

2009

Annual Report



Roger Jackson Centre for Health and Wellness Research

Roger Jackson Centre
for Health and Wellness Research



UNIVERSITY OF
CALGARY
KINESIOLOGY



Sport Medicine Centre



Human Performance Laboratory

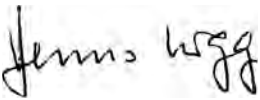
Canada is still excited about the success of the Vancouver 2010 Olympic Winter Games, and the spirit in the aftermath of this big event is a spirit that we have tried to embrace for a long time in the Roger Jackson Centre for Health and Wellness Research. Success comes with an investment in people, careful planning, and focused execution, and this approach has worked for our winter Olympic athletes and has worked for us in the past.

We are proud that more than 20 of the Olympic medalists are present or former students of the University of Calgary. We are also proud to have had the chance to make a small contribution to the Olympic effort by caring for the well-being of many of our athletes through the expert work of physicians and rehabilitation specialists in our Sport Medicine Centre, and through the scientific testing and evaluation of athletes, their clothing and equipment through members of the Human Performance Laboratory. It has been fun!

The federal government just announced continuing financial support for our athletes through the "Own the Podium" initiative. Similarly, we are committed to investing in the education of young scientists. In 2009, we were successful in securing a \$1.65 million training program (CREATE) through the Natural Sciences and Engineering Research Council of Canada which will provide scholarships for approximately 12 undergraduate and 12 post-graduate trainees per year, for the next five years. Combined with our AHFMR Team Grant on Osteoarthritis, which provides further scholarships for students, we are in a unique and enviable position as we enter this new decade.

As always, our dreams could not have been realized without the generous support of our friends and colleagues, and the Faculty of Kinesiology as well as the University of Calgary. Our heartfelt thanks go to all of you who believe in dreams and believe in our ability to make those dreams come true.

Calgary, Spring 2010



Benno M. Nigg
Co-Director



Walter Herzog
Co-Director



Cy Frank
Co-Director



Highlights

- Honour Dale Butterwick – Winner of the Students' Union Teaching Award for the Faculty of Kinesiology.
- Honour Walter Herzog – Winner of the Faculty of Kinesiology Excellence in Teaching and Research Award.
- Honour Janet Ronsky – Fellow, The Canadian Academy of Engineering.
- Honour Preston Wiley – Elected President of the Canadian Academy of Sport Medicine.
- Appointed Janet Ronsky – Director, Biovantage – Alberta Ingenuity Centre.
- Appointed Janet Ronsky – Director, BOSE Biomaterials & Tissue Engineering Technology Development Centre.
- Appointed Benno Nigg – Board of Management of Alberta Economic Development Authority (AEDA).
- Award P. Tish K. Doyle-Baker – RJC Faculty Award.
- Award Carolyn Emery – Professorship in Paediatric Rehabilitation (2009-2014).
- Award Carolyn Emery – Alberta Heritage Foundation for Medical Research Population Health, Investigator Award (2009 - 2012 salary support).
- Award Jared Fletcher – First Place, PhD Presentation, Exercise Physiologists of Western Canada, Winnipeg, Manitoba.
- Award Sang Kuy Han – Finalist for the NDI New Investigator Award of the North American Congress on Biomechanics (PhD).
- Award Walter Herzog – Killam Fellowship – Canada Council for the Arts (2009-2011).
- Award Caeley Lorincz – Finalist, Young Investigator Award, International Society of Biomechanics, Capetown, South Africa.
- Award Caeley Lorincz – Markin Graduate Scholar Award. University of Calgary.
- Award Sarah Manske – Research Achievement Award, Natural Sciences and Engineering Research Council of Canada.
- Award Jared Fletcher – RJC Student Award.
- Award Nick Mohtadi – Canadian Orthopaedic Association, Top Poster Award. The Development and Reliability of a Quality of Life Hip Outcome Measure for Young Active Patients. Canadian Orthopaedic Association. Whistler, BC.
- Award Tannin Schmidt – Network Scholar Award, Canadian Arthritis Network.
- Award Andrzej Stano – RJC Staff Award.



Highlights

- Award Lindsey Westover – 3rd Place, M.Sc. Best Paper Competition, ASME Summer Bioengineering Conference, Lake Tahoe, California.
- Ph.D. Andrew Betik – Supervisor: Dr. Doug Syme, Thesis: Efficacy of exercise in ameliorating the age-related reduction in mitochondrial oxidative capacity.
- Ph.D. Julia Devonish – Supervisor: Dr. Nicole Culos-Reed, Thesis: Physical Activity for Lung Cancer Survivors.
- Ph.D. Grant Goulet – Supervisor: Dr. Ron Zernicke, Thesis: Validation and application of iterative coupling to poroelastic problems in bone fluid flow.
- Ph.D. Sangkuy Han – Supervisor: Dr. Walter Herzog, Thesis: In Situ Chondrocyte Mechanics and Numerical Modeling.
- Ph.D. Blayne Hettinga – Supervisor: Dr. Darren Stefanyshyn, Thesis: Development of a forward simulation model of the speed skating push off for the optimization of subject specific klapskate design.
- Ph.D. Caeley Lorincz – Supervisor: Dr. Ron Zernicke, Co-Supervisor: Dr. Raylene Reimer, Thesis: Functional adaptation of bone: interactive effects of diet and mechanical loading environment.
- Ph.D. Alannah Maurer – Supervisor: Dr. Raylene Reimer, Thesis: Effects of early dietary programming on nutrient-gene interactions related to glucose and lipid metabolism.
- Ph.d. Mohammed Reza Sadeghian Shahi – Supervisor: Dr. Brian MacIntosh, Thesis: Skeletal muscle fatigue and endurance time with breathing heliox in healthy humans.
- M.Sc. Hashel Al Tunaiji – Supervisor: Dr. Preston Wiley, Thesis: The Resting Foot Angle: A Comparative Study Using Various Standardized Measurement Methods.
- M.Sc. Melissa Decloe – Supervisor: Dr. Carolyn Emery, Supervisory Committee: Dr. Winne Meeuwisse, Thesis: Risk factors for injury in female youth ice hockey.
- M.Sc. Kelly Dinsmore – Supervisor: Dr. Brian MacIntosh, Thesis: The evaluation of workload, heat stress and electrolyte carbohydrate beverage consumption in an occupational environment.
- M.Sc. Michelle Fry – Supervisor: Dr. P. Tish K. Doyle-Baker, Thesis: The physical and psychosocial health profile of transit employees by occupational category in Calgary Alberta.
- M.Sc. Gavin Hamilton – Supervisor: Dr. Winne Meeuwisse, Supervisory Committee: Dr. Carolyn Emery, Thesis: An Analysis of Injury Definitions and Risk of Subsequent Injury in Cirque du Soleil Performers.



