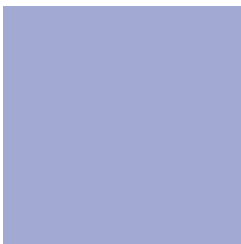
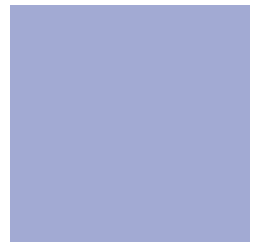
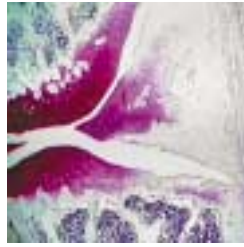


# INSTITUTE FOR REHABILITATION RESEARCH AND DEVELOPMENT

*2002-2004 Report*



This report reflects research and development activities completed or in progress between April 1, 2002 and March 31, 2004.

Requests for additional copies can be sent to [ccook@ottawahospital.on.ca](mailto:ccook@ottawahospital.on.ca), or by contacting the Institute for Rehabilitation Research and Development at:

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The full report can be downloaded from IRRD's website:  
<http://www.rehab.on.ca/irrd>

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## The Institute for Rehabilitation Research and Development

The Research Department at The Rehabilitation Centre (TRC) officially became the Institute for Rehabilitation Research and Development (IRRD) in 1992. In December of 2000, IRRD became Canada's first freestanding research institute for rehabilitation medicine. Former Prime Minister Jean Chrétien and Christopher Reeve were present to launch IRRD as an independently incorporated body within the walls of TRC.

The Institute fosters research, development, and networking activities with a focus on clinical and practical applications. The staff and researchers of IRRD strive to acquire knowledge across the spectrum of research in rehabilitation, from basic science to clinical outcome trials and population based health outcome studies. We are committed to finding new and innovative methods of delivering knowledge to the clinician and the consumer, and to helping people with disabilities achieve full integration and participation in all aspects of life.

### *Our Vision*

The pursuit of excellence in rehabilitation research and development.

### *Our Mandate*

To conduct pure, clinical and community research with high relevance to TRC and the broader rehabilitation community.

To provide advice on and assistance with research methodology and data analysis/interpretation to TRC staff engaged in research, program evaluation, best practice review and implementation, and TQM/CQI.

To identify TRC projects with potential for external funding and assist with seeking external funds.

To conduct research on, develop and oversee knowledge transfer within TRC for best practice.

To develop, plan and oversee networking activities at the regional and national levels to enhance knowledge dissemination.

To exchange knowledge and expertise for the benefit of the international rehabilitation community.

To leverage the expertise, products and services of IRRD/TRC to generate revenue to support research and development activities and initiatives.

To develop and research new technologies that improve the lives of persons with rehabilitation needs.

## Message from the Board Chair and the Director of Research



*Abla Sherif,  
Board Chair*



*Jamie MacDougall,  
Director of Research*

The past two years have been interesting for the Institute for Rehabilitation Research and Development (IRRD). The researchers have been very successful in obtaining new grants from a variety of agencies and, as well, a number of important projects have been completed. Many of our projects involve constructive collaborations with clinicians from within The Rehabilitation Centre (TRC). This close liaison between researchers and clinical staff ensures that the findings from research are ultimately translated into clinical practice. We congratulate all the researchers and participating clinicians for their outstanding efforts over the past several years.

We would like to thank the core staff within IRRD for their support of the research process at TRC. The exemplary efforts of Sue Balmer, Debra Schleyer, Dorothyann Curran and Carolynn Cook ensure a

high quality of research and smooth functioning of the Institute. In addition, David Jackson, Chair of the Research Ethics Board (REB), and the REB as a whole, should be commended for their careful work in maintaining the high ethical standard of research at TRC. We would also like to thank Dan DeForge, Physiatrist-in-Chief and Cathy Danbrook, Chief Executive Officer for their unfailing support of our activities in a time of rapid change. Virtually all of our administrative and financial affairs are now managed by The Ottawa Hospital (TOH), and we thank TOH personnel for their efforts during this process of migration to their administrative systems. As well, we are increasingly involved with the Ottawa Health Research Institute (OHRI), and their cooperation in facilitating the research process is much appreciated.

Finally, we thank all the patient volunteers for their active involvement in the research projects. Without their participation and support, research to help others would not be possible. They truly make a selfless and important contribution to the whole process. In this connection we would also like to acknowledge the contribution of the Disability Awareness and Prevention Program (DAPP) and all the volunteers at TRC who contribute to our efforts in so many ways.

## Message de la présidente du Conseil et du directeur de la Recherche

Les deux dernières années se sont révélées des plus stimulantes pour l'Institut de recherche et de développement en réadaptation (IRDR). Les chercheurs ont déployé des efforts fructueux pour obtenir de nouvelles subventions de la part de divers organismes et, en outre, d'importants projets ont été complétés. Bon nombre de nos projets comportent une collaboration constructive des cliniciens du Centre de réadaptation (CR). Ces rapports étroits entre les chercheurs et le personnel clinique assurent que les conclusions des recherches s'appliquent en définitive dans la pratique clinique. Nous félicitons tous les chercheurs et les cliniciens participants pour leurs efforts exceptionnels au cours des dernières années.

Nous aimerions remercier le personnel de base de l'IRDR de leur appui à la recherche au sein du CR. Les efforts exemplaires de Sue Balmer, Debra Schleyer, Dorothyann Curran et Carolynn Cook assurent des recherches de grande qualité et le fonctionnement harmonieux de l'Institut. En outre, David Jackson, président du Conseil d'éthique en recherche (CER), et l'ensemble du CER méritent des félicitations pour avoir su maintenir des normes d'éthique élevées dans la recherche au CR. Nous aimerions aussi remercier Dan DeForge, physiatre en chef, et Cathy Danbrook, directrice générale, du soutien indéfectible qu'ils accordent à nos activités dans une période de rapide évolution. Presque toutes nos affaires administratives et financières sont maintenant gérées par L'Hôpital d'Ottawa (L'HO) et nous remercions les employés de L'HO de leurs efforts durant ce processus de migration vers leurs systèmes administratifs. De plus, nous participons de plus en plus aux travaux de l'Institut de recherche en santé d'Ottawa et la coopération de ses membres visant à faciliter le processus de recherche est vivement appréciée.

Enfin, nous remercions de leur active participation tous les patients qui ont accepté bénévolement de prendre part aux projets de recherche. Sans leur collaboration et leur soutien, la recherche visant à aider les autres ne serait pas possible. Ils apportent véritablement une contribution altruiste et importante à tout ce processus. À cet égard, nous aimerions souligner la contribution du Programme de sensibilisation et de prévention des incapacités (PSPI) et tous les bénévoles qui contribuent à nos efforts à de si nombreux égards.

## Message from the Chief Executive Officer and the Physiatrist-in-Chief

We wish to congratulate all the researchers and staff at the Institute for Rehabilitation Research and Development (IRRD) for their outstanding accomplishments over the past two years. At The Rehabilitation Centre (TRC) and The Ottawa Hospital (TOH) research and development contribute immensely to our success as academic centres of excellence.

The past several years have seen many changes in the relationship between TRC and TOH and as the environment in which we deliver health care in Ontario evolves, there will be new challenges in the years to come. However, TRC will remain committed to supporting research as one of its key activities. As hospitals and health care institutions move toward evidence-based clinical practice, the healthy research climate within TRC will undoubtedly facilitate the achievement of this important goal.



*Catherine Danbrook,  
Chief Executive Officer*



*Dan DeForge,  
Physiatrist-in-Chief*

As always, our research is guided by questions put to us by our clients such as "will I be able to walk" and "how can I lessen the impact of pain on my life?" These questions will help us devise new treatments for problems, and new methods will help us measure the efficacy of our treatments. True clinical efficiency can only be found if we ask ourselves whether we can prove that what we do really works. That is research.

We would like to thank and congratulate Dr. Jamie MacDougall for his leadership and commitment to the outstanding research organization that is the Institute for Rehabilitation Research and Development.

## Message de la directrice générale et du physiatre en chef

Nous souhaitons féliciter tous les chercheurs et employés de l'Institut de recherche et de développement en réadaptation (IRDR) de leurs réalisations exceptionnelles au cours des deux dernières années. La recherche et le développement au Centre de réadaptation (CR) et à L'Hôpital d'Ottawa contribuent considérablement à notre réussite en qualité de centres universitaires d'excellence.

Les dernières années ont été la scène de nombreux changements dans la relation entre le CR et L'HO. Aussi, comme l'environnement dans lequel nous dispensons des soins de santé en Ontario a évolué, de nouveaux défis se présenteront à l'avenir. Par ailleurs, le CR maintient son engagement envers la recherche à titre de l'une de ses principales activités. Les hôpitaux et les établissements de soins de santé adoptent progressivement une pratique clinique fondée sur des preuves et le climat propice à la recherche qui règne au CR facilitera sans doute les réalisations menant à l'atteinte de cet objectif important.

Comme toujours, nos recherches s'inspirent des questions que nous soulèvent nos clients, comme "Serai-je à nouveau capable de marcher?" ou "Comment atténuer l'effet de la douleur sur ma vie?" Ces questions nous aideront à mettre au point de nouveaux traitements, et de nouvelles méthodes nous aideront à mesurer l'efficacité de nos traitements. La véritable efficacité clinique ne peut se réaliser que si nous nous demandons s'il nous est possible de prouver que ce que nous faisons fonctionne vraiment. C'est la nature même de la recherche.

Nous aimerions remercier et féliciter le Dr Jamie MacDougall de son leadership et de son engagement envers l'organisme de recherche exceptionnel qu'est l'Institut de recherche et de développement en réadaptation.

