



PROGRESS REPORT

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CCRF RESEARCH CHAIR IN SPINE MECHANICS AND NEUROPHYSIOLOGY

UNIVERSITY OF GUELPH

BACKGROUND

The Canadian Chiropractic Research Foundation (CCRF) Research Chair in Spine Mechanics and Neurophysiology at the University of Guelph was first established in September of 2008. This position was made possible through the generous and collaborative support of the Ontario Chiropractic Association, the Canadian Chiropractic Research Foundation and the University of Guelph.

I assumed the CCRF Chair in September of 2008 after successfully completing my PhD (biomechanics, neurophysiology) from the University of Guelph in August 2008. In my current rank as Assistant Professor, my responsibilities within the department are allocated 70% to research, 20% to teaching and 10% to Service. I have been assigned to teach a 4th year undergraduate course in the Human Kinetics programme entitled "Health and Injury Biomechanics" and I presently supervise one Master's student and several undergraduate students in various research projects within the Department.

OVERVIEW

For chiropractic to be universally accepted into mainstream healthcare, it must first be accepted into mainstream science. For this to happen, chiropractic must characterize and validate its physiologic effects using the language of basic science. There is currently an inadequate body of basic science substantiating the physiologic mechanisms of spinal manipulative therapy (SMT). The credibility and value assigned to chiropractic by the scientific and medical communities, government, insurance and other stakeholders is and will be directly linked to the quality of basic science (RCT studies), published in high ranking peer-reviewed journals, validating its physiologic mechanisms. Health policy and health funding will be evidence-based; accordingly, greater emphasis must be placed on systematically building a larger chiropractic research infrastructure that will facilitate world-class research. In particular, chiropractic must seek to enhance its research presence in the basic sciences by creating collaborations with leading international academic and research institutions and creating positive interdisciplinary relationships. This paradigm will enhance our value as spinal experts and facilitate full acceptance and integration of chiropractic services into mainstream healthcare.



OVERVIEW OF MY RESEARCH PROGRAM

The primary goal of my research as CCRF Chair in Spine Mechanics and Neurophysiology at the University of Guelph is to investigate and characterize the fundamental physiologic mechanisms of chiropractic SMT.

Overall, my research interests lie in the investigation of the neurophysiologic mechanisms of pain. I am specifically interested in the study of the mechanisms of chronic and myofascial pain.

There are three main themes guiding my research:

- To elucidate the neurophysiologic mechanisms of *central sensitization* (hyperexcitability in the central nervous system) and its role in the clinical expression of chronic and myofascial pain.
 - In the course of this research thread, I have developed and published a novel hypothesis describing the pathophysiology of myofascial pain, named the "*Neurogenic Hypothesis*".
- To investigate the physiologic mechanisms of therapeutic interventions, such as SMT, in the management of pain (chronic, myofascial). To this extent, I am investigating the hypothesis that these therapeutic modalities achieve systematic physiologic effects by modulating central sensitization.
- Investigate the physiologic mechanisms of therapeutic interventions, such as SMT, in the pathophysiology of *non-musculoskeletal (visceral)* conditions. This thread aims to determine whether therapeutic modalities, such as SMT, can affect disease (visceral responses) by modulating central sensitization.

Central sensitization is a neurophysiologic mechanism which has been linked to the expression of pain (chronic, myofascial) and pathophysiology of non-musculoskeletal (visceral) conditions. Elucidating the interactions between central sensitization, pathology and therapeutic modalities provides the scientific foundation to explaining the musculoskeletal and non-musculoskeletal (visceral) impact of SMT. *This research has important implications towards validating chiropractic in the treatment of pain as well as the promotion of health and wellness.*

RESEARCH FACILITIES

The CCRF Chair has provided me immediate access to over \$1 million in state-of-the-art laboratory facilities, including two biomechanics labs (John Zettel, Lori Vallis) and one neurophysiology lab (Leah Bent). The biomechanics facility includes:

- a unique and rare six-degrees of freedom robot that can be used for displacement control in a wide range of biomechanical applications and spinal research.