Highlights

- M.Sc. Brandon Hisey – Supervisor: Dr. Walter Herzog, Thesis: New Observations on Residual Force Enhancement in Cat Soleus.
- M.Sc. Breda Hsiao Fon Lau – Supervisor: Dr. Dale Butterwick, Thesis: The development and implementation of a healthcare access and patient satisfaction questionnaire (HAPSQ) for measuring wait times, satisfaction, and costs with acute knee injury care in Alberta.
- M.Sc. Konstantin Mazursky – Supervisor: Dr. Brian MacIntosh, Thesis: Skeletal muscle alterations in young and mature rats after injection of monocrotaline.
- M.Sc. Kristie More (nee Pletsch) – Supervisor: Dr. Preston Wiley, Thesis: Predicting Patient Outcome of Non-Operative Treatment for a Chronic Rotator Cuff Tear.
- M.Sc. Ion Robu – Supervisor: Dr. Janet Ronsky, Thesis: In vivo investigation of patellofemoral joint characteristics under loading.
- M.Sc. Cindy Samaan – Supervisor: Dr. Janet Ronsky, Thesis: Biomechanical Assessment following Gender-Specific Female Total Knee Replacement.
- M.Sc. Jennifer Schack – Supervisor: Dr. Nicole Culos-Reed, Thesis: Exploring Physical Activity Levels, Preferences and Barriers in Southern Alberta Aboriginal Cancer Populations.
- M.Sc. Jane Stewart – Supervisor: Dr. P. Tish K. Doyle-Baker, Thesis: Understanding the Lived Experiences of Physically Active Women with Knee Osteoarthritis.
- M.Sc. Steven Thannhauser – Supervisor: Dr. Janet Ronsky, Thesis: Biomechanical Assessment of CAD/CAM and Hand-Cast Prostheses for Transtibial Amputees.
- M.Sc. Elias Tomaras – Supervisor: Dr. Brian MacIntosh, Thesis: Warm-up: Fatigue and performance enhancement.
- M.Sc. Constance Tweedie – Supervisor: Dr. Russ Hepple, Thesis: Impact of selecting for high voluntary activity on muscle mitochondrial function.
- M.Sc. Kim Wagner Jones – Supervisor: Dr. Raylene Reimer, Thesis: The impact of high milk product intake during weight loss on markers of insulin resistance.
- M.Kin. Mike Patton – Supervisor: Dr. David Smith, Project: Validation of a Phase-less Model of Oxygen Uptake Kinetics.
- M.Kin. Matthew Price – Supervisor: Dr. David Smith, Project: Monitoring elite athletes over a season.
- MBT Gigi Ho – Supervisor: Dr. Raylene Reimer, Thesis: Biomedical Technologies.



General comments

Biomechanics

**BENNO M. NIGG, PETER FEDEROLF
& LISA STIRLING**

Impact forces and soft tissue vibrations are still a major research topic for our group. The proposed concept of impact forces, soft tissue vibrations and muscle tuning has now found acceptance in the international scientific community. Our specific research concentrated on three questions: (i) what are the biological effects of vibrations, (ii) what are the effects of changes in amplitude and frequency of vibrations on force production and (iii) how can we affect vibrations of soft tissue compartments (e.g. with apparel).

Furthermore, our group made progress in developing a multi-factorial fatigue index that can be used to quantify fatigue during physical activity. The correct identification of fatigued individuals during running was, in some cases, higher than 85%.

A third group of projects concentrate around the question of why shoe and orthotic interventions typically do not change the movement and the alignment of the skeleton. We concentrated on finding the variables that do react to shoe/orthotic interventions to understand the mechanisms controlling these changes.

A fourth group of projects concentrated on the effects of stability and instability in shoe construction. Effects on cognitive and physical performance, as well as injury prevention, are studied.

WALTER HERZOG

This past year we have continued research in the areas of (i) mechanisms of muscle contraction, (ii) cartilage mechanobiology and osteoarthritis, and (iii) biomechanics of spinal manipulation. Regarding area (i), we have performed experimental work demonstrating that force regulation in skeletal muscles does not exclusively occur through cross-bridge based actin-myosin interactions, as has been tacitly assumed to date. Rather, it appears that there is substantial force regulation when actin-myosin based cross-bridge interactions are eliminated, and this force regulation appears to depend strongly on the presence of titin and calcium activation. We showed that force regulation occurs in the IG-domain of titin through calcium binding and that the unfolding force of the Ig domains is increased in the presence of calcium. However, this mechanism can only account for a small percentage of the "titin" based force regulation observed in isolated myofibrils. Therefore, we speculate that a great amount of force regulation in titin occurs through titin binding to actin when an active muscle is stretched.

Regarding area (ii), we have refined our approach of measuring the mechanics and biological response of articular cartilage cells (chondrocytes) in the intact, in vivo mouse knee loaded through muscular contraction. Also, we systematically quantified the pressure distributions in the patellofemoral, and lateral and medial tibiofemoral joints of the rabbit knee throughout the range of motion, for



dynamic and static loading of the joint through muscular forces.

Finally, in area (iii), we have continued to systematically quantify the strains in the vertebral artery during spinal manipulation of the neck and have verified for the first time that stresses and strains during manipulation treatments in the C1-C6 region of the neck are substantially smaller than during passive range of motion testing. These measurements further support the notion that spinal manipulation treatment cannot cause a stretch induced stroke in the vertebral artery as has been suggested by some health professionals.

STEVEN BOYD

BONE IMAGING LABORATORY

Our research group focuses on the use of micro-computed tomography (micro-CT) for the study of bone disease and joint injury. The work in the Bone Imaging Laboratory involves clinical measurements of 3D bone architecture in patients. We are studying patients receiving experimental treatments for osteoporosis, and developing a baseline database of bone

quality in a population based study. In addition to our clinical work in the RJC, we also are doing pre-clinical research at our facilities in the Heritage Medical Research Centre where we have in vivo micro-CT equipment for studying bone quality in models of osteoporosis. The pre-clinical work in the hospital and the clinical work in the RJC allows for so-called bench-to-bedside application of our research findings.

The lab consists of seven full-time graduate students all registered in the graduate program of the Schulich School of Engineering or Faculty of Kinesiology, a Research Assistant, a Technician, three postdoctoral fellows and several undergraduate students coming from Calgary, other schools in Canada, and international schools (Switzerland and France). We have active current collaborations with the Faculty of Medicine, Alberta Childrens' Hospital, Faculty of Kinesiology and the Schulich School of Engineering at the University of Calgary, in addition to collaborations with faculty in other universities in Canada and abroad (e.g., Switzerland).

ANDREA CLARK

Osteoarthritis is a debilitating disease resulting in joint stiffness, swelling and pain. Three million (1 in 10) Canadians suffer from osteoarthritis but there is no treatment to stop or reverse the progression of joint degeneration. Osteoarthritis is characterized by the breakdown of articular cartilage. Cartilage cells (chondrocytes) are sensitive to their cartilage matrix environment and can rapidly respond to changes therein.



