidly to high fever, altered mental status, seizures, profound muscle rigidity, rhabdomyolysis, brain injury, and death. Current therapy with oral baclofen and benzodiazepines is useful but has variable success, particularly in severe cases. We note that ITB withdrawal is similar to serotonergic syndromes, such as in overdoses of selective serotonin reuptake inhibitors or the popular drug of abuse 3,4- methylenedioxymethamphetamine (Ecstasy). We postulate that ITB withdrawal may be a form of serotonergic syndrome that occurs from loss of gamma-aminobutyric acid B receptor-mediated presynaptic inhibition of serotonin.  
CONCLUSION: Cyproheptadine may be a useful adjunct to baclofen and benzodiazepines in the management of acute ITB withdrawal syndrome.

Title: ***Current implications of drug resistance in spinal cord injury.***

Author: Murphy DP; Lampert V

Source: American Journal of Physical Medicine and Rehabilitation, January 2003, Volume 82, Number 1: 72-5

Abstract: A 54-yr-old man with C6 quadriplegia and a neurogenic bowel and bladder was evaluated for clearance of a urinary tract infection after treatment for organisms susceptible to the antibiotics used, and an organism resistant to all antibiotics on the panel grew on the initial follow-up urine culture. Multidrug-resistant organisms present increasing challenges and risks in the management of the neurogenic bladder in patients with spinal cord injury. In an effort to control and reduce the impact and risk associated with these organisms, management methods of the neurogenic bladder and infection control policies should be adjusted according to guidelines from the Centers for Disease Control and related research; such policies could include surveillance for multidrug-resistant organisms and isolation of patients who test positive for these organisms.

Title: ***Intramedullary spinal cavernous malformation following spinal irradiation. Case report and review of the literature.***

Author: Narayan P; Barrow DL

Source: Journal of Neurosurgery, January 2003, Volume 98, Supplement 1: 68-72

Abstract: There is a growing body of evidence in the literature suggesting that cavernous malformations of the central nervous system may develop after neuraxis irradiation. The authors discuss the case of a 17-year-old man who presented with progressive back pain and myelopathy 13 years after undergoing craniospinal irradiation for a posterior fossa medulloblastoma. Spinal magnetic resonance (MR) imaging, performed at the time of his initial presentation with a medulloblastoma, demonstrated no evidence of a malformation. Imaging studies and evaluation of cerebrospinal fluid revealed no evidence of recurrence or dissemination. Spinal MR imaging demonstrated an extensive lesion in the thoracic spine with an associated syrinx suggestive of a cavernous malformation. A thoracic laminectomy was performed and the malformation was successfully resected. Pathological examination confirmed the diagnosis. The patient did well after surgery and was ambulating without assistance 6 weeks later. To the best of the authors' knowledge, this is the second reported case in the literature and the first in the young adult age group suggesting the de novo development of cavernous malformations in the spinal cord after radiotherapy. An increased awareness of these lesions and close follow-up examination are recommended in this setting.

Title: ***Fall-related fractures in persons with spinal cord impairment: A descriptive analysis.***

Author: Nelson A; Ahmed S; Harrow J; Fitzgerald S; Sanchez-Anguiano A; Gavin-Dreschnack D

Source: SCI Nursing, Spring 2003, Volume 20, Number 1: 30-7

Abstract: Falls are a significant cause of injury, disability, and death in the elderly, but little is known about the risk of wheelchair-related falls. The purpose of this study is to describe the incidence, etiology, location of fracture, treatment, and health care utilization of fall-related fractures in persons with spinal cord impairment (SCI). A retrospective review of 45 medical records of patients with SCI who sustained fractures, nonconcomitant with the onset of their initial injury, was completed at a Veterans Health Administration (VHA) SCI service over a 10-year period. Of the 24 veterans who sustained fall-related fractures, three (12%) were found to have repeated falls with fractures. Falls were sustained during activities (more than one wheelchair activity contributed to a fall; e.g., transfer activity with brake failure in a van) including transfer (44%), reaching (11%), propelling (15%),

moving in bed (22%), transferring or riding in a vehicle (30%), and showering (7%). Factors contributing to falls included loss of balance, equipment failure, muscle spasms, excessive speed, not wearing protective straps, and narcolepsy. Among the 31 fractures sustained in 27 fall episodes in 24 subjects, lower extremity fractures accounted for 97% of the injuries and a fractured 7th rib accounted for one injury (3%). Tibial fractures occurred more frequently than femoral or ankle fractures. Four (15%) fall episodes resulted in bilateral fractures. The treatment of choice was to immobilize the fractured extremity with a soft, well-padded splint. Surgical fixation was performed in only two cases. Over 80% of the patients with fall-related fractures were admitted for inpatient stays with a mean of 66 inpatient days per patient. Hospital days were most often the result of home inaccessibility, inadequate support at home, or surgical intervention.

Title: ***Nitrous oxide use in first-year students at Auckland University.***

Author: Ng J; O'Grady G; Pettit T; Frith R

Source: Lancet, April 19, 2003, Volume 361, Number 9366: 1349-50

Abstract: In a recent Lancet Case report, a patient presented with subacute combined degeneration of the spinal cord after recreational use of nitrous oxide (N<sub>2</sub>O). There is very little information about use of this substance as a recreational drug. In a questionnaire-based study, we surveyed 1782 students in their first year at the University of Auckland, New Zealand. 1360 (76%) questionnaires were completed and consistent. 780 (57%) students were aware of recreational use of N<sub>2</sub>O, 158 (12%) used the substance recreationally, and 39 (3%) inhaled it at least monthly. Users were most likely to be white and to be men. Our results show a high frequency of recreational N<sub>2</sub>O use in first-year students at Auckland University. Although this study does not accurately reflect use of this substance in the wider community, the high prevalence suggests that presentations of subacute myelopathy in an otherwise fit young person should prompt an enquiry about use of N<sub>2</sub>O.

Title: ***Postacute management of patients with spinal cord injury due to metastatic tumour disease: Survival and efficacy of rehabilitation.***

Author: Parsch D; Mikut R; Abel R

Source: Spinal Cord, April 2003, Volume 41, Volume 4: 205-10

Abstract: STUDY DESIGN: Retrospective study utilising clinical records and public administration databases. OBJECTIVES: This study was performed to analyse the clinical presentation and survival rate of individuals with spinal cord injury (SCI) due to spinal metastasis after primary treatment, and to evaluate the efficacy of rehabilitative efforts.

SETTING: Spinal Cord Injury Unit, University Hospital, Heidelberg.

METHODS: A total of 68 consecutive patients were included. Demographics, clinical data, tumour type, level and completeness of SCI, initial treatment, functional independence measure (FIM) and survival time were derived from hospital and public administration databases. Cox regression and fuzzy logic rule generation were used for statistical analysis.

RESULTS: Of the 68 patients, 66 patients died 11 months (median, interquartile range (IQR) 4-29 months) after the onset of neurological symptoms at an average age of 58 years. The functional independence measure (FIM) score describing the general clinical and functional status proved to be the most reliable prognostic factor of survival. Other more specific parameters (eg tumour type or level of lesion) did not have such an impact. In total, 51 patients completed the rehabilitation programme within 50 days (median, IQR 27-99 days). The FIM score improved from 62 at admission to 84 at discharge.

CONCLUSION: The clinical and functional status is a valuable prognostic factor for survival. Since institutionalized rehabilitative efforts are effective, this group of patients should be accepted into such a program.

Title: ***Use of data from nonrandomized trial designs in evidence reports: An application to treatment of pulmonary disease following spinal cord injury.***

Author: Samsa GP; Govert J; Matchar DB; McCrory DC

Source: Journal of Rehabilitation Research and Development, January–February 2002, Volume 39, Number 1: 41-52

Abstract: Evidence reports summarize the evidence pertaining to various health-related topics. Including evidence from nonrandomized studies into such reports involves a trade-off between availability and bias. We describe a general framework by which information from nonrandomized studies might be integrated reasonably into evidence reports and illustrate its application to a recent evidence report on preventing pulmonary complications among patients with spinal cord injury. The proposed framework, which is based upon the premise that producing a fair summary of the evidence requires only a level of evidence judged by clinical experts to be sufficient to the task at hand, may help focus scarce resources, strengthen the quality and documentation of decisions including evidence from nonrandomized studies, and suggest high-priority areas for future research.

Title: ***4-aminopyridine influences heart rate variability in long-standing spinal cord injury.***

Author: Segal JL; Warner AL; Brunnemann SR; Buntzen DC

Source: American Journal of Therapeutics, January–February 2002, Volume 9, Number 1: 29-33

Abstract: Humans with traumatic spinal myelopathy exhibit intralesional conduction block and autonomic failure as pathophysiologic sequelae of their injury. Analysis of heart rate variability (HRV) provides a means of assessing changes in the function of the autonomic nervous system (ANS) and the cardiac sequelae of injury. Thirteen patients with long-standing spinal cord injury (SCI) and 13 able-bodied controls were studied. Each patient received a single 10-mg dose of an immediate release (IR) formulation of 4-aminopyridine (4-AP). Twenty-four hour heart rate (HR) and HRV data were acquired using a Holter ambulatory electrocardiographic (ECG) monitor. Analysis of acquired data was carried out using a minicomputer programmed to separate ECG R-R intervals into frequency patterns that appear as peaks dispersed along a frequency range of 0.0 to 1.0 Hz. Twenty-four hour baseline, pretreatment low-frequency (LF) HRV power was diminished in all patients with SCI compared with able-bodied-controls and was significantly decreased in tetraplegic patients ( $P = 0.03$ ). This difference in LF HRV power disappeared during the 24 hours immediately after administration of 4-AP, and mean LF HRV power in tetraplegic patients became indistinguishable from LF HRV power in controls. 4-Aminopyridine appears to influence ANS function and LF HRV in humans with long-standing SCI.

Title: ***Pharmacological interventions for spasticity following spinal cord Injury.***

Author: Taricco M; Adone R; Pagliacci C; Telaro E

Source: The Cochrane Library, 2003, Oxford, Publisher Information Number 2.

Abstract: A substantive amendment to this systematic review was last made on 31 January 2000. Cochrane reviews are regularly checked and updated if necessary.

BACKGROUND: Spasticity is a major health problem for patients with a spinal cord injury (SCI) that limits patients' mobility and affects independence in activities of daily living and work. Spasticity may also cause pain, loss of range of motion, contractures, sleep disorders and impair ambulation in patients with an incomplete lesion. The effectiveness of available drugs is still uncertain and they may cause adverse effects. Assessing what works in this area is complicated by the lack of valid and

reliable measurement tools. The aim of this systematic review is to critically appraise and summarise existing information of the effectiveness of available treatments and to identify areas where further research is needed.

**OBJECTIVES:** To assess the effectiveness and safety of Baclofen, Dantrolene, Tizanidine and any other drugs for the treatment of long term spasticity in SCI patients as well as the effectiveness and safety of different routes of administration of Baclofen.

**SEARCH STRATEGY:** We searched the Injuries Group specialised register, the Cochrane Controlled Trials Register, MEDLINE, EMBASE and CINHALH up to 1998. Drug companies and experts active in the area were also contacted.

**SELECTION CRITERIA:** All parallel and crossover RCTs including spinal cord injury patients complaining of "severe spasticity". Studies where less than 50% of patients had a spinal cord injury were excluded.

**DATA COLLECTION AND ANALYSIS:** Methodological quality of studies (allocation concealment, blinding, patients characteristics, inclusion and exclusion criteria; interventions; outcomes; lost to follow up) was independently assessed by two investigators. The heterogeneity among studies did not allow quantitative combination of results.

**MAIN RESULTS:** Nine out of 53 studies met the inclusion criteria. Study design was: 8 cross over, 1 parallel-group trial. Two studies (14 SCI patients), showed a significant effect of intrathecal baclofen in reducing spasticity (Ashworth Score and ADL performances), compared to placebo, without any side effect. The study comparing tizanidine to placebo (118 SCI patients) showed a significant effect of tizanidine in improving Ashworth Score but not in ADL performances. Tizanidine group reported significant rates of adverse effects (drowsiness, xerostomia). For the other drugs (Gabapentine, Clonidine, Diazepam, Amytal and oral Baclofen ) the results do not provide evidence for a clinical significant effectiveness.

**REVIEWERS' CONCLUSIONS:** There is insufficient evidence to assist clinicians in a rational approach to antispastic treatment for SCI. Further research is urgently needed to improve the scientific basis of patient care.

Title: ***Dysphagia in patients with acute cervical spinal cord injury.***

Author: Wolf C; Meiners TH

Source: Spinal Cord, June 2003, Volume 41, Number 6: 347-53

Abstract: **STUDY DESIGN:** Longitudinal observational.

**OBJECTIVES:** (a) To establish a reliable and feasible method to indicate the presence and severity of dysphagia and (b) to establish a course of treatment in individuals presenting with cervical spinal cord injury (CSCI).

**SETTING:** Spinal Cord Injury Center, Werner Wicker Klinik, Bad Wildungen, Germany.

**PATIENTS AND METHODS:** This is a cross-sectional study of 51 patients consecutively admitted to the Intensive Care Unit of the SCI in-patient service. They were subjected to neurological and fiberoptic endoscopic examination of swallowing (FEES). Data concerning artificial respiration, presence of tracheostomy, oral or non-oral feeding were obtained from the medical charts. Statistics were carried out by a calculation of a nonparametric correlation (Spearman).

**RESULTS:** Five levels of dysphagia could be distinguished. At levels 1 and 2, patients presented with a severe impairment of swallowing, in level 3 aspiration was met by a powerful coughing reflex, level 4 comprised a laryngeal edema and/or a mild aspiration of fluids only and at level 5 laryngeal function was not compromised. On admission, 20 patients with CSCI presented with mild (level 4), eight with moderate (level 3) and 13 with severe dysphagia (levels 1 and 2). In 10 no signs of dysphagia could be detected. After treatment, level 1 was no longer detected, one patient showed level 2, two patients showed level 3, all other patients showed only mild or no signs of dysphagia any longer.

**CONCLUSIONS:** Dysphagia of various severities was present in the majority of these patients with CSCI together with respiratory insufficiency. FEES allows for the detection and classification of dysphagia as well as for an evaluation of the therapeutic management. Under interdisciplinary treatment the prognosis of dysphagia is good.

Title: ***Clinical trial of acupuncture for patients with spinal cord injuries.***

Author: Wong AM; Leong CP; Su TY; Yu SW; Tsai WC; Chen CP

Source: American Journal of Physical Medicine and Rehabilitation, January 2003, Volume 82, Number 1: 21-7

Abstract: OBJECTIVE: To examine whether electrical acupuncture therapy through adhesive surface electrodes and concomitant auricular acupuncture therapy could improve the neurologic or functional recovery in acute traumatic spinal cord injury patients.  
DESIGN: A total of 100 acute traumatic spinal cord injury patients with American Spinal Injury Association (ASIA) impairment grading of A and B were recruited into this study. They were randomly divided into the acupuncture and control groups. In the acupuncture group, electrical acupuncture therapy via the adhesive surface electrodes were applied to the bilateral Hou Hsi (SI3) and Shen Mo (B62) acupoints. In auricular acupuncture, four acupoints related to the spinal cord were selected for stimulation at the antihelix, helix, and lower portion of the ear-back areas. Acupuncture therapy was initiated early in the emergency room setting or soon after spinal surgical intervention. Rehabilitation therapy was also provided to the patients during acupuncture therapy. In the control group, only rehabilitation therapy was provided to the patients. Neurologic and functional scores were assessed during the time of admission, hospital discharge, and 1-yr postinjury follow-up.  
RESULTS: There were significant improvements in neurologic (sensory and motor), functional, and FIM scores in the acupuncture group compared with the initial admission period when assessed during the time of hospital discharge and the 1-yr postinjury follow-up. A greater percentage of patients in the acupuncture group recovered to a higher ASIA impairment grading.  
CONCLUSION: The use of concomitant auricular and electrical acupuncture therapies, when implemented early in acute spinal cord injury, can contribute to significant neurologic and functional recoveries.

Title: ***Developing clinical practice guidelines for spinal cord medicine: Lessons learned.***

Author: Biddle AK; Fraher EP

Source: Physical Medicine and Rehabilitation Clinics of North America, February 2000, Volume 11, Number 1: 227-43

Abstract: This article describes the process used by the Consortium for Spinal Cord Medicine to develop evidence-based clinical practice guidelines for managing and treating individuals with spinal cord injury and provides important information on lessons learned and the potential problems to avoid. Issues to consider during the guideline development process include topic selection and explication, methods for selecting the panel chair and panel members, the writing of recommendations and supporting scientific rationales, peer-reviewing guidelines, and the process for disseminating, implementing, and evaluating guidelines. The applicability, advantages, and disadvantages of available evidence and guideline recommendation grading systems and issues arising from the lack of scientific evidence supporting particular recommendations are also discussed. Copyright (c) 2000 by W.B. Saunders Company

## Neurogenic Bowel and Bladder

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Title: ***The prevention and management of urinary tract infections among people with spinal cord injuries.***

Author: Corporate Name National Institute on Disability and Rehabilitation Research

Source: SCI Nursing, June 1993, Volume 10, Number 2: 49-61

Abstract: The Urinary Tract Infection Consensus Conference brought together researchers, clinicians, and consumers to arrive at consensus on the best practices for preventing and treating urinary tract infections in people with spinal cord injuries; the risk factor and diagnostic studies that should be done; indications for antibiotic use; appropriate follow-up management; and needed future research. Urinary tract infection (UTI) was defined as bacteriuria (10<sup>2</sup> bacteria/ml of urine) with tissue invasion and resultant tissue response with signs and/or symptoms. Asymptomatic bacteriuria represents colonization of the urinary tract without symptoms or signs. Risk factors include: over-distention of bladder, vesicoureteral reflux, high pressure voiding, large post-void residuals, presence of stones in urinary tract, and outlet obstruction. Possible physiologic/structural, behavioral, and demographic risk factors were identified also, Indwelling catheterization, including suprapubic, and urinary diversion and the drainage methods most likely to lead to persistent bacteriuria. Infection risk is reduced with intermittent catheterization, but more severely disabled people who require catheterization by others are at greater risk for UTIs. Clean self-intermittent catheterization does not pose a greater risk of infection than sterile self-intermittent catheterization and is much more economic. However, care must be given to proper cleansing of reusable catheters. Quantitative urine-culture criteria for the diagnosis of bacteriuria include: catheter specimens from individuals on intermittent catheterization > or = 10 squared cfu/ml; clean-void specimens from catheter-free males using condom collection devices > or = 10 to the fourth power cfu/ml; and specimens from indwelling catheters of any detectable concentration. Dip stick screening tests may offer promise as an early warning system of UTI since they can be self-administered. Symptomatic UTI should be treated with antibiotics for 7 to 14 days. Longer courses have not been beneficial. In patients with symptomatic UTIs, it is not necessary to wait for the results of cultures before starting treatment. Asymptomatic bacteriuria need not be treated with antibiotics. There is little evidence presently to support the use of antibiotics to prevent infections. Following a recent episode of febrile UTI, possible contributing prior events should be reviewed. The upper tracts should be evaluated (imaging studies) to identify possible abnormalities. A common concern among people with spinal cord injuries is that physicians will alter bladder management programs without regard to lifestyle needs. Social/vocational flexibility may be more important to them than a state-of-the-art bladder management program. Future research should focus on obtaining more representative samples and investigate psycho-social-vocational implications as well as additional clinical-medical factors.

Title: ***Disruption of bladder epithelium barrier function after spinal cord injury.***

Author: Apodaca G; Kiss S; Ruiz W; Meyers S; Zeidel M; Birder L

Source: American Journal of Physiology—Renal Physiology, May 2003, Volume 284, Number 5: F966-76. Epub January 14, 2003

Abstract: Neural-epithelial interactions are hypothesized to play an important role in bladder function. We determined whether spinal cord injury (SCI) altered several indicators of urinary bladder epithelium barrier function, including continuity of the surface umbrella cell layer, transepithelial resistance (TER), and urea and water permeability. Within 2 h of SCI, significant changes in uroepithelium were noted, including disruption of the surface umbrella cells and an approximately 50% decrease in TER. By 24 h, TER reached a minimum and was accompanied by significant increases in water and urea permeability. Regeneration of the surface uroepithelium was accomplished by 14 days after SCI and was accompanied by a return to normal TER and urea and water permeabilities. This early disruption

of the uroepithelial permeability and accompanying changes in uroepithelial morphology were prevented by pretreatment with hexamethonium (a blocker of ganglion transmission), indicating involvement of sympathetic or parasympathetic input to the urinary bladder. In addition, prior treatment with capsaicin worsened the effect of SCI on uroepithelial permeability, suggesting that capsaicin-sensitive afferents may play a protective role in the process. These results demonstrate that SCI results in a significant disruption of the urinary bladder uroepithelium and that these changes may be mediated in part by an interaction with bladder nerves.

Title: ***Structural basis of neurogenic bladder dysfunction. III. Intrinsic detrusor innervation.***

Author: Haferkamp A; Dorsam J; Resnick NM; Yalla SV; Elbadawi A

Source: Journal of Urology, February 2003, Volume 169, Number 2: 555-62

Abstract: PURPOSE: We studied the ultrastructure of intrinsic detrusor innervation in long-standing neurogenic bladder dysfunction in the human.

MATERIALS AND METHODS: Endoscopic or open detrusor biopsies were obtained from 15 female and 31 male patients 7 to 96 years old who had hyperreflexic neurogenic bladder dysfunction for less than 1 to 43 years. Of the patients 9 had meningomyelocele, 25 had spinal cord injury and 12 had a brain disorder. Changes in intrinsic detrusor nerves were evaluated by electron microscopy qualitatively and quantitatively according to predefined criteria.