Figure 1: Six-Degree of Freedom Robotic Platform



- Optotrak kinematic data acquisition system for analysis of human movement
- accelerometry and force transducers for the quantification of human movement

Dr Leah Bent is one of few researchers in Canada who is trained in the technique of microneurography. Microneurography is a technique used to record signals from neurons by inserting microelectrodes directly into peripheral nerves, allowing us to collect high-quality data on in-vivo human subjects. Her state-of-the-art laboratory facility includes:

- electrically shielded room to ensure the highest quality nerve recordings (noise reduction)
- CED data acquisition hardware, data acquisition software (Spike and Signal)
- two ISO 80 amplifiers for afferent/efferent recordings
- Bortec 8 Channel EMG analysis system
- Grass S88X nerve and muscle stimulator
- PCs for data collection/analysis



Figure 2: Neurophysiology Lab

The research infrastructure at the University of Guelph has provided me unique research opportunities which I have translated into high quality randomized controlled trials (RCT) published in leading peer-reviewed neuroscience and rehabilitation journals including Clinical Rehabilitation, Pain (International Pain Society), Journal of Pain (American Pain Society, in press) and Journal of Rehabilitation Medicine (accepted for publication). The future value and credibility of chiropractic in the eyes of the medical community and other stakeholders rests upon our ability to maintain high standards of research by continuing to publish high quality RCTs in leading international journals. In the absence of a significant chiropractic research infrastructure, it is imperative that chiropractic continue to seek out and invest in existing modern, state of the art research facilities where we can continue to produce internationally recognized research.

ACADEMIC ACTIVITIES

Within my first year as CCRF Chair and Assistant Professor, I have actively integrated into the academic and research culture of the university through the following:

TEACHING

- I have been assigned to teach a 4 year undergraduate course entitled "Health and Injury Biomechanics". I redesigned the course and taught it for the first time during the Winter 2009 semester and continue to teach it during the Winter semester.
- I took on my first Masters student, commencing in the Fall of 2009
- I act as research advisor to 6 undergraduate research students



RESEARCH COLLABORATION

I have fostered significant interdisciplinary research collaborations with leading institutions and prominent researchers including:

- Dr John Bush, PhD at MIT (Boston, MA)
- Dr Jim Dickey, PhD (University of Western Ontario)
- Drs Leah Bent, PhD and John Zettel, PhD (University of Guelph)
- Dr John Triano, DC PhD (CMCC, McMaster University)
- Dr Howard Vernon, DC PhD (CMCC)
- Dr Kelly Ainsworth, DC, MD and Dr Srinivasan Harish, MD (Radiology, McMaster University)
- Dr Catherine Alderdice, MD (Rheumatologist, Guelph, ON).

Interdisciplinary research such as this fosters positive interdisciplinary cooperation, increases the research scope and profile of chiropractic science and serves to enhance the value and credibility of chiropractors as experts in musculoskeletal health.

As listed, I have established a significant research collaboration with the internationally recognized physicist, Dr John Bush¹. Dr Bush is a full professor in the Department of Applied Mathematics at the Massachusetts Institute of Technology (MIT) in Boston, MA. MIT is a world renowned research and academic institution which was ranked 1st internationally in the fields of Technology and Natural Sciences by the 2009 Times Higher Education-QS World University Rankings. In October 2008, I was invited to speak at MIT's Department of Mathematics on the topic of pain and therapeutic applications in pain management. Since then, Dr Bush and I have agreed to collaborate on investigating the mechanisms of pain transmission and how therapeutic interventions, such as SMT, may modulate this on a biophysical level. Dr Bush's work is internationally acclaimed and his research has been featured on the cover of the journal "Nature" twice. This collaboration will greatly increase the potential for high profile chiropractic research by providing immediate access to the research expertise and infrastructure at one of the world's top research and academic institutions.

FUNDING/GRANTS

I have secured a prestigious research grant as a Principal Investigator from the Canadian Arthritis Network (CAN), Network of Centres of Excellence (Government of Canada) in the amount of \$48,100 to investigate the mechanisms of pain in osteoarthritis.

I am currently the only chiropractic researcher (DC, PhD) holding the distinction of "Canadian Arthritis Network Investigator". This honour, which is given to approximately 150 of Canada's leading researchers in arthritis, includes internationally-renowned scientists and specialists from a variety of disciplines (genetics, rheumatology, biomechanics, neuroscience, biochemistry). This acknowledgement of our expertise enhances the profile of chiropractic research and promotes cooperative interdisciplinary collaboration.