Micro-computed tomography scan of a human hand.



General comments

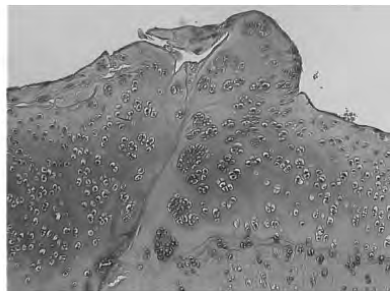
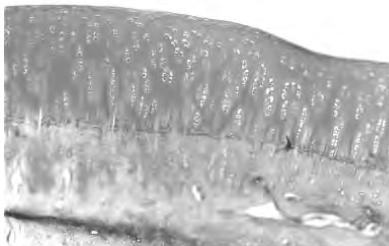
The focus of our research is to identify and characterize specific signal transduction mechanisms through which chondrocytes respond to mechanical and chemical changes in the cartilage with a biological response. These investigations will be carried out using innovative real-time confocal microscopy techniques and genetically engineered mice. Real-time in situ confocal microscopy enables elegant studies of simultaneous mechanical loading and biological responses of cartilage tissue and cells to be conducted. In addition to live cell imaging, genetically engineered mice will be utilized so that the role of very specific cartilage/chondrocyte molecules can be elucidated. In addition to improving our understanding of articular cartilage function and health, these data will provide a first step in evaluating potential targets for pharmaceutical intervention to treat osteoarthritis. This year we have developed new techniques to image the cilia of live chondrocytes maintained in their native cartilage environment on murine femoral condyles. Our data suggest that chondrocytes located in cartilage surfaces that are more loaded (both in magnitude

and duration) within the knee have a higher incidence of cilia, and those cilia are longer in length, compared to unloaded areas.

GERALD COLE

Research and development activities over the past year became highly focused on preparing the Canadian Alpine Ski Team (CAST) for competition at the 2010 Olympic Games in Vancouver.

The STEALTH GPS device that was developed with the Position, Location And Navigation (PLAN) Group of the Schulich School of Engineering is being used by CAST in three areas: (i) in training for determining skier line selection in speed events, (ii) in training for optimizing technique in giant slalom, and (iii) as an efficient timing and speed measurement device with the ski testing program. Key attributes of STEALTH are its size (weighing in at 0.5kg making it comfortable and safe for the ski racers to wear at high speed) and its positional accuracy (capable of tracking a skier's position to plus/minus 5 cm while sampling at 20 Hz). The primary factor influencing the reliability of the system in alpine terrain, is inconsistent GPS



Histological slices of normal (left) and osteoarthritic (right) cartilage.





Testing the dynamics and kinematics of downhill skiing (a project in collaboration with Dr. Erich Müller's group, Salzburg, Austria).

satellite availability. To address this issue, the R&D team this year added measurements from the GLONASS satellite constellation to the GPS measurements with the end result of repeatably achieving the 5cm positional accuracy. Use of the STEALTH system was expanded this year to the Canadian snowboarding and freestyle teams.

Together with Dr. Stephen Norris, we continued our investigations into specific apparel designs with the goal of improving skiing performance. Concepts that were studied included compression and elastic storage and release of energy within the suit material. Difficulties were encountered in the development of a suitable protocol to test for improvements in strength and endurance under the isometric and eccentric muscle

contraction conditions common to alpine skiing. Results of this work are currently confidential, but should be published within the next year.

Reduction of ACL injuries continues to be an important issue to CAST, particularly given the rash of injuries experienced by the team leading up to the 2010 Olympic Games. The governing body of alpine skiing, FIS, has also identified injuries to be an important issue to the sport, and they convened a special meeting in 2009 with medical representatives from the different teams. Together with CAST medical staff, we implemented video analysis into their annual physical assessment of the skiers for the purpose of identifying skiers at risk to injury. This assessment will continue to be tracked and related to performance and injuries in the ski team. The FIS

meeting will be discussed within CAST following the 2010 Olympic Games, and it is expected that some research projects will come out of this for the Human Performance Lab and Sport Medicine Centre.

JANET RONSKY

Our research focuses on relations amongst joint structure, joint function and neuromotor control, specifically in the areas of knee joint injuries and cartilage degeneration, scoliosis, and joint prostheses. Recently, we have developed a novel loading device for non-invasive in-vivo MRI based characterization of the force-deformation characteristics of human cartilage. Preliminary results reveal the technique can detect increased deformation with static load intervals measured at 10 and 20min. The method can detect cartilage deformations of $\pm 0.24\text{mm}$, and has day-day repeatability of $\pm 1.3\%$. The technique is currently being extended to incorporate measures of cartilage content and structure in association with material properties.

We investigated anecdotal evidence for superior functional outcomes for Gender specific (GSF) total knee joint (TKA) prostheses relative to traditional designs in females. GSF patients ($n=9$) showed excellent symmetry between limbs, and no significantly increased loads on the contralateral limb. This important finding is contrary to typical results for traditional TKA patients. Although adaptations in the GSF group appeared to be minimal, they tended to result in increased ankle flexion moments to account for decreased knee moments.

The distribution of external flexion impulses on the operated limb of GSF patients did not differ from controls in the proportion contributed from each joint. On the contralateral limb, however, GSF patients adapted with a greater proportion of the external flexion impulses experienced at the ankle. Interestingly, in contrast to the traditional TKA devices where the compensations are typically experienced at the hip, these results suggest the GSF subjects utilize a more distal adaptation strategy.

TANNIN SCHMIDT

Our research involves mechanistic based, multidisciplinary study of articular cartilage lubrication with biomechanical-biotribological, biophysical, and biochemical methods. Relevant areas include the study of normal, injured, and diseased cartilage and synovial fluid, where composition and interactions of mechanically relevant biomolecules can be altered, as well as other tissues in the joint affected by injury and disease. Our current work involves examination and elucidation of the structure-function relationship governing the multiple biological properties of cartilage lubricating macromolecules present in synovial fluid and at the surface of cartilage that contribute to the overall maintenance and integrity of the knee. The composition and structure of these lubricating molecules can be altered after a traumatic knee injury, which is associated with an increased incidence of osteoarthritis. The desired outcome of our research is to develop new cell or tissue based treatments and/or therapeutics that



stop, slow, and/or reverse the progressive degeneration of articular cartilage after a sports injury that leads to the well-established high occurrence of osteoarthritis in knee joints.

DARREN STEFANYSHYN

The general research interests of our group focus on questions related to human locomotion, sport performance and sport injury biomechanics. Our research extends to functional sport equipment with a goal of tuning the properties of the equipment to specific athlete characteristics in order to maximize the athlete's performance and minimize the risk of injury.