RESULTS: Axonal degeneration was observed in 44 of the 45 biopsies with discernible intrinsic nerves. Structurally normal axons were 5(1/2) or 4 times more common in brain disorder than meningomyelocele or spinal cord injury group biopsies (median 33%, 6%, 8%, respectively). Axonal regeneration, not encountered in nonneuropathic dysfunctional detrusors, was observed in restricted distribution in most biopsies (76%) and was independent of the duration of neurogenic bladder dysfunction. Axon sprouts were observed in 17 biopsies (38%), and copeptidergic axons formed 20% (median per biopsy) of discernible axon profiles in contrast to less than 1% in normal detrusor. Activated Schwann cells were observed in all but 1 biopsy. The axonal changes were not associated with the level or degree of spinal cord lesion in patients with meningomyelocele or spinal cord injury. CONCLUSIONS: Combined degeneration and regeneration is the characteristic change in intrinsic nerves of detrusor in upper motoneuron neurogenic bladder dysfunction. The observed changes offer the possibility of clinically recognizing neuropathic contribution to a dysfunctional detrusor, as well as the potential to distinguish its spinal versus supraspinal etiology.

Title: ***Structural basis of neurogenic bladder dysfunction. II. Myogenic basis of detrusor hyperreflexia.***

Author: Haferkamp A; Dorsam J; Resnick NM; Yalla SV; Elbadawi A

Source: Journal of Urology, February 2003, Volume 169, Number 2: 547-54

Abstract: PURPOSE: We describe the ultrastructure of detrusor smooth muscle in long-standing neurogenic bladder dysfunction in the human.

MATERIALS AND METHODS: Detrusor biopsies were obtained from (15 female and 31 male) patients 7 to 96 years old with neurogenic bladder dysfunction for less than 1 to 43 years. Of the patients 9 had meningomyelocele, 25 spinal cord injury and 12 brain disorder. Urodynamically, all patients had detrusor hyperreflexia (neurogenic detrusor overactivity) in addition to bladder outlet obstruction in 4, impaired detrusor contractility in 19, decreased bladder compliance in 4, and detrusor-sphincter dyssynergia in 24. Ultrastructural changes in detrusor, including those associated with detrusor overactivity, impaired detrusor contractility and bladder outlet obstruction, were evaluated qualitatively and quantitatively.

RESULTS: Intermediate junctions of muscle cells were absent or reduced in 45 biopsies, which instead had dominant intimate cell appositions with much narrower junctional gaps. A greater than 2 intimate cell apposition-to-intermediate junction ratio was present in 45 biopsies (98%), and intimate

cell apposition linked chains of 5 muscle cells or greater in all biopsies (100%). Muscle cell degeneration was observed in 34 biopsies from 20 of 27 patients (74%) with normal contractility and 14 of 19 (74%) with impaired detrusor contractility. No particular changes were associated with functional bladder outlet obstruction due to detrusor-sphincter dyssynergia.

**CONCLUSIONS:** The ultrastructural complete dysjunction pattern is a feature of hyperreflexia as well as nonneuropathic detrusor overactivity of various etiology. A greater than 2 intimate cell apposition-to-intermediate junction ratio had 98% sensitivity but its specificity remains to be determined. The lack of relationship between muscle cell degeneration and detrusor contractility probably reflects limitations of urodynamic measurement of contractility in patients with spinal cord injury and meningomyelocele.

**Title:** *The role of capsaicin-sensitive afferents in autonomic dysreflexia in patients with spinal cord injury.*

**Author:** Igawa Y; Satoh T; Mizusawa H; Seki S; Kato H; Ishizuka O; Nishizawa O

**Source:** BJU International, May 2003, Volume 91, Number 7: 637-41

**Abstract:** **OBJECTIVES:** To determine whether capsaicin-sensitive nerves in the bladder form the afferent limb involved in autonomic dysreflexia (AD) in patients with spinal cord injury (SCI).  
**PATIENTS AND METHODS:** Seven men with SCI (five cervical cord, two thoracic cord) with AD and detrusor hyper-reflexia (DH) were enrolled. Under general anaesthesia, capsaicin solution (100 mL of 2 mmol/L in 10% ethanol) was instilled in the bladder and retained for 30 min. The patients were assessed by medium-fill cystometry (CMG) just before and 50 min after the capsaicin treatment. Intra-arterial blood pressure (BP) and heart rate were monitored continuously throughout the procedure; 10% ethanol was instilled before capsaicin treatment in four patients as a control. Serum catecholamines were measured during bladder filling and capsaicin treatment, and the blood ethanol concentration also measured after instillation in all patients. The CMG with concomitant monitoring of BP and heart rate was repeated 1 week, 1, 3, 6, 12 and 24 months after instillation. In two patients the instillations were repeated 5 and 12 months after the first because of recurrence of DH. Urodynamic variables assessed were maximum cystometric capacity (MCC), maximum amplitude of uninhibited detrusor contraction (UICmax), the bladder capacity at 40 cmH<sub>2</sub>O detrusor pressure (Cdp40) and a systolic BP of > 140 mmHg or diastolic BP of > 90 mmHg (C(HT)).  
**RESULTS:** There was an increase in BP and a decrease in heart rate in all patients during bladder filling before capsaicin treatment. Instillation of capsaicin produced a significant increase in both systolic and diastolic BP and a significant decrease in heart rate. The maximum cardiovascular effects were at 5-10 min after instillation and gradually returned to baseline within 40 min. The vehicle had negligible effects on either BP or heart rate. After capsaicin treatment, the responses of BP and heart rate to bladder distension were significantly reduced. Both serum catecholamine values and the blood ethanol concentration remained within normal limits. The mean (range) follow-up after the first treatment was 15 (6-30) months. One month after treatment all seven patients became continent and their episodes of AD became negligible and well tolerable between catheterizations (for 3-4 h); the effects lasted for  $\geq$  3 months in all. MCC was significantly increased at 4 weeks and 3 months, and UICmax significantly decreased at 4 weeks after treatment. Both mean Cdp40 and C(HT) increased 1 week, 1 and 3 months after treatment. Two patients received a second instillation, and have been continent with no symptomatic AD for 6 and 24 months. The remaining five patients have been continent with no symptomatic AD for 6-12 months.  
**CONCLUSION:** These results indicate that intravesical capsaicin, but not the vehicle, acutely triggers AD in patients with SCI, suggesting involvement of bladder capsaicin-sensitive afferents in AD in these patients. The results also suggest that intravesical capsaicin may be a promising therapy for both AD and DH in such patients. Further long-term follow-up studies are needed to evaluate the duration of its effect.

Title: ***Evaluation of anorectal function in patients with tethered cord syndrome: Saline enema test and fecoflowmetry.***

Author: Kayaba H; Hebiguchi T; Itoh Y; Yoshino H; Mizuno M; Morii M; Adachi T; Chihara J; Kato T

Source: Journal of Neurosurgery, April 2003, Volume 98, Supplement 3: 251-7

Abstract: OBJECT: Disturbance in anorectal function is a major factor restricting the activities of daily living in patients with spinal cord disorders. To detect changes in anorectal motilities due to a tethered spinal cord, anorectal functions were evaluated using a saline enema test and fecoflowmetry before and after patients underwent untethering surgery.  
METHODS: The bowel functions in five patients with a tethered cord syndrome (TCS) were evaluated by performing a saline enema test and fecoflowmetry. The contractile activity of the rectum, the volume of infused saline tolerated in the rectum, anal canal pressure, and the ability to evacuate rectal content were examined. The characteristic findings in anorectal motility studies conducted in patients with TCS were a hyperactive rectum, diminished rectal saline-retention ability, and diminished maximal flow in saline evacuation. A hyperactive rectum was considered to be a major contributing factor to fecal incontinence. In one asymptomatic patient diminished anal squeezing pressure was exhibited and was incontinent to liquid preoperatively, but recovered after surgery. Two patients who underwent surgery for myeloschisis as infants complained of progressive fecal incontinence when they became adolescents. In one patient fecal incontinence improved but in another patient no improvement was observed after untethering surgery.  
CONCLUSIONS: Fecodynamic studies allow the detection of neurogenic disturbances of the anorectum in symptomatic and also in asymptomatic patients with TCS. More attention should be paid to the anorectal functions of patients with TCS.

Title: ***Silent autonomic dysreflexia during a routine bowel program in persons with traumatic spinal cord injury: A preliminary study.***

Author: Kirshblum SC; House JG; O'Connor KC

Source: Archives of Physical Medicine and Rehabilitation, December 2002, Volume 83, Number 12: 1774-6

Abstract: OBJECTIVE: To determine the existence and frequency of silent autonomic dysreflexia in subjects with a complete spinal cord injury (SCI) above the neurologic level of T6.  
DESIGN: Prospective design.  
SETTING: Blood pressure monitoring of subjects during a routine bowel program.  
PARTICIPANTS: Ten subjects with chronic (>1 y), complete (American Spinal Injury Association Impairment Scale class A) SCI with a neurologic level of injury above T6.  
INTERVENTIONS: Not applicable.  
MAIN OUTCOME MEASURES: An increase in systolic blood pressure (SBP) of greater than 20 to 40 mmHg above baseline or an SBP greater than 150 mmHg.  
RESULTS: The mean resting blood pressure for the subject group was 104/65 mmHg. During the bowel program, no subject reported experiencing any of the classic symptoms of autonomic dysreflexia. The mean maximum blood pressure recorded during the bowel program was 160/90 mmHg. All of the patients had an increase in SBP greater than 20 mmHg above baseline, and 70% had an increase in SBP greater than 40 mmHg above baseline. Sixty percent of subjects had an increase in SBP greater than 150 mmHg, with 40% of subjects reaching an SBP greater than 170 mmHg at least once during their bowel program.  
CONCLUSION: Silent autonomic dysreflexia occurs frequently in SCI during bowel programs. Further study is recommended to determine whether preventative measures or treatment is needed.

Title: ***Comparison between conventional cystometry and stimulated filling cystometry by diuretics in a neurogenic bladder after spinal cord injury.***

Author: Ko H; Lee JZ; Park HJ; Kim H; Park JH

Source: American Journal of Physical Medicine and Rehabilitation, October 2002, Volume 81, Number 10: 731-5

Abstract: OBJECTIVE: To determine in the neurogenic bladder whether cystometry performed under near physiologic condition by filling stimulation using diuretics reveals different findings compared with conventional cystometry (CMG).  
DESIGN: One group of subjects from a university teaching hospital was tested in two conditions. The maximum detrusor pressure (MPdet) and compliance of the bladder in CMG and furosemide-stimulated filling cystometry (FCMG) were compared in 27 patients with neurogenic bladder after spinal cord injury. The MPdet was estimated. Compliance was calculated. For CMG, the bladder was filled. FCMG was performed 3 hr after CMG. For FCMG, furosemide was injected after infusion of normal saline. Recording intravesical pressure started after emptying the bladder immediately after furosemide injection.  
RESULTS: Significant differences were found between CMG and FCMG in hyperreflexic neurogenic bladders with respect to a decrease in MPdet and increase in compliance with FCMG. However, there were no significant differences in MPdet and compliance in hyporeflexic or areflexic neurogenic bladders between the two techniques.  
CONCLUSION: We have found that FCMG is useful in evaluating both genuine MPdet and compliance in patients with hyperreflexic neurogenic bladder dysfunction. FCMG provides more reliable information on detrusor characteristics than CMG in hyperreflexic neurogenic bladder. We suggest that FCMG is an alternative, effective, and near physiologic diagnostic method, having short assessment time for improving evaluation of the detrusor characteristics of hyperreflexic neurogenic bladder.

Title: ***Effects of ejaculation by penile vibratory stimulation on bladder capacity in men with spinal cord lesions.***

Author: Laessoe L; Sonksen J; Bagi P; Biering-Sorensen F; Ohl DA; McGuire EJ; Kristensen JK

Source: Journal of Urology, June 2003, Volume 169, Number 6: 2216-9

Abstract: PURPOSE: We examined the effects of ejaculation by penile vibratory stimulation on bladder capacity in men with spinal cord lesions.  
MATERIAL AND METHODS: Included in our study were 14 men with spinal cord lesions from C4 to T7 with detrusor hyperreflexia. Cystometry was performed before and immediately after ejaculation by penile vibratory stimulation to establish baseline conditions and repeated after 1 month of ejaculation by penile vibratory stimulation every third day. The third cystometry study was done after 1 month of ejaculation by penile vibratory stimulation every third day at home to determine any long-term effects of treatment. This third cystometry was performed 72 hours after the last ejaculation to exclude any acute effects of ejaculation by penile vibratory stimulation on detrusor hyperreflexia. In addition, 1 to 3 days later ejaculation was induced by penile vibratory stimulation and immediately followed by cystometry to examine whether it was possible to achieve an acute effect as well as a potential long-term effect.  
RESULTS: Baseline urodynamic investigations revealed bladder hyperreflexia and external sphincter dyssynergia in all individuals. There was no statistically significant difference in bladder capacity at leak point before and immediately after ejaculation by penile vibratory stimulation. However, after 4 weeks of frequent penile vibratory stimulation treatment bladder capacity at leak point increased significantly from a median of 190 ml. (range 17 to 700) at baseline to 293 (range 30 to 700) (Wilcoxon

signed rank test  $p = 0.03$ ). Furthermore, there was a trend toward decreased intravesical pressure during the filling phase.

**CONCLUSIONS:** Ejaculation by penile vibratory stimulation was associated with a significant increase in bladder capacity at leak point after 4 weeks of frequent treatment. This finding may have implications in the management of incontinence in men with spinal cord lesions.

**Title:** *Detrusor and blood pressure responses to dorsal penile nerve stimulation during hyperreflexic contraction of the bladder in patients with cervical cord injury.*

**Author:** Lee YH; Creasey GH; Lim H; Song J; Song K; Kim J

**Source:** Archives of Physical Medicine and Rehabilitation, January 2003, Volume 84, Number 1: 136-40

**Abstract:** **OBJECTIVE:** To investigate the immediate effect of dorsal penile nerve (DPN) stimulation on detrusor pressure (P(det)) and blood pressure during hyperreflexic contractions of the bladder in patients with cervical spinal cord injury (SCI).

**DESIGN:** Blood pressure and P(det) monitoring during cystometry with and without DPN stimulation.

**SETTING:** Urodynamic laboratory in a university hospital in Korea.

**PARTICIPANTS:** Eight men (age range, 20-55y) with cervical SCI that was incurred from 4 months to 10 years before this study.

**INTERVENTION:** During water cystometry, blood pressure was monitored with an intra-arterial catheter introduced percutaneously into the radial artery and was recorded simultaneously with the P(det). Blood pressure was also measured manually with an electronic blood pressure cuff. Electric stimulation was applied to the DPN by using surface electrodes each time a bladder contraction was detected. Stimulation intensity was twice the threshold of the pudendal-anal reflex.

**MAIN OUTCOME MEASURES:** P(det), systolic blood pressure, and diastolic blood pressure.

**RESULTS:** As P(det) increased, the blood pressure increased in all cases. All the reflex contractions of the bladder were effectively suppressed by DPN stimulation, and as the P(det) decreased during stimulation, radial arterial pressure also decreased immediately and significantly.

**CONCLUSIONS:** DPN stimulation can decrease P(det) and the increased blood pressure associated with it.

**Title:** *Current implications of drug resistance in spinal cord injury.*

**Author:** Murphy DP; Lampert V

**Source:** American Journal of Physical Medicine and Rehabilitation, January 2003, Volume 82, Number 1: 72-5

**Abstract:** A 54-yr-old man with C6 quadriplegia and a neurogenic bowel and bladder was evaluated for clearance of a urinary tract infection after treatment for organisms susceptible to the antibiotics used, and an organism resistant to all antibiotics on the panel grew on the initial follow-up urine culture. Multidrug-resistant organisms present increasing challenges and risks in the management of the neurogenic bladder in patients with spinal cord injury. In an effort to control and reduce the impact and risk associated with these organisms, management methods of the neurogenic bladder and infection control policies should be adjusted according to guidelines from the Centers for Disease Control and related research; such policies could include surveillance for multidrug-resistant organisms and isolation of patients who test positive for these organisms.

Title: ***Long-term urodynamics followup of bladder augmentation for neurogenic bladder.***

Author: Quek ML; Ginsberg DA

Source: Journal of Urology, January 2003, Volume 169, Number 1: 195-8

Abstract: PURPOSE: Augmentation enterocystoplasty is well tolerated by patients with neurogenic bladder in whom conservative therapy has failed. However, few studies exist on long-term urodynamic evaluation of these patients. We assessed the clinical and urodynamic outcomes of patients with neurogenic bladder treated with augmentation enterocystoplasty with at least 4 years of followup. MATERIALS AND METHODS: A total of 26 patients with neurogenic voiding dysfunction underwent augmentation enterocystoplasty alone or in conjunction with various continence or antireflux techniques. Clinical outcomes regarding incontinence, medications, catheterization schedule, subsequent interventions, bowel function and patient satisfaction were addressed. Urodynamic evaluation was performed to assess the long-term durability of bladder augmentation. RESULTS: Mean followup was 8.0 years (range 4 to 13). All but 1 patient (96%) in our series had near or complete resolution of urinary incontinence. Mean total bladder capacity +/- SD increased from 201 +/- 106 to 615 +/- 204 ml. ( $p < 0.001$ ) and mean maximum detrusor pressure decreased from 81 +/- 43 to 20 +/- 12 cm. H<sub>2</sub>O ( $p < 0.01$ ). Mean interval between catheterizations was 5 hours, with volumes ranging from 314 to 743 ml. Only 2 patients (8%) needed a low dose of oxybutynin postoperatively to maintain continence consistently. Of the 26 patients 23 (88%) reported no significant change in bowel function and nearly all patients expressed extreme satisfaction with urological management. A subsequent urological procedure was required in 12 patients (46%) at a mean of 4.4 years after initial surgery. (2)CONCLUSIONS: Bladder augmentation provides durable clinical and urodynamic improvement for patients with neurogenic bladder dysfunction refractory to conservative therapy. Furthermore, there is a high level of patient satisfaction with bladder augmentation.

Title: ***Current practice patterns in the urologic surveillance and management of patients with spinal cord injury.***

Author: Razdan S; Leboeuf L; Meinbach DS; Weinstein D; Gousse AE

Source: Urology, May 2003, Volume 61, Number 5: 893-6

Abstract: OBJECTIVES: To determine current trends in management and surveillance of the spinal cord injury (SCI) population among specialized urologists who routinely work and provide care to patients with SCI. There is a lack of consensus on the optimal urologic surveillance and management protocol of the urinary tract in SCI patients. METHODS: A mailed questionnaire was sent to the 269 American members of the Society for Urodynamics and Female Urology (SUFU). The type of investigation used in the assessment and follow-up of upper and lower urinary tract function in SCI patients and their optimal frequency and management modalities were the topics of inquiry. RESULTS: One hundred sixty of the 269 urologists responded for a response rate of 60%. Most physicians (85%) favor a yearly renal ultrasound for routine surveillance of the upper tracts, whereas more than half (65%) routinely use videourodynamic studies for evaluation of the lower urinary tract. The combination of clean intermittent catheterization (CIC) plus anticholinergic agents is the favored modality for management of hyperreflexic bladder, whereas CIC alone is preferred for the areflexic bladder. CONCLUSIONS: This study confirms that most urologists working with SCI patients follow principles reported in published data regarding the need for evaluation, surveillance, and management of the urinary tract. However, there is a lack of consensus in the specific methods used for surveillance of the urinary system. The present results emphasize the need for clear guidelines in this area.

Title: ***Significance of low compliance bladder in cauda equina injury.***

Author: Shin JC; Park C; Kim HJ; Lee IY

Source: Spinal Cord, December 2002, Volume 40, Number 12: 650-5

Abstract: STUDY DESIGN: Prospective investigation using serial urodynamic studies.  
OBJECTIVE: To evaluate type of neurogenic bladder and to observe changes of autonomous detrusor contraction (ADC) after the normalization of the compliance and capacity of the bladder in cauda equina injury.  
SETTING: Spinal Cord Injury Unit, Yonsei Rehabilitation Hospital, Seoul, Korea.  
METHODS: Urodynamic studies were performed in 50 patients with complete cauda equina injury from trauma with an infusion ratio of 30 ml/min. Findings of urodynamic studies and clinical features of patients with low compliance were compared with those of the normal compliant patients. Fourteen patients with low compliance received oral administration of oxybutynin and propiverine and intravesical instillation of oxybutynin to increase the compliance and capacity of the bladder, and follow-up urodynamic studies to monitor the change were undertaken.  
RESULTS: Bladder compliance was decreased in 14 (28%) patients and normal in 36 (72%) patients. There was a significantly long time interval between the onset of injury and the initiation of rehabilitative treatment in the neurogenic bladder group with low compliance when compared to those of the normal compliance group ( $P < 0.05$ ). Clean intermittent catheterization was used as the voiding method, significantly less than the normal compliance group ( $P < 0.05$ ). ADC was observed in six out of fourteen patients with low compliance neurogenic bladder, but none in the normal compliance group. Upon the completion of conservative treatment, ADC disappeared in four patients whose compliance and capacity of the bladder were normalized on follow-up urodynamic studies.  
CONCLUSION: ADC was only observed in the low compliant bladder and as ADC disappeared when compliance and capacity of the bladder was normalized; low compliance appeared to be the main cause of ADC. In addition, this study supports that the maintenance of compliance of the bladder may be the most important factor in the management of neurogenic bladder.