¹ <http://math.mit.edu/~bush/><14>49<http://math.mit.edu/~bush/><15>



CHIROPRACTIC EXPOSURE WITHIN THE UNIVERSITY SETTING

In my capacity as CCRF Chair at the University of Guelph, I have enhanced chiropractic exposure within the university setting through the following:

- In the March 25, 2009 edition of "*at Guelph*", the University of Guelph's school newspaper, I was featured in an article that reported on the recently established Guelph CCRF Chair position and the advancement of chiropractic science.
- I was one of several faculty members in the University of Guelph invited to speak at the 2009 "*Make Your Mark in Research*" lecture series during Orientation Week. The purpose of this lecture series was to target a cross-section of Guelph faculty members to speak to first year students about career opportunities and research. I spoke about my career as a chiropractor and how this experience led me into research.
- My clinical experience as a chiropractor and related research interests has attracted great attention from students within the Human Kinetics program at U Guelph. Several students I taught during the Winter 2009 have since pursued chiropractic as a career and I currently supervise no less than 6 undergraduate students in research projects related to my work.
- I have conducted two invited presentations within the U of Guelph Department of Human Health and Nutritional Science Lecture Series discussing my research goals and initiatives as a chiropractic clinician/researcher.

CURRENT RESEARCH IN PROGRESS:

I am actively cultivating an expanding research program which includes the following studies currently in progress:

- *investigation of the mechanisms of pain in osteoarthritis (funded by: Canadian Arthritis Network) [In collaboration with Dr Leah Bent (University of Guelph)].
- *Investigation of the mechanical properties of the neuron and pain transmission. [In collaboration with Dr John Bush (Massachusetts Institute of Technology, Boston, MA)].
- *investigation of the antinociceptive mechanisms of SMT. [In collaboration with Dr Howard Vernon, CMCC].
- *diagnostic ultrasound imaging of the myofascial trigger point. [In collaboration with Dr John Triano, CMCC/McMaster]
- *investigation of the effects of central sensitization on skin temperature (visceral response). [In collaboration with Dr Jim Dickey, University of Western Ontario].
- *investigation of the effects of therapeutic ultrasound on skin temperature (visceral response).
- *Investigation of the effects of central sensitization on balance. [In collaboration with Dr. John Zettel, University of Guelph].

*denotes RCT



PUBLICATIONS:

PUBLISHED IN PEER REVIEWED JOURNALS:

- *Srbely JZ, Dickey JP, Lowerison M, Edwards MA, Nolet PS, Wong LL. Stimulation of Myofascial Trigger Points with Ultrasound Induces Segmental Antinociceptive Effects: A Randomized Controlled Study. (Pain. 2008 Oct 15;139(2):260-6.)
- Srbely JZ. Ultrasound in the management of osteoarthritis: Part 1 - A Review of the Current Literature. JCCA J Can Chiropr Assoc. 2008 Mar ;52 (1):30-7
- *Srbely JZ, Dickey JP. Randomized controlled study of the antinociceptive effect of ultrasound on trigger point sensitivity: novel applications in myofascial therapy? Clin Rehabil. 2007 May;21(5):411-7.
- *Srbely J, Dickey JP. Stimulation of Myofascial Trigger Points Causes Systematic Physiologic Effects. JCCA J Can Chiropr Assoc. 2005 Jun;49(2):75.

ACCEPTED FOR PUBLICATION

- *Srbely JZ, Dickey JP, Bent LR, Lee D. Capsaicin Induced Central Sensitization Evokes Segmental Changes in Trigger Point Sensitivity In Humans. (Accepted, J Pain)
- *Srbely JZ, Dickey JP, Lee D, Lowerison M. Dry Needle Stimulation of Myofascial Trigger Points Evokes Segmental Antinociceptive Effects: A Double-Blind Randomized Controlled Study (Accepted, J Rehabil Med)

INVITED REVIEW

- Current Pain and Headache Reports (Vol. 14, Issue 5), Due April 5, 2010, "New Insights into the Treatment of Myofascial Pain."

*denotes RCT

BENEFITS OF THE CCRF CHAIR IN SPINE MECHANICS AND NEUROPHYSIOLOGY

The investment in the CCRF Chair at the University of Guelph provides many immediate, short term and long term returns to chiropractic research and to the profession by offering:

- immediate access to over \$1 million in state-of-the-art research infrastructure in biomechanics and neurophysiology at the University of Guelph. This provides chiropractic researchers an optimal environment to produce and publish high impact research which will strengthen the evidence basis of chiropractic.
- increased opportunity for chiropractic researchers to foster interdisciplinary research collaborations. These collaborations increase the scope and breadth of chiropractic research and provide access to a greater expertise and research infrastructure. These relationships bring significant credibility and value to the profession by elevating our research to the standards of elite institutions of higher learning.