Our performance research involves developing a basic understanding of the mechanics of human movement during various locomotor and athletic movements. The goal is to determine the mechanical factors dictating an athlete's performance and how performance can be improved by manipulating these particular factors. In 2009 we made great progress in our research on performance apparel for a variety of different sports. We also completed several equipment projects aimed directly at helping athletes at the 2010 Olympics and look forward to the implementation of our research findings in competition in Vancouver.

Our injury research involves identifying potential injury factors such as global loading characteristics associated with ankle and knee sport related injuries as well as developing an understanding of the role played by equipment. This past year we have

focused our attention on a wide range of footwear traction projects relating to various sports such as soccer, running, American football and basketball as well as general locomotion on slippery surfaces. We continue to work closely with several industrial partners on the development of appropriate footwear traction.

VINCENT VON TSCHARNER

Studies on the behavior of muscles during movements require an in depth analysis of the classification of EMG intensity patterns and EMG spectra. We investigated whether non linear classifiers were yielding much higher classification rates. Our results showed that the linear classifiers allowed us to detect which patterns were used by the classifier to discriminate between conditions. At this point in our research this information was as important as obtaining a better classification score. Understanding the reasons why the signals were classifiable was and is a major topic of our current research.

Gaining experience by using the wavelet analysis continued. The wavelet analysis resolves the spectrum of an EMG at each time point. The theory of wavelet analysis was expanded to include wavelet coherence and to measure phase shifts between signals. In our previous work we showed the decay of the average motor unit conduction velocity that occurred in the abductor pollicis brevis muscle with fatigue. This year we showed, using the wavelet coherence, that the motor unit conduction velocity depended on the frequency range that was used to compute the conduction velocity.



This confirmed the hypothesis that fast motor units contribute power at higher frequencies in the power spectra.

In another line of research, we pursued the knowledge that the intensity of wavelet transformed EMG signal forms an envelope around the EMG signal. The envelope pulsates with the rhythm of the beta waves of the brain's motor cortex. This opened a new field of research. It allows monitoring the central control of muscle activity. This rhythm changed its frequency in the abductor pollicis brevis muscle with fatigue.

Mind Sciences

S. NICOLE CULOS-REED

HEALTH & EXERCISE PSYCHOLOGY

Our research focuses on Physical Activity for Cancer Survivors and improving the quality of life of cancer patients and survivors. Part of this research has included the development of exercise programs and lectures which are also open to support persons. Upcoming work will include providing greater accessibility and options for physical activity programs to the cancer survivor population, to examine the feasibility of lifestyle interventions at various stages of the cancer continuum (diagnosis, treatment, post-treatment, survivorship, and palliation) and to collaborate with other cancer centers to better understand the role of physical activity for different cancer types. Our goal is not only to increase activity thereby improving the physical condition of cancer survivors, but also to improve

their emotional, and ultimately their overall, quality of life.

As an example, our research on yoga for cancer survivors has developed into a community program, offered at multiple locations within Calgary, as well as across Alberta and Canada. In addition, we have produced a "Yoga for Cancer Survivors" DVD that is distributed to cancer survivors through various resources, in order to encourage survivors to seek a better quality of life. The distribution of this DVD will reach much farther than our current program, offering the opportunity to study a much larger populace. The feedback we receive from these classes and DVD will be critical to our on-going research on the benefits of physical activity for cancer survivors.

JAMIE JOHNSTON

MOVEMENT NEUROPHYSIOLOGY LAB

My research program is comprised of two research streams that use different approaches to and objectives for understanding the neural control of the hand. For stream one, my research priorities are to (i) address fundamental issues in motor neuroscience (e.g., sensorimotor integration, coordination of multiple degrees of freedom, motor learning) using the hand as my research model and (ii) to develop and use sensitive multidimensional analytical techniques to a) provide quantifiable information about hand functional deficits to clinicians (e.g., in carpal tunnel syndrome, stroke), b) assess progress made after clinical interventions and during hand rehabilitation, and c) test the effectiveness of functional and therapeutic



electrical stimulation devices. The objective of research stream two is to provide insights into the design of the control systems of bio-inspired robotic and prosthetic hands by characterizing the neural mechanisms underlying coordinated digit actions of the physiological hand. This is accomplished by investigating (i) the use of muscle synergies as a means to coordinate multiple DOF, (ii) the role of sensorimotor integration in adapting hand muscle coordination patterns to the physical properties objects (e.g., weight, texture) during multi-digit object manipulation and (iii) the behavioral consequences of common (correlated) neural input to motor neuron pools of multiple muscles. To accomplish my objectives, my research group employs both established and novel experimental paradigms using sophisticated neurophysiological tools (e.g., intramuscular electromyography and electrical stimulation), as well as, computer models of muscle activity to address outstanding issues regarding the neural control of the physiological hand.

JOAN VICKERS

NEURO-MOTOR PSYCHOLOGY

My research group investigates the role of the gaze and visual attention in motor skill acquisition and performance. In the course of all actions, the brain is limited in how much information it can process and act upon at a time. Performers must constantly decide where to look, what to attend to and how to time fixated information with precisely controlled actions. Gaze can be directed to only

one area at a time and information central to success is selected from spatially complex environments under severe time constraints. A tight perception-action coupling is required between visual, cognitive and motor processes. Our main discovery is the quiet eye, which is the final fixation or tracking gaze before a final movement is performed. The quiet eye has been adopted by many sports and professions (e.g. police work) and is central to understanding how the human functions at a high level.

Nutrition, Metabolism & Genetics

RAYLENE REIMER

The human food supply has changed drastically over the past 50-75 years with an alarming increase in obesity following close behind. The objective of my research program is to identify effective nutritional strategies to prevent and/or treat obesity and type 2 diabetes. The projects we are currently working on to achieve this objective include:

Role of Early Diet in Programming Lifelong Obesity Risk: It is now clear that dietary influences exerted early in life have long-term consequences, many of which are pathological or lead to disease. The goal of this work is to undertake basic research on how dietary patterns during growth and development affect physiological responses related to lipid and glucose metabolism in later life and program risk for obesity and type 2 diabetes. This year we initiated a program to see if it is possible to reverse the



susceptibility to obesity once it has already been “programmed” during the first three weeks of life.

Role of Intestinal Adaptation in Obesity: Using both the genetically obese JCR:La-corpulent rat and diet-induced obese rat models we are examining the role of diets high in protein and fiber on intestinal adaptation, gut hormones involved in satiety, hepatic lipid synthesis and body weight regulation. Other novel nutrients we are examining include novel fiber and starch ingredients derived from pulses and calcium and specific proteins and bioactive ingredients found in dairy products which are linked to improved weight loss. We are specifically addressing the mechanisms by which these dietary components promote weight loss and regulate adiposity. Most recently we have translated the findings of our animal work into human clinical studies separately evaluating the effects of a prebiotic fiber supplement and high dairy product intake on weight loss.

