

Canadian Association of Physical Medicine and Rehabilitation



BOOK OF ABSTRACTS

57th Annual Scientific Meeting

**May 27 – 30, 2009
The Rimrock Resort Hotel
Banff, AB**

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Canadian Association of Physical Medicine and Rehabilitation
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The Rimrock Resort Hotel
Friday, May 29, 2009
1020 - 1200

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A 01

PROSTHESIS OUTCOME IN LOWER-LIMB AMPUTEES WITH LATE PROSTHESIS FITTING DUE TO A DELAY IN WOUND HEALING

David Berbrayer, MD, Bsc (Med), FRCPC, DABPMR

Objective: To determine impact of delay in prosthetic fitting (>30 days) due to wound infection on QOL and mobility in amputees

Design: Two groups of patients were considered for this study; those who had complete wound healing and received their prosthesis within 30 days of surgery and those who experienced delayed wound healing resulting in late prosthesis fitting (healed=4, not-healed=6). Patients were required to complete the questionnaires after receiving 6 weeks of prosthesis training as an outpatient. Prosthesis outcome was measured using a set of scales from the Prosthesis Evaluation Questionnaire (PEQ) and the Houghton Score... The degree of wound healing at the time of discharge from the inpatient clinic was determined by reviewing the patients' charts and consulting the wound-care specialist nurse.

Results: There were no significant differences between the two groups in the following PEQ measures: Prosthesis Utility, Perceived Response, Social Burden, Ambulation, Transfer, Self-efficiency and Satisfaction. There was, however, a significant difference among the two groups in the PEQ scales of Residual Limb Health ($p=0.017$), Frustration ($p=0.035$) and Well-being (0.019), with the group who had complete wound healing at the time of discharge scoring consistently higher. There was no significant difference between the two groups on the Houghton score.

Conclusions: The results of this study show that patients who undergo late prosthesis fitting, do experience some decline in their level of functionality. Although there was a significant difference between the two groups only on 3 PEQ scales, patients with delayed wound healing did score consistently lower in all PEQ measures and were noted to be on average less optimistic and more concerned about the outcome of their amputation and rehabilitation training.



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A 02

**IMPACT OF POST-SECONDARY EDUCATION ON THE QUALITY OF LIFE (QOL)
OF ADULT SPINA BIFIDA (SB) PATIENTS**

Dr. David Berbrayer

Objective: Does attaining post- secondary education lead to a better quality of life in SB?

Design: SB (n=50) > 24 years of age completed two questionnaires. First questionnaire patient demographics. Second QOL questionnaire, fourteen questions, fourteen domains patient's life 7-point "agreement" scale. Individual scores assessed specific domains of life.

Results: 9 participants completed both questionnaires. One 24-year-old male Grade 12. Allergy to rubber latex and transportation barrier for post-secondary education. Part-time grass cutter / street cleaner, no relationship. QOL survey impairment to bowel/bladder control (1 / 7) difficulty relationships (4 / 7). Overall score 74 / 98 (5.3 / 7).

8 participants (four males, four females), 24 - 65 years completed high school and post-secondary education. 4-college 3 university 1 completed college courses no diploma. 4 employed (full-time or part-time) 2 married. 2 participants employed, not married QOL scores 84 / 98 (6.0 / 7) and 59 / 98 (4.2 / 7).

4/8 unemployed. 2 not involved relationships QOL scores 66 / 98 (4.7 / 7) and 63 / 98 (4.5 / 7).

2 unemployed involved relationships QOL scores 80 / 98 (5.7 / 7) and 84 / 98 (6.0 / 7).

4/8 unemployed. 2 not involved relationships QOL scores 66 / 98 (4.7 / 7) and 63 / 98 (4.5 / 7).

2 unemployed involved relationships QOL scores 80 / 98 (5.7 / 7) and 84 / 98 (6.0 / 7).

Conclusions:

1. SB high school only better mobility, engaged in recreational activities, coped with pain.
2. SB post-secondary better social situations.
3. SB post-secondary, a job, and partner better QOL than SB post-secondary, job, but no relationship.
4. SB post-secondary, no job and partner better QOL than SB post-secondary, no job and no partner.



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A 03

THE ROLE OF PAIN IN THE LIVES OF ADULTS WITH CEREBRAL PALSY (CP)

Dr. David Berbrayer

Objectives: To examine nature and influence of pain in adult cerebral palsy (CP).

Design: Cross sectional survey assess demographics, health, disability, and pain lives and function of adult CP. Survey questions regarding demographics, disability & general health & pain in general. Subjects asked degree pain interferes with daily living, and back pain.

Results: 12 surveys. General state of health 6.92/10 (SD = 1.51) degree of life satisfaction 7/10 (SD = 1.91). 2/3 female (n = 8) 1/3 male (n = 4). Average age 33 (range: 18-60 years). 67% Caucasian (n = 8), 8% South Asian 8% East Asian and 8% (n = 1) self-reported “other” ethnicity. 80% completed some high school, 17% completed high school, 17% some university or college training, 42% graduated from college or university, and 8% graduate degree. One individual no high school. 75%(n = 9) working or attending school part-time. 83% ‘single’. 50% (n = 6) diplegic 33% (n = 4) quadriplegic 92% reported > 1 month having pain, 91% weekly. Common pain: legs, lower back, and feet. Mean intensity pain 5.82 (SD = 2.71). Mean worst pain previous 3 months 7.64 (SD = 1.91) mean least pain 1.27 (SD = 2.45). Pain, in general, found interference daily living. Back pain experienced by 82%. 78% back pain weekly. Average intensity back pain 2.67 (SD = 2.74) Mean worst back pain preceding 3 months 7.67 (SD = 2.40) mean least back pain 1.00 (SD = 1.58). Back pain interfered all daily function

Conclusions:

1. 90% experiencing pain at least once a month
2. 55% pain most days of week with average intensity of 6.09, , over 3 month period
3. 82% Lower back pain
4. Leg pain more common (91%).



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A 04

A RANDOMIZED DOUBLE-BLINDED CROSSOVER STUDY ASSESSING THE EFFECT OF CANNABINOIDS ON SPASTICITY IN SPINAL CORD INJURY PERSONS: A PILOT STUDY.

S. Pooyania, MD.; K. Ethans, FRCPC; T. Szturm, PHD; A. Casey, FRCPC; D. Perry, FRCPC
Physical Medicine and Rehabilitation Department University of Manitoba

Objectives: To determine whether nabilone, a synthetic cannabinoid, alleviates spasticity in people with spinal cord injury (SCI).

Methods: Twelve subjects were enrolled in this double-blind, placebo-controlled, crossover study. They received either nabilone or placebo during the first four-week period (0.5mg OD with option to increase to 0.5mg BID), then outcome measures were assessed. After a two-week washout, subjects were crossed-over to the opposite arm.

The primary outcome was the Ashworth scale for spasticity in the most involved muscle group, chosen by the subject and clinician. The secondary outcomes included Spasm Frequency Scale, Visual Analog Scale, Wartenberg Pendulum Test, sum of the Ashworth Scale in eight muscle groups of each side of the body, and the Clinician's and Subject's Global Impression of Change .

Results: One subject dropped out during placebo arm due to unrelated urinary stricture, and eleven completed the study. There was a significant decrease on active treatment for the Ashworth in the most involved muscle (mean difference=0.909, SD=0.85, p=0.0039), as well as the total Ashworth score (p=0.0010); VAS trended towards significance (p=0.0762). There was no significant difference in other measures. Side effects were mild and tolerable.

Conclusion: Nabilone may be beneficial to improve spasticity in people with SCI.

Key words: cannabinoids, nabilone, spasticity, spinal cord injury, THC



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A 06

COLLABORATIVE TEAM PROCESSES - WHAT IS THE EVIDENCE?

Joy Wee

Objective: This paper reviews and compares health care team structures and processes, through a discussion of available reports on team functioning.

Methods: The benefits of evidence-based practice have long been recognized in the delivery of health care, and much effort has been made to compile evidence in several areas of rehabilitation. One could argue that similar efforts should be made to document available evidence for collaborative team processes. Rehabilitation professionals need to be able to measure the impact of the team processes they employ in the delivery of rehabilitative care, in order to understand what works well and what does not. A review of published literature in the English-language will be undertaken to explore processes employed by inter-professional and other health care teams, including evaluative evidence of such processes.

Results: Historical objectives guiding the development of health care teams are discussed in this paper. Different types of team formations are described, along with published reports on processes employed and team assessment procedures used. Results are synthesized and suggestions provided for future research.

Conclusion: Rehabilitation professionals invest much time and effort into developing strong teams. Evaluating the impacts of various team processes could provide much needed evidence that teams may draw upon during their development.



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A 07

**PARTNERING WITH PATIENTS AND FAMILIES TO BALANCE SAFETY AND
AUTONOMY**

Angie Andreoli, Carol Fancott, Barbara Secker, Elaine Aimone, Karima Velji, Leslie Bolt, Ross Baker,
Gaétan Tardif

Purpose: This study explores patient and family perspectives on safety, risk and autonomy within rehabilitation. Given the strong ethical, professional and political implications for respecting independence and promoting safety, there is a clear onus on the team to understand patient and family attitudes towards safety and risk-taking.

Methodology: Twelve focus groups were conducted across each of our clinical programs including cardiac, geriatric, musculoskeletal, neuro and spinal cord rehabilitation. Five of these groups were conducted with former patients of a large academic rehabilitation hospital; five were conducted with families of former patients.

Conclusions: The loss of autonomy and reacquiring identity are two inextricably linked concepts that are critical to how patients and families approach risk and safety. For patients, this journey involves an emerging self-awareness and changing expectations about a body that is now unfamiliar.

Both emotional safety and physical safety are priorities for both patients and families; however emotional safety is often left unaddressed by healthcare professionals. For patients, support for issues such as fear, vulnerability and isolation are critical factors impeding their search for autonomy and often trump physical issues such as safe transfers and mobility

The environment can either threaten or preserve the successful balance between autonomy and safety. The human environment (staff attitude, responsiveness, engagement) and physical environment (space, security, equipment) can determine success or failure in the rehabilitation setting.

The transition from rehabilitation can create unforeseen tensions that are unique to this care setting. Understanding patient and family views on safety and risk is invaluable in engaging them as active partners in their healthcare team. This knowledge can be used to optimize patient and family participation in providing care and safety, as well as taking the necessary risks inherent in the rehabilitation process.



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A 08

**EVALUATION OF AN EVIDENCED-BASED STANDARDIZED KNEE
PHYSICAL EXAMINATION VIDEO MODULE FOR MEDICAL STUDENTS**

Debert C.T.¹, Hazlewood G.², Penney C.J.²

¹Chantel T. Debert
Department of Clinical Neurosciences
Faculty of Physical Medicine and Rehabilitation
University of Calgary, 3330 Hospital Dr. NW
Calgary, Alberta, Canada T2N 4N1
Ph: (403)921-8831
E-mail: ctdebert@ucalgary.ca

²Department of Medicine, Faculty of Rheumatology

Objectives: To develop an evidenced-based video to teach medical students a standardized knee physical examination and to determine whether this e-learning tool is a satisfactory learning method for medical students.

