

in contrast to cell deformations in loose connective tissues, articular cartilage chondrocytes deform instantaneously upon loading of the joint and lose approximately 25-30% of their volume within seconds, but take minutes to recover their original shape. Furthermore, volume loss in chondrocytes increases with increasing loads up to a threshold value and then remains constant.

Currently, we are combining these mechanical measurements with calcium signaling by these cells to obtain insight into the pathways that link tissue and cell mechanics to adaptive and degenerative responses in intact joints.

Centre of Excellence

In 2009, our 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). The goal of this four year grant is to facilitate new projects and foster collaborations that will support the IOC Medical Commission's mandate of protection of the athletes' health and injury prevention.



Vancouver Olympics



The Applied Exercise Physiology group provided scientific support to athletes, coaches and sport organizations in their preparation for the Vancouver 2010 Winter Olympics with the main focus on the enhancement of exercise tolerance through hypoxia and hyperoxia to achieve an adaptation of the cardiovascular and muscular systems. We used a combination of both natural altitude environments and normobaric hypoxic interventions via oxygen filtration, which we applied extensively with specific teams. Additionally, we concentrated on developing daily and weekly monitoring tools and testing protocols to evaluate the degree of preparedness or fatigue as a result of different training regimes. Through the development of a long-term database that established the effects of specific training on heart rate variability we were able to provide coaches with valuable feedback on the capabilities of athletes to handle training loads through scientifically trained exercise physiology technicians embedded within many teams.

Additionally, other members from Biomechanics, Exercise Physiology, Sports Technology and Sports Medicine team of our centre contributed to the "Own The Podium" program through research and development projects.

Fatigue

Fatigue during whole-body exercise is a multi-factorial phenomenon including biomechanical, physiological, neurological and psychological influences. Consequently, fatigue cannot be quantified by one individual variable. To quantify fatigue, one must assess changes occurring in multiple variables spanning these systems. At the Roger Jackson Centre, we have developed and demonstrated a method, which allows multiple variables from different disciplines to be integrated into one single fatigue index.



Annual Report 2009 - Highlights

Roger Jackson Centre for Health and Wellness Research



HPL - Calgary
Human Performance
Laboratory



**Sports Medicine
Centre**



**UNIVERSITY OF
CALGARY**
KINESIOLOGY

The Year 2009

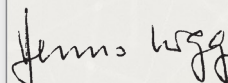
Canada is still excited about the success of the Vancouver 2010 Olympic Winter Games, and the spirit in the aftermath of this big event is a spirit that we have tried to embrace for a long time in the Roger Jackson Centre for Health and Wellness Research. Success comes with an investment in people, careful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

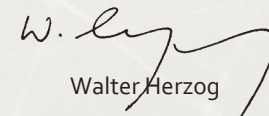
We are proud that more than 20 of the Olympic medalists are present or former students of the University of Calgary. We are also proud to have had the chance to make a small contribution to the Olympic effort by caring for the well-being of many of our athletes through the expert work of physicians and 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 invest in the education of young scientists. In 2009, we were successful in securing a \$1.65 mill 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 be made reality 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
the co-directors of the Roger Jackson Centre


Benno M. Nigg


Walter Herzog


Cy Frank

The full version of the
annual report can be found at
www.kin.ucalgary.ca/hpl

Awards and Honors

Some members of the Human Performance Laboratory and the Sports Medicine Center were honored for their scientific contributions.

Internal Awards

- Doyle-Baker, T.** Faculty Award.
- Stano, A.** Staff Award.
- Fletcher, J.** Student Award.
- Butterwick, D.** Students' Union Teaching Award for Kinesiology.
- Herzog, W.** Kinesiology Excellence in Teaching & Research Award.

Special Appointments

- Janet Ronsky** Fellow, The Canadian Academy of Engineering.
- Benno Nigg** Board of Management of Alberta Economic Development Authority.
- Preston Wiley** Elected President, Canadian Academy of Sport Medicine.

