

# RESEARCH

Division of Orthopaedics, Department of Surgery, Faculty of Medicine, University of Calgary

# UPDATE

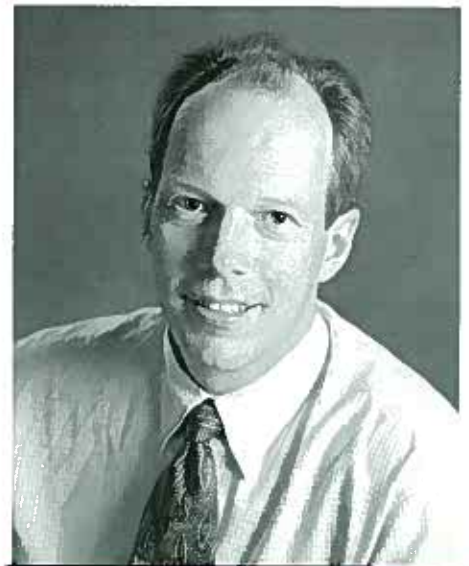
APRIL 2004

Bone and Joint Health is at the cusp of a new era. After several years of work by members of the Division of Orthopaedic Surgery and citizens of the community interested in Musculoskeletal Health, plans are being formulated to design and construct a new building at the Foothills Medical Centre site. Construction has already begun on the new Health Research and Innovation Centre at the Foothills site. The establishment of a patient care facility adjacent to a research institution will offer an excellent opportunity to enhance the research efforts of the Division of Orthopaedic Surgery and Bone and Joint Health.

This exciting opportunity will allow the Research Section to expand its role in the coming years, and in the meantime, will add to our workload as the roles and responsibility of this section will need to be defined. This process will begin in earnest in the next several months, once the structure of Bone and Joint Health is clarified within the Calgary Health Region and the University of Calgary. While it will be some years before we actually inhabit spaces in these new buildings, we will need to start planning soon to develop a vision and create programs within the Research Section.

In this seventh edition of the Research Update, we highlight current research by our faculty members, residents, and graduate students. Projects from the laboratory, clinical treatment and epidemiology investigations of Musculoskeletal Health are featured. In addition, a synopsis of the Annual Research Symposium where faculty members of the Division of Orthopaedic Surgery present their work to colleagues is included. As these articles attest, in combination with the list of kudos, our collection of faculty and students truly are leaders in Musculoskeletal and Bone and Joint Health research.

I invite you to read this edition of the Research Update to learn more about our activities. I also charge you with the task of thinking about your vision of the role of the Research section in our emerging Bone and Joint Health program, and encourage you to share these views with each other and with me.



Dr. Hevin Hildebrand, Chair, Research Section

Financial Support Provided by The Calgary Orthopaedic Research and Education Fund



Alberta Heritage  
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Medical Research



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# Scoliosis Study — Alternatives to X-Rays



**Dr. Jim Harder, Paediatric Section**

**S**coliosis is a disease of the spine occurring in young people (pre-puberty, usually in their early teens) that takes several, if not many, years to run its course. It causes the spine to twist; in some cases the deformity is minor, while in others, if left unchecked it may be so severe as to cause organ damage and require bracing and/or surgery. The only way to track the disease other than by watching the person's upper body slowly twist out of shape, is by taking regular X-rays. But constant X-rays are not a good option; for one thing, they are in two dimensions, while the spine is twisting in three, like a DNA helix (although not as regularly); for another, physicians want to limit their patients' exposure to radiation if at all possible, since it may have an impact on breast and reproductive tissue.

Finding a better way to track the disease has been the ongoing aim of Dr. Jim Harder, paediatric orthopaedist, Alberta Children's Hospital and Dr. Janet Ronsky, biomedical engineer, Faculty of Engineering, U of C, and Dr. Ron Zernicke, kinesiologist, Faculty

of Kinesiology, U of C. Their long-term collaboration with the Ecole Polytechnique and St. Justine Hospital in Montreal is beginning to pay dividends, as the early results of their research support their original hypothesis. That is, that the three-dimensional shape of the body correlates to the three-dimensional curvature of a scoliotic spine.

"If we can understand that relationship, we can use torso measurements as an indicator of what is going on internally," explains Dr. Ronsky. In order to do that, Drs. Harder, Ronsky, Zernicke and their Montreal colleagues have assembled a multi-disciplinary team to pull together the various aspects of the project, including physicians, engineers and kinesiologists.

The first step is to image the body; using light technology to project a grid on the body, the team is taking pictures with four circumferential light cameras. "The curves, squeezes and stretches that show up on the imaged grid are then compared to an image of a normal torso, and the differences digitized," explains Dr. Harder.

This information is then fed into a neural network which has been developed by Dr. Ronsky and Dr. Zernicke. A neural network is like an artificial 'brain', a software program that will eventually be able to process a patient's image and come up not only with an analysis of what is happening to the spine, but also to predict the severity of the disease in that patient. "The neural network never forgets," says Dr. Ronsky. "If it has seen 250 similar curves that all resulted in minimal curvatures, and it sees a similar one on the next patient, it will tell us 'this curve is okay'."