- exposure of chiropractic to the daily university setting/culture. This exposure provides a forum for open dialogue between chiropractic and the scientific community facilitating better communication, enhanced interdisciplinary relationship-building opportunities and ultimately improved interprofessional cooperation.
- chiropractors the opportunity to teach in higher learning institutions. This contributes significant value to the profession by validating the expertise of chiropractic physicians in mainstream science.
- increased access for chiropractic researchers to seek out alternate/additional funding sources to support their research. As an example, I translated the OCA/CCRF \$60,000 investment in the first year into a substantial \$48,100 operating grant from the Canadian Arthritis Network to further support my research initiatives.
- opportunities for chiropractic researchers to collaborate and increase the exposure/credibility of chiropractic research on a national/international forum . For example, as a Canadian Arthritis Network investigator, I recently attended the Annual Conference in Vancouver where I exposed our profession through interaction with the other Network Investigators and leaders in arthritis research.

FUTURE RESEARCH GOALS AND OBJECTIVES:

- Continue to investigate the neurophysiologic mechanisms and role of central sensitization in the clinical expression of pain and pathology. These neural mechanisms form the physiologic basis for the rationale justifying the effects of therapeutic modalities in pain management. I will continue to facilitate this research through multi-site (MIT, Guelph, U Western Ontario, McMaster, CMCC) interdisciplinary research.
- Investigate the physiologic impact of therapeutic interventions (such as SMT) on *central sensitization*.
 - *This is an important topic of research that will form a major pillar in the scientific storyline of chiropractic. Modulating the mechanisms of central sensitization has immense implications in both pain management as well as health promotion.*
 - I will continue to focus on RCT study designs to capture high quality data on a cellular and/or electrophysiologic level, using highly specialized recording techniques such as microneurography found in the neurophysiology lab at the University of Guelph.
- Strive to increase the research presence of chiropractic in biomechanics and neurophysiology by continuing to develop intra, inter and transdisciplinary research collaborations. This is a significantly underserved area of research in our profession, yet research in these disciplines is a priority to the long term credibility and acceptance of chiropractic into mainstream healthcare.
- Develop an experimental technique/protocol to quantify central sensitization which will provide researchers and clinicians better tools to assess/monitor pain and treatment outcomes both in the lab and the clinic.



SUMMARY

The Task Force on Chiropractic Research in Canada concluded that researchers will play a “vital role towards the acceptance of chiropractic” (Grier et al., 1996). Indeed, before being universally accepted as an integral part of mainstream healthcare, chiropractic science must first be embraced by mainstream science. This will be realized only through consistent publication of high quality research in high profile journals. To justify increased public utilization of chiropractic and access to government funding, chiropractors will have to validate the chiropractic effect using the language of basic science.

Chiropractic researchers must also be visible and active within institutions of higher learning. This leads to increased opportunities for positive interprofessional relations and enhances the credibility of chiropractic by validating the knowledge and expertise of chiropractors.

The CCRF Research Chair in Spine Mechanics and Neurophysiology at the University of Guelph has facilitated these objectives by:

- Providing immediate access to \$1 million in state-of-the-art research infrastructure (biomechanics, neurophysiology) to facilitate the ongoing creation of cutting-edge chiropractic research, especially RCTs, which aim to validate the physiologic mechanisms of chiropractic SMT.
- Promoting interdisciplinary, multi-site research collaborations which facilitate research excellence and develop positive interdisciplinary relationships/interprofessional cooperation.
- Increasing the potential for research affiliations with world-renowned researchers at internationally-recognized academic institutions (eg. Dr John Bush, Massachusetts Institute of Technology, MIT) which significantly add to the visibility and credibility of chiropractic. These collaborations enhance the potential for chiropractic researchers to produce high quality research published in high impact journals.
- Providing increased access for funding opportunities to further support chiropractic research and demonstrate the high standard of chiropractic research to funding agencies.
- Exposing chiropractic to the daily university setting, promoting open communication and interdisciplinary/interprofessional cooperation.
- Providing an avenue to train future chiropractic researchers in biomechanics and neurophysiology, to sustain the long-term viability of chiropractic research in these important and foundational disciplines.

These objectives aim to cultivate an evidence-based chiropractic paradigm which will significantly enhance the value of chiropractic services to government, insurance, patients and other stakeholders and facilitate universal acceptance/integration of chiropractic services into mainstream healthcare.



CONCLUDING REMARKS

I have just completed my first year as CCRF Chair in Spine Mechanics and Neurophysiology. As a practicing chiropractor and chiropractic researcher, I have been warmly received and accepted by my colleagues within the Department of Human Health and Nutritional Science. There is an open attitude towards complementary health professions and a positive view on chiropractic research, in particular. The University of Guelph offers an ideal setting for chiropractic to advance its research agenda by providing a cooperative and nurturing research environment. I have had a very positive experience in my first year as CCRF Chair and wish to thank the OCA, CCRF and University of Guelph for their ongoing and generous support of this initiative.