External Awards

- Emery, C.** Professorship in Paediatric Rehabilitation (2009 – 2014).
- Herzog, W.** Killam Fellowship – Canada Council for the Arts (2009 – 2011).
- Schmidt, T.** Network Scholar Award, Canadian Arthritis Network.
- Mohtadi, N.** Can. Orth. Ass. Top Poster Award, Whistler, BC.
- Fletcher, J.** 1st Place, PhD Presentation, Ex. Phys. Western Canada, Winnipeg, MB.
- Westover, L.** 3rd Place, M.Sc. Best Paper, ASME Bioeng. Conf., Lake Tahoe, CA.
- Lorincz, C.** Finalist, Young Inv. Award, ISB, Capetown, South Africa.
- Han, SK.** Finalist (PhD), NDI New Inv. Award, NACOB, PA, USA.
- Manske, S.** Research Achievement Award, NSERC, Canada.



Training of Young Scientists and Professionals

The year 2009 has seen the implementation of the first year of the NSERC sponsored CREATE training program for biomedical engineers for the 21st century. This program was initiated by our center to support students with an interest in biomedical engineering. Eight trainees were supported through this program, and we anticipate doubling these numbers for year two. The CREATE training program offers a unique learning experience through a multi-faculty, multi-disciplinary approach to biomedical research and education and provides scholarships, travel grants and support for scientific interactions in seminars and conferences. The total value of this trainee support grant is \$1,650,000 for 2009-2015.



Osteoarthritis

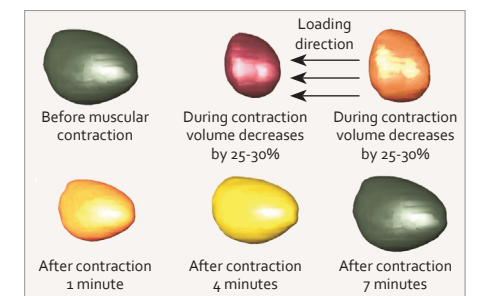


Osteoarthritis affects most elderly people and understanding osteoarthritis and possibly being able to influence it by reducing pain and improving locomotion abilities, is one of the most important research questions of our time. The University of Calgary has started a large osteoarthritis program (funded by the Alberta Heritage Foundation for Medical Research, AHFMR) and our research center is centrally involved in this project. The AHFMR Osteoarthritis Interdisciplinary Team Grant is entering its third of five years. The major accomplishments of this grant include the acceleration of young faculty members and trainees into scientific research, the initiation of a number of biotechnology companies and potential patents, the formation of new research groups and new research topics under the umbrella of the grant, and tremendous leverage of the funding through federal and provincial granting agencies and private sponsorship.

Cartilage Deformation – An Exciting Step Forward

The reaction of articular cartilage under load is one of the most important pieces of knowledge for understanding the factors responsible for the development of joint arthritis. Up until now, articular cartilage cell mechanics has been studied exclusively using isolated cells (chondrocytes) or chondrocytes embedded in explant tissues (cartilage that was extracted from the joint).

During the past two years, we developed an approach to not only measure the mechanics of chondrocytes in the intact joint, but to also load these joints in the most physiological way - through muscle contraction. We achieved this goal by measuring first ever dynamic chondrocyte deformations in the intact knee of mice that were loaded by stimulation and force production of the knee extensor muscles. Cell deformations are measured using two-photon excitation microscopy combined with a femto-second laser pulse system. We found that,



Support

Our work was financially supported by many different sources, the University of Calgary, Government Grants, Industry and Non-Government Sources and External Student Support. The corresponding amounts in Millions of CAD were

University	3.7	28 %
Gov. Grants	7.5	56 %
Industry	1.1	7 %
Ext. Students	1.2	9 %
Total	13.4	

For 2009, the average support per faculty member was about 392,000. We would like to thank all supporters of our work, the Faculty of Kinesiology, the University of Calgary, all Granting Agencies, Industry and our major sponsor, Engineered Air.