The long-term goal of our work is to identify novel nutritional therapies to prevent and treat chronic disease.

Physiology / Biology

P. TISH K. DOYLE-BAKER

Our group’s focus is primary prevention of cardiovascular disease and obesity as it relates to the impact that energy expenditure and physical activity have on body composition (lean and fat mass), bone health (bone mineral density and content, vitamin D), cholesterol level, and inflammatory blood markers (interleukin-6, and

tumour necrosis factor -alpha) both clinically and from a public health perspective.

Obesity is known as a persistent health threat. Individuals who are overweight are at risk for developing many diseases and conditions, including cardiovascular disease (CVD) and diabetes (DM). The prevalence of obesity and these associated diseases, known as the metabolic syndrome, has reached epidemic proportions. Many of us are unlikely, however, to link obesity and inflammation with these diseases.

Exercise is known to lower blood pressure and decrease the overall risk for CVD and DM by lowering triglycerides, raising high density lipids, and decreasing low-density lipoprotein. Our goal is to add to the research studies that identify the anti-inflammatory effects of exercise and allude to the possibility of a dose response such that greater levels of fitness are associated with an anti-inflammatory profile than are lower degrees of physical fitness. As well, we focus on the anti-inflammatory effect of exercise and how these may be mediated by a reduction in adiposity. Understanding how obesity and inflammation create the “perfect metabolic storm” also leads us to the most prudent protection from it, i.e. exercise and diet.

This year we moved our research from the lab into the workplace and we are waiting to see the results of a 12 week educational intervention we designed called the Heart Smarts for Women Program. This one year study will assess cardiovascular knowledge



and awareness, bone health and Vitamin D intake, body composition, cholesterol, HbA1C, and Quality of Life change in working Calgarian women.

NEIL EVES

Exercise is recognized as a fundamental requirement in the prevention and treatment of a multitude of diseases and can lead to successful disease modification and health promotion. Physiological alterations due to inactivity and disease affect all systems within the body and can lead to rapid worsening of symptoms and deterioration in the ability to perform exercise. At present, there is only minimal understanding of the mechanisms associated with exercise intolerance and how exercise training can attenuate disease progression and improve prognosis (especially in respiratory disorders). The present focus of my research is to investigate the integrative physiological mechanisms responsible for reduced exercise capacity in disease and to design novel interventions that can be implemented to optimally enhance physiological adaptation. Current research projects are examining the contribution of altered inspiratory muscle mechanics on exertional dyspnea and the effects of heart-lung interaction in patients with respiratory disease. We also have a number of ongoing investigations looking at the inflammatory responses to exercise in patients with chronic obstructive lung disease to try and understand how exercise affects this important biological process. It is hoped that our research will provide a better

understanding of the physiological limitations imposed by disease and will help improve treatment for the growing number of individuals who have chronic respiratory conditions.

WAYNE GILES

Present research projects are directed toward understanding the electrophysiological mechanisms for pacemaker activity in the heart and for repolarization of the action potential in atrial and ventricular myocytes. In addition, electrophysiological properties of isolated chondrocytes are studied. This experimental work is complemented with development of mathematical models of the human ventricular action potential.

RUSSEL T. HEPPLE

Our major focus this year was on understanding the mechanisms by which long term caloric restriction (without malnutrition) slows the loss of muscle and preserves its contractile function with aging. To this end, we recently showed that although there is increased activation of the ubiquitin-proteasome pathway of protein degradation in aging muscles, the acceleration of age-related muscle atrophy between late middle age and senescence is greater than would be expected for the increased activation of this pathway. Furthermore, caloric restriction had very minor effects on this pathway, suggesting that optimal activation of the proteasome may be fundamental to the preservation of muscle function with aging. In addition to these studies, we are examining the apoptosis pathway in the context of age-related muscle atrophy and its



attenuation by caloric restriction, as well as determining the impact of selecting for high voluntary running activity on mitochondrial function and age-related muscle changes.

DUSTIN HITTEL

With the ongoing support of a donation from Encana to the REACH! campaign we have purchased a high-resolution respirometer and camera system for our fluorescence microscope. These instruments will allow us to analyze muscle mitochondrial function in vivo (in living tissue) and determine how this relates to the development of type 2 diabetes. This funding has also allowed us to recruit an excellent graduate student from the University of Ottawa (Ms. Neha Sarna). Neha recently shared her research findings as a podium presentation at the international Obesity Society conference in Washington DC. This presentation was very well received. Finally, funding from the REACH! Campaign and NSERC has helped us to publish a paper in the highly cited journal *Diabetes*. In this paper we used an innovative protein profiling technology to show (for the first time) that a protein called myostatin, is secreted from diabetic muscle into the bloodstream. We believe that myostatin contributes to the significant muscle-loss associated with diabetes. Over the next year we will be evaluating myostatin as new "biomarker" and potential therapeutic target for type 2 diabetes.

BRIAN MACINTOSH

The central theme of research in my laboratory is the study of force modulation in skeletal muscle. This includes the study of force-velocity and force-length relationships, and the interactions of these with and without prior activity. Prior activity can be an acute modifier, as in potentiation and fatigue, or a chronic modifier as in training and disuse atrophy. Skeletal muscle contractile responses (twitch and incompletely fused tetanic responses) are modified by regulatory light chain phosphorylation, and my research is concerned with understanding the role of this process in modifying the contractile response, and how certain conditions may modify the interaction of light chain phosphorylation and potentiation or fatigue. My research group has made several key observations recently. Recent work has demonstrated that it is inappropriate to subtract the passive force measured at the initial whole muscle length to estimate active force of contractions. This common approach results in an underestimation of active force at long lengths. Passive force is now known to change during contraction of a muscle that has substantial series elastic properties. Future work will consider the impact this revelation has on some fundamental properties of muscle. Current and recently completed projects address the questions: (i) How does aging, stroke or congestive heart failure alter the fundamental contractile properties: fatigue and potentiation? (ii) How does summation occur in incom-



pletely fused tetanic contractions, (iii) How does breathing a helium oxygen mixture enhance exercise performance when respiratory limitations are not expected? (iv) Can sequential bouts of exercise 24 hours apart be used to objectively identify chronic fatigue syndrome? and (v) What is the appropriate warm-up for performance of athletic events? My work uses a number of approaches to study the contractile properties of skeletal muscle, including in vitro single intact or skinned fibers and fiber bundles, in situ whole muscle and intact human subjects performing in vivo isolated muscle or muscle group contractions or performing whole body exercise.

JANE SHEARER

Worldwide, it is estimated that over 1 billion people are overweight and 300 million are obese. If current trends continue, 700 million adults will be obese by the year 2015 while one in three children will develop type 2 diabetes in their lifetime. As such, obesity represents the single most preventable factor leading to decreased individual health. The goal of the Shearer laboratory is to examine the interactions between nutrition, genes and the development of metabolic diseases including diabetes and cardiovascular disease.