Methods: The evidence based literature was reviewed and a video/photographic still presentation was digitally filmed and narrated. First year University of Calgary medical students accessed the video via an internet blog during the musculoskeletal course. At the end of the course the students were asked to complete an electronic questionnaire.

Results: 97 of 158 students participated in the questionnaire. 96% of the students were aware of the video, 81% stated the video was easily accessible and used it for study purposes, 75% felt the video was easy to understand, 78% felt the video was appropriate for their level of training, 67% felt the video was helpful and 87% would use other MSK physical examination video's (i.e. shoulder exam) for study purposes. Positive feedback included excellent written and visual demonstrations of the anatomy and tests, right speed for learning, and standardization of the knee physical exam. Suggested changes included shortening the video, use of summary questions, less repetition and text, chapters with an index, printable slide information, better video speed control, more visual examples, narration of the still sequences and distribution of the video to the preceptors for physical examination teaching.

Conclusion: The knee video was a satisfactory tool to teach medical students a standardized method for the knee physical examination. Valuable feedback was gathered from this study to better develop and deliver the knee module video as well as other videos to future students and in further studies. This study was approved by the Conjoint Health Research Ethics Board at the University of Calgary.



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A 09

ORGAN TRANSPLANT INPATIENT REHABILITATION – WHY NOT?

Lesley Adcock^{1,2}, Marie Disotto-Monastero³, Arash Kashfi^{1,2}, Manuel Gomez^{1,3}, John Patcai^{1,3}

¹ Faculty of Medicine, University of Toronto

² University Health Network, Toronto General Hospital, Toronto, Ontario, Canada.

³ St. John's Rehab Hospital, Toronto, Ontario, Canada.

Objective: To determine outcomes in solid organ transplant recipients following inpatient rehabilitation and document a unique partnership.

Methods:

1. Review of partnership process between Transplant Program (TP) and Rehab Hospital (RH).
2. Retrospective review of outcomes and discharge disposition of 173 transplant patients admitted to RH between April 1, 2004 and March 31, 2008. Comparisons were made with all general rehabilitation patients admitted during the same time period. Chi square and one sample t-tests were used for statistical analysis. Outcomes were measured using FIMTM.

Results: Written partnership agreement included:

- Education programs,
- Criteria for rehab admission,
- Communication procedures,
- Repatriation protocols for acutely ill patients.

Compared to a general rehabilitation population, transplant patients had:

- More immediate (<3 days) transfers to TP (5.2 % vs 1.9% , p<.05).
- Higher rate TP readmission (19.1% vs 1.9 % , p< 0.05)
- Longer mean active length of stay (27+/_ 16 vs 20 +/_ 18 days, p<.05)
- Higher total FIMTM change (28.16 vs 20.92)
- Lower length of stay efficiency (1.1 vs 1.4, p< .05)
- Higher rate of discharges to home in patients not readmitted to acute care (96.9% vs 94.5% p<.05)

Conclusions: Creation of this partnership required significant planning to ensure the seamless transition of medically stable transplant patients from acute care to rehabilitation and then home. The high rate of TP readmission was communicated, facilitated, accepted and managed within the partnership strategy. Significant differences between the transplant and general rehabilitation populations were found for patients who completed inpatient rehabilitation. FIMTM improvements and a high percent discharge to home were demonstrated by both groups. Outcomes comparable to other rehabilitation patients , including improvement in function , provides justification for formal rehabilitation in the post solid organ transplant patient population.

Conflict of Interest: There were no funding sources and no potential conflicts of interest during the preparation of this abstract.



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A 10

A RANDOMIZED CONTROLLED TRIAL OF A WATER PROTOCOL FOR CLIENTS WITH THIN LIQUID DYSPHAGIA

Carlaw C, Finlayson H, Beggs K, Visser T, Coney D, Marcoux C, Steele C.

Objective: To develop and evaluate a process for use of a water protocol in a rehabilitation setting. Specific aims: 1) to determine the effect of our water protocol on fluid intake, satisfaction and quality of life for dysphagic clients, 2) to assess adverse events, and 3) to determine feasibility and provide data for the design of larger scale studies.

Methods: In this prospective single-blind randomized controlled study, 40 subjects, age 19 years and older with fluoroscopically-confirmed thin liquid dysphagia who have been prescribed thickened liquids, are randomly assigned to either control (standard care) or study (water protocol) conditions. Using the GF Strong Water Protocol algorithm, subjects are assigned to the appropriate water protocol and oral hygiene plans of care. Pre and post measures in the 14-day study period include: 48-hour fluid intake, percentage of fluid requirements met, SWAL QOL, patient satisfaction questionnaire, and adverse events.

Results: The GF Strong Water Protocol algorithm has been successfully instituted to guide clinical decision-making. Ten subjects have been enrolled to date (control N=3, study N=7). No adverse events have occurred in either group.

Conclusions: Use of the GF Strong Water Protocol for clients with thin liquid dysphagia is feasible for this research study. Preliminary data indicate that there have been no adverse events to date. Further data regarding its effect on fluid intake, satisfaction and quality of life for dysphagic clients will be presented once subject enrolment is complete.

Conflicts of interest: None.

Funding: William G. Fraser Rehabilitation Research Award, BC Rehab Foundation.

Presenter: Heather Finlayson, MD, FRCPC, GF Strong Rehab Centre, 4255 Laurel Street, Vancouver, BC, V5Z 2G9, 604-714-4112, heather.finlayson@vch.ca



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A 11

TACKLING ATAXIA AFTER “CHASING THE DRAGON”: THE USE OF BUSPIRONE IN THE REHABILITATION OF PATIENTS WITH HEROIN INDUCED TOXIC LEUKOENCEPHALOPATHY.

Ross Davidson¹ BSc (kin)
Paul Winston² MD BSc FRCPC

“Chasing the dragon,” refers to inhalation of the heated vapors of the freebase form of heroin: heroin pyrolysate. The heroin is placed on tinfoil above a flame, and the vapors are inhaled. The practice, originally identified in Hong Kong in the 1950s, has seen increasing use and become widespread. A complication of this practice is Heroin Induced Leukoencephalopathy (HIL). HIL may present in a variety of ways varying from changes in personality, inattention and forgetfulness to ataxia, dementia, and coma.

Objective: To describe the clinical course of a patient diagnosed with Toxic Leukoencephalopathy who was treated with Buspirone, a serotonergic 5-hydroxy tryptamine_{1A} agonist and D₂-Dopamine agonist/antagonist.

Methods: A review of Medline using the terms ‘Heroin’ ‘Chasing the Dragon’, ‘Toxic Leukoencephalopathy’ and ‘Heroin induced Toxic Leukoencephalopathy’ was undertaken to characterize the epidemiology, signs and symptoms, and natural history of HIL. A chart review of our patient who developed severe ataxia secondary to ‘Chasing the Dragon’ was used to characterize the effect of Buspirone on the course of this individual’s illness.

Results: We describe rapid short-term and sustained improvement in ataxia and dysarthria with Buspirone treatment. Buspirone has been investigated for the management of hereditary cerebellar ataxias but has not previously been implicated as a possible treatment for HIL.

Conclusions: Buspirone is an agent that is potentially active in the treatment of ataxia secondary to “chasing the dragon”. Extensive work has been done to quantify the severity of ataxia and these scales could be used to conduct further research to describe the effect of Buspirone on patients with other causes of ataxia, namely HIL.

Funding: none

¹ UBC Island Medical Program

² Vancouver Island Health Authority



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A 13

**AN INNOVATIVE APPROACH TO TRAUMATIC BRAIN INJURY (TBI) EDUCATION
USING AN ONLINE, “BUILD-A-CASE” METHOD**

Heather Mac Neill, Scott Reeves, Elizabeth Hanna

Traumatic brain injury (TBI) is a leading cause of death and disability.¹ However, health professional education in TBI is often cited as lacking.² We endeavoured to create an online interprofessional education (IPE) program on TBI.

The pilot for the project is to roll out on Apr 7, 2009. Please visit <http://coil.locatebdt.com/> for further information.

One of the challenges we faced with this project was to incorporate IPE into an online format. Interprofessional education (IPE) is a way in which health care professionals come together to learn with, from and about each other.³ Theoretically, this is a very powerful concept, however, there are many roadblocks including scheduling difficulties and accommodating diversity and different professional cultures among learners.⁴

On the other hand, online learning minimizes geographic and learner barriers that are difficult to accommodate in face-to-face IPE. It is also able to respond by multiple modalities, various learning styles, levels and cultures of adult learners⁵ often found in an IPE forum. However, in online learning, learners need to become part of a virtual learning community in order to promote connection and interactivity with each other and the material.⁶

Ryan et al described a face-to-face method of case building with small groups of continuing education learners and a facilitator to build a patient case by consensus, discuss opinions on treatment options, and lastly compare their case to established guidelines.⁷

We will discuss the theory and practical applications behind developing an online build-a-case model using synchronous communication strategies, combining the benefits of IPE and online learning while minimizing the barriers to both. Through its use we hope to gain a better understanding of how participants in an online course on traumatic brain injury experience interprofessional education (IPE) by collaborating together on subject content creation.

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Submitted by:

Project Lead:
Heather Mac Neill, MD, BSc(PT), FRCPC
Lecturer, Division of Physiatry, Dept of
Medicine, University of Toronto
Physiatrist, Director Medical Education
Bridgepoint Hospital
14 St. Matthew's Rd, rm 205A
Toronto, Ont
M4M 2B5
(Tel) 416-461-8252 X2942
(FAX) 416-470-6714
(email)
HMacNeill@bridgepointhealth.caScott

Co-authors:

Scott Reeves, PhD
Scientist, Li Ka Shing Knowledge Institute
of St Michael's Hospital
Director of Research, Centre for Faculty
Development, St. Michael's Hospital
Scientist, Wilson Centre for Research in
Education, University Health Network
Associate Professor, Department of
Psychiatry, University of Toronto
Li Ka Shing Knowledge Institute of St
Michael's Hospital
30 Bond Street, Toronto, Ontario, M5B
1X2

Elizabeth Hanna, MHS., Reg.CASLPO
COIL, 2nd Lead
Interprofessional Education Specialist,
Room 238
Bridgepoint Hospital
14 St. Matthews Road
Toronto, Ontario
M4M 2B5

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CAN BOTULINUM TOXIN IMPROVE GAIT IN PERSONS WITH MULTIPLE SCLEROSIS?