Title: ***Value of sensory examination in predicting bladder function in patients with T12-L1 fractures and spinal cord injury.***

Author: Schurch B; Schmid DM; Kaegi K

Source: Archives of Physical Medicine and Rehabilitation, January 2003, Volume 84, Number 1: 83-9

Abstract: OBJECTIVE: To determine whether early sensory examination, voluntary anal sphincter contraction, or bulbocavernosus reflex (BCR) might predict bladder function in patients with a spinal fracture at the thoracolumbar level.  
DESIGN: Longitudinal study of consecutive patients admitted to a spinal cord injury (SCI) rehabilitation center.  
SETTING: Primary care center, university facility in Switzerland.  
PARTICIPANTS: Fifty-five patients with thoracolumbar fractures.  
INTERVENTIONS: Neurologic (American Spinal Injury Association [ASIA] protocol) and urodynamic examination during the first hospitalization and at follow-up.  
MAIN OUTCOME MEASURES: Neurologic sensory scores and type of neurogenic bladder.  
RESULTS: At first examination, there was no correlation between the sensory examination, voluntary anal sphincter contraction, BCR, and neurogenic bladder type. At follow-up (time since first examination: mean, 698 $\pm$ 47.2d; median, 481d), the sensory examination remained of no value in distinguishing the neurogenic bladder type. However, voluntary anal sphincter contraction distinguished between complete and incomplete neurogenic bladders and BCR differentiated between complete bladder dysfunction of the lower motoneuron and upper motoneuron type. At follow-up, the bladder function (51 patients) remained unchanged in 44 cases and normalized in only 7 cases. Patients who improved their bladder function tended to have higher initial sensory ASIA scores ( $P < .05$ , Kruskal-Wallis test). Of the 7 patients who improved their bladder function, all but 1

(85%) had initial perineal pinprick sensation. Nevertheless, preservation of perineal pinprick sensation was of no positive predictive value, because 21 patients (48%) who initially had perineal pinprick sensation did not improve their voiding function, a finding similar to that of the 23 (52%) without initial perineal pinprick sensation whose bladder function also did not improve.

**CONCLUSIONS:** In SCI patients with thoracolumbar fractures, neurogenic voiding dysfunction cannot be predicted by the sensory evaluation. In patients with an SCI at the thoracolumbar level, pinprick sensation in the perineal area is of negative predictive value: absence of pinprick sensation predicts poor bladder recovery. Most patients with a spinal fracture at T12-L1 did not improve in voiding function.

Title: ***A prospective randomized trial of the LoFric hydrophilic coated catheter versus conventional plastic catheter for clean intermittent catheterization.***

Author: Vapnek JM; Maynard FM; Kim J

Source: Journal of Urology, March 2003, Volume 169, Number 3: 994-8

Abstract: **PURPOSE:** We compared the incidence of hematuria, pyuria and clinical urinary tract infection in patients who performed intermittent self-catheterization using a hydrophilic coated LoFric (Astra Tech AB, Molndal, Sweden) or standard plastic catheter.

**MATERIALS AND METHODS:** A total of 62 male patients who performed intermittent self-catheterization to manage neurogenic bladder were randomized into 2 treatment groups at 3 American study sites. Outcome measures included urinary tract infection, microhematuria, pyuria and satisfaction rates.

**RESULTS:** Of the 62 enrolled patients 49 completed the 12-month study. The withdrawal rate was not different in the 2 groups. At the end of the study there was statistically significantly less hematuria in the hydrophilic coated catheter group compared with controls. In addition, there was a significant decrease in the urinary tract infection rate from baseline in the hydrophilic coated catheter group but not in controls.

**CONCLUSIONS:** Use of the hydrophilic coated catheter by patients on intermittent self-catheterization is associated with less hematuria and a significant decrease in the incidence of urinary tract infections. Therefore, it may be preferable for some patients, especially those with a history of difficult catheterization, urethral trauma or a high rate of urinary tract infection.

Title: ***Rectal pressure response to a meal in patients with high spinal cord injury.***

Author: Walter SA; Morren GL; Ryn AK; Hallbook O

Source: Archives of Physical Medicine and Rehabilitation, January 2003, Volume 84, Number 1: 108-11

Abstract: **OBJECTIVES:** To determine whether there is a postprandial increase of rectal pressure in patients with spinal cord injury (SCI) and to compare their rectal pressures with those of healthy volunteers.

**DESIGN:** A before-after trial comparing SCI and control subjects.

**SETTING:** Patients were recruited from the register of an SCI unit at a rehabilitation medicine department, and the study took place at the university hospital laboratory in Sweden.

**PARTICIPANTS:** Ten patients with high traumatic SCI and 9 healthy volunteers. Eight patients had a lesion above level T5.

**INTERVENTION:** Continuous anorectal manometry was performed. Rectal activity was calculated before and at regular time intervals after a 1000-cal test meal.

**MAIN OUTCOME MEASURE:** Rectal activity measured as area under the pressure curve.

**RESULTS:** There was a significant increase in rectal activity of 46% after 10 minutes in the patients but of 72% after 5 minutes in the volunteers. There was no difference in fasting rectal activity, but patients had a stronger mean rectal postprandial response during 60 minutes compared with volunteers.

CONCLUSIONS: These results support the theory that the colonic response to food is preserved in patients with high SCI.

Title: ***Management of faecal incontinence and constipation in adults with central neurological diseases.***

Author: Wiesel PH; Norton C; Brazzelli M

Source: The Cochrane Library, 2003, Oxford, Publisher Information Number 2.

Abstract: A substantive amendment to this systematic review was last made on 24 September 2000. Cochrane reviews are regularly checked and updated if necessary.

BACKGROUND: People with neurological disease have a much higher risk of both faecal incontinence and constipation than the general population. There is often a fine dividing line between the two conditions, with any management intended to ameliorate, one risking precipitating the other. Bowel problems are observed to be the cause of much anxiety and may reduce quality of life in these people. Current bowel management is largely empirical with a limited research base.

OBJECTIVES: To determine the effects of management strategies for faecal incontinence and constipation in people with neurological diseases affecting the central nervous system.

SEARCH STRATEGY: We searched the Cochrane Incontinence Group Trials Register, the Cochrane Controlled Trials Register, MEDLINE, EMBASE and all reference lists of relevant articles. Date of the most recent searches: May 2000.

SELECTION CRITERIA: All randomised or quasi-randomised trials evaluating any types of conservative, or surgical measure for the management of faecal incontinence and constipation in people with neurological diseases were selected. Specific therapies for the treatment of neurological diseases that indirectly affect bowel dysfunction have also been considered.

DATA COLLECTION AND ANALYSIS: All three reviewers assessed the methodological quality of eligible trials and two reviewers independently extracted data from included trials using a range of pre-specified outcome measures.

MAIN RESULTS: Only seven trials were identified by the search strategy and all were small and of poor quality. Oral medications for constipation were the subject of four trials. Cisapride does not seem to have clinically useful effects in people with spinal cord injuries (two trials). Psyllium was associated with increased stool frequency in people with Parkinson's disease but not altered colonic transit time (one trial). Some rectal preparations to initiate defecation produced faster results than others (one trial). Different time schedules for administration of rectal medication may produce different bowel responses (one trial). Mechanical evacuation may be more effective than oral or rectal medication (one trial). The clinical significance of any of these results is difficult to interpret.

REVIEWERS' CONCLUSIONS: It is not possible to draw any recommendation for bowel care in people with neurological diseases from the trials included in this review. Bowel management for these people must remain empirical until well-designed controlled trials with adequate numbers and clinically relevant outcome measures become available.

Title: ***Continent lower urinary tract reconstruction in the cervical spinal cord injured population.***

Author: Zommick JN; Simoneau AR; Skinner DG; Ginsberg DA

Source: Journal of Urology, June 2003, Volume 169, Number 6: 2184-7

Abstract: PURPOSE: Patients with cervical spinal cord injury and upper extremity dysfunction are treated primarily with indwelling or condom catheters. We present our experience with a select group of patients with limited upper extremity function to determine long-term success and patient satisfaction after lower urinary tract reconstruction.

**MATERIALS AND METHODS:** Between May 1988 and November 1996, 28 patients with cervical spinal cord injury underwent lower urinary tract reconstruction. Postoperative information was obtained on 21 patients. Charts were reviewed and patients were contacted by an independent reviewer to ascertain patient satisfaction and quality of life. Patient age was 17 to 51 years (average 34.6). Reconstructive procedures requiring catheterization included augmentation ileocystoplasty in 4 patients plus Mitrofanoff appendicovesicostomy in 7, a Kock ileal reservoir in 8 and an Indiana pouch in 2.

**RESULTS:** Catheterization was regularly performed by 20 of the 21 patients (95%). A total of 12 patients (60%) performed self-intermittent catheterization and 8 (40%) relied on an attendant or family member. Of the patients 80% reported improved quality of life since reconstruction, citing such reasons as lack of a need for urinary drainage bags, increased freedom and an improved sense of body image. Using a visual analog scale to grade satisfaction from 1 to 10 (1-extremely unsatisfied to 10-extremely satisfied) 14 patients (67%) reported a score of 8 or more.

**CONCLUSIONS:** With appropriate preoperative selection of the cervical spinal cord injured patient intermittent catheterization is successfully maintained in the long term, allowing greater flexibility in choice, and a resultant high level of patient satisfaction and improved quality of life.

## Nursing Care (Includes Preventive Care, Patient Education, Health Promotion)

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- Title: ***Patient dignity in persons with spinal cord injury.***
- Author: Belanger HG; Nelson AL; McMillan S; Gavin-Dreschnack D; Holley S; Rosenberg D
- Source: SCI Nursing, Spring 2003, Volume 20, Number 1: 25-9
- Abstract: Technology is changing the way nurses provide patient care in spinal cord injury. A key nursing concern is the impact of technology-assisted caregiving tasks (TACT) on the patients' sense of dignity. Despite frequent use of the term dignity in discussing treatment of persons with disabilities, there is a dearth of empirical research related to this topic. In particular, there have been few attempts to define the construct for the purposes of valid measurement. The purpose of this article is, therefore, to critically review the relevant literature on patient dignity with an aim toward eventual development and validation of a Dignity Assessment Tool.
- Title: ***Creating a Web-accessible, point-of-care, team-based information system (PoinTIS): The librarian as publisher.***
- Author: Burrows SC; Moore KM; Kemkau HL, Jr
- Source: Bulletin of the Medical Library Association, April 2001, Volume 89, Number 2: 154-64
- Abstract: The Internet has created new opportunities for librarians to develop information systems that are readily accessible at the point of care. This paper describes the multiyear process used to justify, fund, design, develop, promote, and evaluate a rehabilitation prototype of a point-of-care, team-based information system (PoinTIS) and train health care providers to use this prototype for their spinal cord injury and traumatic brain injury patient care and education activities. PoinTIS is a successful model for librarians in the twenty-first century to serve as publishers of information created or used by their parent organizations and to respond to the opportunities for information dissemination provided by recent technological advances.
- Title: ***Historical perspective of life care planning.***
- Author: Deutsch PM
- Source: Topics in Spinal Cord Injury Rehabilitation, Spring 2002, Volume 7, Number 4: 1-4
- Abstract: Life care planning is a case management tool utilized by rehabilitation counselors, rehabilitation nurses, physiatrists, rehabilitation psychologists, and other health care professionals who have assumed the role of the board eligible or board-certified case manager in implementing/overseeing rehabilitation programs and support care services for the catastrophically disabled. It is based on specific standards and methodologies to which practitioners are expected to adhere. The history of life care planning goes back to the 1970s, with the first publication in the field in 1981. Currently, several rehabilitation counseling, nursing, and disability examining boards are involved in oversight related to life care planning.

Title: ***Ageing and spinal cord injury: Medical, functional, and psychosocial changes.***

Author: Kemp B; Thompson L

Source: SCI Nursing, Summer 2002, Volume 19, Number 2: 51-60

Abstract: Fifty years ago, people who had a spinal cord injury had very limited life expectancies. Today, these individuals can expect to live into their 60s, 70s, and beyond. Advances in rehabilitation, technology, surgery, and medicines have been chiefly responsible for this change. Recent research in both Europe and the United States now indicates that as these people age, they often develop medical and functional problems that are not as common in their nondisabled peers until much later in life. The importance of these "premature" age-related problems has led the National Institute on Disability and Rehabilitation Research to fund the Rehabilitation Research and Training Center (RRTC) on Aging With a Spinal Cord Injury at Rancho Los Amigos National Rehabilitation Center in Downey, California. This article summarizes some of the important findings from this RRTC and from other sources.

Title: ***Providing SCI education during changing times.***

Author: Lindsey LL; Kurilla LL; DeVivo MJ

Source: SCI Nursing, Spring 2002, Volume 19, Number 1: 11-4

Abstract: The educational role of the spinal cord injury (SCI) nurse has changed with the ongoing developments in health care. Current statistics show that length of stay during both acute care and rehabilitation has shortened dramatically. This fact, along with new formats for locating and obtaining educational materials, are a few of the challenges that SCI nurses face in providing essential SCI education. The Rehabilitation Research and Training Center on Secondary Conditions of SCI, and the Model SCI Care Center at the University of Alabama at Birmingham, produce a number of accessible and affordable SCI educational materials. These materials are available through various electronic formats, including the Internet, e-mail, and fax. SCI nurses can use these resources to provide individuals the information needed to handle their long-term health care needs following their injuries.

Title: ***Pain during spinal cord injury rehabilitation: Client perspectives and staff attitudes.***

Author: McDonald H; Fish W

Source: SCI Nursing, Fall 2002, Volume 19, Number 3: 125-31

Abstract: Pain after spinal cord injury (SCI) is well documented in the literature. Effective treatment for pain after SCI remains elusive and treatment protocols have not been well researched. Staff on a 32-bed SCI rehabilitation unit designed and implemented a descriptive research study to improve pain management outcomes. An interdisciplinary plan to improve pain management practices was developed as a result of the study. Guidelines of the American Academy of Pain Medicine and the American Pain Society (1997) and the Agency for Healthcare Policy and Research (1992 [now called Agency for Healthcare Research and Quality]) provided the framework for the interdisciplinary management of pain.

Title: ***Perceptions of the nursing role in spinal cord injury rehabilitation.***

Author: Pellatt GC

Source: British Journal of Nursing, March 13–26, 2003, Volume 12, Number 5: 292-9

Abstract: In the UK, over the last 50 years there have been many developments in the rehabilitation of spinal cord-injured people leading to improvements in outcomes. In spinal cord injury rehabilitation nurses work as members of a multiprofessional team but their role is not clearly defined and, unlike other professionals, they have a 24-hour relationship with patients. This article presents some findings from a larger ongoing ethnographic research study. The aim of this section of the study was to identify how nurses and patients perceive the nursing role in spinal cord injury rehabilitation. Semistructured interviews were carried out with 14 spinal cord-injured patients and 14 registered nurses. The findings suggest that patients value the nursing contribution as a means of emotional and physical support but that they do not necessarily see nursing input as rehabilitation. Nurses see their role as multifaceted but identify difficulties in crossing over from an acute care philosophy to a rehabilitation philosophy. The 24-hours close relationship with patients may be a source of imbalanced power relationships between nurses and patients and this causes distress to some patients. It is suggested that nurses need to develop their bedrock role in a way that empowers patients in spinal cord rehabilitation.

Title: ***Preference based assessment of the quality of life of disabled persons.***

Author: Persson J; Andrich R; Van Beekum T; Brodin H; Lorentsen O; Wessels R; de Witte L

Source: Technology and Disability, 2002, Volume 14, Number 3: 119-24

Abstract: A new method for assessing preference based outcome measures in rehabilitation with assistive devices is reported. The method uses a standard utility instrument, the EuroQol, with complementary items on mobility and social relationships. In addition, a problem solving scale (PIRS) is introduced. Validation has been carried out in a multicenter study of mobility, hearing and communication devices. Utilities and problem solving scores covary strongly for mobility interventions but not for those dealing with communication. So far it is not explained whether the investigated communication interventions result in moderate utility gain only, or whether there is a bias in the corresponding utility scores. Further research on this has been started. The issue of deriving utility weights for the PIRS has also been started. We recommend the described method to be used for cost-utility analyses of rehabilitation measures for disabled persons.

Title: ***Integrated care pathways: outcome from inpatient rehabilitation following nontraumatic spinal cord lesion.***

Author: Playford E; Sachs R; Thompson AJ

Source: Clinical Rehabilitation, May 2002, Volume 16, Number 3: 269-75

Abstract: BACKGROUND: Integrated care pathways (ICPs) map the predicted course of an episode of patient care. They detail the expected interventions during the episode and document departures from the expected pathway (variance). This study describes the use of an ICP to audit the rehabilitation of patients with nontraumatic spinal cord injury admitted between 1997 and 1999. METHODS: The ICPs and outcomes of 85 patients with nontraumatic spinal cord injury admitted to the Neurorehabilitation Unit at the National Hospital for Neurology and Neurosurgery, Queen Square, London were analysed. Data extracted included diagnosis, level of the lesion and duration of stay. The numbers and categories of goals and the rates of goal achievement were extracted and the variance patterns analysed.

**RESULTS:** An average of 28 patients were admitted each year. The level of disability on admission and the duration of stay decreased over the three-year period, while the average patient age increased from 48 to 54 years. None of these changes were statistically significant. On average each patient had three new goals set each week. Ninety per cent of all goals were achieved; this was not dependent on the category of goal. Sixteen patients (19%) accounted for 58% of all nonachieved goals. These patients tended to have acute-onset disability. The number of variances fell from 15 to 7 over the three-year period.

**CONCLUSIONS:** The pathway enables monitoring of the rehabilitation process. As the Unit becomes more experienced there is a trend to shorter, more focused admissions with fewer variances. Specific groups of patients with particular needs can be identified. Future patients benefit from closure of the 'audit loop' and the implementation of clinical change based on information obtained from the ICP.

Title: ***Life care plan development.***

Author: Weed RO

Source: Topics in Spinal Cord Injury Rehabilitation, Spring 2002, Volume 7, Number 4: 5-20

Abstract: The life care plan is a dynamic document based upon published standards of practice, comprehensive assessment, data analysis, and research, which provides an organized concise plan for current and future needs with associated costs for individuals who have experienced catastrophic injury or have chronic health care needs. Life care planning has a rich history of scrutiny and has become the most recognizable approach for estimating lifelong future care. This article will outline general procedures, topics, and suggestions for completing a detailed, comprehensive plan for persons with spinal cord injury. Resources for training and certification are also included.

Title: ***Self-concept and body image in persons who are spinal cord injured with and without lower limb amputation.***

Author: Yetzer EA; Schandler S; Root TL; Turnbaugh K

Source: SCI Nursing, Spring 2003, Volume 20, Number 1: 18-23

Abstract: Spinal cord injury (SCI) requires considerable psychological adjustment to physical limitations and complications. One particularly severe complication of SCI is foot skin breakdown, which can result in lower limb amputation. Relative to SCI adjustment, amputation may produce one of two psychological outcomes: (a.) the fragile self-concept of a person with SCI may be reduced further by limb amputation, or (b.) amputation of a diseased, nonfunctional limb may be associated with restored health and improved self-concept. To better understand the effects of amputation, 26 males with SCI, 11 of whom had a lower limb amputation, were administered the Tennessee Self-Concept Scale (TCS) and the Personal Body Attractiveness Scale (PBAS). The study revealed that persons with SCI with amputation had higher Physical and Total self-concept scores on the TCS, showing a slightly more positive self-concept. On the PBAS, although there were no significant differences in the scores for the legs, ankles, or feet, the persons with SCI with amputation had higher score on the Satisfaction subscale, indicating a slightly greater satisfaction with their thigh in their body image. Implications for future study include replication with larger sample sizes, inclusion of women in the sample, and a longitudinal study. Several nursing interventions are identified.

# Pediatric Spinal Cord Impairment

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**Title:** *Pediatric spinal cord injury in Sweden; how to identify a cohort of rare events.*

**Author:** Augutis M; Malker H; Levi R

**Source:** Spinal Cord, June 2003, Volume 41, Number 6: 337-46

**Abstract:** STUDY DESIGN: Register study enhanced and verified by medical records and personal interviews and examinations.  
SETTINGS: Sweden.  
OBJECTIVES: To define a method of identifying a study population of rare events. To point out the relative importance of every step, an example is given of identifying persons who sustained traumatic spinal cord injury (SCI) in childhood.  
METHODS: Cases were identified in seven steps that all needed to be fulfilled, from definition of selection criteria through combination of several data sources, to the use of several verification methods.  
RESULTS: Initial screening by registers identified 384 possible cases, which however were found by subsequent analysis to include a large number of incorrect cases. At completion of all analytic steps, 35 living cases could be fully verified and 14 deceased cases could be partially verified.  
CONCLUSIONS: Registers offer a practical initial source for study population identification. The screening of International Classification of Diseases codes defining SCI only included less than 30% of 'true' SCIs. Subsequently, further refinement and quality control is necessary in order to ensure validity. Such further verification is time-consuming, but nevertheless necessary in order to verify a true cohort.