## Board of Directors

Abla Sherif, PhD (Chair)

*Director of the International Education Centre, Algonquin College*

Collinda Joseph (Vice Chair)

*Senior Researcher, Distinct Housing Needs, Canada Mortgage and Housing Corporation*

Catherine Danbrook, MHA, CHE

*Chief Executive Officer, The Rehabilitation Centre  
VP Rehabilitation Services, The Ottawa Hospital*

Dan DeForge, MD, FRCPC

*Physiatrist-in-Chief, The Rehabilitation Centre  
Assistant Professor, University of Ottawa*

Jamie MacDougall, PhD (Secretary/Treasurer)

*Director of Research, The Institute for Rehabilitation Research and Development, The Rehabilitation Centre*

Susan St. Amand, CFP, CLU, CH.F.C., TEP

*President, Sirius Financial Services*

Joyce D'Eon, PhD

*Professional Practice Leader, Psychology Services, The Rehabilitation Centre*

Shawn Marshall, MD, MSc, FRCPC

*Medical Director, Acquired Brain Injury Rehabilitation Program, The Rehabilitation Centre  
Assistant Professor, University of Ottawa*

Denis Prud'homme, MD, MSc

*Dean, Faculty of Health Sciences, University of Ottawa*

Peter Walker, MD, FRCPC

*Dean, Faculty of Medicine, University of Ottawa*

Ronald Frey, PhD

*Board Member, The Rehabilitation Centre Board of Directors (retired)*

# Research and Development Personnel

## Primary Investigator List

### *TRC Investigators*

Aziz Al Feeli	Medicine
Jeff Blackmer	Medicine
Lynn Bloom	Social Work
Dan DeForge	Medicine
Joyce D'Eon	Psychology
Nancy Dudek	Medicine
Penny Henwood	Nursing
Lynn Hunt	Occupational Therapy
Julianne Labreche	Communication Disorders
Edward Lemaire	Bioengineering
Shawn Marshall	Medicine
Anna McCormick	Medicine
Ann Meltzer	Communication Disorders
Kerry Rambarran	Prosthetics & Orthotics
Laura Rees	Psychology
Keith Wilson	Psychology

### *External Investigators*

Harvey Chochinov	University of Manitoba
Chris Davis	Carleton University
Bruce Dobkin	University of California Los Angeles
Gordon Guyatt	McMaster University
Kam Lun Leung	Hong Kong Polytechnic University
Anthony Newall	Consultant
Sandra Olney	Queen's University
Nicole Paquet	University of Ottawa
Patricia Roberts	University of Ottawa
Heidi Sveistrup	University of Ottawa
Lisa Waldegger	University of Ottawa
Nancy Young	Hospital for Sick Children

## Administrative & Support Staff

Sue Balmer	Research Physiotherapist
Carolynn Cook	Research Associate
Dorothyann Curran	Research Assistant
Jamie MacDougall	Director of Research
Debra Schleyer	Secretary

## University of Ottawa Research Associates

IRRD has formal research partnerships with several University of Ottawa faculty members:

Lucie Brosseau	School of Rehabilitation Sciences	Faculty of Health Sciences
Claire-Jehanne Dubouloz	School of Rehabilitation Sciences	Faculty of Health Sciences
Don Hillman	The Centre for International Health & Development	Faculty of Medicine
Elizabeth Hillman	The Centre for International Health & Development	Faculty of Medicine
Mario Lamontagne	School of Human Kinetics	Faculty of Health Sciences
Joan McComas	School of Rehabilitation Sciences	Faculty of Health Sciences
Nicole Paquet	School of Rehabilitation Sciences	Faculty of Health Sciences
Patricia Roberts	School of Rehabilitation Sciences	Faculty of Health Sciences
Heidi Sveistrup	School of Rehabilitation Sciences	Faculty of Health Sciences
Robert Swenson	Department of Psychiatry	Faculty of Medicine
Rachel Thibeault	School of Rehabilitation Sciences	Faculty of Health Sciences
Louis Tremblay	School of Rehabilitation Sciences	Faculty of Health Sciences



# Research and Development Partners

## Research Collaborators

- BC Cancer Centre for the Southern Interior
- Bloorview MacMillan Children's Centre
- Carleton University
- Dr. H. Bliss Murphy Cancer Centre
- Hong Kong Polytechnic University
- Hospital for Sick Children
- Jack Purcell Community Centre
- L'Hôtel-Dieu de Québec
- London Health Sciences Centre
- McMaster University
- Orthoactive
- Ortho-Bio-Med
- Ottawa Health Research Institute
- Queen's University
- Regional Palliative Care Program, Edmonton
- St. Paul's Hospital
- Sisters of Charity of Ottawa Health Service
- Smith Prosthetics
- State University of New York
- The Ottawa Hospital
- Toronto Rehabilitation Institute
- Université de Laval
- University of Alberta
- University of British Columbia
- University of California, Los Angeles
- University of Manitoba
- University of Ottawa
- University of Ottawa Heart Institute
- University of Saskatchewan
- University of Toronto

## Funding Sources

- American Foundation for Suicide Prevention
- Canadian Institutes of Health Research
- Canadian Lung Association
- Heart and Stroke Foundation of Ontario
- Labatt 24 Hour Relay Fund
- Ontario Ministry of Health and Long Term Care
- Ontario Neurotrauma Foundation
- Royal College of Physicians and Surgeons
- Stanley Knowles Fund
- The Physicians' Services Incorporated Foundation
- Transportation Development Centre
- University of Ottawa
- US National Institutes of Health
- War Amputations of Canada

## Industry Sponsors

- Acorda Therapeutics
- Allergan Inc.
- AstraZeneca Pharmaceuticals
- GW Pharmaceuticals
- Pfizer Pharmaceuticals
- Sanofi-Synthelabo



# Research

# Activities



## Research Projects

*Referral Patterns to a Multiple Sclerosis Outpatient Rehabilitation Clinic*

**Al Feeli A, Blackmer J**

*Double-Blind Placebo-Controlled, 12-Week Parallel Group Study to Evaluate Safety and Efficacy of Oral Fampridine-SR in Subjects with Moderate to Severe Spasticity Resulting from Chronic, Incomplete Spinal Cord Injury: Protocols SCI-F302 and SCI-F301*

**Blackmer J, DeForge D, Cronin V**

Sponsored by Acorda Therapeutics

*MS Patient Selected Goals in an In-Patient Rehab Unit*

**Bloom L, Lapierre N, Wilson K, DeForge D**

Funded by the Labatt 24 Hour Relay Fund

*Dignity Psychotherapy: An Intervention for Suffering at the End-of-Life*

Chochinov H, **Wilson K**

Funded by the American Foundation for Suicide Prevention

*Adjusting to New Circumstances: Coping with a Spinal Cord Injury*

Davis C, **Blackmer J, Cronin V**

Funded by a Carleton University Canadian Institutes of Health Research Grant

*A Safety and Tolerability Study of Medicinal Cannabis Extracts for Chronic Refractory Spasticity and Neurogenic Pain*

**DeForge D, Blackmer J, Cronin V**

Sponsored by GW Pharmaceuticals

*Open-Label Extension of Double-Blind, Placebo-Controlled, Parallel Group Study to Evaluate Safety, Tolerability and Activity of Oral Fampridine-SR in Subjects with Chronic, Incomplete Spinal Cord Injury: Protocol SCI-F300EXT*

**DeForge D, Blackmer J, Cronin V**

Sponsored by Acorda Therapeutics

*A Multi-Centre, Double-Blinded, Placebo-Controlled Flexible Dose Study to Evaluate the Efficacy and Safety of Viagra (Sildenafil) in Women who have Sexual Arousal Disorder Resulting from a Traumatic Spinal Cord Injury*

**DeForge D**, Gilbert N

Sponsored by Pfizer Pharmaceuticals

*Implementation of the Rehabilitation Integrated Transition Tracking System*

**DeForge D, Marshall S, Curran D**

Funded by the Ontario Ministry of Health and Long Term Care

*Gender Invariance and the Multidimensional Pain Inventory*

**D'Eon J**, Harris C

Funded by the Labatt 24 Hour Relay Fund

*Development of a Pain History Questionnaire and Database*

**D'Eon J, Petersen E, Wilson K, Baldwin H**

*Measurement Issues in the Assessment of Quality of Life in Chronic Pain Patients*

**D'Eon J, Wilson K**

Funded by the Labatt 24 Hour Relay Fund

*A Randomized Clinical Trial of a Locomotor Intervention for Patients with Acute Incomplete Spinal Cord Injury*

Dobkin B, **DeForge D, Nymark J, Badour M, Yazdi F, Kossen Y, Place P, Millar S, Henwood P**, Yan S

Funded by the US National Institutes of Health

*Failure to Fail: The Perspectives of Clinical Supervisors*

**Dudek N**

Funded by the Royal College of Physicians and Surgeons and the University of Ottawa Educational Initiatives in Residency Education Fund

*Dermatological Conditions Associated with Use of a Lower Extremity Prosthesis*

**Dudek N, Marks M, Marshall S**

Funded by the Labatt 24 Hour Relay Fund

*Randomized Clinical Study to Measure the Relative Responsiveness and Validity of Two Different Administration Modes of a Feeling Thermometer for Assessing Health Related Quality of Life in Patients with Chronic Respiratory Disease*

Guyatt G, **McKim D**, Schunemann H, Stubbing D, Goldstein R, Mador J

Sponsored by AstraZeneca Pharmaceuticals

*Exploring Acceptance of Chronic Neuropathic Pain in Spinal Cord Injured Persons*