Christine A Short BSc, MD, FRCPC, Sussan Askari MD
Dalhousie University, Div. Physical Medicine and Rehabilitation, Halifax NS

Background: Multiple sclerosis (MS) is a progressive disease that leads to early disability often at a young age. Canada has a high prevalence of multiple sclerosis. Motor disturbances caused by progressive pyramidal deficit and cerebellar dysfunction, accompanied by ataxia and spasticity can have a significant negative impact on daily function in people with MS. Spasticity can impact many functions, including gait and mobility. In some individuals with MS spasticity may be the only factor preventing ambulation. Spasticity is usually generalized in MS and treated with oral medications. However individual muscles or groups may cause problems with gait and ambulation and may be amenable to local spasticity therapies such as botulinum toxin. Literature in this area for MS is lacking.

Objective: To evaluate the effect of botulinum toxin therapy on ambulation capabilities in persons with MS.

Methods: Case series. In 5 consecutive patients presenting with a diagnosis of multiple sclerosis and spastic gait, we administered botulinum toxin to one or both lower extremities. Ambulation parameters before and after treatment were assessed using an ambulation profile tool developed at our centre. Our primary outcome was walking speed and endurance.

Results: We observed improvements in ambulation speed and endurance. As well there were improvements in ambulation on uneven surfaces, ability to ascend and descend inclines and stairs, as well as overall improvements in total ambulation capability. Subjectively individuals also reported improved clonus, decreased tone, decreased pain and greater ease of ambulation.

Conclusions: Botulinum toxin may have an important role in improvement of ambulation capabilities in persons with Multiple Sclerosis. Further research in this area is needed.

Key Words: Multiple Sclerosis, Spasticity, ambulation profile, gait, Botulinum toxin A



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**EVALUATION OF A MULTIPLE MINI INTERVIEW PROCESS ADDRESSING THE
CANMEDS COMPETENCIES IN RESIDENT SELECTION FOR A PHYSICAL MEDICINE &
REHABILITATION PROGRAM**

Finlayson HC, Townson AF.

Objective: To evaluate a new “multiple mini interview” (MMI) process developed for the selection of medical students applying to a Canadian Physical Medicine & Rehabilitation (PM&R) residency training program. Specific aims: 1) to determine feasibility of the MMI, and 2) to determine intra-rater and inter-rater reliability of the assessment tool.

Methods: A new selection process was developed for our PM&R residency training program in 2009. Fifteen medical student applicants were invited for interviews, which involved the MMI process. The MMI consisted of four fifteen-minute stations with two assessors per station. Each station was designed to evaluate one or two of the key CanMEDS competencies. The assessors included faculty members and residents from the Division of PM&R, and an allied health professional. A rating scale was completed by each assessor at the end of every MMI station. Four domains were scored on each rating scale. Intraclass correlations coefficients were calculated to determine reliability within and between assessors.

Results: The MMI was successfully administered by eight assessors over two half-day periods for fifteen applicants. Data sets were complete for each candidate and each assessor. Results regarding reliability of the assessments are pending at the time of abstract submission, but will be available prior to conference presentation.

Conclusions: It is feasible to use an MMI process that addresses CanMEDS competencies in PM&R residency interviews. Conclusions regarding the reliability of the assessment tool are forthcoming.

Conflicts of interest: None.

Funding: University of British Columbia Department of Medicine, Division of PM&R.

Presenter: Heather Finlayson, MD, FRCPC, GF Strong Rehab Centre, 4255 Laurel Street, Vancouver, BC, V5Z 2G9, 604-714-4112, heather.finlayson@vch.ca



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THE STROKE REHABILITATION EVIDENCE-BASED REVIEW (SREBR): 11TH EDITION

Robert Teasell MD,^{1,2} Norine Foley MSc,¹ Katherine Salter BA¹

Aging, Rehabilitation & Geriatric Care Program, Division of Stroke Rehabilitation and Assistive Technologies, Lawson Health Research Institute, London, Ontario¹ and the Department of Physical Medicine & Rehabilitation, Schulich School of Medicine & Dentistry, University of Western Ontario, London, Ontario, CANADA²

The Stroke Rehabilitation Evidence-Based Review (SREBR) is the most comprehensive and current review available examining interventions associated with stroke rehabilitation. The 11th edition of the SREBR was released in September 2008 and is available at www.ebrsr.com. A comprehensive search strategy using multiple databases was used to identify all intervention studies published between 1970 and August 2008. A hierarchy was used to establish the strength of evidence whereby randomized controlled trials (RCTs) were considered to be the strongest form of evidence. The methodological rigor of individual RCTs was also evaluated using the Physiotherapy Evidence Database (PEDro) scoring system which awards a maximum of 10 points. This edition of the SREBR includes the results from 860 RCTs, of which 144 were related to secondary prevention of stroke. The remaining 716 RCTs investigated therapies, technologies or medications related to stroke rehabilitation. The median PEDro score of secondary prevention trials was 8 (minimum: 4, maximum: 10) and 6 (minimum: 2, maximum: 10) for non-pharmacological trials. Absence of concealed allocation, blinding of subjects and intention-to-treat analysis were the most common methodological deficiencies. Overall, there were 105 strong (>1 RCT) levels of evidence, 145 moderate (1 RCT of fair quality) levels of evidence, 59 limited (non RCTs) levels of evidence and 33 conflicting levels of evidence. The research basis for stroke rehabilitation interventions is impressive and continues to grow, despite small samples sizes for trials not relating to secondary prevention and flaws in methodology.

This project was funded by a grant from the Canadian Stroke Network



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THE INFLUENCE OF A CONCURRENT COGNITIVE TASK ON FOOT PEDAL REACTION TIME AMONG STROKE PATIENTS WITH RIGHT- OR LEFT-HEMIPLEGIA

Pauley, T., Ismail, F., Boulias, C., & Devlin, M.

Objective: To determine the impact of cognitive interference on foot pedal reaction time among stroke patients with right- or left-hemiplegia.

Methods: A controlled trial without randomization design was utilized. Subjects included 10 stroke rehabilitation patients with right- and 10 with left-hemiplegia, and 10 age-matched healthy controls. Foot pedal response times were measured using three reaction time paradigms: simple RT, dual-task RT, and choice RT. Patients used the non-paretic leg for all trials. Repeated measures ANOVA was used to compare reaction time (RT), movement time (MT), total response time (TRT).

Results: Controls demonstrated faster RT and MT than patients with right-hemiplegia for all conditions ($p < .05$ for all). Controls demonstrated faster RT than patients with left-hemiplegia for the choice RT condition only ($p < .05$). There was no difference in MT between controls and patients with left-hemiplegia for any conditions ($p > .10$ for all). Across all RT conditions, patients with right-hemiplegia demonstrated significantly impaired TRT relative to both controls (839 ± 182 vs. 615 ± 96 msec, $p < .001$) and patients with left-hemiplegia (675 ± 177 msec, $p < .001$) (Figure 1). Controls achieved significantly faster TRT than patients with left-hemiplegia for the choice RT condition only (680 ± 48 vs. 827 ± 170 msec, $p < .05$). There were no differences between these groups for the simple (530 ± 80 vs. 553 ± 115 msec, $p = .62$) or dual-task RT conditions (634 ± 89 vs. 646 ± 126 msec, $p = .80$).

Conclusions: Patients with left-hemiplegia were able to achieve TRT comparable to control subjects while concurrently executing a cognitive task, but not when unable to pre-plan the response. TRT of patients with right-hemiplegia were significantly impaired for all testing conditions.

Funding: This project was funded by a research grant provided by the Physicians' Services Incorporated Foundation.

Presenter's contact information:

Tim Pauley, PhD (candidate)
Manager, Research & Evaluation
West Park Healthcare Centre
82 Buttonwood Ave
Toronto, Ontario, M6M 2J5
Tel: (416) 243-3600 x2628
Fax: (416) 243-33454
Email: tim.pauley@westpark.org



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**A CONTROLLED TRIAL OF THE EFFECTS OF FOOT PEDAL OPERATION TECHNIQUE
ON REACTION TIME AMONG STROKE PATIENTS WITH RIGHT- OR LEFT-
HEMIPLEGIA**

Pauley, T., Ismail, F., Boulias, C., & Devlin, M.

Objective: To determine whether stroke patients with right- or left-hemiplegia are capable of achieving foot pedal response times comparable to health controls subjects at discharge from inpatient rehabilitation.

Methods: A controlled trial without randomization design was utilized. Subjects included 10 stroke rehabilitation patients with right- and 10 with left-hemiplegia, as well as 10 age-matched healthy controls. All patients were tested during the final week of inpatient rehabilitation. Response times were measured using three different foot pedal operation techniques: (1) right-sided accelerator with the right foot operating the accelerator and brake, (2) right-sided accelerator with the left foot operating the accelerator and brake, and (3) left-sided accelerator with the left foot operating the accelerator and brake. Repeated measures ANOVA was used to compare reaction time (RT), movement time (MT), total response time (TRT).

Results: Across all pedal conditions, control subjects demonstrated significantly faster RT than patients with right- (263 ± 30 vs. 348 ± 54 msec, $p < .001$) or left-hemiplegia (316 ± 57 msec, $p < .05$). Though controls demonstrated consistently faster MT than patients with right-hemiplegia ($p < .05$ for all), there was no difference between controls and those with left-hemiplegia when using the right non-paretic leg (258 ± 77 vs. 251 ± 66 msec, $p = .82$). Likewise, though controls demonstrated consistently faster TRT than patients with right-hemiplegia ($p < .001$ for all), there was no difference between controls and those with left-hemiplegia when using the right non-paretic leg (515 ± 98 vs. 553 ± 115 msec, $p = .44$) (Figure 1).

Conclusions: At the time of discharge from inpatient rehabilitation, stroke patients with left-hemiplegia can operate foot pedals as quickly as controls when using the non-paretic right leg. Patients with right-hemiplegia demonstrate significant impairment of the paretic and non-paretic legs.

Funding: This project was funded by a research grant provided by the Physicians' Services Incorporated Foundation.

Presenter's contact information:

Tim Pauley, PhD (candidate)
Manager, Research & Evaluation
West Park Healthcare Centre
82 Buttonwood Ave
Toronto, Ontario, M6M 2J5
Tel: (416) 243-3600 x2628
Fax: (416) 243-33454
Email: tim.pauley@westpark.org



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**AN UPDATE OF THE SYSTEMATIC REVIEW OF THE REHABILITATION OF
MODERATE TO SEVERE ACQUIRED BRAIN INJURIES-V4**

Robert Teasell¹⁻³, Shawn Marshall⁴, Nora Cullen⁵, Mark Bayley⁵, Laura Rees⁴, Margaret Weiser², Maureen Hildritch², Corbin Lippert², Pat McCabe², Anna McCormick⁴, Jo-Anne Aubut³ and Matthew Meyer³ for the ERABI team.