**Title:** *Pediatric spinal cord injury in Sweden: Incidence, etiology and outcome.*

**Author:** Augutis M; Levi R

**Source:** Spinal Cord, June 2003, Volume 41, Number 6: 328-36

**Abstract:** STUDY DESIGN: Retrospective descriptive study.  
OBJECTIVES: To assess incidence, causes and early outcome of traumatic spinal cord injury (SCI) among children in Sweden, thereby identifying high-risk groups and situations as a basis for preventative measures and improved care.  
METHODS: Data from population registers, County Habilitation Centers as well as from informal sources were used to estimate the incidence of SCI in Sweden during the years 1985-1996 among children aged 0-15 years. Contacts with the treating hospitals, reviews of medical records and/or personal interviews were used to verify primary data. In total, 92 children were thus identified.  
RESULTS: The incidence was found to be 4.6/million children/year (95% CI 3.6-5.5). When excluding prehospital fatalities, the incidence was 2.4 (95% CI 1.8-3.1). The main cause of injury among fatalities was traffic accidents. Associated injuries occurred in 41% of the children. Among survivors (10-15 years), sports-related injuries (43%) were as common a cause as traffic accidents (39%). The survivors were treated in 18 different hospitals.  
CONCLUSION: Pediatric SCI in Sweden is rare, presumably because of effective primary prevention. Preventative measures should be further differentiated for each age group of children in accordance with their differing risk profiles. In contrast to the effective preventative measures that have been implemented in Sweden, care of these patients is still too fractionated and decentralized for sufficient specialization to emerge.

Title: ***Community integration among adults with spinal cord injuries sustained as children or adolescents.***

Author: Anderson CJ; Krajci KA; Vogel LC

Source: Developmental Medicine and Child Neurology, February 2003, Volume 45, Number 2: 129-34

Abstract: The purpose of this study was to determine factors associated with community integration of adults who sustained spinal cord injuries as children or adolescents. Outcome measures included the Craig Handicap Assessment and Reporting Technique and measures of independent living. Independent variables include demographic factors, level of injury, functional independence as measured by the Functional Independence Measure, and perceived health as measured by Short Form-12 physical and mental component scores. Data were analyzed by multiple regression analyses for each of the outcome measures. Two-hundred and sixteen adults (150 males and 66 females) were interviewed. Mean age at interview was 29 years (range 24 to 27 years) and mean age at injury was 14 years (range 0 to 18 years). Results showed that the five factors most strongly associated with community integration were education level, employment, income, functional independence, and health status. Factors that were not associated with community integration included sex, age at injury, duration, and level of injury.

Title: ***Predicting normal lung function in patients with childhood spinal cord injury.***

Author: Bergstrom EM; Savic G; Short DJ; Williams SS

Source: Spinal Cord, June 2003, Volume 41, Number 6: 354-8

Abstract: STUDY DESIGN: A prospective observational study.  
OBJECTIVES: To compare the height and arm span measurements in childhood spinal cord injured (SCI) people and examine the subsequent effect on calculating the predicted lung function using standard formulae and to discuss which of the two measurements is the most appropriate to use in these formulae.  
SETTING: National Spinal Injuries Centre, Stoke Mandeville Hospital, Aylesbury, UK.  
METHOD: A total of 12 children had lung function tests performed and at the same time had height and armspan measured. The predicted lung function was calculated twice; once using height and then using arm span and compared. The actual lung function test results were expressed as percentage of the two predicted values, respectively, and compared.  
RESULTS: The difference between the mean height (1499 mm) and arm span (1649 mm) measurements was significant ( $P < 0.001$ ). In all cases, the arm span measurement was greater than the height. The two predicted lung function values (one calculated using height and the other armspan) were significantly different ( $P < 0.001$ ). When lung function test results were expressed as percentage of the two predicted values they gave a very different interpretation of the results. The actual performance was much lower than the predicted values if arm span, rather than height, was used in prediction equations.  
CONCLUSION: In childhood SCI, the difference in height and arm span is significant. This affects the predicted lung function values significantly and thus changes the interpretation of the lung function test results. The most appropriate measurement to use in prediction equations (height or arm span) in these subjects is yet to be decided.

Title: ***The relation of thoracic and lumbar fracture configuration to the development of late deformity in childhood spinal cord injury.***

Author: Bergstrom EM; Henderson NJ; Short DJ; Frankel HL; Jones PR

Source: Spine, January 15, 2003, Volume 28, Number 2: 171-6

Abstract: STUDY DESIGN: A retrospective clinical observational study was conducted. OBJECTIVE: To assess the relation of spinal fracture type and its magnitude of distortion to subsequent long-term development of late spinal deformity in childhood onset spinal cord injury. SUMMARY OF BACKGROUND DATA: In this study, 76 adults who sustained spinal cord injury during childhood were examined clinically and radiographically alongside a retrospective review of case notes and radiographs. METHODS: The nature of the spinal injury and the progression of its displacement were defined from radiographs taken immediately after injury, then at 4 months and at 1 year. Eventual adult spinal deformity was defined from standardized erect long-plate radiographs. Scoliosis, kyphosis, and lordosis were measured using Cobb's method. RESULTS: There was no statistically significant difference in the severity of scoliosis, kyphosis, or lordosis between traumatic and nontraumatic injuries, nor between patients with and those without radiologically visible bony injury. Of the 14 patients with traumatic thoracic and lumbar injuries who had undergone no surgical intervention, 10 (71%) showed development of major scoliotic curves that did not include the fracture site. The patients with no angular displacement at the fracture site after 1 year went on to experience the development of more severe scoliosis (mean, 66 degrees) than those who had displaced fractures (mean, 38 degrees). In five, a low kyphotic curve and a compensatory lordosis above it developed. CONCLUSIONS: There is no evidence that the bony injury to the vertebral column itself in the child with spinal cord injury influences the development of late scoliosis or lordosis, but it may influence any eventual kyphosis.

Title: ***Pediatric spinal cord injury without radiographic abnormality (SCIWORA): The absence of occult instability and lack of indication for bracing.***

Author: Bosch PP; Vogt MT; Ward WT

Source: Spine, Decemeber 15, 2002, Volume 27, Number 24: 2788-800

Abstract: STUDY DESIGN: A retrospective review of medical records and imaging studies of children diagnosed with spinal cord injury without radiographic abnormality (SCIWORA) or SCIWORA-like symptoms at Children's Hospital of Pittsburgh between 1965 and 1999 was undertaken. OBJECTIVES: To evaluate the existence of occult segmental spinal instability and a role for bracing as treatment for SCIWORA, we contrasted the Children's Hospital of Pittsburgh experience with literature reports on SCIWORA. SUMMARY OF BACKGROUND DATA: There is a great deal of confusion and conflicting evidence regarding pediatric SCIWORA in the literature. Previous reports from our institution reported unique findings, including the only description of serious, recurrent SCIWORA in the literature. These findings have frequently been cited as the justification for long-term immobilization in all cases of SCIWORA. METHODS: All records on patients coded as spinal cord injury without fracture or dislocation (ICD-9 code 952.xx) were reviewed. Children 17 years of age or younger with traumatic spinal cord injury and normal plain radiographic findings were included. Penetrating trauma, infection, or metabolic diseases were excluded. RESULTS: A total of 189 patients were diagnosed with SCIWORA at our institution over the 35-year review period. These patients differed from those reported in the literature with respect to a higher incidence, older age, less involved neurologic injury, and more low-energy mechanisms, such as sports and falls. There were no cases of a patient with SCIWORA who deteriorated and developed a

permanent neurologic deficit after having either recovered or plateaued from an initial SCIWORA. All recurrent SCIWORA recovered to normal neurologic function. Bracing did not demonstrate any benefit in preventing these minor recurrent SCIWORAs.

CONCLUSION: We identified no cases of serious, recurrent SCIWORA at our institution from 1965 to 1999. A case-by-case evaluation is required for the treatment of spinal cord injury without apparent spinal column injury, and bracing is not uniformly indicated.

Title: ***Posttraumatic stress and family functioning in pediatric spinal cord injuries: Moderation or mediation?***

Author: Boyer BA; Hitelman JS; Knolls ML; Kafkalas CM

Source: American Journal of Family Therapy, 2002, Volume 31, Number 1: 23-37

Abstract: Assessed whether posttraumatic stress moderated or mediated the relationship between family functioning and functional independence in pediatric spinal cord injury. Family Assessment Device, Posttraumatic Diagnostic Scale/Child Posttraumatic Stress Disorder Symptom Scale, and Pediatric Orthopedic Surgeons of North America Pediatric Musculoskeletal Functional Health Questionnaire data were collected from 64 patients (aged 11-24 yrs) and their parents. Regression analyses indicated that posttraumatic stress mediates, rather than moderates, the relationship between family functioning and functional independence. This study suggests that family functioning indirectly influences functional independence through its effects on severity of posttraumatic stress.

Title: ***Psychological management of two cases of self injury on the paediatric intensive care unit.***

Author: Colville GA; Mok Q

Source: Archives of Disease in Childhood, April 2003, Volume 88, Number 4: 335-6

Abstract: Self injury has not been previously reported in an intensive care setting. Two cases are presented of ventilator dependent children with high spinal cord lesions who exhibited an unusual form of self mutilation, namely lip biting. The key to extinguishing this behaviour was to address the children's psychological needs.

Title: ***Pediatric spine and spinal cord injury after inflicted trauma.***

Author: Ghatan S; Ellenbogen RG

Source: Neurosurgery Clinics of North America, April 2002, Volume 13, Number 2: 227-33

Abstract: Pediatric spine and spinal cord injury are rare sequelae of intentional trauma. They may easily be overlooked, however, and probably represent an underreported phenomenon. Recent autopsy data analyzed in conjunction with prior case series indicate that injury to the upper cervical spine and brainstem may significantly contribute to the major morbidity, mortality, and neuropathology in shaken infants. The findings in the previous case report illustrate several important points regarding spine and spinal cord injury after intentional trauma. First, the very young are susceptible to severe, higher cervical injury of both spine and spinal cord. Second, spine and spinal cord injury were initially overlooked because of masked neurologic findings with the concomitant head injury and multiple other systemic injuries. Finally, the child's outcome with significant cognitive delay because of global brain injury in conjunction with the focal high cervical cord injury may support the hypothesis that hypoxic damage could have occurred secondary to brainstem and high cervical cord injury. At the authors' institution, a detailed history and vigilant physical examination are stressed.

When the mechanism of injury reported in the history is incongruous with the physical or initial radiographic findings and intentional trauma is suspected, a full skeletal survey, ophthalmologic evaluation, and social evaluation is undertaken. MRI and CT scanning are individualized according to the clinical assessment.

Title: ***Long-term follow-up of home mechanical ventilation in young children with spinal cord injury and neuromuscular conditions.***

Author: Gilgoff RL; Gilgoff IS

Source: The Journal of Pediatrics, May 2003, Volume 142, Number 5: 476-80

Abstract: OBJECTIVES: To provide outcomes of two decades of experience in home ventilation of children with spinal cord injury and neuromuscular conditions.  
STUDY DESIGN: Data were collected through chart review and interviews on 39 children who had become ventilator-dependent before their 6th birthday; 23 children had neuromuscular diseases and 16 had spinal cord injuries.  
RESULTS: Patients required an average of 0.7 rehospitalizations per year. There were 8 deaths. Survival rates were 97% at 1 year, 97% at 3 years, 84% at 5 years, and 71% at 10 years. Thirty children attended school, 13 were in regular school (1 at university level), 5 were home-schooled, 5 were in special education schools, and 5 were in regular school with some special education classes. One graduated high school, and another graduated university and received a graduate degree. Three children had progressive weakness. Two gained significant muscle strength.  
CONCLUSIONS: Our experience showed that these patients can be discharged to home with low morbidity and mortality rates and successful reintegration into the community.

Title: ***Reconstruction of the upper extremity in the child with tetraplegia.***

Author: James MA

Source: Hand Clinics, August 2002, Volume 18, Number 3: 529-33

Abstract: According to Howard H. Steel, the orthopedic surgeon who first recognized the need for special care for children with spinal cord injury (SCI), and who persuaded Shriners Hospitals to establish specialized programs for these children over 20 years ago, no field of the health sciences is the statement "a child is not a small adult" more apropos than in the arena of trauma to the spinal cord. Children and adolescents with tetraplegia differ in many ways from adults with the disease. The dissimilarities that influence the outcome of surgical reconstruction of the upper extremity are the focus of this article.

Title: ***Management of suspected cervical spine injuries—the paediatric Perspective.***

Author: McCarthy C; Oakley E

Source: Accident and Emergency Nursing, July 2002, Volume 10, Number 3: 163-9

Abstract: Paediatric cervical spine immobilisation and management is one of the most difficult tasks to master in the paediatric trauma population. The Royal Children's Hospital—Melbourne has admitted 54 patients with diagnosed cervical spine injuries since January 1999. The management of such patients admitted to acute care facilities with suspected cervical spine injuries is inconsistent and at times sub-optimal. Management controversies centre around, application of cervical collars, clearance of

the c-spine, patient movement and general care principles. In an endeavour to address these issues, the Royal Children's Hospital Trauma Service, in conjunction with the Emergency Department developed cervical spine guidelines. Teams consulted in the formulation of these guidelines included, Emergency Department, Intensive Care Unit, Orthopaedics, Neurosurgery, Radiology and General Surgery. These guidelines were developed as a clinical tool to guide management and standardise the approach of care for these patients. Specifically, the guidelines address: immobilisation of the paediatric cervical spine; radiology; clearing the cervical spine of injury; suspected or proven cervical spine injury; guidelines for times to fitting Philadelphia collar; ongoing care.

Title: ***Self-injurious behavior in children and adolescents with spinal cord injuries.***

Author: Vogel LC; Anderson CJ

Source: Spinal Cord, December 2002, Volume 40, Number 12: 666-8

Abstract: STUDY DESIGN: A case report of self-injurious behavior in four children and adolescents with spinal cord injuries (SCI).  
OBJECTIVES: To report a relatively unusual complication of pediatric-onset SCI, focusing on the potential role that dysesthesia may play in self-injurious behavior. SETTING: A Spinal Cord Injury Program in a Children's Hospital in Chicago that serves children from midwestern and south-central United States of America.  
METHOD: Case reports and literature review.  
RESULTS: Case reports are presented of four children or adolescents with SCI who exhibited self-injurious behavior. Two of the subjects had symptoms consistent with dysesthesia. The self-injurious behavior in these two subjects and a very young child responded to treatment with anticonvulsants. The self-injurious behavior in the fourth patient was probably the result of poor technique of using his mouth to move his hands, which responded to conservative management including education, occupational therapy and gloves.  
CONCLUSION: Self-injurious behavior is a relatively unusual complication of pediatric onset SCI, and may be a manifestation of dysesthesia and be responsive to treatment with anticonvulsants.

# Psychosocial Aspects (Life Satisfaction, Quality of Life, Community Reintegration, Vocational Rehabilitation, Mental Health Problems related to SCI, Family Issues, Parenting, Bioethics, Spiritual Issues)

Title: ***Awareness and use of advance directives in the spinal cord injured population.***

Author: Blackmer J; Ross L

Source: Spinal Cord, November 2002, Volume 40, Number 11: 581-94

Abstract: **STUDY DESIGN:** Research was conducted through the use of semi-structured patient interviews. Subjects were recruited through the Saskatchewan branch of the Canadian Paraplegic Association (CPA) and through the clinical practice of the primary investigator. A total of twenty-one patients were interviewed. A qualitative outcome analysis was performed on information collected.  
**OBJECTIVES:** Advance directives (or living wills) serve to communicate the wishes of individuals in the event that they should no longer be capable of making those wishes known. This can include directives on issues such as resuscitation status and withdrawal or withholding of care. The goal of this study was to determine the present level of knowledge and interest of spinal cord injured (SCI) patients on the topic of advance directives, and to determine what specific issues they felt need to be addressed in such a document in this population.  
**SETTING:** The study was performed in Saskatoon, Saskatchewan, Canada. Although design and analysis were done in a tertiary care centre, the interviews themselves were conducted in the homes of the participants.  
**RESULTS AND CONCLUSION:** The results show that spinal cord injured patients have some knowledge of what is involved in the preparation of an advance directive and that they feel these documents are important. A relatively small percentage have completed their own written directives but a large percentage planned to do so after completing this survey. There is some disagreement about when after the injury the topic should first be discussed. Information about medical conditions which are more likely to arise following a SCI should be included in an SCI-specific document. A template for an SCI-specific living will (the SCIAD) is provided.

Title: ***Alexithymia and sense of coherence in patients with total spinal cord transection.***

Author: O'Carroll RE; Ayling R; O'Reilly SM; North NT

Source: Psychosomatic Medicine, 2003: 151-155

Abstract: Investigated the possibility that total spinal cord transection leading to tetraplegia would affect the ability to experience and identify emotions. The authors also examined whether the dispositional orientation of "sense of coherence" contributed to self-rated quality of life after spinal cord transection. 20 patients (mean age 31.1 yrs) with total spinal cord transection at the level of the 6th cervical vertebrae and 20 age- and sex-matched healthy control subjects completed measures of alexithymia, sense of coherence, and quality of life. There were no differences between the 2 groups on alexithymia scores. However, spinal injury patients reported significantly decreased quality of life relative to matched healthy control subjects. A strong sense of coherence was associated with better self-reported quality of life. This relationship remained after controlling for current affective status. The authors conclude that (1) loss of afferent feedback to the brain via the spinal cord does not have a significant effect on alexithymia scores, particularly factor 1 (difficulty in identifying feelings), and (2) sense of coherence may be an important factor in determining psychological adjustment after serious injury.

Title: ***Effective interventions for personality disorders in SCI rehabilitation: Focus on borderline.***

Author: Bockian NR

Source: SCI Psychosocial Process, Spring 2002, Volume 15, Number 1: 30-6

Abstract: Careful planning is essential to treating individuals with personality disorders (PDs). Prior research has shown that specific treatments induce substantial rates of remission after 1 to 2 years, while "treatment as usual" in the community yields similar levels of remission after 7 to 15 years (Perry, Banon, & Ianni, 1999). The Personality Disorders Treatment Planner (Bockian & Jongsma, 2001) can be a useful guide to developing and documenting an appropriate treatment plan for individuals with PDs. Sample treatment plans (one for each of four different approaches, namely, cognitive-behavioral, psychodynamic, client-centered/humanistic, and family systems) are included as examples of how to conceptualize and document treatment planning.

Title: ***Impact of minority status following traumatic spinal cord injury.***

Author: Burnett DM; Kolakowsky-Hayner SA; White JM; Cifu DX

Source: NeuroRehabilitation, 2002, Volume 17, Number 3: 187-194

Abstract: Interpreted data from the Spinal Cord Injury-Model Systems as it applies to demographics, incidence and functional outcomes of minority patients with spinal cord injury. A retrospective analysis was performed of 4,176 18-94 yr old patients admitted to acute inpatient rehabilitation Spinal Cord Injury Model Systems Centers. Descriptive statistics including means, standard deviations, and proportions were computed for all relevant variables. Subjects were grouped into 2 categories, non-minorities (White) and minorities, who were >90% African American. Differential statistics were used for comparisons with regard to demographics, etiology, sponsor of care, length of stay, charges, ASIA Motor Index scores, and FIM scores. Analyses revealed significant differences between minorities and non-minorities in terms of age at injury, gender, marital status, employment status, education level, health insurance provider, injury severity, etiology, and discharge disposition. It is concluded that violence is the leading single cause of spinal cord injury in minority patients admitted to the model systems centers.

Title: ***Revisiting the James versus Cannon debate on emotion: Startle and autonomic modulation in patients with spinal cord injuries.***

Author: Cobos P; Sanchez M; Garcia C; Vera Maria Nieves; Vila J

Source: Biological Psychology, November 2002, Volume 61, Number 3: 251-269

Abstract: W. James' hypothesis that impaired peripheral physiology in patients with spinal cord injuries (SCIs) impairs emotional processing, as manifested in the modulation of physiological responses and in the subjective component of emotions, was examined in the present study. A pilot study confirmed the utility of Lang's picture viewing paradigm in a group of 79 college students using the Spanish norms of the International Affective Picture System. In the main study, 19 patients with SCI and 19 well controls matched for sex, age and education were examined. Results showed: (1) no differences between SCI and control participants in the valence and arousal ratings of the pictures; (2) similar heart rate modulation in both groups, i.e., the unpleasant pictures produced greater deceleration than the pleasant ones; and (3) no decrease in emotional experience in the SCI group compared with the control group. The implications of the results for the James versus W. B. Cannon controversy on the theory of emotions are discussed.

Title: ***A pilot study of perceived needs of persons with new spinal cord injury.***

Author: Cushman LA; Scherer MJ

Source: Psychological Reports, 2002, Volume 90, Number 3, Part 2: 1153-1160

Abstract: Persons with new spinal cord injury have varying perceptions of their own needs in multiple life domains such as readiness and need to use assistive technologies, but these are often not directly addressed. These areas were the focus of the present study. This descriptive study looked at subjective need in a variety of areas with a new measure and also assessed perceptions related to assistive technology and quality of life. Perceptions of various needs were compared at baseline and at 1- and 6-mo. follow-up. The Perceived Needs Inventory, the Assistive Technology Device Predisposition Assessment, and the Diener Satisfaction with Life Scale were the main outcome measures given 22 patients with new injuries in an inpatient service for acute spinal cord injury with community follow-up. As the Perceived Needs Inventory provided distinct information and showed good test-reliability and some evidence of construct validity, it may be a useful adjunctive tool with such patients.

Title: ***Changes in the quality of life in severely disabled people following provision of powered indoor/outdoor chairs.***

Author: Davies A; De Souza LH; Frank AO

Source: Disability and Rehabilitation, March 18, 2003, Volume 25, Number 6: 286-90

Abstract: PURPOSE: To determine the benefits for patients who received an electric powered indoor/outdoor chair (EPIOC) and to quantify their perceived changes to their quality of life.  
METHOD: Community-based cohort study of all patients provided with an EPIOC over 4 months; and followed up about 3 months later in a community served by a regional wheelchair service in North West London (population about 3.1 million) using the EuroQol EQ-5D with visual analogue scales for each of the five dimensions of the EQ-5D.  
RESULTS: Sixty-four wheelchair users were assessed initially and 51 completed follow up. Chair users showed no significant improvement in health state as measured by the EQ-5D after EPIOC provision. The visual analogue scales (VASs) indicated that, although perceived overall health state, independence and social life did not appear to improve, the dimensions of mobility, quality of life and pain/discomfort improved significantly on provision of an EPIOC.  
CONCLUSION: EPIOC users reported significant improvements in several important aspects of their lives; not just in mobility (as expected) but also in reduction of pain and discomfort. The use of VASs provided a more holistic set of outcome measures that demonstrate quality of life benefits beyond that of health state alone.