Cardiovascular Disease Prevention and Management: Under normal conditions, 60–80% of energy required by the beating heart is derived from fat with the remaining supplied by glucose. Numerous pathological conditions, including diabetes, perturb this balance resulting in abnormal heart function and further pathological declines.

Projects in this area examine why this imbalance occurs and potential therapeutic strategies including stem cell therapy.

Metabolic Consequences and Markers of Obesity: There is increasing evidence that defective mitochondrial energetics and abnormal substrate metabolism are fundamental characteristics of the failing heart. This project examines how obesity alters both skeletal muscle and cardiac mitochondrial integrity & function. Specific markers of metabolic dysfunction in the blood and tissues are also being explored (metabolomics).

DAVID J. SMITH & STEPHEN NORRIS

The research interests of our group include the enhancement of athlete exercise tolerance through hyperoxia, hypoxia and vibration; adaptations of the cardiovascular and muscular systems to training interventions; changes in oxygen uptake kinetics; and monitoring techniques to assess readiness for competition or degree of fatigue resulting from training. A traditional approach to training endurance athletes has been the use of hypoxia which is a general reduction in oxygen delivery. Our approach to hypoxia training is to use both a natural altitude environment as well as normobaric hypoxic interventions via oxygen filtration. Our research is focused on the degree of competitive edge these modalities may give high performance athletes. In monitoring athletes we are building up a long-term database of the effects of different training interventions on heart rate variability. The use of vibration for improving the training



regimes of athletes is also part of our ongoing research. The potential training effects of vibration that may occur in the post-vibration period may lead to better warm-up protocols for athletes competing in sporting events that require high amounts of power output. In addition to our main focus of athlete performance, we are also continuing our studies on the effect of exercise for cancer survivors. Our interventions are examining the effect of different intensities and sequence of aerobic exercise for these survivors. Finally, our group continues to provide ongoing national leadership to athletes, coaches and sport organizations, in preparation for the upcoming Vancouver 2010 and London 2012 Olympic Games.

Sports Medicine Research

**WILLEM MEEUWISSE &
CAROLYN EMERY**

In 2009, the Sport Injury Prevention Research Centre has been recognized internationally as one of the four Centres of Excellence in Research in Injury Prevention in Sport by the International Olympic Committee (IOC). In addition, we have partnered with the University of Ballarat (one of the other IOC Centres of Excellence in Injury Prevention in Sport) through the University of Ballarat Strategic Funding Initiative as co-investigators in the "Injury Prevention and Safety Promotion (IPSP) Research Theme" a 3-year international collaborative research program.

This year, our group completed a 2-year National multicentre study of

injuries related to body checking in youth ice hockey. The question of safe introduction of body checking has been hotly debated with incomplete evidence of its impact. This study will be a definitive work involving collaborations with Edmonton, Montreal and Quebec. In addition, we have completed the first comprehensive prospective cohort study examining injury in female youth ice hockey. Our group is also engaged and has completed the analysis of data from the National Hockey League Concussion study, which has accumulated 7 years of prospective data in collaboration with the University of Pittsburgh.

In 2009, we have completed a pilot research program demonstrating the effectiveness of a combined neuromuscular injury prevention strategy and obesity prevention strategy in the reduction of sport injury and increasing healthy outcomes in junior high school students. This broad school-based injury prevention initiative has evolved from lessons learned in the sport-specific injury prevention programs we have developed and evaluated to date in youth basketball and soccer. Ongoing research also includes the development and evaluation of a youth sport injury prevention clinic to identify predictors of injury in youth sport. The long-term goal of this work is to maximize health and minimize the long-term impact of injury and joint osteoarthritis in the child and adolescent population.

Other ongoing research activities with our colleague Dr. Brent Hagel (Paediatrics, Faculty of Medicine) included the examination of human



General comments

risk factors in avalanche incident and examination of risk factors for injury in youth skiing and snowboarding.

This year, our group also had a substantial international impact through international keynote opportunities nationally and internationally. This was a testament to the success of our research accomplishments at the SIPRC, Faculty of Kinesiology.

PRESTON WILEY & VICTOR LUN

Our group continues to evaluate assessment and management of overuse and degenerative musculoskeletal injury. We have just completed projects evaluating treatment for plantar fasciitis as well as evaluating

different strength programs for knee osteoarthritis. As well we carry on projects that evaluate elite athlete health.

We have now developed a knee osteoarthritis clinic that integrates with collaborators in the Faculties of Medicine and Kinesiology. These projects are evaluating markers of osteoarthritis as well as changes in synovial fluid. We are evaluating the role of corticosteroid injection and strength exercises as a combined model of treatment for knee osteoarthritis.

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Imaging cartilage cells (chondrocytes) using confocal microscopy.

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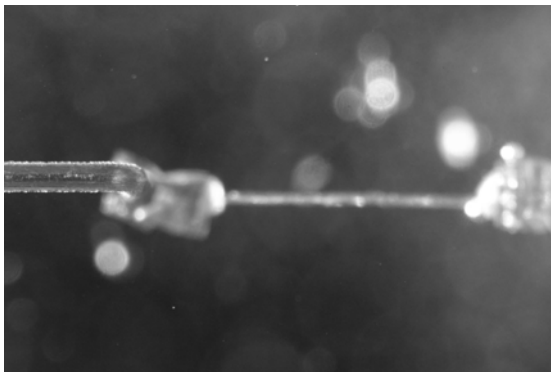
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Single frog fibre, about 2mm long, used for testing properties of skeletal muscle force production and mechanisms of contraction.



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Technical reports

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- Boyd, S. K., Szabo, E., (2009). The implication of microarchitecture changes resulting from strontium ranelate treatment on its effects on bone strength. In. Paris, France: Institut de Recherches Internationales Servier, p. 39.
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- Morrison, M., Cole, G.K., Lachapelle, G. and Ong, R., (2009). On the Edge: Elite Sensor Training. GPS World, October.
- Nigg, S., Baltich, J., Coza, A., Federolf, P. and Nigg, B. M., (2009). Soft Tissue Vibrations: A Literature Review. adidas a.i.t.
- Smith, D.J., (2009). Player Fitness Assessment – Calgary Flames Hockey Club.
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- Stefanyshyn, D. J. and Wannop, J. W., (2009). Basketball banking. Research and Development Report for adidas International.
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- Stirling, L., Friesenbichler, B., von Tscharnar, V. and Nigg, B. M. (2009). Indicators of fatigue during prolonged running: electromyographic results. adidas International.
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- Worobets, T. J., Graf, E. S., Smith, G., Stefanyshyn, D. J., (2009). Towards understanding how club characteristics influence driving distance. Research Report for TaylorMade adidas Golf.
- Worobets, J. T., Panizzolo, F., Hung, S., Smith, G. and Stefanyshyn, D. J., (2009). The influence of Gecko traction on dry and wet running performance. Research Report for adidas International.
- Worobets, J. T., Panizzolo, F., Smith, G. M. and Stefanyshyn, D. J., (2009). Influence of sprint shoe stiffness on sprint performance during the late acceleration phase. Research Report for adidas International.
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- Worobets, J. T., Wannop, J. W. and Stefanyshyn, D. J., (2009). Influence of powerweb stiffness on hip joint mechanics, energy storage and performance during sprinting and jumping. Research Report for adidas International.