¹Department of Physical Medicine and Rehabilitation, Schulich School of Medicine and Dentistry, University of Western Ontario, London ON, ²St. Joseph's Health Care, London, ON, ³Aging, Rehabilitation and Geriatric Care Research Centre, Lawson Health Research Institute, London ON, ⁴Ottawa Hospital Rehabilitation Centre, Ottawa ON, and ⁵Toronto Rehabilitation Institute, Toronto ON,

Objective: To conduct a systematic review of the rehabilitation literature of moderate to severe acquired brain injuries (ABI) from traumatic and non-traumatic causes.

Methods: The following databases were searched for articles relating to the interventions used to assist individuals with an ABI: MEDLINE/PUBMED, CINAHL, EMBASE, and PsycINFO. The review included randomized controlled trials (RCTs), non-RCTS, cohort, case-control, case series, pre-post and single subject interventions related to intervention strategies used to assist those with an ABI recover. Data extracted included demographic information, inclusion and exclusion criteria, the description of the intervention and the study results. Articles were scored for quality using either the Downs and Black or the Physiotherapy Evidence Database Scale (PEDro) evaluation tools. A level of evidence using a modified Sackett scale was assigned to each intervention.

Results: Despite the large body of literature addressing ABI rehabilitation interventions, only 28.7% were found to be RCTs and less than half of those selected were considered strong evidence. Therefore strong levels of evidence were limited or not available for most areas of ABI rehabilitation.

Conclusions: Due to the high proportion of low quality interventional studies found, there appears to be a need to improve upon the methodological quality of ABI rehabilitation research.

This work was supported by the Ontario Neurotrauma Foundation.



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**LOCOMOTION BIOMECHANICS USING THE NIAGARA FOOT PROSTHESIS:
A PRELIMINARY REPORT**

Valerie Wellens^{1,*}, J.L. Lanovaz¹, A.G. Linassi¹, S.R. Holcomb², J.T. Bryant³

¹University of Saskatchewan, ²Saskatchewan Abilities Council, ³Queen's University

Objective: This study will examine the 3D gait characteristics of unilateral below-knee amputees using the Niagara Foot prosthesis.

Methods: The Niagara Foot is a relatively new prosthetic design, primarily intended for use in developing countries. It combines low cost and durability with high performance energy return features. The design has been successfully tested mechanically and in field trials, but to date there has been little quantitative gait data describing the performance of the foot. Biomechanical gait analysis techniques will be used to extract quantitative gait measures. Five to ten unilateral below-knee amputees will walk while 3D ground reaction forces are recorded via an embedded force platform. A motion capture system will be used to record the 3D movement of the lower limbs and torso of each subject. These data will be combined to calculate joint moments and powers at the hips, knees and the unaffected ankle. Data will be compared to those collected using the subject's usual prosthetic foot and when using a Niagara Foot with a compliant heel.

Results: Preliminary results from one subject suggest that the Niagara Foot produces similar kinematic and kinetic profiles as other high-quality energy return prosthetic feet. These similarities were observed for both the affected and unaffected limb.

Conclusion: These data will increase the general knowledge base regarding foot prosthesis mechanics and enhance evidence based approaches to low cost prosthetic designs. Future work will focus on characterizing the energy return capacity of the Niagara Foot and examining the effect of modifying heel compliance, a unique feature of the foot design.

Presenting author:

Valerie Wellens

87 Campus Drive

Saskatoon, SK, S7N 5B2

Ph: (306) 261-3807

E-mail: v.wellens@usask.ca



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**NEUROGENIC THORACIC OUTLET SYNDROME: A TREATABLE DISORDER. THE
NATURAL HISTORY AND OUTCOME IN A CASE SERIES**

Harpreet Sangha¹, Thomas A. Miller², Doug C. Ross³

¹Resident Physical Medicine and Rehabilitation

²Department of Physical Medicine and Rehabilitation, St. Joseph's Health Care London

³Department of Surgery Division of Plastic Surgery, St. Joseph's Health Care London
The Schulich School of Medicine & Dentistry, The University of Western of Ontario

Introduction: Thoracic outlet syndrome is a broad clinical entity encompassing a spectrum of entrapment syndromes caused by compression of vessels and nerves that travel from the thoracocervical region to the axilla. Entrapment symptoms can range from mild intermittent postural sensory phenomenon to severe compression with permanent neurovascular compromise. This latter “true” or “non-disputed” form, termed neurogenic thoracic outlet syndrome [NTOS], is rare but has a characteristic clinical presentation, and reliable, confirming radiographical and electrodiagnostic findings.

Objective: Demonstrate the clinical, electrodiagnostic and radiographic features with a goal of improving outcomes.

Results: We present a case series of 3 patients with NTOS. The first, involves a teenage girl with early detection and subtle electrodiagnostic findings. The patient was treated with surgical release of her thoracic inlet and this resulted in an excellent functional outcome. The second patient, a university student, had a slightly delayed diagnosis with more advanced neurological loss. She went on to have surgical release with good-to-modest results. The third patient presented in her third decade and late in her disease process with severe neurologic and electrophysiologic deficit. She did not have surgical intervention and has had a very poor functional result with progression of her neurological deficits over a 5 year follow up period.

Conclusion: This cohort illustrates the natural history and importance of early detection and diagnosis. The clinical features, and electrodiagnostic characteristics are presented through a discussion of relevant anatomy, radiological findings and electrophysiological results. The importance of early diagnosis and appropriate surgical intervention is emphasized to maximize outcome, and hopefully prevent the Gilliat-Sumner hand.



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**DOES THE TREATMENT OF SPASTIC EQUINOVARUS DEFORMITY FOLLOWING
STROKE WITH BOTULINUM TOXIN IMPROVE GAIT VELOCITY? A SYSTEMATIC
REVIEW AND META-ANALYSIS**

Manuel Murie-Fernandez MD,¹ Norine Foley MSc,³ Keith Sequeira MD,^{1,2} Robert Teasell MD^{1,2}

Department of Physical Medicine & Rehabilitation, St. Joseph's Health Care London,¹ and the Schulich School of Medicine and Dentistry, University of Western Ontario, London, Ontario,² & Aging, Rehabilitation and Geriatric Care Program, Lawson Health Research Institute, Parkwood Hospital site, London, Ontario³ CANADA

Objective: While botulinum toxin-A (BT-A) has been used successfully to treat lower- limb focal spasticity, its ability to improve characteristics of gait has not been well-defined. The objective of this systematic review was to examine the efficacy of BT-A to increase gait velocity in stroke patients with spastic equinovarus.

Methods: Relevant studies were identified through a literature search encompassing the years 1985 to January 2009. The following databases were searched: MEDLINE, EMBASE and the Cochrane Clinical Trials Register. Studies were included if the sample was comprised of adult subjects (>18 yrs) recovering from either first or subsequent stroke, presenting with spastic equinovarus deformity of the ankle preventing full active dorsiflexion, and injection with BT-A was the intervention under investigation, such that subjects who received BT-A were compared with subjects who had received placebo, differing doses of BT-A, or other therapies. A standardized mean difference (SMD) and 95% confidence interval (CI) in gait velocity between the treatment and control group was calculated for each study using Hedge's g, and the results pooled.

Results: 12 trials (9 randomized controlled trials and 3 uncontrolled trials) were identified. The following treatment contrasts were examined among the RCTs: i) BT-A vs. placebo (n=3); BT-A vs. BT-A + electrical stimulation (n=3); dose ranging studies (n=2). Three uncontrolled trials, assessing gait velocity of subjects' before and after treatment with BT-A were also included. Data from all 12 studies representing 471 subjects were available for pooled analysis. BT-A treatment was associated with a small effect size on improvement in gait velocity (SMD=0.322 ± 0.118; 95% CI 0.091 to 0.522, p<0.006).

Conclusions: BT-A treatment for spastic equinovarus post- stroke spasticity was associated with a small improvement in gait velocity.



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**HEALING AFTER AN ACHILLES TENDON INJURY, RELATIONSHIP BETWEEN SIZE
AND STRENGTH**

G. Trudel, G.P. Doherty, Y. Koike N. Ramachandran, M. Lecompte, L. Dinh, H.K. Uthoff

Objective: To determine the usefulness of dimensional changes in predicting the mechanical properties of rabbit Achilles tendons after injury.

Methods: We created a 2×7-mm full-thickness central tendon defect in one Achilles tendon of healthy rabbits. Rabbits in groups of 10 were killed immediately or 4 or 8 weeks after surgery (n=30). We then performed magnetic resonance (MR) imaging, ultrasonography (US) and mechanical testing to failure using a dual cryofixation assembly on experimental and contralateral tendons. The main outcome measures included: tendon dimensions and stress and peak load to failure. Data were compared using one-way analysis of variance. We conducted post-hoc analyses of statistically significant comparisons with multiple *t*-tests.

Results: On MR imaging and US, all dimensions of the injured tendons after 4 weeks and more were greater than those of the contralateral tendons ($P<0.05$). Mechanical stress was markedly lower in the experimental than in the contralateral tendons at both 4 weeks (39 ± 9 N/mm² vs. 77 ± 16 N/mm²) and 8 weeks (58 ± 6 N/mm² vs. 94 ± 26 N/mm²) ($P<0.05$). Mean peak load to failure was significantly lower immediately after surgery (332 ± 128 N) than at 4 and 8 weeks (712 ± 106 N and 836 ± 90 N, respectively).

Conclusions: Normal peak loads 4 weeks after injury were withstood by an enlarged tendon of lower stress. These findings support physical loading 4 weeks after an Achilles tendon injury.



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RISEDRONATE FOR PREVENTION OF SUBLESIONAL OSTEOPOROSIS AFTER SPINAL CORD INJURY: A 12-MONTH, MULTI-CENTRE, RANDOMIZED, DOUBLE BLIND, PLACEBO-CONTROLLED TRIAL.

B. C. Craven, MD^{1, 2, 4}; J. D. Adachi, MD^{2,3,5}; J. M. Bugaresti, MD^{2,3,4}
C.H. Goldsmith, PhD^{3,5}; C. F. McGillivray, MD^{1,4}; C. E. Webber, PhD²

¹ University of Toronto, Toronto, Canada; ²Hamilton Health Sciences, Hamilton, Canada; ³McMaster University, Hamilton, Canada; ⁴Toronto Rehab, Lyndhurst Centre, Toronto, Canada; ⁵St. Joseph's Healthcare, Hamilton, Ontario.

Objective: To determine the efficacy and safety of risedronate in the prevention of sublesional osteoporosis after traumatic spinal cord injury (SCI).

Design: Randomized, double blind, placebo-controlled trial.

Participants/Methods: Subjects within 100 days of SCI (C2-T10 AIS A-D) were recruited from Toronto Rehab and Hamilton Health Sciences. Thirty-five subjects were randomized either to receive oral risedronate 30 mg once weekly or placebo for 52 weeks. The outcomes were the change in bone mineral density (BMD) of the distal femur (DF), proximal tibia (PT), lumbar spine, left and right hip regions at one year, measured by dual energy x-ray absorptiometry. The frequency and severity of adverse events (AE) and serious adverse events (SAE) were recorded.