Title: ***A comparison of adjustment and self-awareness in adults after traumatic brain injury and spinal cord injury: The transition from hospital to community.***

Author: Fleming J; Tooth L; Connell J; Strong J

Source: Journal of Cognitive Rehabilitation, 2002, Volume 20, Number 3: 28-36

Abstract: Investigated self-awareness and emotional adjustment in adults with traumatic brain injury (TBI) and spinal cord injury (SCI) over the period of transition from hospital to the community. It is commonly accepted that in TBI, impaired self-awareness probably is due to a combination of both neurological and psychological causes. Clients with SCI were selected as a comparison group for TBI clients because they also had experienced a severe traumatic injury with long-term consequences but had not sustained any brain damage. The aims of the study were to investigate to what extent impaired

self-awareness in adults with TBI is related to neurological impairment in comparison to psychological adjustment factors, and as compared to the control group; to compare the level of emotional distress experienced by adults with TBI and SCI; and to investigate the effect of discharge from hospital to home on the development of self-awareness and emotional adjustment. Self-awareness in the TBI group was significantly more impaired on 1 but not 2 other measures and, for both groups, self-awareness increased significantly over the 2-mo period following hospital discharge. The hypothesis that there would be a significant difference in level of emotional distress between the 2 groups was not supported.

Title: ***Anxiety and position-dependent neurologic findings due to autonomic dysreflexia.***

Author: Freudenreich O; Murray GB

Source: Psychosomatics: Journal of Consultation Liaison Psychiatry, January–February 2001, Volume 42, Number 1: 81-82

Abstract : Presents a case of anxiety due to autonomic dysreflexia to illustrate that it remains important to rule out physiological causes of anxiety, regardless of how well psychological explanations fit. The S was a 38-yr-old man whose spinal cord had been severed in a car accident, leaving him with an incomplete C4 spinal cord injury. Following hospital admission for elective correction of a urethrocutaneous fistula, the S complained of anxiety after the second of two operations. Despite the persistence of neurological findings while in the hospital, the anxiety abated over several days. Two signs made the S's anxiety "explainable" as part of autonomic dysreflexia: severe headaches and new anisokoria and position-dependent half-sided hyperhidrosis of the upper body.

Title: ***Personal assistance services in patients with SCI: Modeling an appropriate level of care in a life care plan.***

Author: Harrell TW; Krause JS

Source: Topics in Spinal Cord Injury Rehabilitation, Spring 2002, Volume 7, Number 4: 38-48

Abstract: People who have survived a spinal cord injury (SCI) need help to perform many of the activities of daily living that are required for their long-term care. The need for such help varies significantly by level of lesion and the unique circumstances of the individual. There is also significant variability in which individuals with SCI have access to paid personal assistance service (PAS). This article examines the accessibility of PAS to SCI survivors, explores alternative models for service delivery, and discusses the implications for life care planning.

Title: ***Life satisfaction following spinal cord and traumatic brain injury: A comparative study.***

Author: Hicken BL; Putzke JD; Novack T; Sherer M; Richards JS

Source: Journal of Rehabilitation Research and Development, May–June 2002, Volume 39, Number 3: 359-65

Abstract: The current study was designed to examine the predictive validity of several factors that are common to spinal cord injury (SCI) and traumatic brain injury (TBI) populations to overall life satisfaction. We examined several demographic and functional predictors (1) within each group separately and (2) using both groups while controlling for unique predictors within groups. Participants included 190 and 57 individuals with SCI and TBI, respectively. To minimize the influence of injury duration, we assessed life satisfaction at 1-year postinjury in both groups. Functional disability (Functional

Impairment Measure [FIM]) was the only common predictor within groups. For the TBI group, marital status was also a significant predictor of life satisfaction. None of the other predictors examined was significant among the SCI group. After functional disability and marital status were controlled, overall life satisfaction did not differ between groups. Total explained variance in life satisfaction was low in both groups, 9% and 25% in the SCI and TBI groups, respectively. Future directions are discussed.

Title: ***Individualizing relaxation training in spinal cord injury: Importance of injury level and person factors.***

Author: Hough S; Kleinginna C

Source: Journal Rehabilitation Psychology, November 2002, Volume 47, Number 4: 415-425

Abstract: OBJECTIVE: To illustrate the value of modifying relaxation training techniques according to level of spinal cord injury.  
PARTICIPANTS AND SETTING: Six individuals receiving psychological services on an inpatient spinal cord injury unit.  
PROCEDURE: Psychological assessment and interdisciplinary team consultation were used to develop individualized relaxation training protocols.  
RESULTS: Staff observations and patient self-reports revealed improvements in various behavioral and affective factors (e.g., reduced pain, increased participation in therapy, diminished depression).  
CONCLUSIONS: Clinicians should consider level of spinal cord injury and individual differences when selecting relaxation techniques.

Title: ***Psychiatric interventions in spinal cord injury.***

Author: Gallagher RM; McKegney FP; Gladstone T

Source: Psychosomatics: Journal of Consultation Liaison Psychiatry, 1982, Volume 23, Number 11: 1153, 1159-1167

Abstract: Describes a psychiatric intervention service that provides a model of cost-effective spinal cord injury (SCI) team care within the existing health-care system. Five stressful transition phases during acute care of SCI are discussed: (1) start of intensive care, (2) transfer to orthopedics or neurosurgery, (3) surgery and stabilization of the frame, (4) removal from the Stryker frame, and (5) transfer to rehabilitation. Results for 22 consecutive patients compare favorably with those of regional SCI centers funded by the Rehabilitation Services Administration. (11 ref)

Title: ***Emotional distress and activities of daily living functioning in persons with multiple sclerosis.***

Author: Gulick EE

Source: Nursing Research, 2001, Volume 50, Number 3: 147-154

Abstract: Examined if personal attributes and social support function as mediating and/or moderating variables between emotional distress and activities of daily living functioning in persons with multiple sclerosis (MS). 686 persons with MS (aged 20-86 yrs) provided data through self-report measures of emotional distress, personal attributes, social support, and activities of daily living functioning. Personal attributes and social support functioned as mediator variables between emotional distress and activities of daily living functioning. Additionally, personal attributes and not social support functioned as a moderator. Significant main effects were shown for social support and emotional distress in the moderator model.

Title: ***Suicidal ideation among patients with acute life-threatening physical illness: Patients with stroke, traumatic brain injury, myocardial infarction, and spinal cord injury.***

Author: Kishi Y; Robinson RG; Kosier JT

Source: Psychosomatics: Journal of Consultation Liaison Psychiatry, 2001, Volume 42, Number 5: 382-390

Abstract: Evaluated the clinical characteristics and correlates of suicidal ideation in patients with acute life-threatening physical illnesses and assessed the duration of suicidal ideation. The study included a consecutive series of 496 patients admitted with stroke, traumatic brain injury, myocardial infarction, or spinal cord injury. Study participants were administered a semistructured psychiatric interview as well as a series of standardized quantitative scales of mood, cognitive function, physical impairment, social ties, and social functioning. Follow-up evaluations of up to 24 mo were also carried out. This study found that 36 (7.3%) patients with acute medical illness had clinically significant suicidal ideation. The suicidal ideation occurred mostly among patients with major depression and sometimes in those with minor depression. About 25% of patients with major depression and acute physical illnesses developed suicidal ideation. After the improvement of depressive disorders, suicidal ideations were ameliorated. These findings suggest that the detection and treatment of depressive disorders is the most important factor in preventing suicide among this patient population.

Title: ***Caregiver functioning after traumatic injury.***

Author: Kolakowsky-Hayner SA; Kishore R

Source: Journal of NeuroRehabilitation, 1999, Volume 13, Number 1: 27-33

Abstract: Investigated pervasiveness of unhealthy family functioning and psychological distress among primary caregivers of 28 adult outpatients with traumatic injuries. This article also described caregiver functioning and psychological distress in caregivers of persons with traumatic brain injury (TBI) and caregivers of persons with a traumatic spinal cord injury (SCI) and determined similarities and differences between the 2 populations. Caregivers completed self-report measures including the Brief Symptom Inventory and Family Assessment Device. Results show similarities found between groups with regard to severity and mechanism of injury. Caregivers exhibited the highest levels of unhealthy functioning with regard to communication skills. Highest levels of healthy functioning were noted with regard to behavioral control. Almost 75% of caregivers reported elevated stress levels. Primary caregivers of persons with SCI report significantly more stress secondary to phobic anxiety than caregivers of persons with TBI.

Title: ***Incorporating or resisting assistive devices: Different approaches to achieving a desired occupational self-image.***

Author: Lund Maria Larsson; Nygard L

Source: OTJR: Occupation, Participation and Health, 2003, Volume 23, Number 2: 67-75

Abstract: The purpose of this study was to enhance the understanding of how people with disabilities experience the meaning of their assistive devices in their occupations and how they act on their experiences. Seventeen participants were interviewed and data were analyzed using a qualitative approach. The participants' experiences showed that they reacted differently to the manifold and often contradictory meaning of assistive devices. The analysts organized the participants' reactions into three categories: pragmatic users, ambivalent users, and reluctant users. The differences between the participants were understood as representing different adaptive approaches to achieve desired occupational self-images. Thus, the assistive devices were not in themselves important, but were merely a means to achieve a desired self-image. The findings reflect that the participants'

experiences of using assistive devices reveal meanings about their use that go beyond the traditional medical perspective that focuses on the role of assistive devices as compensation for physical impairment.

Title: ***Phases of adaptation to disability as predictors of future time orientation among individuals with spinal cord injuries.***

Author: Martz EC

Source: Dissertation Abstracts International: Section B: The Sciences & Engineering, 2002, Volume 63, Number 5-B: 2351

Abstract: Rehabilitation counseling involves long-term planning with clients with disabilities by its focus on vocational goals and employment selection, both of which involve future-oriented thinking. Psychosocial adaptation to the trauma of a disability also is integral to the vocational rehabilitation process. By definition, the two adaptive phases of acknowledgment and adjustment to disability include both a goal-setting component and an integration of the perceived future implications of the disability. These adaptive components were hypothesized to be related positively to individuals' future time orientation. Further, six non-adaptive phases to disability of shock, anxiety, denial, depression, internalized anger, externalized hostility were proposed to affect future time orientation in an inverse manner, in view of research that indicated such relationships should exist. The purpose of this research was to investigate whether these eight distinctive phases of adaptation to disability predicted the temporal orientation of individuals with spinal cord injuries. Further, seven potential socio-demographic and disability-related variables were examined as predictors of future time orientation. These seven predictors were: cause of spinal cord injury, daily level of pain experienced, duration of spinal cord injury, ethnicity, existence of pressure sores, severity of disability, and work status. Of 979 individuals from two spinal cord injury clinics who were invited to participate in this research, 317 veterans and civilians returned a self-report questionnaire that contained the Reactions to Impairment and Disability Inventory (RID; Livneh & Antonak, 1990) and the Future Time Orientation scale (FTO; Gjesme, 1979). After analyzing select characteristics of the veteran and civilian groups, it was decided to examine the two samples in separate statistical analyses. Backward multiple regressions were run in each sample to examine the two research questions. The results indicated that several psychological reactions to disability, specifically the reactions of shock and acknowledgment in both groups, and anxiety, depression, and externalized hostility in the veteran group, were the best predictors of future time orientation. Further, 17% of the variance in FTO was explained by the 15 predictor variables in the civilian group and 32% of the variance in FTO was explained by the 15 predictor variables in the veteran group, compared to the 15% and 32% explained by the model of eight phases of adaptation in the civilian and veteran groups respectively. Thus, in the civilian group, socio-demographic and disability-related variables did not explain much more variance in FTO than the variance that was already explained by the eight phases of adaptation. In the veteran group, there was no change in explained variance when the seven socio-demographic and disability-related variables were added to the eight phases of adaptation to disability. Implications for rehabilitation counseling and suggestions for future research were briefly discussed.

Title: ***Age-related outcomes in persons with spinal cord injury: A summary paper.***

Author: McKinley W; Cifu D; Seel R; Huang M; Kreutzer J; Drake D; Meade M

Source: NeuroRehabilitation, 2003, Volume 18, Number 1: 83-90

Abstract: Etiology and level of injury often discriminate between age groups for persons with spinal cord injury, complicating the understanding of what role age actually has on outcomes. The age of the patient is sometimes used as a factor in determining the appropriateness of a referral to inpatient rehabilitation.

When role of age is unclear or misunderstood, though, the referral and admission decision is subject to discrimination and ageism. This paper presents information that may assist in making more appropriate decisions. By reviewing the results of four studies examining the role of age-at-injury on the outcomes of persons with spinal cord injury, including such factors of functional improvement and discharge disposition, the overall effects of age can better be understood and more appropriate conclusions drawn.

Title: ***The positive by-products of spinal cord injury and their correlates.***

Author: McMillen JC; Cook C Loveland

Source: Rehabilitation Psychology, May 2003, Volume 48, Number 2: 77-85

Abstract: OBJECTIVE: To assess positive by-products from the struggles with traumatic spinal cord injury and to explore their correlates.  
STUDY DESIGN: Forty-two participants and nominated proxy informants were interviewed 18-36 months post spinal cord injury.  
MAIN OUTCOME MEASURES: The Perceived Benefit Scales (J. C. McMillen & R. Fisher, 1998) and Symptom Checklist 90-Revised (L. R. Derogatis, 1994).  
RESULTS: Increased compassion and family closeness and decreased alcohol consumption were commonly reported following injury. Correlations between self- and proxy ratings of positive by-products were low. Positive by-products were not related to psychopathology and had different correlates.  
CONCLUSION: Positive by-products are different from other kinds of outcomes, but because loved ones do not necessarily notice these benefits, their validity remains in doubt.

Title: ***Post-traumatic stress disorder and emotional distress in persons with spinal cord lesion.***

Author: Nielsen MS

Source: Spinal Cord, May 2003, Volume 41, Number 5: 296-302

Abstract: STUDY DESIGN: Questionnaire.  
OBJECTIVE: To evaluate the prevalence of post-traumatic stress disorder (PTSD) and emotional distress in persons with recent onset of spinal cord lesion.  
SETTING: Denmark.  
METHODS: A total of 69 patients with paraplegia or tetraplegia from two rehabilitation centres in Denmark filled in the questionnaire. PTSD and emotional distress were assessed using the Harvard Trauma Questionnaire and the Medical-Based Emotional Distress Scale, 83 days on average after the spinal cord lesion. The level of neurological lesion and completeness were recorded adhering to the International Standards for Neurological Classification of Spinal Cord Injury.  
RESULTS: The prevalence of PTSD was 20%. Patients with PTSD experienced significantly more symptoms of depression and more emotional distress than patients without PTSD. Age and neurological level were related to PTSD in patients with traumatic injuries, but not in patients with nontraumatic lesions.  
CONCLUSIONS: Persons with a recent onset of spinal cord lesions are at increased risk of having PTSD, and comorbidities such as depression and other symptoms of emotional distress.

- Title: ***Preference based assessment of the quality of life of disabled persons.***
- Author: Persson J; Andrich R; Van Beekum T; Brodin H; Lorentsen O; Wessels R; de Witte L
- Source: Technology and Disability, 2002, Volume 14, Number 3: 119-24
- Abstract: A new method for assessing preference based outcome measures in rehabilitation with assistive devices is reported. The method uses a standard utility instrument, the EuroQol, with complementary items on mobility and social relationships. In addition, a problem solving scale (PIRS) is introduced. Validation has been carried out in a multicenter study of mobility, hearing and communication devices. Utilities and problem solving scores covary strongly for mobility interventions but not for those dealing with communication. So far it is not explained whether the investigated communication interventions result in moderate utility gain only, or whether there is a bias in the corresponding utility scores. Further research on this has been started. The issue of deriving utility weights for the PIRS has also been started. We recommend the described method to be used for cost-utility analyses of rehabilitation measures for disabled persons.
- Title: ***The assessment of attitudes toward individuals with disabilities in the workplace.***
- Author: Popovich PM; Scherbaum CA; Scherbaum KL.; Polinko N
- Source: Journal of Psychology, 2003, Volume 137, Number 2: 163-177
- Abstract: The authors conducted 2 studies to develop and test measures that assess beliefs about what constitutes a disability, affective reactions to working with individuals with disabilities, and beliefs about the reasonableness of workplace accommodations, in general and within the context of the Americans With Disabilities Act (ADA). The results of these 2 studies showed substantial differences in what was considered to be a disability. In general, more physical and sensory-motor conditions were considered disabilities than were psychological conditions. Furthermore, the conditions believed to be disabilities did not necessarily match what is covered by the ADA. Gender and experience with individuals who are disabled were also found to predict affective reactions and the reasonableness of accommodations. Implications for organizations are discussed.
- Title: ***Interference due to pain following spinal cord injury: Important predictors and impact on quality of life.***
- Author: Putzke JD; Richards JS; Hicken BL; DeVivo MJ
- Source: Pain, 2002, Volume 100, Number 3: 231-242
- Abstract: Examined important predictors of pain following spinal cord injury (SCI), and the impact of pain on self-reported quality of life (QOL). In Study 1, 415 SCI patients completed the SF-12 and other questionnaires concerning medical and demographic characteristics at baseline and at 1- and 2-yr follow-ups. Results show that the age of 30-59 yrs, lower self-reported mental health, and pain interference at 1-yr post-SCI were the most important unique predictors of pain interference 2 yrs post-SCI. In Study 2, 270 SCI patients were classified as: (1) those pain-free at years 1 and 2; (2) those pain-free at year 1 and in pain at year 2; (3) those in pain at year 1 and pain-free at year 2; and (4) those in pain at years 1 and 2. Results show that only those experiencing a change in pain interference status reported a change in QOL. More specifically, those developing pain interference from year 1 to year 2 reported decreased life satisfaction, physical health, and mental health, whereas, those with resolving pain interference from year 1 to year 2 reported an increase in these same domains. Unexpectedly, change in pain interference status was unrelated to change in self-reported handicap. Implications and future directions are discussed.

Title: ***Psychiatric diagnosis and treatment following spinal cord injury.***

Author: Stewart TD

Source: Psychosomatics: Journal of Consultation Liaison Psychiatry, 1988, Volume 29, Number 2: 214-220

Abstract: Discusses how the altered neurophysiology of spinal cord injury affects psychiatric diagnosis and treatment. The assessment of depression, suicidality, and psychosis requires consideration of the impact from this injury. It is argued that detection and treatment of alcoholism are also vital for the spinal-cord impaired. Treatments, be they neurochemical or psychotherapeutic, are profoundly influenced by such injury.

Title: ***The psychiatric team on a spinal cord injury service.***

Author: Seligson D; Gallagher RM

Source: Psychosomatics: Journal of Consultation Liaison Psychiatry, 1982, Volume 23, Number 11: 1152, 1154-1159

Abstract: An orthopedist and a psychiatric team describe their experience in the development of an interdisciplinary spinal cord injury service (SCIS). Factors underlying the development of the SCIS; components of the SCIS (allied professionals, medical specialties, and a psychiatric team); reasons for including a psychiatric team in the SCIS; and functioning of the SCIS are discussed. (8 ref)

Title: ***Quality of life issues in individuals with spinal cord injury... "Quality of life measurement: Building an agenda for the future"***

Author: Tate DG; Kalpakjian CZ; Forchheimer MB

Source: Archives of Physical Medicine and Rehabilitation, December 2002, Volume 83, Number 12: S18-25

Abstract: Assessments of quality of life (QOL) are increasingly used in rehabilitation, embracing a number of conceptual approaches and measurement tools. Very few studies on QOL have addressed the specific needs of persons with spinal cord injury (SCI). Literature reviewed here describes 2 meta-analytical studies on SCI as well as several individual studies that focus on predictors and correlates of QOL applied to SCI. Results from a unique study on QOL after SCI using a qualitative methodology are also discussed. In addition, we describe the findings from another study, which used the Medical Outcomes Study 12-Item Short-Form Health Survey to assess QOL and relate it to the concept of being disabled.

Title: ***Purpose in life as a mediator of adjustment after spinal cord injury.***

Author: Thompson NJ; Coker J; Krause JS; Henry E

Source: Rehabilitation Psychology, 2003, Volume 48, Number 2: 100-108

Abstract: OBJECTIVE: Determine how purpose in life influences adjustment after spinal cord injury (SCI).  
STUDY DESIGN: Cross-sectional survey with mediation analysis.  
SUBJECTS: 1,391 adults with traumatic SCI 1 or more years prior.  
MAIN OUTCOME MEASURE: Ladder of Adjustment (N. M. Crewe & J. S. Krause, 1990). The Purpose in Life scale (PIL: .J. C. Crumbaugh, 1968), the Zuckerman-Kuhlman Personality Questionnaire (M. Zuckerman, D. M. Kuhlman, J. Joireman, P. Teta, & M. Kraft, 1993), and the Multidimensional

Health Locus of Control scale (K. A. Wallston, B. S. Wallston, & R. DeVellis, 1978) were assessed.  
RESULTS: PIL mediated between most measures and adjustment.  
CONCLUSIONS: Logotherapy is effective in strengthening purpose in life. Its use with persons with SCI may improve their adjustment and quality of life.