Keynote lectures

- Boyd, S. K. Technical and safety considerations. First Canadian Bone Imaging Conference, Vancouver, Canada. December 4, 2009.
- Butterwick, D. Helmet and rodeo vest efficacy. Justin Sportsmedicine Annual Rodeo Medicine Conference: Evaluation and Management of the Injured Rodeo Athlete. Las Vegas, Nevada, December 7-8, 2009.
- Culos-Reed, N. Medical Affairs in Community Oncology (MACO), Telehealth Event – "Yoga Thrive", October 5, 2009.
- Culos-Reed, N. Building a Sustainable Community Program for Cancer Survivors. Women Work Wonders Event, October 7, 2009.
- Emery, C. A. Body checking in youth ice hockey. Canadian Academy of Sport Medicine, Vancouver, British Columbia, Canada, June 2009.
- Herzog, W. Force Enhancement and Mechanisms of Skeletal Muscle Contraction. Australia and New Zealand Society of Biomechanics, Southport, Australia, November 20-December 1, 2009.
- Herzog, W. Effects of Manipulation of the Spine. 2nd International Fascia Research Congress, Amsterdam, Netherlands, October 26-30, 2009.
- Herzog, W. Respect Thy Elders: or Lessons Learnt from the Literature. XXIIth International Society of Biomechanics, Cape Town, South Africa, July 2-11, 2009.
- Herzog, W. The Biomechanics of Movement Control. Progress in Motor Control, Marseille, France, July 23 – 25, 2009.
- Lun, V. Medicine and the Sliding Sports. Sport Medicine Conference in Preparation for 2010. Vancouver, British Columbia, Canada, June 3-7, 2009.
- Mohtadi, N. G. Clinical Trials. 15th Canadian Connective Tissue Conference, Calgary, Alberta, Canada, July 17-18, 2009.
- Mohtadi, N. G. Double Bundle ACL Reconstruction: The Learning Curve. 2009 Mini-Magellan Meeting. Osaka, Japan, April 7, 2009.
- Nigg, B. M. Barefoot Shoes – Energy Return & Future Shoe Development. 9TH IX Biennial Footwear Biomechanics Symposium, South Africa, July 10-12, 2009.



Keynote lectures

- Nigg, B. M. Impact forces, soft tissue vibrations and muscle tuning. MBT Symposium, Melbourne, Australia, March 2009.
- Nigg, B. M. Paradigm shifts in shoe design, the future of footwear. MBT Symposium, Sydney, Australia, March 2009.
- Nigg, B. M. Shoes, inserts and orthotics – aligning the skeleton. Biomechanics Symposium, Universidade Lusófona, Lisbon, Portugal, May 2009.
- Smith, D. J. Altitude/Hypoxic Training: The Canadian Model. United States Olympic Committee, International Altitude Training Conference, Colorado Springs, Colorado, USA, October 2009.
- Smith, D. J. Physiological Monitoring of Athletes. Canadian Academy of Sports Medicine Annual Conference. Vancouver, British Columbia, Canada, June 2009.
- Stefanyshyn, D. J. Walking Biomechanics and Walking Shoes. Busan International Footwear & Leather Show, Busan, Korea, November 2009.
- Vickers, J. N. and Lewinski, B. Police Officer's Gaze Behaviours And Shooting Performance During A Live Force On Force Encounter. 4th International Conference on Space and Cognition: Spatial Cognition and Action. Rome, Italy, September 14-18, 2009.
- Zernicke, R. Play at your own risk: Sport and the injury epidemic. NCAA Scholarly Colloquium, Washington, DC, USA, January 2009.
- Zernicke, R. Bone health: Diet, exercise, and injury mechanisms. International Symposium on Sport Injury Prevention, Oslo Sports Trauma Research Center, Oslo, Norway, May 2009.
- Zernicke, R. Role of Bone in Osteoarthritis. The Canadian Arthritis Society, National Research Knowledge Translation Lecture Series, Internet webinar coordinated through Toronto, Ontario, Canada, July 2009.
- Zernicke, R. Optimizing Bone Health — Diet & Physical Activity. Canadian Institutes for Health Research/Institute for Musculoskeletal Health and Arthritis, Bone Health Consensus Conference. Toronto, Ontario, Canada, November 2009.
- Zernicke, R. Can Sports Medicine Methods Reduce the Risk of Workplace Musculoskeletal Disorders? Symposium on Ergonomic Interventions and Research: Preventing Musculoskeletal Disorders. San Francisco, California, USA, December 2009.



Contributions

EDITORIAL AND REVIEW BOARDS

Members of the RJC have served on the following editorial boards and review committees:

Acta Physiologica
Advances in Tribology
American Journal of Respiratory and Critical Care Medicine
American Journal of Physiology
American Journal of Preventive Medicine
American Journal of Sport Medicine
American Journals of Physiology Regulatory, Integrative and Comparative Physiology
Applied Physiology, Nutrition and Metabolism
Brazilian Journal of Biomechanics
British Sports Medicine Journal
Canadian Journal of Applied Physiology
Canadian Journal of Physiology and Pharmacology
Canadian Journal of Public Health
Canadian Medical Association Journal
Circulation Research
Clinical Journal of Sport Medicine
Clinical Medicine and Research
Encyclopedia Reference of Neuroscience
Ergonomics
European Journal of Applied Physiology
European Journal of Sport Sciences
European Respiratory Journal
Exercise and Sports Science Reviews
Experimental Brain Research
Experimental Gerontology
Experimental Physiology
Family Health Magazine
Footwear Science
Human Movement Science
IEEE Transactions in Neural Systems and Rehabilitation Engineering
Injury Prevention
International Journal of Coaching
International Journal of Sport Medicine
International Journal of Sport Psychology
Israel Science Foundation
Journal of Adolescent Health
Journal of Applied Physiology
Journal of Behavioural Medicine
Journal of Biomechanics