Results: Thirty subjects completed the intervention, two dropped out and three were removed for non-adherence. The mean percent changes in BMD [(mean absolute change) in g/cm^2] of the DF in the risedronate and placebo groups were -15% (0.163) and -13% (0.1250, and for the PT were -8.8% (0.079) and -8.6% (0.073), respectively. There was no difference in the between group mean percentage change in BMD of left hip, right hip, DF and PT. There was a significant difference between risedronate group, and placebo group in the lumbar spine [+2.1% (0.020) vs. -1.5% (0.015), $p = 0.028$]. The rates of AE and SAE were 93.8% and 18.8% in the risedronate group versus 89.5% and 31.6% in the placebo group, respectively. There was no association between treatment and AE rate or treatment and AE severity.

Conclusions: Risedronate 30 mg weekly was effective in maintaining BMD of the lumbar spine, but not the hips or knee region, early after SCI. Risedronate was safe and well tolerated. Future intervention trials should provide concurrent treatment with calcium and vitamin D, and evaluate the efficacy of a more potent dosing regimen.

This trial was funded by the Ontario Neurotrauma Foundation.



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DRIVING AND REINTEGRATION INTO THE COMMUNITY IN POST-STROKE PATIENTS

Hillel M. Finestone, Shawn C. Marshall, Linda Greene-Finestone, Paddi O'Hara, Lynn Hunt

Introduction: Driving is often considered an activity of daily living, especially for people in rural areas. The purpose of our study was to investigate the relationship between stroke patients' driving and reintegration into their communities.

Methods: Fifty-eight community-dwelling patients who had sustained a stroke and who were referred for a specialized driving evaluation at various assessment facilities in Ontario were studied prospectively. Information on medical health, stroke type, quality of life and driving habits was obtained via questionnaires, and a standardized "Reintegration to Normal Living" assessment tool was administered on study entry and 3 and 12 months later.

Results: None of the subjects were driving at study entry. At 12 months, data from 35 patients indicated that 23 had passed their driving test and had resumed driving. The 12 nondrivers had a significantly lower mean community reintegration score than the drivers (1.4 vs. 1.8, $p=0.005$). On multiple regression analysis, the only variable to predict community reintegration at 12 months was ability to drive. A logistic regression to predict driving versus nondriving at 12 months identified total Functional Independence Measure score and age as the only significant variables (with 77% overall accuracy).

Conclusion: Driving following a stroke contributes to reintegration into the community.



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SPINAL CORD INJURY REHABILITATION EVIDENCE (SCIRE): VERSION II

Andrea Townson, M.D.^{1,2}; Janice Eng, Ph.D.^{1,2}; Robert Teasell, M.D.^{3,4}; William Miller, Ph.D.^{1,2}; Dalton Wolfe, Ph.D.^{3,4}; Jane Hsieh, MSc⁴; Sandra Connolly, BHScOT⁴; Kristin Konnyu, MSc¹; Brianne Foulon, HBA⁴; Jo-Anne Aubut BA⁴, Swati Mehta HBSc⁴, and the SCIRE Research Team.

¹GF Strong Rehabilitation Centre, Vancouver, BC; ²University of British Columbia, Vancouver, BC; ³University of Western Ontario, London, ON; ⁴Lawson Health Research Institute, London, ON.

Objective: To update the SCIRE systematic review with new evidence published between 2005 and 2007, and to translate the knowledge for use among health care professionals.

Methods: Multiple electronic databases were searched for articles addressing interventions and outcome measures used in spinal cord injury (SCI). Methodological quality of the intervention studies was assessed using either the PEDro and/or Downs and Black tools and levels of evidence were assigned using a modified Sackett scale. Summary statements were created to facilitate knowledge mobilization among clinicians. Outcome measures with evidence supporting the reliability, validity and responsiveness specific to the SCI population were summarized and evaluated according to the strength and corroboration of evidence.

Results: The update included adding relevant literature to the already established 22 chapters, and developing three new chapters on Physical Activity, Wheelchair and Seating Equipment, and Aging. 5,900 new references were reviewed, bringing the total number of reviewed articles to date to over 23,000. Of this, the data from over 1,200 articles have been extracted and synthesized into one comprehensive systematic review, including evidence from 193 randomized controlled trials (RCTs). There were 115 studies with level 1 evidence, 199 with level 2, 21 with level 3, 610 with level 4, and 64 studies with level 5 evidence. 84 outcome measures were identified.

Conclusion: SCIRE comprises the most up-to-date research evidence underlying interventions and outcome measures specific to rehabilitation following spinal cord injury. SCIRE translates knowledge and informs health care professionals of best practices. SCIRE Version II is available free of charge online (www.icord.org/scire).

Support: This work was supported by the Ontario Neurotrauma Foundation, International Collaboration on Repair Discoveries, and the Spinal Cord Injury Solutions Network.



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**MEASURING EFFECTS OF BOTOX INJECTIONS INTO A SPASTIC FOOT USING A
PEDOBAROGRAPH**

Justin Lewicke B.Sc. Kin., Dr. Lalith Satkunam MBBS, FRCPC, Linda Minor B.Sc. PT

The purpose of this study is to examine the utility of the pedobarograph (mapping plantar aspect foot pressure) in determining effectiveness of Botox injections into the toe-flexors. In the past, it has been difficult to quantify the effects that Botox therapy has in gait, but patients often report improved comfort. With the measurement of plantar surface foot pressures pre and post treatment, it is possible to evaluate the changes in peak pressure, pressure distribution, and total contact area. This study reports a case series using the pedobarograph to show improvement following Botox injections. The implications for this type of information include: improved selection of muscles for injection and improved assessment of response to the drug. Botox is an expensive drug and more efficient use is beneficial to both the health provider and the patient.



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A DUAL CRITERION-RELATED VALIDATION STUDY OF SACROILIAC JOINT STRESS TESTS

Gordon Stanford DC, Robert Burnham MSc, MD, FRCPC

Objective: to evaluate the validity of various sacroiliac joint (SI) stress tests using a dual prospective-retrospective criterion-related technique

Design: criterion-related validation study

Setting: interventional spine pain management practice

Subjects: 43 patients with suspected unilateral mechanical SI joint pain

Intervention: 7 SI joint stress tests were performed 30 minutes prior to and following fluoroscopically guided SI joint intra-articular local anesthetic block

Outcome measures: sensitivity, specificity and likelihood ratios for each SI joint stress test and combinations of more than 1 test for both the pre-block assessment and for SI joint stress tests that converted from positive to negative post block (normalized)

Results: no solitary positive pre-block SI joint stress test significantly increased the likelihood of having SI joint pain. Having 2 or more positive pre-block tests marginally but significantly increased the likelihood of SI joint pain. The combination of ipsilateral Gaenslen's and Patrick's tests was most predictive. Normalization of a single stress test or combinations of 2 or more tests following SI joint block did not improve the likelihood of having SI joint pain.

Conclusions: solitary SI joint stress tests lack validity according to both the criterion-related evaluations used in this study. Two or more positive pre-block SI joint stress tests do validly increase the likelihood of SI joint origin pain.

Funding source: International Spinal Intervention Society



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**VENTILATOR-DEPENDENT MOTOR-COMPLETE TETRAPLEGIA FOLLOWING
CERVICAL TRANSFORAMINAL EPIDURAL INJECTION: A CASE REPORT**

Habra NM. MD, Fournier C. MD, Jacquemin G. MD

Study design: Case report

Summary of background data: There have been few reported cases of spinal cord infarction following cervical transforaminal epidural injections. Although rare, the consequences can be devastating.

Objectives and results: We report the case of a healthy 51-year-old man who presented with acute left C7 radiculopathy. A fluoroscopically-guided cervical transforaminal epidural injection was performed at the C6-C7 level using 40 mg of triamcinolone and 0.5 cc of saline solution. Within minutes of the injection, the patient developed motor-complete tetraplegia with respiratory insufficiency warranting intubation. The initial cervical magnetic resonance imaging revealed no spinal cord changes but a follow-up study 24 hours later demonstrated an image compatible with spinal cord ischemia from C2-C6 in the territory of the anterior spinal artery. There was no evidence of direct spinal cord trauma or epidural hematoma.

Conclusion: Ventilator-dependent motor-complete tetraplegia is a rare complication following cervical transforaminal epidural injection. The main causal mechanism is believed to be the larger size of the triamcinolone particles versus other corticosteroids embolizing during inadvertent intravascular injection.



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RADIOFREQUENCY SENSORY ABLATION AS A TREATMENT FOR SYMPTOMATIC UNILATERAL LUMBOSACRAL JUNCTION PSEUDARTICULATION (BERTOLLOTTI'S SYNDROME): A CASE REPORT

Robert Burnham MSc, MD, FRCPC

Objective: to describe the clinical presentation, diagnostic evaluation and successful treatment of a case of symptomatic unilateral lumbosacral junction pseudarticulation using a novel radiofrequency nerve ablation technique.

Method: a 56-year-old female patient who had suffered with right upper buttock discomfort for 16 years was found to have an elongated right L5 transverse process that articulated with the sacrum (Bertolotti's syndrome). Fluoroscopically guided local anesthetic/corticosteroid injection into the pseudarthrosis completely eliminated her pain for the duration of the local anesthetic only. Complete pain relief was also achieved by injecting local anesthetic circumferentially around the posterior pseudarthrosis articular margin. Bipolar radiofrequency strip thermal lesions were then created circumferentially around the posterior pseudarthrosis articular margin.

Results: 100% pain relief and full restoration of function was achieved for 16 months post-procedure.

Conclusion: this case report describes a novel radiofrequency technique for treating symptomatic lumbosacral junction pseudarticulation that warrants further evaluation.



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**MULTIDISCIPLINARY CHRONIC PAIN MANAGEMENT IN A RURAL CANADIAN
SETTING**

Wallace Dudley PhD, Jeremiah Day MD, CCFP, Robert Burnham MSc, MD, FRCPC

Introduction: chronic pain is prevalent, complex and most effectively treated by a multidisciplinary team particularly if psychosocial issues are prevalent. The limited access to and high costs of such services are often prohibitive for the rural patient.

Objective: to describe the development and 18 month outcomes of a small multidisciplinary chronic pain management program run out of a physiatrist's office in rural Alberta.

Methods: the multidisciplinary team consisted of a family physician, physiatrist, psychologist, physical therapist, kinesiologist, nurse and dietician. Each was involved with the multidisciplinary portion of the program on a part-time basis. Based on the findings of a detailed intake medical assessment, patients were managed in 1 of 3 methods: consultation only, a limited multi-disciplinary program or full multidisciplinary program. The full multidisciplinary program involved ½ day long visits to the clinic once weekly during which the patient was reassessed by all team members other than the physiatrist and participated in group education and psychotherapy sessions. During the week, the patient worked on their home program and studied from a self-management workbook. Self-reported measures of pain, disability, mood and satisfaction were prospectively recorded serially through the program.