Title: ***Return to work after spinal cord injury: A review of recent research.***

Author: Yasuda S; Wehman P; Targett P; Cifu DX; West M

Source: NeuroRehabilitation, 2002, Volume 17, Number 3: 177-186

Abstract: Reviews research on return to work (RTW) for individuals who sustain spinal cord injury (SCI), including the effects of demographic variables, occupational characteristics, workplace accommodations, quality of life, physical functional limitations, and other variables. Demographic variables that influence RTW for persons with SCI include age at injury onset, chronological age, gender, education, ethnicity, marital status, and per-injury work intensity. Others include satisfaction, and adjustment to sustaining SCI. In an effort to enhance employment opportunities for individuals with disabilities including SCI, Ticket to Work Incentive Improvement Act of 1999 has been passed by Congress and some states have begun implementing targeted initiatives through the State Partnership Systems Change Initiatives.

Title: ***Regulation of emotion and psychological symptoms in people with spinal cord injury.***

Author: Znoj HJ; Lude P

Source: Swiss Journal of Psychology—Schweizerische Zeitschrift fuer Psychologie—Revue Suisse de Psychologie, 2002, Volume 61, Number 4: 203-210

Abstract: This cross-sectional study examined the contribution of regulation of emotion on depression, symptoms of traumatic and general distress, perceived disability, and somatic symptoms following spinal cord injury. Depressed and non-depressed male and female participants (N=264, mean age 46 years) differed in their use of adaptive and maladaptive ways of regulating emotions. In addition to somatic symptoms and symptoms of traumatic stress, maladaptive emotional regulation (avoidance and distortion of awareness) accounted for 8% of the total variance of depression. It is concluded that adaptive and maladaptive ways of regulating emotions are important factors in dealing with negative feelings. Regulation of emotion appears to influence perceived disability mainly via depression. Limitations of the study and implications for rehabilitation are discussed.

Title: ***The effects of service dogs on the lives of persons with mobility impairments: A pre-post study design.***

Author: Rintala DH; Sachs-Ericsson N; Hart KA

Source: SCI Psychosocial Process, Summer 2002, Volume 15, Number 2: [65], 70-82

Abstract: The purpose of this study was to assess the benefits of the placement of service dogs with persons with mobility impairments. Both qualitative and quantitative methods were used to obtain data regarding expectations, perceived benefits, perceived negative aspects, and overall satisfaction with service dogs. Participants were applicants to Texas Hearing and Service Dogs (THSD) who had been placed on a waiting list for a service dog. The data were obtained by telephone interviews and mailed questionnaire packets at study entry, just prior to receiving a service dog, and 6, 12, and, in a few cases, 24 months after dog placement. Another group of participants who already had received a dog

from THSD provided information on one occasion. Analyses of the data found that postplacement actual experience with the service dogs met the preplacement expectations of the participants. Participants reported that their service dogs had a positive effect on going out in public, feeling needed, feeling independent, and safety. Further, respondents reported that more people approached them when in public. Responses from the participants who had already had a service dog for longer periods of time substantiated the positive effects reported by the group that responded both before and after placement of a dog. Self-esteem, as measured by the Rosenberg Self-esteem Scale, was enhanced significantly from before to after placement of a service dog. Family caregivers also benefited by being able to pursue other activities and by having more peace of mind. Negative aspects of dog placement included work in caring for the dog, inconvenience, expenses, and other people's negative reactions to the dog. Results of the study support the conclusion that persons who elect to get a service dog and can follow through with the application, waiting period, and training are likely to find that there will be many powerful improvements in various important life areas.

# Rehabilitation

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Title: ***The nature of working in the United States: An occupational therapy perspective.***

Author: Baker NA; Jacobs K

Source: Work: Journal of Prevention, Assessment and Rehabilitation, 2003, Volume 20, Number 1: 53-61

Abstract: Although working is considered by occupational therapy practitioners to be an important life role, there is very little information about the nature of working in the occupational therapy literature. This article reviews the construct of working in three ways: 1) The history of working and how it has shaped the modern beliefs about working; 2) The nature of working; and 3) The health promoting attributes of working. The paper will also discuss research done on how working is viewed by individuals with disabilities and will touch on some of the implications of the cultural bias in the workplace toward workers with disabilities. Through this increased knowledge of the nature of working, occupational therapy practitioners and other vocational rehabilitation professionals will be better equipped to break down the subtle cultural barriers, and help individuals with disabilities to participate in working.

Title: ***Spinal cord injury computer-assisted instruction for medical students.***

Author: Campagnolo DI; Stier KT; Sanchez W; Foye PM; DeLisa JA

Source: American Journal of Physical Medicine and Rehabilitation, April 2003, Volume 82, Number 4: 316-9

Abstract: OBJECTIVE: To determine if a computer-assisted instruction program would improve fourth-year medical students' knowledge base related to spinal cord injury, as determined by pretest and posttest scores.

DESIGN: A multimedia computer-assisted instruction program was developed and offered on a volunteer basis to an entire class of fourth-year medical students (n = 168). Effectiveness of the instructional content was evaluated with pretests and posttests, and overall user satisfaction with the module was assessed with the courseware evaluation. RESULTS: The responses yielded 83 sets of completed pretest and posttest pairs and 80 sets of fully completed courseware evaluations. Mean posttest score was significantly higher than the mean pretest score (pretest, 6.65 +/- 1.44, vs. posttest, 7.36 +/- 1.38; df = 82, t = -4.74, P < 0.001). Courseware evaluations yielded positive ratings in all areas, including applicability and usability.

CONCLUSIONS: The significantly increased posttest scores suggest that the students left the program with an expanded knowledge base in the content areas of spinal cord injury medicine covered in the computer-assisted instruction program.

Title: ***Efficacy of functional electric stimulation cycle ergometry training on lower limb muscles in spinal cord injured individuals.***

Author: Demchak TJ

Source: Thesis Information Ph.D. The Ohio State University, 2001. 56 p

Abstract: The purpose of the present study was to determine the effect of functional electric stimulation cycle ergometry (FES-CE), applied to acute spinal cord injured (SCI) patients, on the changes in CSAf, myosin heavy chain composition (MHC) caused by SCI. Adaptation in power output was assessed to determine muscle function following SCI. Motor complete SCI patients were recruited from The Ohio State University inpatient SCI center. Six cervical and four thoracic spinal cord injured individuals participated in the study. Each group contained five subjects (M: 4, F: 1). Subjects were assigned to

either a spinal cord injured control group (IC) or FES-CE group (IE) and matched for age, activity, and gender. Subjects age was 26 [plus or minus] 3, 30.4 [plus or minus] 14, and 22.2 [plus or minus] 5 for the UIC, IC, and IE, respectively. The IE group trained 3d/wk, 30 minutes/day for 13 weeks. Muscle biopsies were taken from the vastus lateralis muscle at pre- and post-treatment, and for UIC subjects biopsies were taken 13 weeks apart. Muscle samples were cut and stained with hemotoxin and eosin, for the determination of CSA f and nuclear density were determined. Myosin heavy chain composition was also analyzed using SDS-PAGE. Power output measured in watts (W) increased with FES-CE training and reached a maximum power output of 24.5 watts. Muscle CSAf decreased 38% and 65% at six and 19 weeks post-SCI, respectively. Initially, the IE group had a similar decrease in CSAf six weeks following SCI, however, CSAf increased 63% following 13 weeks of FES-CE training. There was no effect of SCI or FES-CE training on myonuclear density or MHC composition. Changes in CSAf and power output increased at a greater rate with acute SCI than seen previously with chronic SCI patients. The present study suggests that early intervention using FES-CE training can attenuate the decrease in CSAf and function seen in SCI patients. Our results strongly support early intervention with FES-CE following SCI to maintain muscle mass and function following SCI.

Title: ***Spasticity, strength, and gait changes after surgery for cervical spondylotic myelopathy: A case report.***

Author: Engsberg JR; Laurysen C; Ross SA; Hollman JH; Walker D; Wippold FJ 2nd

Source: Spine, April 1, 2003, Volume 28, Number 7: E136-9

Abstract: STUDY DESIGN: A case report with repeated measures is presented.  
OBJECTIVE: To describe an objective method for evaluating changes in upper- and lower-extremity spasticity and strength, as well as temporal and kinematic gait variables, after surgical intervention for cervical spondylotic myelopathy.  
SUMMARY OF BACKGROUND DATA: Degenerative cervical spinal disease is a common disorder, with some form of spondylosis demonstrated radiographically in more than 80% of those older than 55 years. Normative pre- and postoperative objective data quantifying spasticity, strength, and gait do not exist.  
METHODS: A 65-year-old woman underwent C2-C3 anterior cervical discectomy and fusion for progressive myelopathy secondary to a spondylosis and disc herniation. The measure for spasticity and strength at the ankles and elbows and a gait analysis were collected before surgery and at 11 days, 3 and 6 months after surgery. Spasticity and strength were assessed using a dynamometer, and a six-camera video system was used to record the gait.  
RESULTS: Preoperative left elbow flexor spasticity was more than 10 times greater than the values for the able bodies. It was reduced to normal levels after surgery. Substantial presurgery weakness was present in the elbow flexors and extensors bilaterally. Elbow extensor strength was at able-body levels after surgery. Gait speed was 57% of the able-body level before surgery and 78% of the able-body level 6 months after surgery.  
CONCLUSIONS: This case study demonstrated the role of biomechanics in characterizing impairments associated with cervical spondylosis and its surgical intervention. Measures for spasticity, strength, and gait taken before and after surgery indicated a favorable outcome. This report provides a foundation for the continued use of biomechanical methods to measure changes in function and impairments associated with surgical intervention of cervical spine disorders.

Title: ***Biomechanical analysis of a posterior transfer maneuver on a level surface in individuals with high and low-level spinal cord injuries.***

Author: Gagnon D; Nadeau S; Gravel D; Noreau L; Lariviere C; Gagnon D

Source: Clinical Biomechanics (Bristol, Avon), May 2003, Volume 18, Number 4: 319-31

Abstract: OBJECTIVE: The purpose of this study was to determine the movement patterns and the muscular demand during a posterior transfer maneuver on a level surface in individuals with spinal cord injuries. DESIGN: Six participants with high-level spinal cord injury (C7 to T6) were compared to five participants with low-level spinal cord injury (T11 to L2) with partial or complete control of abdominal musculature. BACKGROUND: Developing an optimal level of independence for transfer activities figures among the rehabilitation goals of individuals with spinal cord injury. There has been no biomechanical study which specifically describes the posterior transfer maneuver. METHODS: Tridimensional kinematics at the elbow, shoulder, head and trunk, as well as surface electromyographic data of the biceps, triceps, anterior deltoid, posterior deltoid, pectoralis major, latissimus dorsi, trapezius and rectus abdominus muscles were recorded during the posterior transfer. To quantify the muscular demand, the electromyographic data were amplitude normalized to the peak value obtained from maximum voluntary contractions. The transfer was divided into pre-lift, lift, and post-lift phases for analysis. RESULTS: The duration of the lift phase was significantly shorter ( $P < 0.05$ ) for the high-level spinal cord injury (1.24; SD, 0.37 s) when compared to the low-level spinal cord injury (1.74; SD, 0.39 s). The patterns and magnitudes of the angular displacements were found similar between groups ( $P$  values: 0.45-0.98). However, the high-level spinal cord injury initiated the task from a forward flexed posture, whereas the low-level spinal cord injury adopted an almost upright alignment of the trunk. Higher muscular demands were calculated for all muscles among high-level spinal cord injury participants during the transfer when compared to the low-level spinal cord injury. However, only the anterior deltoid (high level=92.4%; low level=34.2%) and the pectoralis major (high level=109.8%; low level=25.6%) reached statistical significance during the lift phase. CONCLUSIONS: Participants with high-level spinal cord injury presented different movement characteristics and higher muscular demands during the posterior transfer than low-level spinal cord injury ones. This is probably to compensate for the additional trunk and upper limb musculature impairment. RELEVANCE: The findings of this study may help to develop guidelines of specific strengthening programs for the thoracohumeral, scapulothoracic and shoulder muscles designed to restore optimal transfer capacity in individuals with spinal cord injury. Furthermore, innovative rehabilitation programs targeting the ability to control the trunk could be beneficial for these individuals.

Title: ***Effect of training on contractile and metabolic properties of wrist extensors in spinal cord-injured individuals.***

Author: Hartkopp A; Harridge SD; Mizuno M; Ratkevicius A; Quistorff B; Kjaer M; Biering-Sorensen F

Source: Muscle Nerve, January 2003, Volume 27, Number 1: 72-80

Abstract: Paretic human muscle rapidly loses strength and oxidative endurance, and electrical stimulation training may partly reverse this. We evaluated the effects of two training protocols on the contractile and metabolic properties of the wrist extensor in 12 C-5/6 tetraplegic individuals. The wrist extensor muscles were stimulated for 30 min/day, 5 days/week, for 12 weeks, using either a high-resistance (Hr) or a low-resistance (Lr) protocol. Total work output was similar in both protocols. The nontrained arm was used as a control. Maximum voluntary torque increased in the Hr ( $P < 0.05$ ) but not the Lr group. Electrically stimulated peak tetanic torque at 15 HZ, 30 HZ, and 50 HZ were unchanged in the Lr group and tended to increase only at 15 HZ ( $P < 0.1$ ) in the Hr group. Resistance to fatigue, however, increased ( $P < 0.05$ ) in both Hr (42%) and Lr (41%) groups. Muscle metabolism was

evaluated by  $(^{31}\text{P})$  nuclear magnetic resonance spectroscopy ( $(^{31}\text{P})\text{-NMRS}$ ) during and following a continuous 40-s 10-HZ contraction. In the Hr group the cost of contraction decreased by 38% ( $P < 0.05$ ) and the half-time of phosphocreatine (PCr) recovery was shortened by 52% ( $P < 0.05$ ). Thus, long-term electrically induced stimulation of the wrist extensor muscles in spinal cord injury (SCI) increases fatigue resistance independent of training pattern. However, only the Hr protocol increased muscle strength and was shown to improve muscle aerobic metabolism after training. *Muscle Nerve* 27: 72-80, 2003

Title: ***Integrated care pathways: outcome from inpatient rehabilitation following nontraumatic spinal cord lesion.***

Author: Playford E; Sachs R; Thompson AJ

Source: *Clinical Rehabilitation*, May 2002, Volume 16, Number 3: 269-75

Abstract: BACKGROUND: Integrated care pathways (ICPs) map the predicted course of an episode of patient care. They detail the expected interventions during the episode and document departures from the expected pathway (variance). This study describes the use of an ICP to audit the rehabilitation of patients with nontraumatic spinal cord injury admitted between 1997 and 1999.

METHODS: The ICPs and outcomes of 85 patients with nontraumatic spinal cord injury admitted to the Neurorehabilitation Unit at the National Hospital for Neurology and Neurosurgery, Queen Square, London were analysed. Data extracted included diagnosis, level of the lesion and duration of stay. The numbers and categories of goals and the rates of goal achievement were extracted and the variance patterns analysed.

RESULTS: An average of 28 patients were admitted each year. The level of disability on admission and the duration of stay decreased over the three-year period, while the average patient age increased from 48 to 54 years. None of these changes were statistically significant. On average each patient had three new goals set each week. Ninety per cent of all goals were achieved; this was not dependent on the category of goal. Sixteen patients (19%) accounted for 58% of all nonachieved goals. These patients tended to have acute-onset disability. The number of variances fell from 15 to 7 over the three-year period.

CONCLUSIONS: The pathway enables monitoring of the rehabilitation process. As the Unit becomes more experienced there is a trend to shorter, more focused admissions with fewer variances. Specific groups of patients with particular needs can be identified. Future patients benefit from closure of the 'audit loop' and the implementation of clinical change based on information obtained from the ICP.

Title: ***A randomized clinical trial of a wellness intervention for women with multiple sclerosis.***

Author: Stuifbergen AK; Becker H; Blozis S; Timmerman G; Kullberg V

Source: *Archives of Physical Medicine and Rehabilitation*, April 2003, Volume 84, Number 4: 467-76

Abstract: OBJECTIVE: To examine the effects of a wellness intervention program for women with multiple sclerosis (MS) on health behaviors and quality of life (QOL).

DESIGN: Randomized clinical trial.

SETTING: Community setting in the southwestern United States.

PARTICIPANTS: Convenience sample of 113 women with physician-confirmed MS (mean age, 45.79y).

INTERVENTIONS: The 2-phase intervention program included lifestyle-change classes for 8 weeks, then telephone follow-up for 3 months. Participants were followed over an 8-month period.

MAIN OUTCOME MEASURES: A series of self-report instruments to measure barriers, resources, self-efficacy for health behaviors, health promotion behaviors, and health-related QOL were completed at baseline, 2 months (after the classes), 5 months (after telephone follow-up), and at 8 months. Principal outcomes measures were health-promoting behaviors (scores on the Health

Promoting Lifestyle Profile II) and QOL (scores on the Medical Outcomes Study 36-Item Short-Form Health Survey [SF-36] scales).

RESULTS: Hierarchical linear modeling techniques revealed a statistically significant group by time effect for self-efficacy for health behaviors, health-promoting behaviors, and the mental health and pain scales of the SF-36.

CONCLUSION: These data provide initial support for the positive effects of wellness interventions to improve health behaviors and selected dimensions of QOL for women with MS.

Title: ***Rehabilitation outcomes in traumatic spinal cord injury in Australia: Functional status, length of stay and discharge setting.***

Author: Tooth L; McKenna K; Geraghty T

Source: Spinal Cord, April 2003, Volume 41, Number 4: 220-30

Abstract: STUDY DESIGN: Retrospective, descriptive study.  
OBJECTIVES: To describe patients' length of stay (LOS), functional status and discharge setting after rehabilitation and how degree of impairment (complete/incomplete paraplegia/tetraplegia) impacts on these outcomes. To compare actual LOS with estimated LOS. Estimated LOS was based on an Australian model, the Australian National Sub-acute and Non-acute Patient Classification System (AN-SNAP), which classifies patients using admission Functional Independence Measure (FIM trade mark ) scores. To further describe outcomes for each AN-SNAP class by degree of impairment.  
SETTING: Spinal Injuries Unit of major Metropolitan hospital in Brisbane, Australia.  
METHODS: Retrospective chart review of 167 patients with traumatic spinal cord injury (SCI). Main outcome measures were rehabilitation LOS, discharge FIM trade mark scores and discharge setting. Injury measures were degree of impairment, acute LOS and rehabilitation admission FIM trade mark scores. Standard demographic measures were also collected.  
RESULTS: The median rehabilitation LOS was 83 days and mean discharge FIM trade mark scores 102 for all patients. These differed by impairment (incomplete paraplegia LOS 43, FIM 117; complete paraplegia LOS 96, FIM 109; incomplete tetraplegia LOS 64, FIM 100; complete tetraplegia LOS 206, FIM 78). Patients discharged to the community (noncare facility) ranged from 93% with incomplete paraplegia to 73% with complete tetraplegia. For patients in the three AN-SNAP classes with the lowest FIM scores, the actual LOS was up to twice the estimated LOS. A large variability in discharge outcomes was found within individual AN-SNAP classes, despite similar FIM trade mark scores on admission.  
CONCLUSIONS: Rehabilitation outcomes differed substantially by impairment. The variability in outcomes for patients within the same AN-SNAP class questions the ability of this system to accurately predict LOS, and therefore cost of rehabilitation services, for patients with traumatic SCI in Australia.

## Sexual Dysfunction, Fertility Issues

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Title: ***Impact of aging on sexual function in men with spinal cord injury.***

Author: Behnegar A; Marion RJ

Source: Topics in Spinal Cord Injury Rehabilitation, Summer 2002, Volume 8, Number 1: 16-28

Abstract: As longevity after spinal cord injury (SCI) has increased, attention has shifted from treatment of active conditions to prevention of secondary disability and enhancement of quality of life. Satisfactory sexual functioning is an important contributor to quality of life. Little attention, however, has been paid to the impact of aging on sexual function after SCI. This article describes the effects of aging on sexual functioning in able-bodied persons and how these effects may influence sexual functioning in men with SCI. Physiological decreases in hormonal concentrations, muscle mass, and bone strength can have a marked effect on individuals who already have deficits in these areas as a result of SCI. Many of the treatments of sexual dysfunction in SCI are relatively new, such as intracorporeal injections and oral sildenafil, and the safety and efficacy of long-term use are not clear. Medical conditions common in the elderly, such as coronary artery disease, cerebrovascular disease, and depression, can have an additive effect on sexual functioning in persons with SCI, and treatment of these conditions may require a change in the management of the SCI-related sexual dysfunction. A satisfactory sex life can be achieved after SCI, but the maintenance of sexual function will require close monitoring and coordination among SCI clinicians and those involved in the treatment of sexual dysfunction. More research is needed on the unique problems associated with sexual functioning in the aging individual with SCI.

Title: ***Ejaculation and orgasm: Sexuality in men with SCI.***

Author: Elliott S

Source: Topics in Spinal Cord Injury Rehabilitation, Summer 2002, Volume 8, Number 1: 1-15

Abstract: Ejaculation and orgasm are two entities of sexual satisfaction in men after spinal cord injury (SCI). The scientific literature focuses on potentiating erection and on the sperm retrieval procedures for fertility purposes, but little has been written about the pleasurable aspects of ejaculation and the potential for orgasm in men after SCI. Men with SCI who have lower motor neuron or incomplete injuries appear to have an increased chance of ejaculating through sexual practices, whereas men who have injuries above neurological level T10 respond best to vibrostimulation. Orgasm after SCI is a local, learned spinal reflex that is interpreted via cerebral centers. In general, intense genital stimulation maybe needed to elicit the subjective experience of orgasm, but extragenital stimulation or cerebral input alone can lead to orgasmic release for some men after SCI. Sexual rehabilitation includes three principles: maximization of the innate physiological potential, adaptation to limitations, and promotion of a positive outlook for sexual potential via experimentation.