Contributions

Journal of the Canadian Diabetes Association
Journal of Chronic Obstructive Pulmonary Disease
Journal of Clinical Nutrition
Journal of Electromyography and Kinesiology
Journal of Exercise and Sports Psychology
Journal of Experimental Psychology
Journal of Neurophysiology
Journal of Manipulative and Physiological Therapeutics
Journal of Motor Behavior
Journal of Nutrition
Journal of Orthopaedic Research
Journal of Physical Activity and Health
Journal of Science and Medicine in Sport
Journal of Sport and Exercise Psychology
Journal of Sport Sciences
Journal of Sports Biomechanics
Journal of the Canadian Chiropractic Association
Medicine and Science in Sports and Exercise
Molecular and Cellular Biomechanics
Neuroscience
North American Journal of Sport Physical Therapy
Nutrition and Metabolism
Open Biomedical Engineering Journal
Perception
Perceptual Motor Skills
Pflugers Archiv
Physician and Sportmedicine
Physiotherapy Canada
Psycho-Oncology
Rehabilitation Psychology
Respiratory Physiology and Neurobiology
Sport Medicine
Supportive Care in Cancer
The Spine Journal

REVIEW OF GRANT APPLICATIONS

Members of the RJC have served reviewing grant application for:

AHFMR Student Advisory Committee
Canadian Foundation for Innovation (CFI)
Canadian Institutes of Health Research (CIHR)

- Biomedical Engineering
- Institute of Aging, Mobility in Aging Priority Working Group
- Nutrition, Food & Health Peer Review Committee
- Operating Grants
- Strategic Teams in Applied Injury Research



Contributions

International Rugby Board
Movement and Exercise
National Institutes of Health
Natural Sciences and Engineering Research Council Canada (NSERC)

- Discovery Grants

Netherlands Disease Prevention Programme
Research Foundation – Flanders (Belgium)
UKBB Intramural Research Fund

Official research related functions

DALE BUTTERWICK

Board of Directors, Canadian Professional Rodeo Sport Medicine Society.

NICOLE CULOS-REED

Organizer, Physical Activity and Cancer Educational Day, TBCC
(January, 2010).

Committee Member:

- Graduate Education Committee – Faculty of Kinesiology
- Hopewell Search Committee – Chair in Clinical Neurosciences (2009-2010)
- USRP Review Committee
- Faculty Promotions Committee

P. TISH K. DOYLE-BAKER

Sport Medicine Representative (SMCA)
Arthur JE Child Chair search and selection committee

CAROLYN EMERY

Chair, National Sport Injury Prevention Research Centre - Canadian Academy
of Sport Medicine Research Symposium (2008 -).

Chair, Scientific Review Committee – Canadian Physiotherapy Association
National Congress (2008 -).

Chair, Canadian Physiotherapy Research Advisory Consortium (2008 -).

Liaison, Canadian Physiotherapy Association Divisions Research (2008 -).

National Research Representative, Sport Physiotherapy Canada Executive
(2008 -).

NEIL EVES

Chair, Exercise and Disease Self-Management, Canadian Respiratory
Conference, Montreal, QC.

WALTER HERZOG

Provost/VPA, Advisory Review Committee, Arthritis Society Chair in
Rheumatic Diseases/Rheumatology (2009-2014).

Chair, CIHR Biomedical Engineering Review committee (2008-2009).



Official research related functions

Past President of International Society of Biomechanics (2009-2011).

VICTOR LUN

Chairperson, Research Committee, Canadian Academy of Sport Medicine.

BRIAN MACINTOSH

President, Canadian Society for Exercise Physiology (November, 2007 to November, 2009).

Associate Dean, Faculty of Graduate Studies (since Jan, 2009).

WILLEM MEEUWISSE

Co-Chair, Research Symposium on Injury Prevention in Youth Sport, Vancouver, BC, June 2009.

Steering Committee, "Ice Hockey Summit: Action on Concussions" event, Mayo Clinic, Rochester, MN October 2010.

Member, Scientific Committee, 3rd World Congress on Sports Injury Prevention, Monaco, April 2011.

NICK MOHTADI

Co-Director, University of Calgary Sport Medicine Centre.

Clinical Research Director, McCaig Institute for Bone & Joint Health, Research Portfolio.

Member, Division of Orthopaedic Surgery Research Committee.

Continuing Medical Education – 7th Biennial Congress of the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine. Osaka, Japan, 2009.

BENNO M. NIGG

Member, IOC Medical & Science Commission.

Scientific Board Member, Jacobs Center, Bremen, Germany.

Member, International Academy of Biology and Engineering in Medicine.

Member, Swiss Academy of Medical Science.

RAYLENE REIMER

Conference Organization/Professional Committees, Nestle CSCN/CSNS Student Abstract Competition Judge, April 2009.

JANET RONSKY

Director, Alberta Research Council, Board of Directors.

DAVID SMITH

Director of Sport Science, Canadian Sport Centre – Calgary.

Treasurer, Sport Science Association Alberta (SSAA).

DARREN STEFANYSHYN

Chairperson, International Society of Biomechanics Technical Group on Functional Footwear.

Executive Board, International Society of Biomechanics.

Associate Editor, Footwear Science.

Editorial Board, Sports Technology.



Official research related functions _____

JOAN VICKERS

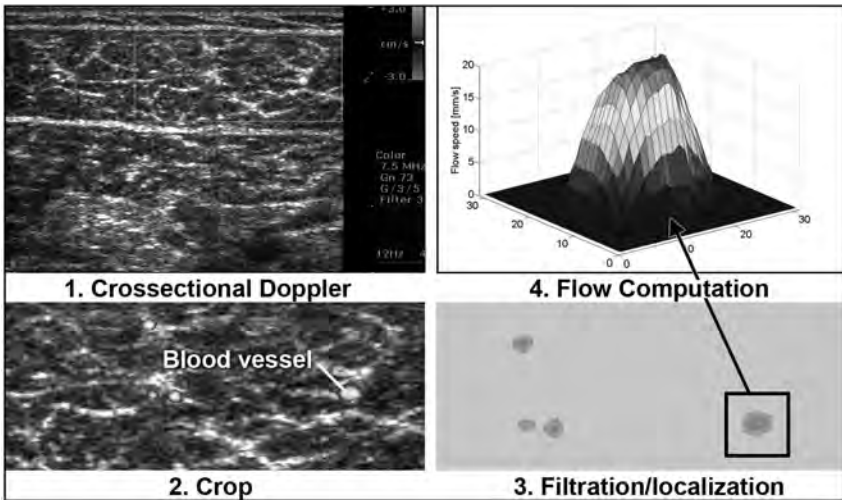
Scientific Committee Member, 4th International Symposium Spatial Cognition and Action, Rome, September 14-18.
Editorial Board, International Journal of Coaching.

PRESTON WILEY

Co-Director, University of Calgary Sport Medicine Centre.
Chair, Planning and Scientific Committee, Sport Medicine Conference in Preparation for 2010, Vancouver, Canada.
Credentials Committee Member, Canadian Academy of Sport Medicine.

How to contact us _____

www.kin.ucalgary.ca/hpl and www.sportmed.ucalgary.ca



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