**Henwood P**

Funded by the Labatt 24 Hour Relay Fund

*A Validity Based Evaluation of the Driving Assessment Program for Stroke Patients*

**Hunt L, O'Neill P**, Blair R, Harper D, **Pepin P**

Funded by the Transportation Development Centre and the Labatt 24 Hour Relay Fund

*The Effect of a Therapy Dog on the Communication Skills of an Adult with Aphasia*

**Labreche J**, Garcia L, Lafrance C

*Development and Pilot Testing of a Measurement-Based CAD/CAM System for Fitting People with New Trans-Tibial Amputations*

**Lemaire E, Fawcett J, Nielen D**, Kaphingst W

Funded by the Labatt 24 Hour Relay Fund

*Internet-Based Telehealth for Remote C-Leg Configuration*

**Lemaire E, Fawcett J, Nielen D**, Smith C

Funded by War Amputations of Canada

*Design and Testing of a Stance-Phase Control Knee Joint for Lower Extremity Orthotics*

**Lemaire E**, Harrison R, Jeffreys Y, **Goudreau L**

*Enhancement of Prosthetics and Orthotics Learning and Teaching through State-of-the-Art Teaching Technology and Appropriate Methodology*

Leung K, **Lemaire E**, Wong M

Funded by the Labatt 24 Hour Relay Fund

*Development and Validation of the Physical Impairment Questionnaire*

**Marshall S**, Garber B, Girrotti M, Gray D, **Wilson K**, O'Rourke K, Hebert P, Yelle Y, Pagliarello G

Funded by The Physicians' Services Incorporated Foundation and the Labatt 24 Hour Relay Fund

*Retrospective Study to Determine Predictors of Passing a Medical Driving Evaluation*

**Marshall S, Hunt L**, Hing M, Molnar F, **Wilson K**

Funded by the Labatt 24 Hour Relay Fund and the University of Ottawa Institute on Health of the Elderly

*Establishment of a Program Evaluation Model for the Robin Easey Centre Brain Injury Community Re-Integration Service*

**Marshall S**, Pelletier F, Cowin L

Funded by the Ontario Neurotrauma Foundation

*Local Corticosteroid Injection for Carpal Tunnel Syndrome: A Systematic Review*

**Marshall S**, Tardif G, Ashworth N

Funded by the Labatt 24 Hour Relay Fund

*A Prospective Study of Mild Traumatic Brain Injury*

**Marshall S, Wilson K**, Garber B, O'Rourke K, Coyle D, Tellier A, Stiell I

Funded by the Ontario Neurotrauma Foundation

*The Use of Botulinum Toxin A in Adults with Cerebral Palsy*

**McCormick A**

Sponsored by Allergan Inc.

*The Outcome of a Stuttering Treatment Program from the Client's Perspective: The Development of a Communication Status Questionnaire (COM-STAT)*

**Meltzer A**, Wright M, Woodend K

Funded by the Labatt 24 Hour Relay Fund

*Long-Term Safety and Tolerability Study of SR57746A in Patients with Amyotrophic Lateral Sclerosis*

Newall A, **Jackson D, Walker K, Buenger U**

Sponsored by Sanofi-Synthelabo

*Reducing Disability in Chronic Stroke Through Physical Conditioning: A Dual-Centre Trial*

Olney S, **McNamara P, Heard J**, Bullis N, **Nymark J, Yazdi F, Grinnell D**

Funded by the Heart and Stroke Foundation of Ontario and the Stanley Knowles Fund

*Control of Body Displacement in Different Somatosensory Conditions*

Paquet N, Rainville C, Tremblay F, Lajoie Y, **Marshall S**

*The Effectiveness of the Kinetic Wedge Foot Orthoses Modification to Improve Posture During Walking*

**Rambarran K, Lemaire E**

*Speed of Information Processing in MS Patients*

**Rees L**, Tombaugh T

*Rate of Speech and Fluency in Reading and Speaking*

Roberts P, **Meltzer A**, Wilding J

Funded by the Labatt 24 Hour Relay Fund

*Balance Training Using Virtual Reality as Compared to a Conventional Exercise Program in Traumatic Brain Injury*

Sveistrup H, McComas J, **Marshall S, Finestone H, McCormick A**

Funded by the Ontario Neurotrauma Foundation (funds not administered through IRRD)

*A Randomized Controlled Crossover Trial of Rollator Walkers Compared to Oxygen in Chronic Obstructive Pulmonary Disease and Exertional Desaturation*

Waldegger L, **McKim D**, McDowell I

Funded by the Canadian Lung Association

*Gender Differences in Preferences Regarding Intubation and Mechanical Ventilation in Patients with Severe Chronic Obstructive Pulmonary Disease*

**Wilson K**, Aaron S, Hebert P, **McKim D**, Sevigny E, Vandemheen K, O'Connor A

Funded by the Labatt 24 Hour Relay Fund

*Canadian National Palliative Care Survey*

**Wilson K**, Chochinov H, Graham M, Allard P, Chary S, De Luca M, Gagnon P, Kuhl D, O'Shea F, Macmillan K, Fainsinger, R

Funded by the Canadian Institutes of Health Research (funds not administered through IRRD)

*Major Depression and Insomnia Among Chronic Pain Patients: A Prospective Study with Ambulatory Monitoring*

**Wilson K**, Emery P

Funded by the Labatt 24 Hour Relay Fund

*Evaluating the Transition from Childhood to Adult Health Services Among Youth and Young Adults with Complex Physical Disabilities*

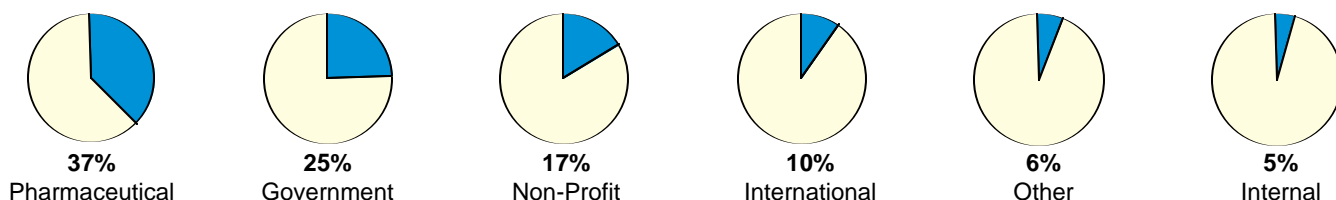
Young N, Williams J, Law M, Boydell K, Fehlings D, Wedge J, Rumney P, Steele C, Mukherjee S, **McCormick A**

Funded by the Bloorview MacMillan Children's Foundation (funds not administered through IRRD)

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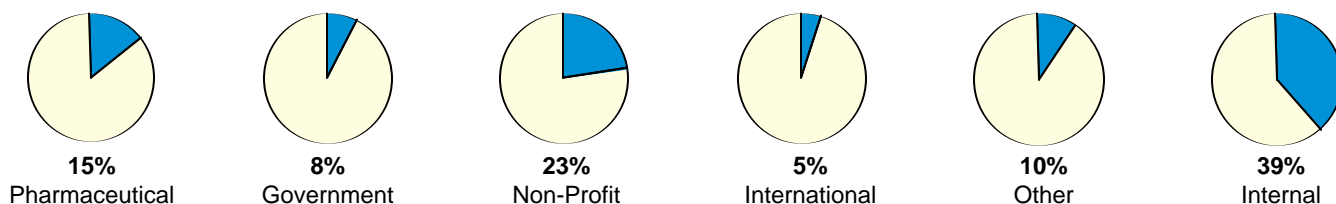
## Funding Summary

### Percent of Funds Awarded by Type of Granting Agency



There were 44 active research projects between April 2002 and March 2004, 37 (84%) of which were funded. The funding for thirty-four of these projects was administered through IRRD, with a combined total of just over \$2 million. The highest percent of funds awarded (37%) was for pharmaceutical trials. Government grants, both federal and provincial, account for an additional 25% of the funds, followed by grants received from non-profit organizations (17%) and collaborative studies funded by US agencies (10%). The remaining monies represent external contracts, summer student awards and internal funding (Labatt 24 Hour Relay Fund).

### Percent of Funded Projects by Type of Granting Agency



A total of 39 grants were awarded to the 34 funded projects. In terms of external funding, the highest percent of grants was obtained from non-profit organizations (23%). This was followed by pharmaceutical companies (15%), other sources (10%), government ministries (8%) and international agencies (5%). Thirty-nine percent of the grants were obtained internally through the Labatt 24 Hour Relay Fund. These funds account for 5% of the total amount of money awarded and represent mainly pilot projects and top-up funds.

## Publications

### *Refereed Publications*

Allard P, Brajtman S, Brazil K, Guirguis-Younger M, Legault F, McPherson CM, Kelly ML, **Wilson KG**, Bond J, Chambers LW, Kozak JF, MacLean M, Ross M, Gagnon P. Optimizing research on end-of-life care for seniors. *Geriatrics Today* 2003;6:173-176.

**Blackmer J**. Drug therapy for autonomic dysreflexia: The author responds. *Canadian Medical Association Journal* 2004;170:1210.

**Blackmer J**. Ethics Corner: The debate on Bill C-6. *Canadian Medical Association Journal* 2004;170:1355.

**Blackmer J**. Reply to WJ Sullivan. *Spinal Cord* 2004;42:133.

**Blackmer J**. Ethics and the disabled [letter to the editor]. *Archives of Physical Medicine and Rehabilitation* 2003;84:1726.