Results: clinically and statistically significant improvements in pain, disability and mood were achieved.

Conclusions: successful multidisciplinary chronic pain management services can be provided in a rural setting.

Funding Sources: David Thompson Health Region; Purdue Pharma, Pfizer Pharmaceutical



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FOOT-FLOOR ANGLE: A DIRECT MEASURE OF TOE-WALKING IN CHILDREN WITH HEMIPARETIC CEREBRAL PALSY BEFORE AND AFTER TENDON LENGTHENING

Authors/Institutions: J.M. Watt, J. Lewicke, B. Watkins, J. Andersen, J. McIvor, Syncrude Center for Motion and Balance, Glenrose Rehabilitation Hospital, Edmonton, Alberta, CANADA; J.M. Watt, B. Watkins, J. Andersen, J. McIvor, S. Dulai, Physical Medicine Clinic, Glenrose Rehabilitation Hospital, Edmonton, Alberta, CANADA; J.M. Watt, J. Andersen, Department of Pediatrics, University of Alberta, Edmonton, Alberta, CANADA; J. McIvor, S. Dulai, Department of Surgery, University of Alberta, Edmonton, Alberta, CANADA; L.M. Burkholder, Department of Clinical Neurosciences, University of Calgary, Calgary, Alberta, CANADA

Background/Objectives: Clinicians working with children with neuromotor disabilities are interested in assessing and treating toe-walking (TW). TW is characterized by initial toe contact as well as absent first(heel)rocker and heelstrike(HS) in stance, but does not necessarily equate with excessive equinus. Conventional kinematics and kinetics in instrumented gait analysis can infer the presence/absence of HS at initial contact(IC) and first rocker, but does not assess the relationship of the foot to the floor. The foot-floor angle(FFA), is a direct measure of the angle of inclination between the foot and the floor. This study explores the relationship between sagittal ankle dorsiflexion angle(ADA) and FFA at IC, in assessing TW before and after surgical intervention in children with hemiparetic cerebral palsy(HCP).

Design: Retrospective cohort study

Participants and Setting: Tertiary rehabilitation hospital/gait analysis laboratory. A convenience sample of 11 children (4-10 years) with hemiparetic cerebral palsy, Gross Motor Function Classification Scale level I, referred to the laboratory for preoperative assessment of unilateral toe-walking was studied. Normative data obtained from 20 children (4-10 years) served as controls.

Materials/Methods: Subjects underwent three-dimensional motion analysis as part of clinical care or in collecting normative data. Children with HCP were assessed preoperatively and again one year after gastrosoleus lengthening. ADA and FFA were calculated from kinematic data. Kinematic and kinetic data (KD) were interpreted by two independent observers for the presence of first rocker.

Results: Preoperatively, ADA and FFA in hemiparetic side ankles (HA) were significantly different from control ankles (CA) and from non-hemiparetic side ankles (NHA), indicative of TW. After tendon lengthening of the HA, ADA improved by 8.3 degrees (95% CI, 3.0 to 13.6) and FFA improved by 12.1 degrees (95% CI, 8.5 to 15.7) at IC.(Table 1) Post-operatively, 4/11 HA achieved HS according to FFA. 9/11 HA remained plantarflexed(PF) by ADA at IC, but 3 of those had HS according to FFA and first rocker in KD. FFA also showed HS in 1 dorsiflexed HA, and toewalking in 1 dorsiflexed HA according to ADA. In 13/40 CA and 2/11 NHA, FFA and KD demonstrated HS at IC despite ADA showing PF.



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Conclusions/Significance: Toe-walking can be assessed directly using FFA derived from kinematic data. In this study, improvements in ADA and FFA at IC were seen after gastrocnoleus lengthening in children with HCP. FFA identified heelstrike at IC where the ankle appeared to be plantarflexed by ADA, as well as TW at IC where the ankle appeared to be dorsiflexed by ADA. TW can be due to inadequate dorsiflexion at IC or other factors above the ankle, such as excessive knee flexion, even when the ankle is dorsiflexed. FFA can measure the degree of severity of TW at IC directly, irrespective of ADA, and may be helpful in addition to ADA in assessing outcome after surgical and other interventions. The usefulness of FFA trajectory in assessing the rest of the gait cycle is being investigated.



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NEUROMUSCULAR PARTITIONING IN THE LATERAL AND MEDIAL HEADS OF GASTROCNEMIUS BASED ON INTRAMUSCULAR NERVE DISTRIBUTION PATTERNS

Eldon Loh, Mayoorendra Ravichandiran, Kajeandra Ravichandiran, Lalith Satkunam, Anne Agur

Objective: To create a three-dimensional model of intramuscular nerve distribution within gastrocnemius in order to determine potential neuromuscular partitions that could guide chemodenervation management technique for spasticity.

Methods: Four formalin-fixed cadaveric gastrocnemius specimens were serially dissected. Using a Microscribe 3D-X Digitizer, points along the surface of the muscle were digitized to generate a contour of the muscle volume. Nerve branches from the tibial nerve that entered gastrocnemius were then digitized. Non-neural tissue was removed with fine forceps to expose the course of these nerve branches within gastrocnemius. The entire visualized course of these nerve branches and their subsequent branches were digitized. Autodesk® Maya, with plug-ins developed in the laboratory, generated a manipulable three-dimensional model of the nerve within the muscle volume using digitized data.

Results: A three-dimensional model was generated and analyzed for each specimen. Medial and lateral gastrocnemius had 2-5 nerve entry points into the muscle volume. The most proximal group of nerve branches entered at approximately 13% of the muscle belly length, the second group at 20% and the third group at 27%. Despite a variable number of nerve entry points, the nerve distribution patterns within both medial and lateral gastrocnemius were consistent across specimens. Both lateral and medial heads of gastrocnemius had a proximal group of nerve fibers supplying the proximal portions of a given head, a lateral group supplying the distolateral 2/3 and a medial group supplying the distomedial 1/3. In one lateral gastrocnemius, 2 nerve branches emerging from the lateral aspect of soleus supplied the distolateral portion of the muscle.

Conclusion: A consistent pattern of nerve distribution was identified, suggesting distinct neuromuscular partitions within gastrocnemius. Knowledge of anatomic partitioning patterns may lead to more efficient injection protocols for spasticity management with chemodenervating agents.

Conflict of interest: None declared.

Presenting Author Information:

Dr. Eldon Loh
Division of Physical Medicine & Rehabilitation
Room 1226, 10320 - 111 Avenue
Glenrose Rehabilitation Hospital
Edmonton, Alberta T5G 0B7
E-mail: eldonloh@gmail.com
Phone: 780-423-0567



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**HISTORICAL ACCOUNTS ON THE ROLE OF PHYSICAL MEDICINE PHYSICIANS IN
REHABILITATION: DIFFERENCES IN THE SCIENTIFIC AND HUMANITIES
LITERATURE**

Eldon Loh

Objective: To compare and contrast historical accounts in the medical and humanities literature describing the relationship of physical medicine physicians to rehabilitation.

Hypothesis: As medical history accounts in medical literature tend to be descriptive and linear, and history of medicine accounts in humanities literature tend to explain events through a particular theory, it was hypothesized that the two types of accounts would portray the role of physical medicine physicians in rehabilitation differently.

Methods: Literature search for articles focusing on the development of Physical Medicine and Rehabilitation in both medical (MEDLINE) and humanities (JSTOR, History of Medicine, Science and Technology) databases. The author compared descriptions on the development of physiatry as portrayed in medical and humanities literature.

Results: The specialty's scientific journals portrayed the techniques of physical medicine as most relevant to rehabilitation and therefore imply that specialty development was inevitable. They focused on the pioneering work of a group of American physical medicine physicians who developed a personal interest and unique motivation to care for the disabled. Accounts in the humanities literature emphasized the organizational conflicts and sociopolitical factors that drove specialty formation. They portrayed the inclusion of rehabilitation within physical medicine as dependent on the ability of physical medicine physicians to capitalize on political events and to limit competition from other specialties.

Conclusions: Historical accounts in the scientific and humanities literature provide vastly different perspectives regarding the origins of rehabilitation medicine, particularly the role of physical medicine physicians within rehabilitation medicine. The differences between these two types of historical accounts likely relates to their underlying purpose. Histories in the scientific literature seek to describe the linear development of the specialty and the contributions of its most important figures, while those in the sociological literature apply key events in the specialty's history into a broader theory on specialty development.

Conflict of interest: None declared.

Presenting Author Information:

Dr. Eldon Loh
Division of Physical Medicine & Rehabilitation
Room 1226, 10320 - 111 Avenue
Glenrose Rehabilitation Hospital
Edmonton, Alberta T5G 0B7
E-mail: eldonloh@gmail.com
Phone: 780-423-0567



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**EFFECT OF HAND WARMING ON ELECTRODIAGNOSTIC TESTING RESULTS AND
DIAGNOSIS IN PATIENTS WITH SUSPECTED CARPAL TUNNEL SYNDROME**

Taylor R. Burnham and Robert S. Burnham MD, MSc, FRCPC

Objective: to evaluate the effect of hand warming on electrodiagnostic results and diagnosis in patients with suspected carpal tunnel syndrome (CTS).

Design: 65 upper limbs in 33 consecutive patients referred for electrodiagnostic evaluation of suspected CTS were tested at room temperature (average hand temperature 31.9°C) and retested following 20 minutes of heating pad warming (average hand temperature 33.5°C).

Results: warming resulted in significantly faster transcarpal tunnel sensory and motor conduction (6-10%), reduced median:ulnar sensory latency to D4 difference (23%) and increased transcarpal tunnel motor amplitude drop (11%). The changes resulted in 15% less limbs meeting the electrodiagnostic conduction velocity criteria of CTS, 9% less by median:ulnar sensory latency to D4 difference and 5% more meeting conduction block criteria.

Conclusion: hand warming using a heating pad for 20 minutes increases transcarpal tunnel conduction velocity and motor conduction block-like amplitude changes. These phenomena introduce potential sources of diagnostic error particularly in borderline cases. Changes in conduction velocity may result in CTS under diagnosis (type 2 error) whereas the changes in conduction block may result in over diagnosis (type 1 error).