Title: ***Spinal cord injured women's views of sexuality: A Norwegian survey.***

Author: Lysberg K; Severinsson E

Source: Rehabilitation Nursing, January–February 2003, Volume 28, Number 1: 23-6

Abstract: The purpose of this study was to learn the views of women with spinal cord injuries (SCI) about their sexual life 1 or more years after the trauma. Based on a descriptive survey design, data were collected through a self-administered questionnaire completed by 48 women. The data were analyzed with descriptive statistics. The results show that most of the respondents had been injured

10 or more years. More than 50% were sexually active before the trauma. Fifty percent of the respondents reported that their views on sexuality had not changed as a result of the trauma. Twenty-one percent reported that sexuality was less important to them after the trauma. There is a need for studies of possible nursing interventions that will influence SCI women to recognize both their need for, and their right to, a satisfactory sexual life.

Title: ***Sexual expression following spinal cord injury.***

Author: Mona LR; Krause JS; Norris FH; Cameron RP; Kalichman SC; Lesondak LM

Source: NeuroRehabilitation, 2000, Volume 15. Number 2: 121-131

Abstract: Sexual adjustment, defined within this study as post-injury sexual views of the self, among 195 Ss with spinal cord injury was explored through cognitive adaptation theory. It was predicted that cognitive adaptation constructs and sexual self-esteem would be predictive of sexual adjustment. It was also hypothesized that sexual self-esteem would be predictive of sexual adjustment over and above cognitive adaptation constructs. Ss completed surveys that assessed optimism, self-esteem, personal control, life meaning, sexual self-esteem, and sexual adjustment. A series of hierarchical regression models were performed with results being consistent with proposed hypotheses. Implications for rehabilitation professionals are discussed and clinical suggestions are provided.

Title: ***Documentation of the impact of spinal cord injury on female sexual function: The Female Spinal Sexual Function Classification.***

Author: Sipski ML, Alexander CJ

Source: Topics in Spinal Cord Injury Rehabilitation, Summer 2002, Volume 8, Number 1: 63-73

Abstract: Significant new research has examined the impact of specific levels and degrees of spinal cord injury (SCI) on female sexual response. Research has also recently examined two methods of improving sexual responsiveness in women with SCI. The use of false-positive feedback and sildenafil were both noted as potential treatment methods that deserve further study. Concomitant with these observations, there has been a significant increase in overall interest in female sexual dysfunction. This interest has resulted in a new classification system for female sexual dysfunction, which takes into account both physiological and psychological aspects of sexual dysfunction. We propose a new classification system to predict female sexual function and dysfunction after SCI. This nomenclature, the Female Spinal Sexual Function Classification, is recommended for use as an adjunct to the International Standards for Neurological Classification of Spinal Cord Injury.

Title: ***A controlled trial of positive feedback to increase sexual arousal in women with spinal cord injuries.***

Author: Sipski ML; Rosen R; Alexander CJ; Hamer R

Source: NeuroRehabilitation, 2000, Volume 15, Number 2: 145-153

Abstract: Performed a lab-based controlled study of the use of false positive and neutral feedback on facilitating increased subjective and genital arousal in 37 females with various degrees of spinal cord injury (SCI). 10 able-bodied females served as controls. It was hypothesized that all SCI Ss would have the capacity to increase their level of subjective sexual arousal through the use of false feedback. Furthermore, Ss with greater preservation of sensory function in the T11-L2 dermatomes, and thus a greater ability to have psychogenic genital vasocongestion, would have a greater degree

of genital responsiveness than those Ss with minimal or no sensory preservation in these dermatomes. The protocol consisted of 4 baseline periods alternating with 3 periods of audiovisual erotic stimulation. Ss received either false positive or false neutral-negative feedback about their genital responsiveness as measured by a vaginal photoplethysmograph. Results provide evidence of the ability to positively alter level of cognitive sexual arousal using feedback in females with all degrees of SCIs. Furthermore, results confirm that those Ss with preservation of sensory function in the T11-L2 dermatomes also have the capacity for increasing genital sexual arousal through psychogenic sexual stimulation.

Title: ***Management of male infertility after spinal cord injury.***

Author: Sonksen J; Chen D

Source: Topics in Spinal Cord Injury Rehabilitation, Summer 2002, Volume 8, Number 1: 29-41

Abstract: Ejaculatory dysfunction and impairment of semen quality are commonly found in men after spinal cord injury (SCI). Each condition alone and in combination has the potential to interfere with the ability of the individual and his partner to have children. Over the past several decades, clinical treatments and techniques have been developed and advances in assisted reproductive techniques have taken place that now allow spinal cord-injured men to father children. This review will focus on the current understanding of ejaculatory dysfunction, semen characteristics, and clinical treatments and techniques to enhance fertility in men with SCI.

## Skin Care (Includes Wound Care Management, Plastic Surgery, Pressure Relief Support Surfaces)

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Title: ***Hemipelvectomy for severe decubitus ulcers in patients with previous spinal cord injury.***

Author: Chan JW; Virgo KS; Johnson FE

Source: American Journal of Surgery, January 2003, Volume 185, Number 1: 69-73

Abstract: BACKGROUND: Patients with spinal cord injury (SCI) frequently have pressure ulcers. Surgery is sometimes needed to close them. In rare cases, hemipelvectomy is warranted for extremely severe complications.

METHODS: We conducted a retrospective study using national Department of Veterans Affairs (DVA) computer data sets to identify clinical features of SCI patients who underwent hemipelvectomy for life-threatening septic complications of decubitus ulcers.

RESULTS: Among the approximately 4 million patients receiving care in the DVA system, more than 40,000 patients were treated on an inpatient basis for SCI during the search period (fiscal years 1989 to 1998). They represent approximately 20% of the total national patient pool. There were 56 patients who supposedly had undergone hemipelvectomy. Chart review eliminated cases that did not meet our inclusion criteria, resulting in 8 evaluable cases. All had complete SCI due to trauma and later developed severe pressure sores with pelvic osteomyelitis or life-threatening soft tissue infection.

CONCLUSIONS: This series is the largest reported to date. The surgery involved significant blood loss (mean 2.6 L). Reoperations and complications were common. The mortality rate was 25%, but the survivors were all markedly improved by the surgery. Some of the complications appeared to be related more to the SCI than to the pelvic sepsis or surgery, suggesting that meticulous perioperative care may be valuable in reducing the complication rate in SCI patients undergoing this radical operation for very severe sequelae of pressure ulcers.

Title: ***Pressure ulcer prevention and treatment: a synopsis of the current evidence from research.***

Author: Cullum N

Source: Critical Care Nursing Clinics of North America, December 2001, Volume 13, Number 4: 547-54

Abstract: Systematic reviews are increasingly viewed as the most reliable means of summarizing research findings to inform clinical decision-making. A number of systematic reviews have been completed around various aspects of pressure ulcer prevention and treatment. The volume and quality of research in pressure ulcer management is generally disappointing, with few clear messages for practitioners however, there is good evidence that higher specification foam alternatives to the standard hospital mattress can reduce pressure ulcer incidence. There is also some evidence that low air loss beds are more effective in reducing the incidence of pressure ulcers than standard ICU beds, and that air-fluidized supports may be more effective in healing pressure ulcers than standard care. There is insufficient high quality research to enable reliable conclusions to be drawn on the relative merits of most other preventive and treatment interventions. Copyright (c) 2001 by W.B. Saunders Company

Title: ***Use of behavioral contingencies to promote prevention of recurrent pressure ulcers.***

Author: Jones ML; Mathewson CS; Adkins VK; Ayllon T

Source: Archives of Physical Medicine and Rehabilitation, June 2003, Volume 84, Number 6: 796-802

Abstract: OBJECTIVE: To determine effectiveness of an intervention using monetary rewards as a consequence for preventing or reducing severity of pressure ulcers in spinal cord injury (SCI) patients with a history of chronic, recurrent ulcers.  
DESIGN: Multiple baseline analysis across subjects (time-lagged control), comparing severity of pressure ulcers and treatment costs during baseline and intervention.  
SETTING: Outpatient wound-care clinic of private, nonprofit specialty hospital.  
PARTICIPANTS: Nine adults (all with paraplegia) with a history of hospitalizations for treatment of pressure ulcers.  
INTERVENTIONS: In study 1, participants (n=6) undertook (1) a comprehensive self-care plan, (2) had a graduated schedule of visits with an advanced practice nurse, and (3) received monetary rewards for successfully preventing serious ulcers. In study 2, participants (n=3) undertook interventions 1 and 2, but monetary rewards were in staged phases so a component analysis could compare the effectiveness of visits alone to visits plus monetary rewards.  
MAIN OUTCOME MEASURES: Severity of pressure ulcers measured with the Pressure Ulcer Scale for Healing (PUSH Tool 3.0); and direct costs of treatment and preventive care for pressure ulcers.  
RESULTS: In study 1, severity of pressure ulcers-and their related treatment costs-decreased for the 6 participants. Maintenance of effects postintervention was highly variable, with only 3 participants showing long-term improvements. In study 2, for 2 participants, visits alone did not reduce pressure ulcer severity, but visits plus payments did effectively reduce ulcer severity, indicating improved prevention behaviors.  
CONCLUSIONS: Findings support the assumption that pressure ulcers may recur among some individuals because there are insufficient positive consequences for effective prevention.

Title: ***Gluteal neuromuscular stimulation in therapy and prophylaxis of recurrent sacral pressure ulcers.***

Author: Lippert-Gruner M

Source: Spinal Cord, June 2003, Volume 41, Number 6: 365-6

Abstract: STUDY DESIGN: Case study.  
OBJECTIVE: Positive influence of electrostimulation on the healing process of the gluteal decubital ulcers.  
SETTING: Department of Neurosurgery, University of Cologne, Germany.  
METHOD: The present study reports on the effects of the electrostimulation of the floor-of-the-pelvis-muscles by means of an anal electrode. This procedure was shown to have a positive influence on the healing process of the gluteal decubital ulcers sustained by a patient with incomplete sensomotor paraplegia. Apart from the contraction of the floor-of-the-pelvis-muscles, we observed a contraction of the gluteal muscles on both sides.  
RESULTS: The ulcers, which had been resisting conventional treatments for months, showed signs of a beginning healing tendency. After 4 weeks both ulcers were completely healed up.  
CONCLUSION: Because of its easy handling and its good amicability, electrostimulation of the gluteal region - one of the most common localisations of pressure-caused ulcers - by means of an anal electrode might be put to good effect even in prophylaxis in the treatment of paraplegic patients.

Title: ***Improving pressure ulcer prevention through education.***

Author: Moore Z

Source: Nursing Standard, October 24–30, 2001, Volume 16, Number 6: 64, 66-8, 70

Abstract: Pressure ulcers adversely affect the quality of life of many patients and cause anxiety and distress for their families. Pressure ulcer prevention and management is an integral part of nursing practice, but despite numerous policies and guidelines, research, and improvements in equipment, the incidence and prevalence of pressure ulcers have not fallen. In this article, the author examines issues involved in promoting more effective pressure ulcer management.

Title: ***Protection of skin integrity: Progress in pressure ulcer prevention since the AHCPH 1992 guideline.***

Author: Rutledge DN; Donaldson NE; Pravikoff DS

Source: Cinahl Information Systems, 2000, Glendale, CA 17 p

Abstract: Pressure ulcers affect an individual's functional and emotional quality of life, and can lead to serious threats to overall health, and are financially costly to the patient and society. The 1992 Agency for Health Care Policy and Research (AHCPR) guideline "Pressure Ulcers in Adults: Prediction and Prevention" included recommendations regarding risk assessment, care, and treatment. While individual programs have documented success in pressure ulcer incidence reduction, there has been minimal impact nationally on reducing the prevalence of pressure ulcers. With its synthesis of post-guideline research and other evidence, this manuscript gives nurses and other healthcare providers new knowledge with the potential to improve prevention of pressure ulcers and the resulting quality of care, cost, and outcomes. Clinicians will find this manuscript to be a thought-provoking tool useful in clinical problem-solving and performance improvement activities. Programs or interventions related to pressure ulcer prevention are likely to be more effective if they are developed after reviewing and considering all authoritative information along with specific conditions unique to the reader's situation and setting. Cinahl Information Systems accepts no liability for such programs or interventions. The full paper from which this summary is derived is available in the Online Journal of Clinical Innovations at <http://www.cinahl.com> or from Cinahl Information Systems, 1509 Wilson Terrace, Glendale, CA 91206.

Title: ***Pressure ulcer prevention and treatment practices in inpatient rehabilitation facilities.***

Author: Sae-Sia W; Wipke-Tevis D

Source: Rehabilitation Nursing, September–October 2002, Volume 27, Number 5: 192-8, 202

Abstract: Although many strategies have been developed to prevent pressure ulcers, they remain a significant healthcare problem, particularly for chronically ill patients in rehabilitation facilities. This study describes self-reported pressure ulcer prevention and treatment practices in rehabilitation facilities. Surveys were sent to all 52 licensed inpatient rehabilitation facilities in Missouri; the response rate was 76.9%. Less than 30% of the facilities used inexpensive nursing interventions such as keeping the head of a patient's bed at or below a level of 30 degrees. Informally established protocols were used more frequently than the evidence-based pressure ulcer prevention and treatment guidelines issued by the Agency for Health Care Policy and Research. Furthermore, only 50% of the respondent facilities used established, valid, and reliable risk assessment tools. There was little difference in the interventions used when a client either developed a pressure ulcer or was assessed as being at risk for an ulcer. These findings reveal a significant gap between research and practice and suggest a need to educate rehabilitation nurses about the most appropriate, evidence-based nursing interventions for preventing and treating pressure ulcers.

Title: ***Adherence to pressure ulcer prevention guidelines: Implications for nursing home quality***

Author: Saliba D; Rubenstein LV; Simon B; Hickey E; Ferrell B; Czarnowski E; Berlowitz D

Source: Journal of the American Geriatrics Society, January 2003, Volume 51, Number 1: 56-62

Abstract: OBJECTIVES: This study aims to assess overall nursing home (NH) implementation of pressure ulcer (PU) prevention guidelines and variation in implementation rates among a geographically diverse sample of NHs.

DESIGN: Review of NH medical records.

SETTING: A geographically diverse sample of 35 Veterans Health Administration NHs.

PARTICIPANTS: A nested random sample of 834 residents free of PU on admission.

MEASUREMENTS: Adherence to explicit quality review criteria based on the Agency for Healthcare Research and Quality Practice Guidelines for PU prevention was measured. Medical record review was used to determine overall and facility-specific adherence rates for 15 PU guideline recommendations and for a subset of six key recommendations judged as most critical.

RESULTS: Six thousand two hundred eighty-three instances were identified in which one of the 15 guideline recommendations was applicable to a study patient based on a specific indication or resident characteristic in the medical record. NH clinicians adhered to the appropriate recommendation in 41% of these instances. For the six key recommendations, clinicians adhered in 50% of instances. NHs varied significantly in adherence to indicated guideline recommendations, ranging from 29% to 51% overall adherence across all 15 recommendations ( $P < .001$ ) and from 24% to 75% across the six key recommendations ( $P < .001$ ). Adherence rates for specific indications also varied, ranging from 94% (skin inspection) to 1% (education of residents or families). Standardized assessment of PU risk was identified as one of the most important and measurable recommendations. Clinicians performed this assessment in only 61% of patients for whom it was indicated.

CONCLUSIONS: NHs' overall adherence to PU prevention guidelines is relatively low and is characterized by large variations between homes in adherence to many recommendations. The low level of adherence and high level of variation to many best-care practices for PU prevention indicate a continued need for quality improvement, particularly for some guidelines.

Title: ***Pressure relief behaviour and the prevention of pressure ulcers in wheelchair users in the community.***

Author: Stockton L; Parker D

Source: Journal of Tissue Viability, July 2002, Volume 12, Number 3: 84, 88, 90 passim

Abstract: This study aims to provide an insight into wheelchair users' preventative health behaviours with respect to pressure-relief behaviour, perceived risk and attribution of responsibility for preventative health measures. Wheelchair users who are dependent upon a wheelchair for their indoor and outdoor mobility have a long-term risk of developing a pressure ulcer. In an attempt to lessen the risk they need to perform pressure-relieving movements frequently. The Department of Health currently advises wheelchair users to perform a pressure-relieving movement every 15 minutes. Many wheelchair users responding to this large scale survey reported that although they were physically capable of performing pressure-relieving movements without help, they either did not do them or did not adhere to current advice. Of those who responded, 20.8% moved only once an hour and a further 54.7% moved less often than once an hour. This study is part of a wider study investigating the preventative health behaviours of wheelchair users.

Title: ***Preventing pressure ulcers among wheelchair users: Preliminary comments on the development of a self-administered risk assessment tool.***

Author: Wall J; Colley T

Source: Journal of Tissue Viability, April 2003, Volume 13, Number 2: 48-50, 52-4, 56 passim

Abstract: The prevalence of pressure ulcers among permanent wheelchair users remains high. While many risk factors for pressure ulcer development in this group have been identified only a minority of these have been evaluated scientifically and it is generally acknowledged that existing risk assessment tools are inadequate for predicting risk in seated persons who use a wheelchair for mobility. A 2-year prospective study is underway to design a new self-administered pressure ulcer risk indicator to be used by non-ambulant wheelchair users and their carers in conjunction with professionals. This instrument will be designed as a result of triangulation of methods. A systematic review of available evidence Latest professional opinion A qualitative study exploring the issues from the perspective of seated persons with a history of pressure ulcers (n = 10) undertaken by one of the authors (JW) A 2-year prospective study identifying key risk factors in a sample of 160 seated persons. This paper offers an insight into the findings on the recruitment of the 160 individuals into the prospective study, which is currently collecting a large amount of data on the health, degree of disability and integrity of skin of all the participants. The paper offers an overview of the medical diagnosis, degree of physical disability, issues pertaining to continence and prevalence of pressure ulcers in this group on recruitment. Early findings suggest that the new risk indicator should include measures of degree of physical disability and ability to transfer as an integral part of self-assessment and therefore prevention of pressure ulcers. The study was due for completion in the autumn of 2002. It is envisaged that early work on the development of the tool should be complete by the summer of 2003.

# Spinal Surgery

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Title: ***Injured metamere and functional surgery of the tetraplegic upper limb.***

Author: Coulet B; Allieu Y; Chammas M

Source: Hand Clinics, August 2002, Volume 18, Number 3: 399-412

Abstract: The size of injured metamere (IM) in tetraplegia exhibits a high variability that explains the different clinical presentations in patients who have the same neurologic level. Even when functional electrical stimulation is not planned, the lower motor neuron (LMN) integrity of paralyzed muscles must be evaluated, especially in patients with high-level tetraplegia. During the acute phase, detecting the size of the IM is important to prevent supination contracture and stiffness of the thumb and finger joints. When planning functional surgery, the LMN integrity of intrinsic muscles helps the surgeon adapt his surgical procedures. Assessing IM size must be integrated systematically into the evaluation of tetraplegic patients.

Title: ***Laminectomy for cervical myelopathy.***

Author: Epstein NE

Source: Spinal Cord, June 2003, Volume 41, Number 6: 317-27

Abstract: STUDY DESIGN: Cervical laminectomy with or without fusion, or laminoplasty, successfully address congenital or acquired stenosis, multilevel spondylosis, ossification of the posterior longitudinal ligament (OPLL), and ossification of the yellow ligament (OYL). To optimize surgical results, however, these procedures should be applied to carefully selected patients.

OBJECTIVES: To determine the clinical, neurodiagnostic, appropriate posterior cervical approaches to be employed in patients presenting with MR- and CT-documented multilevel cervical disease. To limit perioperative morbidity, dorsal decompressions with or without fusions should be performed utilizing awake intubation and positioning and continuous intraoperative somatosensory-evoked potential monitoring.

SETTING: United States of America.

METHODS: The clinical, neurodiagnostic, and varied dorsal decompressive techniques employed to address pathology are reviewed. Techniques, including laminectomy, laminoforaminotomy, and laminoplasty are described. Where preoperative dynamic X-rays document instability, simultaneous fusions employing wiring or lateral mass plate/screw or rod/screw techniques may be employed. Nevertheless, careful patient selection remains one of the most critical factors to operative success as older individuals with prohibitive comorbidities or fixed long-term neurological deficits should not undergo these procedures.

RESULTS: Short- and long-term outcomes following dorsal decompressions with or without fusions vary. Those with myelopathy over 65 years of age often do well in the short-term, but demonstrate greater long-term deterioration. Factors that correlated with greater susceptibility to deterioration include advanced age (>70 years at the time of the first surgery), severe original myelopathy, and recent trauma.

CONCLUSIONS: Success rates of laminectomy with or without fusion, or laminoplasty may be successfully employed to address multilevel cervical pathology in a carefully selected population of patients.