**Blackmer J**. Ethics Corner: A GSW's on the way. *Canadian Medical Association Journal* 2003;170:427.

**Blackmer J**. Ethics Corner: HIV and the MD. *Canadian Medical Association Journal* 2003;170:907.

**Blackmer J**. Rehabilitation medicine: 1. Autonomic dysreflexia. *Canadian Medical Association Journal* 2003;169(9):931-935.

**Blackmer J**. The unique ethical challenges of conducting research in the rehabilitation medicine population. *BMC Medical Ethics* 2003;4(2):<http://www.biomedcentral.com/1472-6939/4/2>.

**Blackmer J**. Medical ethics teaching in Canadian physical medicine and rehabilitation residency training programs. *Annals of the Royal College of Physicians and Surgeons of Canada* 2002;35(Suppl):574-578.

**Blackmer J**, Jefromova L. The use of alternative therapies in the Saskatchewan stroke rehabilitation population. *BMC Complementary and Alternative Medicine* 2002;2:1-6.

**Blackmer J**, Ross L. Awareness and use of advance directives in the spinal cord injured population. *Spinal Cord* 2002;40(11):581-594.

**Bloom L**, Joseph M. The effect of spinal cord injury in adolescence. *SCI Psychosocial Process* 2003;16(4):237-243.

Byszewski A, Graham I, Amos S, Man-Son-Hing M, Dalziel W, **Marshall S**, **Hunt L**, Bush C, Guzman D. A continuing medical education initiative for Canadian primary care physicians: The driving and dementia toolkit: A pre and post evaluation of knowledge, confidence gained, and satisfaction. *Journal of the American Geriatric Society* 2003;51(10):1484-1489.

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**Balmer S**, **McNamara P**, **Ballantine C**. Best practice in outpatient service: Matching capacity to demand. Poster presented at the RehabNet Annual Meeting, Edmonton, Alberta, June 2003.

**Blackmer J**. Medical ethics teaching in Canadian physical medicine and rehabilitation residency training programs. Poster presented at the Canadian Association of Physical Medicine and Rehabilitation Annual Scientific Meeting, Edmonton, Alberta, June 2003. [Abstract: 03-06]

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**Bloom L**, **Lapierre N**, **Wilson K**, **Curran D**, **DeForge D**, **Blackmer J**. Comparison of goal setting between patients with multiple sclerosis and clinicians on an in-patient rehabilitation unit. Poster presented at the Rehabilitation Network of Ottawa Carleton Conference, Ottawa, Ontario, March 2003.

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- Lemaire ED.** Using Macromedia Flash for e-health and e-learning. Presented at the Ottawa Physiatry Research Day, Hull, Quebec, February 2004.
- Lemaire ED.** E-gait: Technology for clinical motion analysis. Presented at the International Society for Prosthetics and Orthotics Annual Scientific Meeting, Toronto, Ontario, October 2003.
- Lemaire ED.** Advances in e-health in physical rehabilitation. Presented at the Rehabilitation Network of Ottawa Carleton Conference, Ottawa, Ontario, March 2003.
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Nelson M, **Bloom L.** How social workers can impact systems for change: Exploring systemic advocacy techniques. Presented to the St. Thomas University School of Social Work, Fredericton, New Brunswick, June 2003.

Nelson M, **Bloom L.** Walking the talk: How Eastern Branch Ontario Association of Social Workers (OASW) empowered front line social workers to expose the effects of cuts to client services. Presented at the OASW Annual Meeting, Ottawa, Ontario, May 2003.

**Nymark J, Lemaire E, Goudreau L, Millar S, Tomas J, Yazdi F, DeForge D.** Clinical and research collaboration in gait research: Building the evidence. Presented at the Rehabilitation Network of Ottawa Carleton Conference, Ottawa, Ontario, March 2003.

**Rambarran KK, Lemaire E, Robertson DGE.** The effectiveness of the kinetic wedge foot orthoses modification to improve gait posture. Presented at the International Society of Biomechanics XIXth Congress, Dunedin, New Zealand, July 2003.

**Rochefort C, Lemaire ED.** Expanding the nurse's role using internet-based telehealth for wound assessment. Presented at Nursing Leadership: Building the Future, Ottawa, Ontario, February 2003.

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**Stang V.** Development of a Spiritual Care Reference Tool for people living with ALS/MND. Poster presented at the 14th International Symposium on ALS/MND, Milan, Italy, November 2003.

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**Trudel G, Laneville O, Uthoff HK.** Heightened thrombin protein localization in articular cartilage during contracture. Presented at the 34th Laurentian Conference of Rheumatology, Mont Tremblant, Quebec, May 2003. [Abstract: 12]

Uthoff HK, Matsumoto F, Himori K, **Trudel G.** Cuff muscle changes following tear and after early and late repair: An experimental study in rabbits. Presented at the 19th Annual Meeting of the American Shoulder and Elbow Surgeons, Pebble Beach, California, October 2002.

Waldegger L. A randomized trial of walkers and oxygen in chronic obstructive pulmonary disease. Presented to Health Canada: Centre for Chronic Disease Prevention and Control, Ottawa, Ontario, March 2003.

Waldegger L. A randomized trial of walkers and oxygen in chronic obstructive pulmonary disease. Presented at the University of Ottawa Student Research Day, Ottawa, Ontario, April 2003.

Waldegger L, **McKim D, McDowell I.** A randomized controlled trial of rollator walkers compared to oxygen in chronic obstructive pulmonary disease. Presented at the American College of Chest Physicians 69th Annual International Scientific Assembly, Orlando, Florida, October 2003. [Chest 2003;124(Suppl 1):164S]

**Wilson KG.** Older driver issues: Individual perspective. In M. Man-Son-Hing (Chair): Driving intervention strategies to maximize older driver safety and independence. Symposium presented at the Annual Ontario Injury Prevention Conference, Toronto, Ontario, February 2004.

**Wilson KG.** Psychological considerations for the older driver. Invited speaker at the Canadian Automobile Association Driver Mobility Forum: The needs of aging drivers in Canada, Ottawa, Ontario, November 2003.

**Wilson KG.** Assessment of depression and anxiety in the terminally ill. Invited workshop at the 15th Annual Palliative Care Conference, Edmonton, Alberta, October 2003.

**Wilson KG.** Highlights of the National Palliative Care Survey. Keynote address at the 15th Annual Palliative Care Conference, Edmonton, Alberta, October 2003.

**Wilson KG.** Highlights of the National Palliative Care Survey. Presented at the Regional Palliative Care Rounds, SCO Health Service, Ottawa, Ontario, October 2003.

**Wilson KG.** Highlights of a research program on insomnia in chronic pain. Presented at the Rehabilitation Network of Ottawa Carleton Conference, Ottawa, Ontario, March 2003.

**Wilson KG.** Euthanasia and physician-assisted suicide in the Canadian National Palliative Care Survey. Invited speaker at City-Wide Palliative Care Rounds, Grey Nun's Community Hospital, Edmonton, Alberta, April 2002.

**Wilson KG, Chochinov HM, Allard P, Chary S, DeLuca M, Gagnon PR, O'Shea F, Macmillan K, Fainsinger RL, Kuhl D.** The Canadian National Palliative Care Survey. Presented at the 14th International Congress on Care of the Terminally Ill, Montreal, Quebec, October 2002. [Journal of Palliative Care 2002;18:232]

Yamikovich T, **Lemaire ED, Kofman J.** Engineering aspects for stance control KAFO. Presented at the International Society for Prosthetics and Orthotics Annual Scientific Meeting, Toronto, Ontario, October 2003.

## Awards

Speech Language Pathologists **Elaine Cawadias** and **Susan Carroll-Thomas** received the National Award of Excellence for Clinical Posters from the American Amyotrophic Lateral Sclerosis Association in May 2002. The award was given for their poster entitled “Enabling Personal Decision-Making: Feeding Choices in ALS/MND”, and was presented in November 2001 at the 12th International Symposium on ALS/MND in Oakland, California.

In May 2002, **Dr. Joyce D'Eon**, Clinical Psychologist at TRC, received the 2002 Canadian Psychological Association Award for Distinguished Contributions to Psychology as a Profession. The award was presented at the 63rd Annual Meeting of the Canadian Psychological Association, held in Vancouver, British Columbia in June 2002.

**Dr. Keith Wilson**, Clinical Psychologist at TRC, received the distinction of being named a Fellow of the Section on Clinical Psychology of the Canadian Psychological Association. The award presentation occurred at the 63rd Annual Meeting of the Canadian Psychological Association held in Vancouver, British Columbia in June 2002.

TRC's Researcher of the Year Award is given to a researcher who has made a difference in the lives of clients with physical disabilities through clinical research. In February 2004, **Jennifer Wilson-Nymark** became the first recipient of this award for her outstanding research contributions in the areas of physiotherapy and gait and motion analysis.



# Congratulations!

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# HIGHLIGHTS

# Chronic Pain Rehabilitation Service Program Evaluation Outcomes

## Chronic Pain Rehabilitation

Chronic pain is a complex disability with a Canadian prevalence rate of approximately 9% for back pain alone (Currie & Wang, 2004). Chronic pain has a multifaceted negative impact on individuals and their families. In addition to the human toll, there are health care, productivity, compensation and litigation costs associated with chronic pain, that are estimated in the millions of dollars provincially and nationally in Canada.

Individuals with chronic pain respond well to multifaceted rehabilitation offered by an interdisciplinary team. Such services focus on improvements in physical, psychological and social functioning and, while reductions in pain may occur, patients are not 'cured' of their chronic pain.

Individuals with chronic pain have received rehabilitation at The Rehabilitation Centre (TRC) since it opened in 1981. Currently, the Chronic Pain Rehabilitation Service (CPRS) receives the largest number of referrals to TRC than any other single patient group. The interdisciplinary team consists of nursing, psychology, physiotherapy, occupational therapy, social work, psychiatry, vocational, nutrition and therapeutic recreation.