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**SUCCESSFUL PROSTHETIC FITTING AND REHABILITATION OF A TRANSTIBIAL
(BELOW KNEE) AMPUTEE WITH SEVERE CHRONIC OBSTRUCTIVE PULMONARY
DISEASE: A CASE REPORT AND LITERATURE REVIEW.**

Authors: A. Arneja MD, FRCPC, J. Sohal M.B.B.S, Sat Sharma MD, FRCPC

Limb prosthesis is rarely offered to patients with severe chronic obstructive pulmonary disease (COPD) because of inability to achieve high-energy expenditure required for successful prosthetic ambulation. We describe a case of successful prosthetic fitting and rehabilitation of a patient with severe COPD with the aid of oxygen supplementation. A 67 year old female patient with severe COPD, FEV1 = 0.54 L/sec (25% predicted), FVC = 1.37 L (52% predicted) and type II respiratory failure (PaO₂ = 58 mmHg, PaCO₂ = 52mmHg) underwent a right transtibial amputation for severe foot gangrene. An aggressive rehabilitation program of conditioning exercises and gait training utilizing oxygen therapy was initiated. She was custom fitted with a right transtibial patellar tendon bearing prosthesis with liner, sleeve suspension system and dynamic solid ankle cushion heel (SACH) foot. Rehabilitation program improved her strength, endurance and stump contracture and she was able to walk for short distances with the prosthesis. Her VICON motion analysis showed a Cadence of 73.5 (steps/min) and a Velocity of 0.29 (m/sec) and no difference in right and left step time and step length. This case report illustrates that elderly with significant severe COPD can be successfully fitted with limb prosthesis and rehabilitated using oxygen along with optimization of their underlying comorbidities. Despite paucity of published information in this area, prosthesis fitting and rehabilitation should be considered in elderly patients with severe COPD.

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Dr. A. Arneja
Rehab Hospital
RR139 – 800 Sherbrook Street
Winnipeg, Manitoba R3A 1M4
Telephone No. (204) 787 2270
Email: arneja@hsc.mb.ca



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CHRONIC PAIN, A COMPOSITE OF MANY CONCURRENT DIAGNOSES - PEELING THE LAYERS OF THE ONION

P Barton FRCPC^{1,2}, G Schultz PhD¹, J Jarrell FRCSC MS^{1,3}, N Virani FRCPC^{1,2}, T Findlay DO CCFP¹.

¹Calgary Health Region Chronic Pain Centre, ²Division of Physical Medicine and Rehabilitation, University of Calgary, ³Department of Obstetrics and Gynecology, University of Calgary.

Aim: The purpose of this study was to determine the specific ICD-10 diagnoses which occur in patients referred to the musculoskeletal pain program of an adult ambulatory interdisciplinary chronic pain program.

Methods: All patients who completed an initial consultation within the Musculoskeletal Program of the Calgary Health Region Chronic Pain Centre between July 1, 2000 and October 31, 2003 and discharged prior to April 30, 2007 were included. Patients were characterized by general demographics and severity of illness based on a number of standardized measures. The three consulting physicians (2 physiatrists and 1 osteopath) used the same diagnostic paradigms for documenting diagnoses. A “pick list” of relevant primary diagnoses: descriptive by body area affected, pathological, biomechanical and psychosocial, as well as secondary diagnoses, was developed and the most appropriate ICD-10 code was applied to each condition with the help of a medical records coding consultant. Charts were reviewed by a medical records technician who documented the diagnoses of each patient based on the initial consultation and subsequent follow up notes.

Results: 169 patients with musculoskeletal pain met study criteria. Their average age was 45.3 (SD 9.6) years. 29% were male and 71% female. Average pain levels were 5.9/10 (SD 2.2). All patients presented with a number of diagnoses including: degenerative disc disease, facet osteoarthritis, myofascial pain, ligamentous laxity, neuropathic pain, depression, non-restorative sleep, etc. Tables and graphs will be presented with documentation, frequencies and distributions of these diagnoses.

Conclusion: The term “chronic pain” is inadequate as a diagnosis for patients who present with the symptom of persistent pain. This work demonstrates that these patients present with multiple diagnoses, all of which must be considered in developing an appropriate treatment program. Further refinements to the ICD-10 for this population are needed.



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CHRONIC NONUNION IN A PATIENT WITH BILATERAL SUPRACONDYLAR DISTAL FEMUR FRACTURES TREATED SUCCESSFULLY WITH LOW-INTENSITY PULSED ULTRASOUND

Zeeshan Waseem* MD and John Flannery MD, FRCPS

Musculoskeletal Rehabilitation

Toronto Rehabilitation Institute

Division of Physical Medicine and Rehabilitation

Department of Medicine

University of Toronto

Objective: To present a unique case of the successful use of low-intensity pulsed ultrasound therapy in a patient with bilateral nonunions of the supracondylar femur.

Methods: Retrospective chart review and review of the literature.

Results: A 77-yr-old female presented to a university-based multidisciplinary musculoskeletal institute with a complex history of persistent nonunion. She was involved in a motor vehicle accident almost three years ago and sustained bilateral supracondylar femur fractures. Both fractures were initially treated with open reduction and internal fixation. Her right fixation failed two times, at 10 days, and 7 months from the time of her accident, and the left femur also failed at 14 months. Each required additional revision surgery with protracted courses of inpatient musculoskeletal rehabilitation. 19 months post MVA, she had persistent nonunion bilaterally in the femurs. We elected to treat her with low-intensity pulsed ultrasound applied directly to the nonunion sites at the distal femurs. The low-intensity pulsed ultrasound was applied for 20 minutes, twice daily, for a period of eight weeks. A program of gentle passive and active range of motion exercises was also initiated. Following completion of the course of therapy, she showed clinical improvement and Xrays showed solid osseous union across the fracture sites. Almost three years later, her fractures continue to show union, she does not require analgesics and is able to ambulate independently with the use of a walker.

Conclusion: Low-intensity pulsed ultrasound is a novel modality used for the treatment of nonunions. To our knowledge, we report the first case in the literature demonstrating the use of low-intensity pulsed ultrasound to heal bilateral nonunions.

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Presenting Author. Correspondance: Address to Zeeshan Waseem, Toronto Rehabilitation Institute, 550 University Avenue, Toronto, Ontario, M5G 2A2, 416-597-3422, zeeshan.waseem@utoronto.ca



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**DEVELOPMENT AND ANALYSIS OF AN OUTCOME TOOL TO EVALUATE
CHEMODENERVATION (BOTOX) IN THE TREATMENT OF ADULT SPASTICITY. A
PILOT STUDY.**

Author(S): Ricardo Viana MD ¹, Thomas A Miller MD, FRCPC ²

¹Resident Physical Medicine and Rehabilitation

²Department of Physical Medicine and Rehabilitation, St. Josephs Health Care
Schulich School of Medicine & Dentistry, The University of Western Ontario, London, Canada

Objective: Develop a simple and reliable outcome tool to assess the effectiveness of treatment in patients with Spasticity

Background: A number of outcome measures have been used, to monitor the effectiveness of spasticity management and treatment. The most commonly used are the modified Ashworth Scale, the Disability Assessment Scale (DAS) and the Global Assessment Scale (GAS).

Methods: A simple outcome tool consisting of 3 different assessment scales was developed to evaluate a cohort of adult patients with spasticity. The tool used a clinical scale of hypertonicity, an impairment rating and disability scale, and a goal attainment scale. The tool was used prospectively and then evaluated retrospectively to determine ease of use and its clinical applicability in patients with spasticity. 20 patients with varying causes of Upper Motor Neuron impairment were assessed. All patients received treatment with BOTOX (chemodenervation) for spasticity.

Results: All patients had chronic stable conditions and time from diagnosis ranged from 3 to 17 years. 20 participants, mean age 69.4 years (48-87years), 50% female, and 66% were living in long-term care facilities. The average dose of BOTOX used was 400 units. Mean Modified Ashworth score pre and post intervention was 2.94 and 2.46 respectively for the upper extremity (UE) and 3.17 and 2.22 respectively for the lower extremity (LE). Mean change in GAS was MD: 0.44, Patient: 0.86, and Care Giver: 1.2. Mean change in DAS score, as reported by patient's, pre and post treatment was 0.6 and 0.78 with the UE and LE respectively, while change in caregiver scores were 0.5 and 1.2 respectively. The Ashworth scale is a global measurement of hypertonicity and tone and did not correlate with changes in disability and or the patients/physicians/caregivers goals. The ease of use, effectiveness of monitoring change in spasticity and perceived change in function, are demonstrated using the tool.

Conclusions: The three outcome measures evaluated assess hypertonicity, disability and goal attainment. The GAS was easiest and most reliable to use. The change in joint ROM and hypertonicity did not often correlate with the perceived and or the measured patient or physician goals. The disability assessment scale allows for patient, caregiver and or physician selected goals. Overall, this pilot study has developed a simple, manageable and reproducible tool to further enhance and assess the effectiveness of Chemodenervation (Botox treatment) in patients with spasticity.

Disclosures: The authors of this study have no real of perceived conflict of interest in relation to the material discussed.

Contact information: Ricardo Viana OT, MD, Ricardo.Viana@londonhospitals.ca



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**AN ECONOMIC REVIEW OF BEST PRACTICE IN INPATIENT STROKE
REHABILITATION**

Matthew J Meyer HBA³, Andrew McClure HBA³, Cheng Pan BHSc³, Manuel Murie-Fernandez MD¹,
Norine Foley MSc RD³, Katherine Salter HBA³, Robert Teasell MD FRCPC¹⁻³

¹Department of Physical Medicine and Rehabilitation, St Joseph's Health Care London ON; ²Schulich School of Medicine, University of Western Ontario; ³Aging, Rehabilitation and Geriatric Care Program, Lawson Health Research Institute, London, ON;

Objective: This study aimed to develop a cost-effectiveness model for the application of principles of best practice in inpatient stroke rehabilitation within a dedicated stroke rehabilitation unit in Ontario.

Methods: Building on previous research and an extensive evidence-based review, three components of best practice were identified as potential cost minimization strategies for inpatient rehabilitation: decreased time from onset to rehabilitation admission, greater intensity of rehabilitation therapy, and early supported discharge. These best practices have been extensively applied to inpatient rehabilitation in the United States. Therefore, American patient data from 2007-08 was compared to Parkwood Hospital, London Ontario data for the same period. A literature review of studies evaluating quality of life was used to estimate effectiveness. The recently developed Rehabilitation Patient Group (RPG) prospective cost weighting was used to estimate potential savings, in Canadian dollars, of attaining outcomes similar to those achieved in the United States. Appropriate inflationary adjustments were made and sensitivity analysis was performed on patient outcome data.

Results: The cost-minimization strategies identified have shown to be equally or more effective in improving quality of life compared to traditional stroke unit rehabilitation such as that provided at Parkwood Hospital. Therefore, a direct cost comparison is appropriate. Potential cost savings are likely to be realized in two ways: decreased use of acute and alternative level of care beds and shorter inpatient rehabilitation stays. After adjusting for additional overhead and staffing costs, conservative estimated annual cost savings for the Ministry of Health and Long-Term Care are in excess of \$250,000 for acute/ALC bed reductions and \$300,000 for decreases in rehabilitation length of stay for one rehabilitation unit.

Conclusions: Reductions in time to admission, increased intensity of therapy, and early supported discharge strategies are indicated as cost-effective. Implementation of these changes will allow for more effective resource utilization and improved patient care. An annual estimated cost savings of \$550,000 could allow for more than 30 additional patients to receive rehabilitative care at no added cost. A prospective trial is warranted.