Title: ***Cervical myelopathy and rheumatoid arthritis: a retrospective analysis of management.***

Author: Falope ZF; Griffiths ID; Platt PN; Todd NV

Source: Clinical Rehabilitation, September 2002, Volume 16, Number 6: 625-9

Abstract: BACKGROUND: Although a number of recent studies have described the outcome of surgical treatment of patients with rheumatoid cervical myelopathy, few have reported outcome in those unable to have surgery. We sought to examine the outcome in this group of patients regardless of surgical intervention.  
DESIGN: Retrospective and descriptive.  
SETTING: Department of Rheumatology, Freeman Hospital, Newcastle upon Tyne, UK.  
METHODS: Retrospective review of case notes of 40 patients (31 females, 9 males) with rheumatoid cervical myelopathy diagnosed 1988-1997.  
RESULTS: The mean age was 64 years (range 36-80 years). The mean duration of rheumatoid arthritis (RA) before the development of myelopathy was 21 years (range 5-44 years). The common impairments were paraesthesia in the arms, neck pain and weakness. Twenty-five patients (60%) were deemed fit for surgery (group I). Twenty-two patients successfully had operative treatment and the others refused. Twelve of the 15 patients who reported pain preoperatively obtained pain relief. Six of the 11 patients who were nonambulant (Ranawat class IIIB) were able to walk postoperatively. There were two deaths within six months (9% mortality) after primary surgery due to pneumonia and sepsis. Seven of the 15 patients managed conservatively (group II) because of coexisting medical complications died within six months of presentation (47% mortality).  
CONCLUSIONS: The study confirms the overall benefit of surgical intervention in those who are medically stable. Following surgery some functional improvement may occur even in patients with severe myelopathy.

Title: ***Laminectomy and posterior cervical plating for multilevel cervical spondylotic myelopathy and ossification of the posterior longitudinal ligament: Effects on cervical alignment, spinal cord compression, and neurological outcome.***

Author: Houten JK; Cooper PR

Source: Neurosurgery, May 2003, Volume 52, Number 5: 1081-7; Discussion 1087-8

Abstract: OBJECTIVE: Multilevel anterior decompressive procedures for cervical spondylotic myelopathy or ossification of the posterior longitudinal ligament may be associated with a high incidence of neurological morbidity, construct failure, and pseudoarthrosis. We theorized that laminectomy and stabilization of the cervical spine with lateral mass plates would obviate the disadvantages of anterior decompression, prevent the development of kyphotic deformity frequently seen after uninstrumented laminectomy, decompress the spinal cord, and produce neurological results equal or superior to those achieved by multilevel anterior procedures.  
METHODS: We retrospectively reviewed the records of 38 patients who underwent laminectomy and lateral mass plating for cervical spondylotic myelopathy or ossification of the posterior longitudinal ligament between January 1994 and November 2001. Seventy-six percent of patients had spondylosis, 18% had ossification of the posterior longitudinal ligament, and 5% had both. Clinical presentation included upper extremity sensory complaints (89%), gait difficulty (70%), and hand use deterioration (67%). Spasticity was present in 83%, and weakness of one or more muscle groups was seen in 79%. Spinal cord signal abnormality on sagittal T2-weighted magnetic resonance imaging (MRI) was seen in 68%. Neurological evaluation was performed using a modification of the Japanese Orthopedic Association Scale for functional assessment of myelopathy, the Cooper Scale for separate evaluation of upper and lower extremity motor function, and a five-point scale for evaluation of strength in individual muscle groups. Lateral cervical spine x-rays were analyzed using a curvature index to determine maintenance of alignment. Each surgically decompressed level was graded on a four-point scale using axial MRI to assess the adequacy of decompression. Late follow-up was conducted by telephone interview.

**RESULTS:** Laminectomy was performed at a mean 4.6 levels. Follow-up was obtained at a mean of 30.2 months after the procedure. The score on the modified Japanese Orthopedic Association scale improved in 97% of patients from a mean of 12.9 preoperatively to 15.58 postoperatively ( $P < 0.0001$ ). In the upper extremities, function measured by the Cooper Scale improved from 1.8 to 0.7 ( $P < 0.0001$ ), and in the lower extremities, function improved from 1.0 to 0.4 ( $P < 0.0002$ ). There was a statistically significant improvement in strength in the triceps ( $P < 0.0001$ ), iliopsoas ( $P < 0.0002$ ), and hand intrinsic muscles ( $P < 0.0001$ ). X-rays obtained at a mean of 5.9 months after surgery revealed no change in spinal alignment as measured by the curvature index. There was a decrease in the mean preoperative compression grade from 2.46 preoperatively to 0.16 postoperatively ( $P < 0.0001$ ). There was no correlation between neurological outcome and the presence of spinal cord signal change on T2-weighted MRI scans, patient age, duration of symptoms, or preoperative medical comorbidity.

**CONCLUSION:** Multilevel laminectomy and instrumentation with lateral mass plates is associated with minimal morbidity, provides excellent decompression of the spinal cord (as visualized on MRI), produces immediate stability of the cervical spine, prevents kyphotic deformity, and precludes further development of spondylosis at fused levels. Neurological outcome is equal or superior to multilevel anterior procedures and prevents spinal deformity associated with laminoplasty or noninstrumented laminectomy.

**Title:** ***Treatment of multilevel cervical spondylotic myeloradiculopathy with posterior decompression and fusion with lateral mass plate fixation and local bone graft.***

**Author:** Huang RC; Girardi FP; Poynton AR; Cammisa Jr FP

**Source:** Journal of Spinal Disorders Techniques, April 2003, Volume 16, Number 2: 123-9

**Abstract:** This is a retrospective review of 32 patients with multilevel cervical myelopathy treated by laminectomy and lateral mass plate fusion. The prognosis of surgically treated myelopathy is evaluated as well as prognostic factors for recovery of myelopathy. Diagnoses included cervical spondylosis or ossification of the posterior longitudinal ligament. Final follow-up was at 15.2 months (mean) postoperatively. Myelopathy was graded preoperatively and postoperatively by the system of Nurick. All patients had preoperative radiographs and magnetic resonance imaging (MRI). The presence of abnormal T2-weighted MRI signal (myelomalacia) was noted. Postoperative studies included flexion-extension radiographs to assess fusion and MRI to evaluate decompression of neural elements and resolution of myelomalacia. Severity of preoperative Nurick myelopathy, presence of myelomalacia, and age were evaluated as potential prognostic indicators for surgically treated myelopathy. Mean Nurick score improved from 2.6 (range 1-4) to 1.8 (range 0-3) postoperatively ( $p < 0.0001$ ). Twenty-two patients (71%) had improvement in Nurick grade of at least one point, and nine showed no improvement. No patients had deterioration of Nurick grade. Preoperative myelomalacia was noted in 15 (47%) patients, and all 15 had residual myelomalacia postoperatively. Severe myelopathy, age, and myelomalacia had no prognostic value for improvement of myelopathy. Complications included pseudarthrosis (3%), wound infection (9%), and transient C5 palsy (6%). This study demonstrates excellent outcomes from laminectomy and fusion in multilevel cervical myelopathy. A high rate of improvement of myelopathy was observed, neurologic deterioration did not occur, and complication rates were low. Severe myelopathy and myelomalacia on preoperative MRI had no prognostic value.

Title: ***Long-term outcome for surgically treated cervical spondylotic radiculopathy and myelopathy.***

Author: Kadoya S; Iizuka H; Nakamura T

Source: Neurologia Medico-Chirurgica, (Tokyo), May 2003, Volume 43, Number 5: 228-40; Discussion 241

Abstract: Long-term follow-up results were examined to verify the efficacy of anterior osteophyctomy for cervical spondylotic myelopathy and radiculopathy, in particular the outcome for patients with developmentally narrow cervical canals and patients with associated ossification of the posterior longitudinal ligament (OPLL). One hundred thirty-nine patients who had undergone anterior osteophyctomy with interbody fusion between 1976 and 1990 were followed up for 1 to 22.5 years (mean 11.4 years). Overall results evaluated by the neurosurgical cervical spine scale scoring and grading showed significant improvement in both improvement score (2.7 +/- 2.3) and improvement rate (52.3 +/- 45.7%). Lower extremity motor function improved in 66.1% of patients, upper extremity motor function in 82.0%, and sensory/pain function in 70.5%. Improvement ranged from one to three grades. Severely affected patients showed good recovery. Outcome for patients with narrow cervical canals (41 patients, 29.5%) did not differ significantly from that for patients with normal canals (98, 70.5%). Patients with associated OPLL (32 patients, 23.0%) had approximately the same outcomes as those with only spondylosis (107, 77.0%). Fifteen patients (10.8%) underwent reoperation because of myelopathy due to disc degeneration adjacent to the fused level (11 patients) or OPLL (4 patients). Anterior osteophyctomy with interbody fusion can achieve good outcomes in patients with cervical spondylotic myelopathy and radiculopathy, regardless of the size of the spinal canal and association with OPLL.

Title: ***Spinal immobilisation for trauma patients.***

Author: Kwan I; Bunn F; Roberts I; Corporate Name WHO Pre-Hospital Trauma Care Steering Committee

Source: The Cochrane Library, 2003, Oxford, Publisher Information Number 2.

Abstract: A substantive amendment to this systematic review was last made on 22 January 2001. Cochrane reviews are regularly checked and updated if necessary.

BACKGROUND: Spinal immobilisation involves the use of a number of devices and strategies to stabilise the spinal column after injury and thus prevent spinal cord damage. The practice is widely recommended and widely used in trauma patients with suspected spinal cord injury in the pre-hospital setting.

OBJECTIVES: To quantify the effect of different methods of spinal immobilisation (including immobilisation versus no immobilisation) on mortality, neurological disability, spinal stability and adverse effects in trauma patients.

SEARCH STRATEGY: We searched the Cochrane Controlled Trial Register (CTR), the specialised register of the Cochrane Injuries Group, MEDLINE, EMBASE, CINAHL, PubMed and the National Research Register. We checked reference lists of all articles and contacted experts in the field to identify eligible trials. Manufacturers of spinal immobilisation devices were also contacted for information.

SELECTION CRITERIA: Randomised controlled trials comparing spinal immobilisation strategies in trauma patients with suspected spinal cord injury. Trials in healthy volunteers were excluded.

DATA COLLECTION AND ANALYSIS: Two reviewers independently applied eligibility criteria to trial reports and extracted data.

MAIN RESULTS: We found no randomised controlled trials of spinal immobilisation strategies in trauma patients.

REVIEWERS' CONCLUSIONS: We did not find any randomised controlled trials that met the inclusion criteria. The effect of spinal immobilisation on mortality, neurological injury, spinal stability and adverse effects in trauma patients remains uncertain. Because airway obstruction is a major cause of preventable death in trauma patients, and spinal immobilisation, particularly of the cervical spine, can contribute to airway compromise, the possibility that immobilisation may increase mortality and morbidity cannot be excluded. Large prospective studies are needed to validate the

decision criteria for spinal immobilisation in trauma patients with high risk of spinal injury. Randomised controlled trials in trauma patients are required to establish the relative effectiveness of alternative strategies for spinal immobilisation.

Title: ***Posttraumatic spinal Charcot's arthropathy.***

Author: Nguyen H; Gelb DE; Ludwig SC

Source: Topics in Spinal Cord Injury Rehabilitation, Fall 2002, Volume 8, Number 2: 48-58

Abstract: Spinal Charcot's arthropathy is a rare condition that in the past has been associated with numerous conditions. Recently, the reported incidence secondary to traumatic spinal cord injury has been on the rise. The diagnosis and management of spinal Charcot's arthropathy is a difficult process. A systematic approach and case examples will be described. The pathogenesis, presentation, management options, surgical approaches, and postoperative considerations are detailed.

Title: ***Evaluation of the patient with spinal trauma and back pain: An evidence based approach.***

Author: Petri R; Gimbel R

Source: Emergency Medicine Clinics of North America, February 1999, Volume 17, Number 1: 25-39

Abstract: The evaluation of spinal trauma and neck or back pain remains one of the most important and most common assessments in emergency medicine. This article provides an overview of an evidence based approach to this situation, and argues that appropriate use of imaging studies can reduce waste and better mitigate devastating outcomes to the patient. Copyright (c) 1999 by W.B. Saunders Company

Title: ***Factors associated with improved neurologic outcomes in patients with incomplete tetraplegia.***

Author: Pollard ME; Apple DF

Source: Spine, January 1, 2003, Volume 28, Number 1: 33-9

Comment in: Spine, January 1, 2003, Volume 28, Number 1: 39

Abstract: **STUDY DESIGN:** Retrospective review of 412 patients with traumatic, incomplete, cervical spinal cord injuries, and an average follow-up period of 2 years.  
**OBJECTIVES:** To determine what patient characteristics, injury variables, and management strategies are associated with improved neurologic outcomes. In particular, the effects of intravenous steroids (NASCIS II protocol), early definitive surgery (<24 hours after injury), early anterior decompression for burst fractures or disc herniations (<24 hours after injury), and surgical decompression for stenosis without fracture were assessed.  
**SUMMARY OF BACKGROUND DATA:** Controversy surrounds the pharmacologic and surgical management of patients with spinal cord injuries.  
**METHODS:** Neurologic data were collected retrospectively and classified using American Spinal Injury Association guidelines. This information was recorded at the time of injury, on admission to rehabilitation, on discharge from rehabilitation, and at 1, 2, and final year of follow-up evaluation. Outcome measures included change in motor score, change in sensory score, final motor score, and final sensory score. The SPSS v10.0.7 statistical software package was used for data analysis.  
**RESULTS:** Neurologic recovery was not related to the following factors: gender, race, type of fracture,

or mechanism of injury. Neurologic recovery also was not related to the following interventions: high-dose methylprednisolone administration, early definitive surgery, early anterior decompression for burst fractures or disc herniations, or decompression of stenotic canals without fracture. Improved neurologic outcomes were, however, noted in younger patients ( $p = 0.002$ ), and those with either a central cord or Brown-Sequard syndrome ( $p = 0.019$ ).

**CONCLUSIONS:** The most important prognostic variable relating to neurologic recovery in a patient with a spinal cord injury is the completeness of the lesion. When an incomplete cervical spinal cord lesion exists, younger patients and those with either a central cord or Brown-Sequard syndrome have a more favorable prognosis for recovery. In this study, no evidence was found to support high-dose steroid administration, routine early surgical intervention, or surgical decompression in stenotic patients without fracture.

**Title:** ***Nontraumatic acute complete paraplegia resulting from cervical disc herniation: a case report.***

**Author:** Suzuki T; Abe E; Murai H; Kobayashi T

**Source:** Spine, March 15, 2003, Volume 28, Number 6: E125-8

**Abstract:** **STUDY DESIGN:** A case report of nontraumatic acute complete paraplegia resulting from cervical disc herniation.

**OBJECTIVES:** To describe a rare case of nontraumatic paraplegia resulting from enlargement of a herniated disc in the cervical spine and to outline appropriate management of a patient with severe spinal cord compression secondary to disc herniation with developmental spinal canal stenosis.

**SUMMARY OF BACKGROUND DATA:** Acute progression of myelopathy into complete paraplegia resulting from disc herniation is rare. There are only four reported cases of nontraumatic acute myelopathy secondary to cervical disc herniation. No other report has described magnetic resonance imaging findings noted before and after the onset of acute myelopathy.

**METHODS:** A cervical disc herniation at C6-C7 is reported in a 29-year-old man who had nontraumatic acute complete paraplegia. Neurologic and magnetic resonance imaging findings are evaluated and discussed.

**RESULTS:** Disc herniation at C6-C7 enlarged nontraumatically, resulting in complete paraplegia. Emergent anterior decompression followed by secondary posterior multilevel decompression was performed. Magnetic resonance imaging studies revealed localized high signal intensity change in the spinal cord. No neurologic recovery was achieved 3 years post-surgery.

**CONCLUSION:** We emphasize that there is a possibility of acute, irreversible progression of paralysis secondary to nontraumatic enlargement of cervical disc herniation with canal stenosis. In these cases, immediate early decompressive surgery is crucial to the prevention of severe myelopathy.

## Sports and Fitness (Wheelchair Games, Recreation)

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Title: ***Karaoke for quads: A new application of an old recreation with potential therapeutic benefits for people with disabilities.***

Author: Batavia AI; Batavia M

Source: Disability Rehabilitation, March 18, 2003, Volume 25, Number 6: 297-300

Abstract: PURPOSE: Karaoke is a recreational activity whereby individuals sing into a microphone along with the melodies and lyrics provided both visually and auditorily by a machine.  
METHODS: The potential therapeutic benefits of karaoke are explored in terms of increased respiratory strength, endurance, control, and capacity, as well as emotional and physical release for people with disabilities.  
RESULTS: Although many individuals with disabilities could benefit from this activity, it is likely to be particularly beneficial to people with compromised respiratory systems, such as persons with high-level quadriplegia (tetraplegia).  
CONCLUSION: This article examines theoretical considerations and proposes a research agenda. Empirical research would be valuable to confirm the potential benefits of karaoke for people with disabilities.

Title: ***Absence of training-specific cardiac adaptation in paraplegic athletes.***

Author: Gates PE; Campbell IG; George KP

Source: Medicine and Science in Sports and Exercise, November 2002, Volume 34, Number 11: 1699-704

Abstract: PURPOSE: The distinctive nature of left ventricular (LV) adaptation reported in able-bodied endurance- and power-trained athletes probably reflects the different hemodynamic loading patterns that occur during acute exercise. The exercise-induced hemodynamic loads in spinal cord injured athletes are different to those in able-bodied counterparts (lower venous return and stroke volume, higher heart rate). We sought to test the hypothesis that wall thickness, but not chamber dimension, would be larger in endurance- and power-trained spinal cord injured athletes compared with sedentary spinal cord injured subjects.  
METHODS: We undertook resting two-dimensional, motion-mode, and Doppler examinations of 11 power-trained, 10 endurance-trained, and 5 sedentary spinal cord injured volunteers and compared structural and functional LV data by using ANOVA. LV structural data were also analyzed after being scaled to body mass (BM)(0.33). RESULTS: There were no statistically significant differences among groups for any of the LV structural or functional measurements. However, there was a trend for larger mean wall thickness (0.95 +/- 0.12 vs 0.83 +/- 0.10 cm) and left ventricular mass (193 +/- 57 vs 164 +/- 66 g) in athletes compared with sedentary individuals.  
CONCLUSION: It seems unlikely that endurance and power training elicits distinctive patterns of LV enlargement in spinal cord injured athletes. Small adaptations of the left ventricle may occur with athletic training in the spinal cord injured athlete. Research within this population is complicated by extreme heterogeneity in important physical, physiological, and athletic-related variables.

Title: ***Peak exercise capacity of electrically induced ambulation in persons with paraplegia.***

Author: Jacobs PL; Mahoney ET

Source: Medicine and Science in Sports and Exercise, October 2002, Volume 34, Number 10: 1551-6

Abstract: INTRODUCTION: Persons with spinal cord injury (SCI) are generally limited to exercise activities using the relatively smaller, less productive upper extremities with limited benefits as compared with leg exercise training. Functional electrical stimulation (FES) assisted ambulation has previously been demonstrated to allow persons with paraplegia to stand and ambulate limited distances.  
PURPOSE: This study compared the peak physiological responses of persons with paraplegia during FES ambulation and voluntary arm exercise.  
METHODS: Fifteen subjects (T -T ) previously habituated to FES ambulation, completed peak testing of both arm cranking (AC) and FES walking to the point of exhaustion. The AC tests were performed using a graded incremental protocol to exhaustion in 3-min stages and 10-W power output increments. The FES walking test consisted of successive 10-m walking bouts, each trial progressively increased in pace. Metabolic activity was continuously monitored via open-circuit spirometry with heart rate (HR) determined by a 12-lead electrocardiograph for AC and by direct palpation during FES.  
RESULTS: Peak  $VO_2$  did not differ between AC (22.9 +/- 3.8 mL x kg x min<sup>-1</sup>) and FES (22.7 +/- 3.9 mL x kg x min<sup>-1</sup>). FES ambulation elicited significantly greater peak values of HR (191 beats x min<sup>-1</sup>) versus 179 beats x min<sup>-1</sup>) and lower peak values of respiratory exchange ratio (1.06 vs 1.12) compared with AC. There were no significant differences in peak values of any other variables.  
CONCLUSION: This study indicates that FES ambulation performance, in persons with paraplegia, elicits similar exercise capacity, as indicated by similar peak oxygen consumption, as voluntary arm exercise.

Title: ***Onset of electrical stimulation leg cycling in individuals with paraplegia.***

Author: Raymond J; Schoneveld K; Van Kemenade CH; Davis GM

Source: Medicine and Science in Sports and Exercise, October 2002, Volume 34, Number 10: 1557-62

Abstract: PURPOSE: This study investigated cardiovascular and hemodynamic responses during the transition from rest to electrical stimulation-induced leg cycling exercise (ES-LCE) in individuals with chronic paraplegia (PARA).  
METHODS: Ten PARA (T(4)-T(9); ASIA A) participated in this study. Heart rate (HR), mean arterial pressure (MAP), stroke volume (SV), and cardiac output (Q) were measured on a beat-to-beat basis at rest and during the first 60 s of ES-LCE.  
RESULTS: PARA exhibited two discrete MAP responses during ES-LCE. Those with high thoracic lesions (HIGH: T(4) -T(6), = 5) responded to ES-LCE with a significant rise in MAP (maxdelta 8.3 +/- 3.6 mm Hg), whereas MAP did not exhibit any sustained change from resting values during ES-LCE in those subjects with lower lesions (LOW: T -T, = 5). In HIGH PARA, the immediate increase in MAP corresponded to a decrease in HR (maxdelta 6.8 +/- 3.1 b x min<sup>-1</sup>), which returned toward resting levels by the end of 60 s. In contrast, for LOW PARA there was no change in HR from resting levels during transition to ES-LCE. In both subgroups, SV and Q were not significantly increased during ES-LCE.  
CONCLUSION: These results suggest that the on-transient responses of MAP during ES-LCE in HIGH PARA elicited reflex changes in HR via the arterial baroreflex, whereas in LOW PARA, an unchanged HR from rest was likely due to a constant MAP during ES-LCE.



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