## Program Evaluation Background

An evaluation conducted in the early 1990's indicated positive patient outcomes. However, both patients' needs and the types of interventions offered have changed since then and an updated evaluation of outcomes was required. As such, the CPRS initiated a comprehensive systematic evaluation of its services in January 2002.

The overall objective of this evaluation was to examine both the inpatient and outpatient components of the service. It was expected that there would be improvements in areas of patient functioning that the service directly targets, such as: physical functioning, daily activities, coping, reports of disability, depression, and quality of life. Other areas that the team thought the program might improve were level of pain intensity, sleep and social functioning. This evaluation provides information about clinical indicators, determines self-management strategies that are maintained post-discharge, and thus continues the process of evidence-based improvements on the Service.

## Method and Results

In total, 75 patients completed the evaluation before and after the six-week program. Of those, 46 patients returned for a follow-up evaluation. As is typical in other chronic pain samples, women comprised two-thirds of the patients. The average age was 45 years and the average duration of pain was 6.7 years. The largest single pain site was low back pain, representing about one-third of the sample. Patients completed the assessment package on a voluntary basis after being informed of the purpose of the evaluation and the time required from them. Those who agreed to participate were asked to complete the evaluation and walk test within the first few days of the program as well as during the very last days. The follow-up took place approximately three months after the patients were discharged. The quality of life measure was administered on only two occasions - at the beginning of the program and then again at follow-up, as this measure addresses broad aspects of life that would not be expected to change during the program.

As the table on the following page indicates, statistical and clinically significant changes were found on both the measures of physical activity and the measure of depression. In terms of speed of walking, overall, patients were now walking within the normal range, and these improvements were maintained at follow-up. A reduction in catastrophizing and overall improvement in the use of coping strategies was noted. Increases in relaxation and pacing strategies were found, as were increases in exercise and stretching, and social support. All of these improvements were maintained at follow-up.

The quality of life measure indicated improvements in three global areas of life functioning (physical, psychological and social domains). The environmental domain did not change (e.g., How satisfied are you with the conditions of your living place?), however as this domain is not impacted by the Service, a change was not anticipated. While the program does

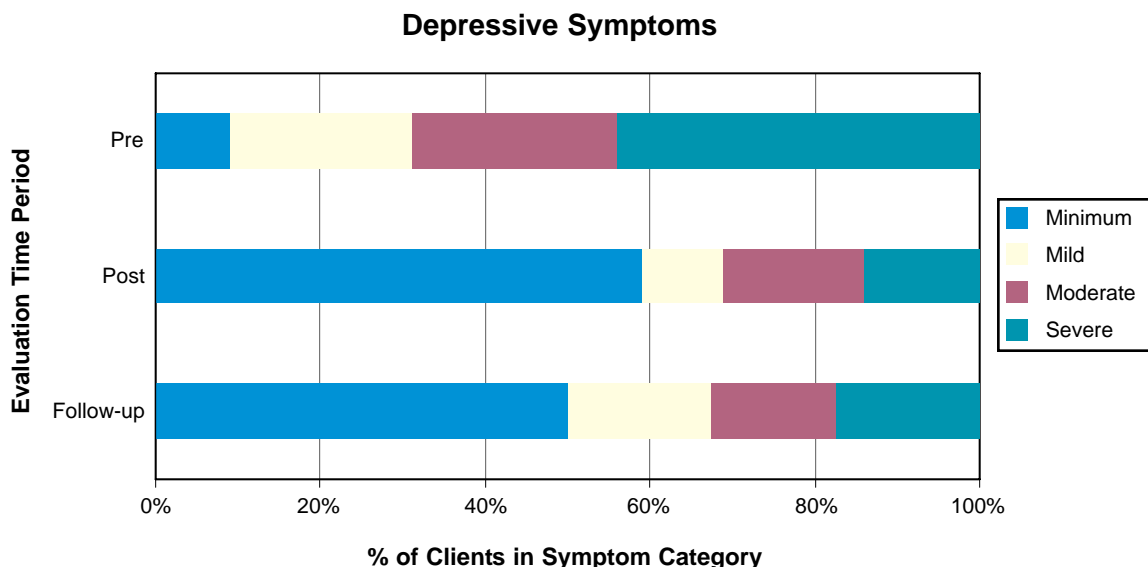


Outcomes Examined	Pre	Post	Follow-up	p
Physical Functioning Walk Test Speed Distance (10 minutes)	.97 (m/sec) 540 m	1.3 (m/sec) 773 m	1.3 (m/sec) 779 m	p < .001 p < .001
Depression	26.2	14.2	16.6	p < .001
Catastrophizing	23.7	17.2	17.8	p < .001
Coping				
Relaxing	18.6	37.1	34.6	p < .001
Pacing	21.3	33.0	31.5	p < .001
Exercise/Stretching	35.0	72.0	58.3	p < .001
Social Support	21.5	27.4	24.9	p < .004
Total	215.5	289.0	257.6	p < .001
Quality of Life*				
Physical	61.4		69.6	p = .005
Psychological	64.8		72.7	p = .006
Social	35.0		39.2	p = .013
Environmental	105.5		108.6	NS
Pain Intensity				
Current Pain	6.5	5.9	5.9	p = .049
Worst Pain	8.6	8.0	8.0	p = .036

\* Significant differences were found between pre/post and pre/follow-up with the exception of the Quality of Life measure, where significant differences were found between pre and follow-up on all but the Environmental subscale.

not target pain reduction, significant reductions in average 'current' and 'worst' pain were found pre to post-rehabilitation, and those changes were also maintained at follow-up. Reductions in pain levels are thought to be related to improvements in physical conditioning, coping, and the use of strategies designed to reduce pain fluctuations (e.g., planning, pacing, prioritizing, etc.).

In regard to depression more specifically, patients reduced the number and severity of depressive symptoms endorsed, and these improvements were also maintained at follow-up. As indicated in the graph below, it is particularly noteworthy that while 91% of patients reported mild to severe depressive symptoms before the program, at follow-up only 51% of patients did so.



## Summary and Conclusions

These impressive results are both statistically and clinically significant and support the link between the Service objectives and the outcomes achieved by this interdisciplinary team. Both the inpatient and outpatient components were effective, and therapeutic gains are maintained even after patients have returned to their communities. Given this complex disability, these results are encouraging for both patients with chronic pain and team members, and support the resources allocated to this Service.

The next part of this evaluation will be to examine the variables related to those patients who benefit most from the program, in order to try to best tailor aspects of the program to the needs of patients. In addition, the inpatient component of the service has since been discontinued and the outpatient program remodeled, thus this evaluation will continue to inform the team on the interventions that most benefit patients.

This evaluation took place with the planning, support and assistance of the patients who volunteered to participate, all Service team members, the support staff affiliated with the Service, and affiliates and staff of the Institute for Rehabilitation Research and Development. These combined efforts are much appreciated. The results will allow for continuous quality improvement of this Service to ensure continued best practice in the rehabilitation of individuals with chronic pain.

These results were presented at a symposium on rehabilitation at the Canadian Psychological Association Meeting, St. John's Newfoundland, in June 2004.

### Reference

Currie SR, Wang J. Chronic back pain and major depression in the general Canadian population. *Pain* 2004;107:54-60.

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## Enhancing Functional Outcome: Gait and Motion Analysis

### Reducing Disability in Chronic Stroke through Physical Conditioning

In spite of intensive rehabilitation in the first few months post stroke, many individuals continue to experience disabilities once discharged from active treatment. The loss of mobility may cause further de-conditioning and physical decline in chronic stroke clients. Over the past several years, physiotherapists at The Rehabilitation Centre (TRC) have been involved in a randomized clinical trial led by Sandra Olney at Queen's University in Kingston. The primary objective of the research was to compare the effectiveness of two types of physical conditioning programs on an individual's physical impairments, disability and perceived handicap.

Study participants were randomly assigned to one of two groups. Individuals assigned to group 1 took part in an intensive supervised physical conditioning program for 10 weeks at a local community centre. The program entailed a gradual progression of strength, flexibility and endurance training. Individuals assigned to group 2 participated in a closely monitored home exercise program for the same duration of time. They were taught a similar exercise program and received written and verbal instructions on how to do their program, as well as how to progress through it independently over the 10 week period. Support was available to them if it was self-initiated by telephone.

The primary outcomes included the Human Activity Profile, a 6 minute walk test, a 22 metre walk test, stair-climbing speed, and the SF-36 Health Survey. Secondary outcomes included measures of muscle strength using a hand held dynamometer, and spasticity using the pendulum test. Measures were obtained before and after the 10 week fitness program, and at six and 12 months following the date of enrollment in the study.



*Participants assigned to the 10 week intensive supervised physical conditioning program work on their endurance at the Jack Purcell Community Centre in Ottawa.*

Data collection was completed in June 2003. Data analyses are ongoing and will continue into 2005. Preliminary findings indicate that modest physical and perceived health gains were achieved following both the community-based and the home-based conditioning programs. While there was no clear advantage between the two formats of instruction, group 1 participants tended to perceive greater health benefits after the program than those in group 2. Clinically, the results suggest that chronic stroke survivors tolerate and make improvements using a structured physical conditioning program either in a class or home-based format. Perceived gains by participants in a supervised class format appear to have benefits beyond physical conditioning.

The Ottawa research team felt it was important to share the findings with the participants who so generously gave their time and effort to help bring the project to a successful completion. On March 5, 2004 all participants were invited back to TRC for a presentation of the findings. Feedback from the consumers regarding this approach was excellent. The preliminary results were also presented at the Interurban Stroke Conference in London, Ontario in May 2004.