This work was funded by the Canadian Stroke Network.



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**MODELS FOR INTEGRATING REHABILITATION AND PRIMARY CARE:
A SCOPING STUDY**

Mary Ann McColl, PhD, MTS¹; Samuel Shortt, MD, PhD¹; Marshall Godwin, MD, MSc²; Karen Smith, MD³; Kirby Rowe⁴; Patti O'Brien, MSc¹; Catherine Donnelly, MSc¹

¹ Queen's University, Centre for Health Services & Policy Research

² Queen's University, Centre for Studies in Primary Care

³ Queen's University, Dept Physical Medicine & Rehabilitation

⁴ Canadian Paraplegic Association - Ontario

Objectives: The objective of the study was to describe the scope and breadth of knowledge currently available regarding the integration of rehabilitation and primary care services.

Methods: A scoping study was conducted to assess the state of knowledge and the need for enhanced research capacity in this area. The *scoping study* is an emerging methodology for literature synthesis, defined as a way of mapping key concepts within a research area by assembling multiple sources and types of evidence available.

Results: Six models were identified for the integration of rehabilitation and primary care services to people with chronic diseases and disabilities: Clinic; Outreach; Self management; Community-Based Rehabilitation; Shared care; and Case management. In addition, a number of themes were identified across models that may act as either supports or impediments to the integration of rehabilitation services into primary care settings: team approach; inter-professional trust; leadership; communication; compensation; accountability; referrals; population-based approach.

Conclusion: Rehabilitation providers interested in working in the primary care sector may be assisted in conceptualizing the benefits that they bring to the setting by considering these models and issues.

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Corresponding Author:

Dr Karen M Smith

340 Union St Kingston, Ont

613 544 1894 phone

613 544 8640 fax

smithk2@providencecare.ca



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**JOINT CONTRACTURES IN THE INTENSIVE CARE UNIT: QUALITY OF LIFE AND
JOINT LIMITATION 2 TO 4 YEARS AFTER DISCHARGE.**

Heidi Clavet PT, Paul C. Hebert MD, Dean A. Fergusson PhD, Steve Doucette MSc, and Guy Trudel MD

Objective: Verify if intensive care unit (ICU) survivors experience quality of life and/or functional limitations two to four years after hospital discharge with a *Quality of Life and Joint Contracture* questionnaire.

Methods: The questionnaire was mailed to 133 patients who remained two weeks or more in a tertiary ICU. It contained 1) the EuroQuol 5D (EQ-5D) and 2) questions pertaining to joint limitations for the shoulders, elbows, hips, knees and ankles. Results were compared to an existing database containing quantitative range of motion measurements from the ICU stay of the same patients.

Results: We obtained a 38% response rate with a mean age of 64.8 (SD 12.4) years, 58% male, and a median of 3.3 years (IQR 2.8-4.0) between hospital discharge and the completion of the questionnaire. Patients who presented joint contractures in ICU reported more problems with their mobility on the EQ-5D compared to those without joint contractures in ICU ($p=0.01$). A larger proportion of patients with joint contractures in ICU reported difficulties performing self-care, usual daily activities, and expressed more pain on the EQ-5D than patients without joint contractures in ICU ($p>.05$). A larger proportion of patients who expressed moderate or severe joint limitations presented joint contractures at the corresponding joint in ICU ($p>.05$).

Conclusion: Patients remaining two weeks or more in ICU may present mobility limitations up to 3 years after their hospital discharge. Joint contractures found in the ICU may also predispose patients to moderate or severe joint limitations persisting at that same joint. This clinical problem invites concerted actions to better delineate and address the key components around the current management of joint contractures in ICU to avert long term functional limitations after discharge.



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MODELS OF CARE FOR THE MANAGEMENT OF ACQUIRED BRAIN INJURY

Authors: Matthew Meyer, JoAnne Aubut, Andrew McClure, Shawn Marshall, Nora Cullen, Mark Bayley, Robert Teasell

Department of Physical Medicine and Rehabilitation, Schulich School of Medicine and Dentistry, University of Western Ontario, London ON; Parkwood Hospital, St. Joseph's Health Care, London ON; Toronto Rehabilitation Institute, Toronto ON; Aging Rehabilitation and Geriatric Care Research Centre, Lawson Health Research Institute, London ON; Ottawa Rehabilitation Centre, University of Ottawa, Ottawa ON

Objective: Results of recent research have begun to emerge regarding specific interventions for the rehabilitation of ABI patients. However, little work has been done to incorporate emerging evidence into the process of creating optimal models of care. In order to develop standards for best practice, an understanding of the strengths and weaknesses inherent in different models is critical. This review aimed to critically analyze international literature related to models of care in acquired brain injury (ABI).

Methods: An extensive review of databases including MEDLINE, EMBASE, CINAHL, and PsycINFO was performed. Background information was drawn from grey literature and peer reviewed articles. Studies were only considered for analysis if published in a recognized peer reviewed journal. Our aim was to compare rehabilitation systems, so only studies that compared at least two distinct management strategies for ABI care were included. Articles were evaluated for their methodological quality using the Physiotherapy Evidence Database scale (PEDro) for RCTs and the Downs and Black assessment tool for non-RCTs. Conclusions were then drawn using a detailed 5 point level of evidence scale. Levels of evidence range from level 1, support by one or more RCTs of high quality (>6 PEDro score), to level 5, being supported by observational studies, consensus reports or single case studies.

Results: Four focus areas emerged from the literature: acute care (ER and ICU), inpatient rehabilitation, outpatient rehabilitation, and complete care pathways. Acute models of care were the most extensively studied with 15 studies found followed by outpatient with 5 and 3 each for inpatient rehabilitation and complete care pathways. There is evidence to support that adherence to Brain Trauma Foundation guidelines for acute care may improve outcomes and decrease mortality rates. Also, multidisciplinary inpatient rehabilitation may be more effective than a single discipline approach. Higher intensity multidisciplinary inpatient rehabilitation may be more effective in improving short term recovery than similar less intensive therapy. Multidisciplinary outpatient rehabilitation may improve functional outcomes up to one year post discharge.

Conclusion: There have been a limited number of studies examining models of care in ABI, which is surprising given its importance. There is insufficient evidence to draw definitive conclusions regarding the optimal model of ABI care. Further research into the efficacy of different rehabilitation models as a component of complete care pathways is needed.

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EMOTIONAL RESPONSES AND DECISION-MAKING IN PATIENTS WITH SPINAL CORD INJURIES

Jennifer E. Salter¹, Stephen, D. Smith², and Karen Ethans¹

¹Department of Physical Medicine and Rehabilitation, University of Manitoba

²Department of Psychology, University of Winnipeg

Abstract: The functional role of the spinal cord in the execution of movements and the processing of sensory information is well-established (Alexander *et al.*, 2009). However, little research has examined whether spinal cord functions extend to other measurable behaviours. For instance, only a handful of studies have investigated the role of the spinal cord in emotional activity, despite the fact that emotions are inherently sensory-motor in nature. This paucity of data is surprising given that afferent feedback from the autonomic nervous system and the internal organs reaches the brain via the spinal cord and appears to bias or influence many emotional responses (Damasio, 1994). This paper reviews relevant anatomical and neuropsychological data to delineate the mechanisms by which the spinal cord influences emotional behaviour, and proposes research aimed at determining whether damage to these mechanisms caused by spinal cord injury will lead to overt emotional differences that might influence rehabilitative success.



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RR 02

PHYSICAL ACCESSIBILITY OF FAMILY PHYSICIANS' OFFICES IN OTTAWA

Gerald Wolff BSc, MD

Meridith Marks BSc, MEd, MD, FRCPC

Department of Physical Medicine & Rehabilitation, University of Ottawa

Objectives: Most Family Physicians believe their offices are physically accessible, but many patients with physical impairments report otherwise. The objective of this study was to compare physicians' perceptions of office accessibility for individuals with a physical disability with an objective measure of accessibility.

Design: Survey

Setting: Primary care physicians' offices.

Participants: Random sample of 50 Ottawa area primary care physicians' offices.

Interventions: Office physical accessibility was evaluated using a 43-item checklist.

Main Outcome Measures: An office was deemed accessible if it met all 6 essential criteria as well as received an overall checklist score $\geq 70\%$.

Results: While 86% of surveyed physicians believed their office was accessible, only 16% actually were. Private offices were even less accessible with only 5% of those assessed meeting adequate levels of accessibility. Offices scored higher on checklist items that dealt with the exterior and entrance of the building, compared to the interior design.

Conclusions: There is a large disconnect between physician perceived versus actual office accessibility. Our findings highlight the urgent need for widely available guidelines to assist physicians and office designers when planning the layout of medical offices. Further research is required to evaluate this issue on a national scale and delineate the impact of specific accessibility barriers.



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MSE 02

MANAGEMENT OF MUSCLE SPASTICITY IN CHILDREN WITH CEREBRAL PALSY

Ms. Vanessa Thoo

Given the high prevalence of children suffering from the sequelae of muscle spasticity including pain and loss of function, a number of treatment options have been developed in order to provide some relief to this patient population – a high proportion of which, are children who suffer from some form of motor impairment due to an insult to the developing brain. While the term cerebral palsy can be applied to many forms of motor disorders and may be associated with sensory and cognitive dysfunction, the focus of this essay will be on the various forms of therapy specific to treatment of spastic CP, including conservative nonpharmacologic methods, medical management and surgical interventions.



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SR 03

SYSTEMATIC REVIEW OF STIMULATION IN SPINAL CORD INJURY (SCI) PATIENTS

Research and Report by: Jennifer Quan, BScPT, 2nd year medical student (UBC)

Objective: To determine the effect of electrical and magnetic stimulation on pulmonary function values used to measure forced expiratory pressures and volumes (required for an effective cough) in spinal cord injury (SCI) patients.

Data sources: Four comprehensive computerized literature searches (MEDLINE, PubMed, EMBASE, CINAHL) were conducted. MeSH terms used were spinal cord injury, quadriplegia, tetraplegia, electrical stimulation, electrostimulation, paralysis, coughing, and expiratory muscles. References of relevant articles were reviewed to identify other related articles.

Study selection: All articles containing original research on electrical or magnetic stimulation on cough effectiveness in SCI patients.

Inclusion criteria: English, humans, tetraplegia, experimental design studies, studies that applied electrical or magnetic stimulation to expiratory muscles.

Exclusion criteria: animals, non-SCI human subjects, non-English publications, multiple intervention studies, and studies conducted earlier than 1993.

Data synthesis: Five quasi-experimental design studies were found. The patients were not equally distributed between the sexes (61 males, 5 females) and most in the young to middle age range (27-75 years). Expiratory muscles were stimulated, and coughing ability was evaluated.

Conclusions: Results suggest that electrical and magnetic stimulation to expiratory muscles in SCI patients show improvements in pulmonary function test values that correspond to forced expiration which translates to an effective cough.