This dual-centre trial was the first major exploration of physical fitness in chronic stroke. The findings will undoubtedly provide a better understanding of physical de-conditioning following stroke rehabilitation and may eventually lead to more active life-styles for our chronic stroke clients.

### **Body Weight Support in Spinal Cord Injury**

Gait enhancement strategies in subacute, incomplete spinal cord injury have been a major focus at TRC since 1995. Pilot research at TRC on weight-supported treadmill gait training with our partner, Dr. H. Barbeau at McGill University, resulted in our participation in a North American clinical trial. Researchers at TRC participated in a large, multi-site randomized controlled trial, directed by researchers at the University of California, Los Angeles and funded by the US National Institutes of Health. The purpose of the trial was to study the effectiveness of a new physical training program aimed at enhancing the walking recovery of people who have suffered a recent, incomplete spinal cord injury. Close to 180 subjects were studied across six centres in the US and Canada.

The TRC team was led by Physiatrist-in-Chief, Dr. Dan DeForge and Research Physiotherapist, Jennifer Wilson-Nymark. The new intervention included an early, intensive program of walking practice on a treadmill with the participant's body weight partially supported using a climbing harness and an overhead lift system. This support assisted the participant to stand upright and allowed the physiotherapists to stimulate correct body posture and leg movement toward more normal stepping. The protocol included specific intervention strategies both on the treadmill and overground. This approach was tested against conventional gait training in physiotherapy. The physically challenging, intensive nature of the new regime was positively received by the participants and exposed consumers in the Ottawa region to a "bench-to-bedside" clinical trial. A paper outlining the methodology of this multi-site trial was published in 2003 by Dobkin et al. [*Neurorehabilitation & Neural Repair* 2003;17(3):153-167]. The results of the study will greatly contribute to the scientific basis of functional and neurological early gait recovery following incomplete spinal cord injury.



*A study participant practices walking on a treadmill with his body weight partially supported by a climbing harness and an overhead lift system.*

## Implementation of the Rehabilitation Integrated Transition Tracking System (RITTS)

The lifelong effects of an injury or disease frequently require ongoing reassessments and professional services that can contribute to a complex web of health care provision. Information collected by individual health care providers is frequently not available to other subsequent health care providers and it is often not available in a timely manner. The primary care provider is often the first person to see patients who enter or who need to come back into the system, and they are critical to the appropriate management of rehabilitation patients. In 2003 the Ontario Ministry of Health and Long Term Care established a Primary Health Care Transition Fund and posted a request for proposals to review projects designed to promote and improve access to primary health care across the province.

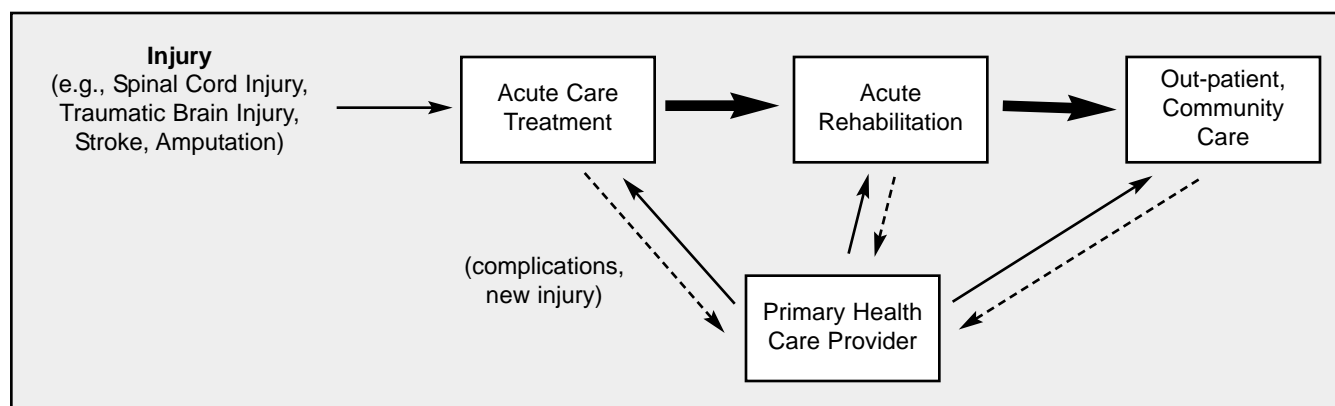
A project team led by Dr. Dan DeForge, representing the Rehabilitation Network of Ottawa Carleton, was successful in obtaining funds to develop, pilot and evaluate the Rehabilitation Integrated Transition Tracking System (RITTS). Over the next 20 months this online referral process and electronic database will be created to better facilitate rehabilitation referrals by improving health provider access to relevant client information, as well as standardizing and streamlining the current paper-based rehabilitation referral process. It will specifically target the integration of primary care providers.

The project is designed to progress in a series of stages. The project is currently in the consultation phase, which involves interviews and meetings with admissions staff, clinicians, clinical managers and information technology staff. Information gathered in this phase will be used to conceptualize and program the on-line referral interface and database in the second phase. This interface will be pivotal to engaging service providers in the standardized referral process and the project team will be working closely with Information Systems at The Ottawa Hospital (TOH) to minimize extra data input and ensure a smooth integration with other existing databases.

The new system will benefit from the project team's experience with two previously designed databases that will serve as a template, both of which were created by programmers working through the Institute for Rehabilitation Research and Development. The first database was developed in a project here at The Rehabilitation Centre, also funded by the Ontario Ministry of Health and Long Term Care, to create a regional referral tracking system specific to persons with traumatic brain injury. Another database, designed for the Regional Stroke Network in Toronto called 'SCRIPT', was also developed to be an on-line referral system and is currently being used in the Greater Toronto Area on a trial basis by 13 health institutions to manage stroke rehabilitation.

The RITTS will be implemented in a limited pilot in 2005 with two or three primary care services outside TOH, including a Family Medicine Unit and a local Community Care Access Centre. Assessments of service provider satisfaction and speed of referral, both of which will be measured by on-line processes, will be made. Feedback from this initial pilot will be incorporated into the system and the next iteration will be ready to expand into more primary care facilities.

The ultimate goal of RITTS is to improve the integration and coordination of services across the health care continuum; between institutions, service providers and community care. It is anticipated that the system will be readily transferred to other health sectors and geographic regions.



*Flowchart illustrating the transition of care and health care information that RITTS is intended to impact.*

## Musculoskeletal Research in Action

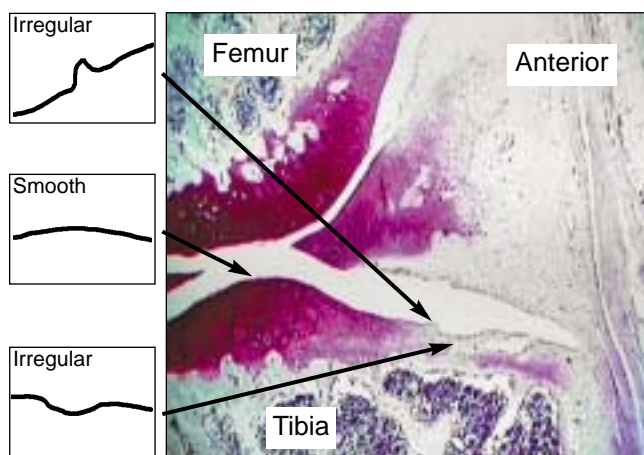
The Bone and Joint Laboratory at the University of Ottawa conducts research on disease mechanisms that cause impairments and add to the disabilities of patients with complex or chronic diseases. The cohesive multidisciplinary team has contributed to breakthroughs in our understanding of conditions such as joint contractures and the effects of immobility on musculoskeletal structures.

### Joint Contractures

Ongoing research involves two important aspects of joint contractures: capsule stiffness and cartilage degeneration. By characterizing the adhesive and fibrotic nature of capsular changes, we have contributed to one of the most critical advances in the pathophysiology of joint contractures in decades. In addition, we have made significant advances in understanding how cartilage damage occurs in joint contractures. Cartilage degenerates in immobile joints and is irreversibly lost past a certain threshold. Identifying the characteristics of this degeneration has been controversial. We have hypothesized that at least two different pathways exist in relation to the site of degeneration. Using an animal model of cartilage degeneration, we measured a number of outcomes and showed that the cartilage in contact with the other side of the joint showed milder degeneration and different characteristics than the cartilage not in contact. We concluded, therefore, that there must be a mechanosensitive pathway for degeneration that is different whether there is contact with cartilage or not. This finding is critical in that it helps to explain discrepancies in the literature regarding the outcomes of cartilage degeneration.

Outcome of Cartilage Degeneration	Apposed		Unapposed	
	Superficial	Deep	Superficial	Deep
Number of Chondrocytes	Higher	Unchanged	Unchanged	Lower
Number of Other Cells	Unchanged	Unchanged	Higher	Higher
Matrix Staining	Unchanged	Unchanged	Lower	Lower
Surface Irregularity	Higher		Higher	
Mean Thickness Cartilage	Unchanged		Unchanged	
Mean Thickness Non-Cartilaginous Tissue	Unchanged		Higher	

*The pattern of degeneration differs markedly whether outcomes are measured from cartilage in contact (apposed) or not in contact (unapposed) with the other bone of the joint.*



*Cartilage surface irregularity of a knee joint immobilized for 32 weeks.*

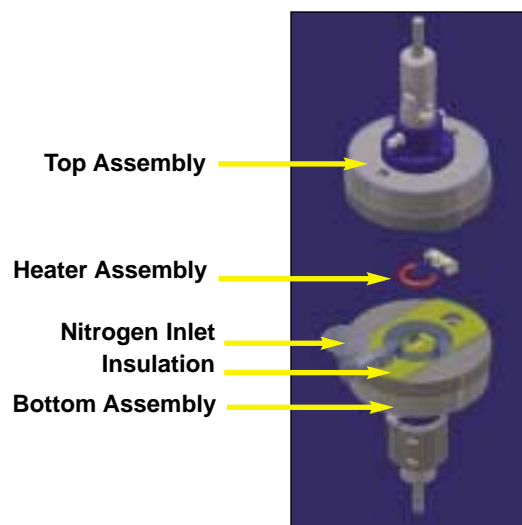
A second contribution to the study of cartilage degeneration is the development of a tool to measure the irregularity of its surface. In conjunction with The Rehabilitation Centre's (TRC), Rehabilitation Engineering Service, we developed irregularity algorithms using image analysis of histologic sections of knee joints. With our technique, we demonstrated that early degeneration of cartilage progresses with the time a joint is immobile. In addition, this new measure can determine the impact of treatment on the reversal of cartilage damage. Moreover, in conjunction with advances in MRI technology, it may become the best tool available to measure early cartilage damage in joints.

## Achilles Tendon Injuries

Another area of research involves diseases of tendons. The achilles tendon on the ankle is the most common site of tendonitis and rupture in the lower limbs. In studying this tendon's reaction to immobility and recovery after an injury, we have found significant correlations between laboratory data (histology and mechanical testing) and clinical data (ultrasounds, MRI and bone densitometry of the heel bone). Specifically, we have demonstrated that bone changes are the best predictor of achilles tendon weakness, a finding that may have repercussions on the clinical follow-up of tendon diseases after immobility.

### Cryoclamp

In order to measure the strength of tendons in various disease conditions, it is necessary to clamp onto the tendon securely. However, effective clamping systems have not been available to date. Working with a group of engineers we were able to produce the first double cryogenic fixation system to test tendons in isolation. This system will not only allow us to broaden our research focus on tendon diseases, but will also benefit others in the biomechanical research community.



### New Initiatives

Our research program on musculoskeletal diseases has brought us in new and unexpected directions. Musculoskeletal complications of immobility are intimately linked to the problems faced by astronauts in a state of weightlessness. We have been selected as part of an international group of scientists who, in preparation for upcoming missions to Mars, are developing a protocol to study the physiological effects of long duration exposure to microgravity. We are also involved with the Canadian Longitudinal Study on Aging to develop a research protocol for the study of normal aging in the Canadian population. Our contribution in this large population study would be to analyze how cartilage and joint range-of-motion change and contribute to disability.

In closing, with the continued support and encouragement of the Institute for Rehabilitation Research and Development and the Department of Physical Medicine and Rehabilitation at The Ottawa Hospital (TRC site), our research laboratories are making important strides in the direction of decreasing impairment and disability in our rehabilitation population. The basic nature of our "wet" research also promises applications beyond our own doors.

## Rehabilitation Engineering: Ability through Innovation

Rehabilitation Engineering is the application of science and technology to improve the quality of life of persons with disabilities. At The Rehabilitation Centre (TRC), Rehabilitation Engineering activities include clinical service delivery, research and development, and technology assessment. A Certificate of Authorization granted by Professional Engineers Ontario allows Rehabilitation Engineering to provide professional engineering services to the public.

### Clinical Services

Clinical services offered include creating custom assistive devices for persons with disabilities or adapting existing devices to meet individual needs and abilities. Working with the client and members of their clinical team, custom solutions are designed, fabricated and tested. Other clinical services include engineering consultation, repair and maintenance of custom or modified equipment, and the creation of custom therapy or patient care equipment. Often adaptations improve client mobility, communication or safety. Although Rehabilitation Engineering can become part of any clinical team that requests our input, we are designated members of the Technology Access Service (TAS) and the Gait and Motion Analysis Laboratory (GAMA), which has both clinical and research components. Thirty-six custom solutions for patients were completed during the reporting period. Twenty-four solutions for TRC's Occupational Therapy, Communication Disorders, Physiotherapy, Prosthetics and Orthotics, and Respiratory Therapy were also completed. Some examples of these clinical solutions can be found in the 2002-2004 Projects section on the following page.

### Research and Development

Rehabilitation Engineering participates in many research and development activities including custom research instrumentation, engineering consultation, clinical tools and rehabilitation product development. Forty-three different projects were completed in 2002-2004 involving researchers from the University of Ottawa Research Labs in Microbiology, Biomechanics, Behaviour Studies, Human Kinetics, Cellular and Molecular Medicine, Animal Care and Veterinary Services, the Biotechnology Research Institute, and the Molecular Genetics Lab at CHEO. A clinical tool was also developed for a private company, the details of which are confidential. Rehabilitation Engineering continues to be the sole international supplier of specialized stir bars required for a standardized method of testing disinfectants, which were developed previously with Dr. Syed Sattar of the University of Ottawa (Microbiology). Ongoing research projects include "A validity-based evaluation of the driving assessment program for stroke patients"; further development of the accessible infant crib to meet Federal Cribs Regulations in collaboration with Centre de réadaptation Lucie-Bruneau and Systèmes Médicaux of Montreal; development of an orthotic safety knee with Dr. Edward Lemaire; and the development of instrumentation for sensory perception research with Dr. Francois Tremblay of the University of Ottawa, Faculty of Health Sciences.

### Technology Assessment

Technology assessment and consultation services are offered to manufacturers of mobility and other assistive devices. TRC is one of two test centres who advise the Ontario Ministry of Health and Long Term Care Assistive Devices Program (ADP) on whether or not products should be eligible for provincial funding. Recommendations are based on engineering and clinical testing. There has been a marked increase in the number of requests and completed evaluations. Over fifty product evaluations and reviews were completed between 2002 and 2004.

A major review of all criteria and test procedures has been undertaken in collaboration with ADP and the London Test Centre to address stakeholder concerns to reduce turnaround time for evaluations, to use data from manufacturer testing where possible, and to incorporate recent ADP policy changes. In the first stage a comprehensive review of all ADP mobility device criteria and test methods were compared to ISO/CSA and ANSI/RESNA standards to identify areas of further harmonization. The next stage will involve working with manufacturers to harmonize test procedures that are out of the scope of the existing mobility device standards. For example, specific standards do not exist for power or manually operated tilt or recline systems, power add-ons or heavy-duty products, all of which are products that require testing before listing with ADP. New documentation and ADP policy revisions will be written in the final stage of this project.

## 2002-2004 Projects

### **Communication Device**

A commercially available set of two-way radios was modified so that they could be independently used safely within the grounds and building of TRC. Working with the occupational therapy technician, one radio was mounted on the client's power wheelchair. The radio was modified so that the client could initiate a call by activating a switch with his head. Although voice activation was an option on the radio, it was decided not to use it because he was often in noisy environments, which would have unnecessarily initiated transmissions to the nurses. The microphone from the radio was also removed and relocated close to the client's mouth. The radio itself was mounted elsewhere on the chair. The system allowed the nurses to give him messages and also hear if an alarm was sounding.



### **Ventilator Mounted on Arrow Power Wheelchair**



An LP6 Ventilator was mounted on an Arrow power wheelchair. The challenge was to do so in a way that was as compact as possible. With the client's previous ventilator tray, the ventilator had to be removed to allow access to certain environments (e.g., elevators). Given that the client now required use of the ventilator at all times, removing it was no longer an option. Our solution involved mounting the battery under the front of the chair and the ventilator at the back, without increasing the overall length of the wheelchair. This allowed the client to access elevators and buses without having to remove the ventilator.

### **Hand-Powered Exercise Bike Conversion**

A stationary exercise bicycle was converted to a hand powered bicycle to provide the client with a means to exercise his arms while providing passive exercise for his legs. A link was created between the pedals and hands that could easily be disconnected by the client to facilitate independent transfers. Counterweights, shown in the inset, were also added to keep the foot pedal level.



### **Custom Footrest**



Since the client's leg is usually fully extended, this custom footrest was designed to be as slim as possible to minimize the overall increase in length to the chair. The footrest could flex towards her foot to provide a bit more room in tight places and still provide support. In addition, it accommodated spring-loaded support of rotation and translation of the foot. A bumper was added to allow the client to open doors while preventing damage to the footrest mechanism. The footrest was incorporated into a leg rest, previously made by Rehabilitation Engineering, that allowed independent angle adjustment at the knee. A new mounting system was also made to accommodate a recent model change of the power wheelchair.



### **Multiple Equipment Mounting on Manual Tilt Chair**

A client required several pieces of critical equipment to be mounted on a manual wheelchair with tilt and recline features. The challenge was to mount a ventilator, oxygen tanks, a feeding pump, a suction machine and other supplies on the chair, allow extreme changes in positioning without interference with the equipment, and keep everything balanced and safe. The solution was to provide a large tray for a small ventilator unit and the feeder under the chair with access to the equipment from the rear of the chair. Special attention was taken in the design of the oxygen tank holder mounted on the backrest to ensure protection of the pressure valves at the top of the tank. The tray at the front for additional supplies was designed to allow clearance for the client's feet.



### **Hand Operated Dictaphone Switches**



A client needed to be able to operate a Dictaphone type recorder and was unable to use the footswitches to control the rewind and play modes. Mini momentary switches were used that could be accessed just above the keyboard. Pressing switch B rewinds the tape until switch B is pressed again. Pressing Switch S will start playing the tape until switch S is pressed again. LED's provide visual feedback on whether the switch is on or off.

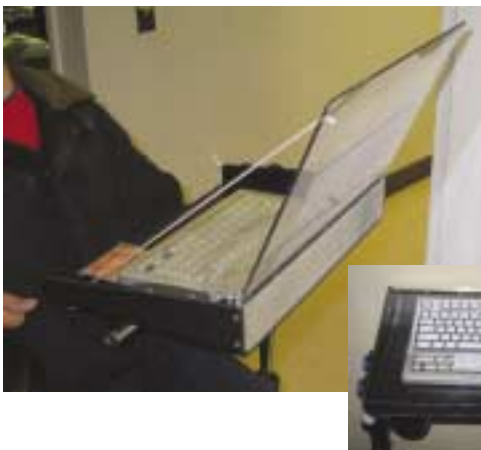


### **Electronic Organizer Tray and Wheelchair Mount**

The custom electronic organizer tray is attached to the joystick box using a spring-loaded clip. The tray can easily be removed for transfers and snaps back into place. Adjustments can be made to the position and angle of the tray.



### **Communication Tray**



This tray and mounting system was designed to accommodate a Link communication device. A Lexan cover was added to protect the Link from rain and snow. The simple mechanism to open and close the cover was designed to allow the client to independently open and close it with a head pointer. When the Link was not in use the client had an alternate communication board which was attached to the cover. The challenge in this case was to provide a mounting system that could accommodate the stress of the client's vigorous use of the power wheelchair and tray.

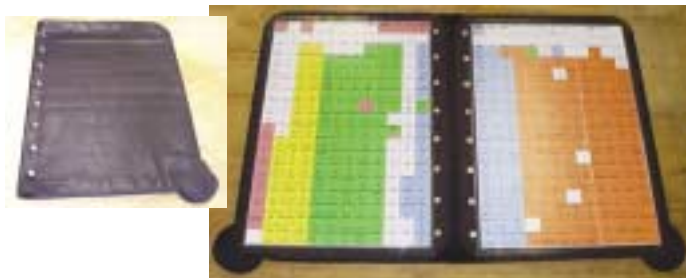
### **Bicycle Pedal Adapters**

A client needed custom bike pedals to accommodate different leg lengths. This was accomplished by attaching a custom bracket to allow for adjustment of the pedal closer to or farther away from the centre of rotation.



### **Communication Book**

This custom communication book was made with the combined skills of Communication Disorders, Rehabilitation Engineering and Total Footcare. The book allowed the client access to four large communication pages. Pages were mounted on Lexan sheets and covered with a protective film. The Lexan pages were then riveted to a durable custom leather cover. Just enough Velcro kept the book closed but also allowed the client to open the book independently.



### **Accessible Infant Crib Development**

The first prototype of an accessible infant crib was made for a TRC client in 1986. Although many enhancements have been made since then, the basic concept remains the same. A fixed crib side was modified into sliding doors with a safety latching system that prevented inadvertent opening and automatic locking when the side was closed. The crib was also raised to a custom height to allow the individual client optimal access. Over the years many parents with disabilities in the Ottawa area have evaluated and provided feedback on different prototypes. In 2003, Rehabilitation Engineering started working in partnership with Centre de réadaptation Lucie-Bruneau and Systèmes Médicaux of Montreal, with guidance from Health Canada, to incorporate additional safety features to meet Canadian Federal Cribs Regulations.

### **Gait and Motion Analysis (GAMA) Laboratory Instrumentation**



Over the past few years new instrumentation has been designed, tested, and fabricated by Rehabilitation Engineering with the GAMA Lab team. The new system allows for 18 channels of electromyographic signal data (EMG), six channels for electrogoniometers, 12 channels handling signals from two force plates, and two channels for two sets of foot switches. Accompanying software for data collection and reporting has also been developed. This greatly enhances the capabilities of the lab. In addition to increased force plate and EMG data collection capabilities, the new instrumentation allows for either computer controlled or manual gain setting adjustment. A battery optimization feature has also been added that automatically switches the battery into charging mode when it is not in use for the isolated patient-side electronics. Further enhancements to the software are ongoing.

## Telerehabilitation and e-Learning

Researchers at the Institute for Rehabilitation Research and Development are finding new ways to take advantage of computer and Internet technology to improve how we provide services for people with disabilities. This section describes a series of projects using information technology and engineering.

### Remote Configuration of the Otto Bock C-Leg

In partnership with Prosthetics and Orthotics at The Rehabilitation Centre (TRC), Smith Prosthetics Services, and War Amputations of Canada, we recently completed a study validating a new approach for remote control of an assistive device. The Otto Bock C-Leg is a microprocessor/computer controlled above knee prosthesis that provides real-time knee joint adjustments based on how the consumer is moving. For example, the knee is stiffer as a person descends stairs and less stiff as they run or ride a bike. Our team used NetMeeting data conferencing tools (Application Sharing) to take remote control of the C-Leg configuration software and enable a prosthetist to change various C-Leg control settings, and view a real-time display of C-Leg force output and knee angle changes. By combining the Application Sharing with Internet-desktop video conferencing, we were able to successfully configure the prostheses for 15 subjects while they were at a remote location. Provided the users have a reliable broadband Internet connection, this approach can be applied anywhere in the world.



*C-Leg Configuration Over the Internet*

### Macromedia Flash for Telerehabilitation

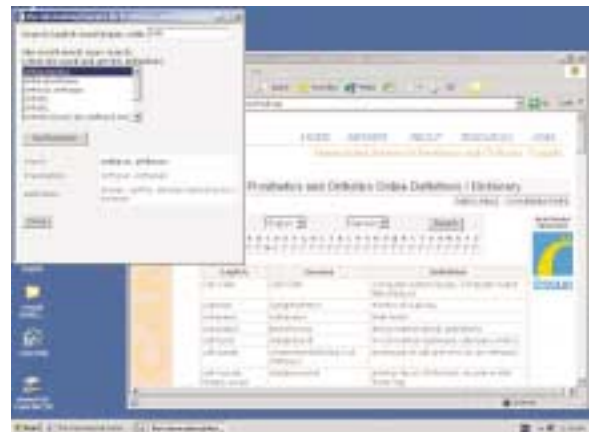


*e-Learning Using Flash*

Macromedia Flash is a web multimedia component that is installed on approximately 98% of all Internet-enabled computers. Recently, multipoint conferencing and video support has been added to Flash, allowing many people to connect and communicate at the same time. Our team has been exploring a series of approaches for providing multipoint e-learning and e-health services. To access the tools, users go to the web site and are automatically connected to the conference. This approach will become an essential part of portable, in-home, and desktop e-health applications such as accessing on-line expertise during a clinical encounter or connecting to a specialist from your home. Current R&D projects include small group learning, telehomecare for people with brain injury, and on-line motion analysis.

### Prosthetic and Orthotic On-line Dictionary/Lexicon

In cooperation with the International Society for Prosthetics and Orthotics (ISPO) Canadian National Society and Ossur, the first web-based multilingual dictionary was created to allow health providers and consumers to look-up over 1000 terms specific to prosthetics and orthotics. This on-line resource can be used to translate between German and English, and other languages as they become available. The database driven approach for this site allows any number of languages to be added as translations become available (French, Chinese, and Vietnamese translations are in progress).



*Prosthetic and Orthotic Web-Dictionary*

## Stance-Phase Control Orthotic Knee Joint

New knee joints for knee-ankle-foot orthoses (KAFO) are coming on the market that lock during stance and unlock during the swing phase of walking gait. However, these joints are either too heavy, unreliable, or require strict walking patterns to be effective. Our research in this area has progressed along two directions. An electromechanical approach uses a new belt-friction design for providing knee locking during weight-bearing but free knee motion during swing. A smart electronic control system will determine when joint locking is required. A hydraulic KAFO knee joint design is in the early prototype stage. While this joint could be integrated with a microprocessor controlled system for activating swing/stance phase control, the hydraulic approach could potentially work as a velocity activated joint that does not require additional control systems.

## Case-Based Continuing Education



*On-Line Case-Based Learning*

An interactive web site has been developed as a case repository and learning resource. Case-based learning is effective for physical rehabilitation continuing education. The web-based tool includes user authentication, an interaction multimedia database for content providers and users, an on-line discussion forum that is integrated with the case database, and Flash-based video/data conferencing. Partners with the Canadian Association of Prosthetists and Orthotists (CAPO), ISPO, George Brown College, Hong Kong Polytechnic University, and Don Bosco University (El Salvador) have agreed to provide case content over the next year. Once a sufficient number of cases are available, a formal evaluation of this approach will be performed.

## Student Projects

Macromedia Flash-Based Motion Analysis Whiteboard  
Gaofeng Liu, MSc (Systems Science)  
University of Ottawa

Biomechanical Analysis of the Sagittal Plane Blockade Model for Foot Orthosis Design  
Kerry Rambarran, MA (Human Kinetics)  
University of Ottawa

Design and Validation of a Stance Phase Control Knee Ankle Foot Orthosis  
Terris Yakimovich, MSc (Mechanical Engineering)  
University of Ottawa

R&D Product Database  
Victor Liang, BSc  
University of Waterloo

C-Leg Evaluation on Stairs and Ramps  
Leslie-Ann Stewart, BA (Human Kinetics)  
University of Ottawa

Web/Multimedia Development  
Fangwei Zeng, Research Assistant  
The Rehabilitation Centre

Web Development and Technology Identification  
Jeff Moncrieff  
Sir Wilfrid Laurier Secondary School

e-Learning Development and Motion Analysis Tools (Shockwave)  
Sean Rose  
Sir Wilfrid Laurier Secondary School

Gait Analysis Data Reporting Software  
Chris Edgecomb  
Sir Wilfrid Laurier Secondary School

Web Development  
Brad MacDonald  
Sir Wilfrid Laurier Secondary School