Now that the researchers have established that they are on the



**Dr. Janet Ronsky, JIARG**

right track, what they need most is numbers: the more patients they can study, the more measurements they can add, the more accurate the neural network can be. "Now it is time to move into the multi-centre phase of this project," says Dr. Harder. "If the multi-centre results are still stable, we've won."

The second phase of this long-term study is clinical application. "I want to be able to use my computer — put in the measurements, get an instant diagnosis, no x-rays," says Dr. Harder. "I'd like to be able to design a smart brace, which affects the three-dimensional aspect of the deformity, and fits well. Right now, I decide where to pad the brace [to modify the curvature]; if it doesn't work, I want to know why. There are no real quantifiers as to the effects of a brace. There are schools of thought that say that the brace is only to please the parents. It would be great if we could make a brace that we know fits well, and could measure and understand what that brace is doing." 📄

# Improved Surgical Procedure for Ankylosing Spondylitis

When you are so bent over that you can only look at the ground while you are standing up, and your ribs are squeezing your internal organs, you are probably ready for the risks of spinal surgery. It's a procedure that is naturally worrisome for patients, who fear that if something goes wrong, they could lose the use of their limbs. But for some of those afflicted with ankylosing spondylitis, it is the only option. As Dr. Jacques Bouchard, Director of the Orthopaedic Surgery Residency Training Program at the University of Calgary and an orthopaedic surgeon who specializes in the spine, explains, "the disease is a type of arthritis that fuses the bones of the spine, sometimes in a flexed [bent forward] position; the vertebrae gradually grow together, starting from the base of the spine."

**L**ike many arthritic diseases, this one can manifest itself in mild, moderate or severe forms; generally it is only the severe cases that need surgery. The traditional procedure involves placing the patient's head in a rigid halo ring, while a wedge of bone is cut out of the spine through the back of the neck. The surgeon then moves the head up and back to a more normal position, re-fixes the halo, and closes the incision. Much of this is done under local anaesthetic, since it is essential for the doctors to ensure that all neurological functions are intact. Needless to say, this can be a very stressful time for the patients as the surgeon uses his eyes and judgement to determine the position of the head, all the while checking with the patient to ensure no nerves are being affected. "The only thing preventing that patient from waking up quadriplegic is me holding his head properly," says Dr. Bouchard.

Not long after he started performing the procedure, Dr. Bouchard became convinced there had to be a better way to do the surgery. "Patients were taken aback when they were told that they would be mostly awake. I felt that the

procedure could be more controlled and safer," he says. And so he decided to make some significant changes.

To be fair, newer technology and surgical techniques have made it easier for him to modify the procedure. For example, advanced techniques allow the anesthetists to intubate the patients before they are anesthetized. They are also able to monitor the spinal cord electronically. In addition, Dr. Bouchard has altered the halo significantly, adding vertical Ilizarov bars, which provide for much more accurate adjustment, both up and down and side to side. The system, which was originally designed for limb-lengthening, operates on a similar principle to a turnbuckle, permitting carefully controlled, very gradual change.

When Dr. Bouchard began using the new procedure in 1999, he had three goals: to verify the safety of the procedure, to assess its relative accuracy, and to gauge patient satisfaction. Because it is not a common operation, he doesn't have a large patient base, but he is pleased with the results, to the point that he no longer uses the traditional procedure. "We have found it safe; we can get the



**Dr. Jacques Bouchard, Spine Section**

degree of correction that we want, and we have a high level of patient satisfaction," he says. This procedure may also offer possibilities of adaptation to other types of surgery involving the upper levels of the spine. This fall, Dr. Bouchard will be presenting his findings to the international Scoliosis Research Society in Quebec City and at the annual Argentine Orthopaedic Society meeting. 📧

# Inner Secrets of Ligaments Revealed

The rotator cuff is a group of four muscles and related tendons, which surround the shoulder joint and are essential for dynamic stabilization and motion of the shoulder. An injury to the rotator cuff can have a significant impact on a person's life. "People who have rotator cuff disorders may have chronic pain, difficulties with the tasks of daily living, and often night pain, which causes loss of sleep," explains Dr. Ian Lo, shoulder surgeon and Assistant Professor at the University of Calgary, Faculty of Medicine, who is currently studying some specific aspects of rotator cuff disease, particularly its origin. Although the term "rotator cuff disease" covers a spectrum of disorders from tendonitis to tears, some massive rotator cuff tears may eventually lead to arthritis.

**"R**otator cuff disease is a very, very common problem, possibly second only to back and neck problems in work-related disorders," says Dr. Lo. "However we also see rotator cuff problems in sports, and even desk jobs."

The supraspinatus tendon is usually the first to be damaged. "We don't know why," says Dr. Lo. "If we can answer that question, it may answer similar questions for many other tendons as well – the achilles, the elbow and so on".

"No one knows what causes rotator cuff problems," he says. "One hypothesis is that abnormal loads on the tendon lead to cellular damage, resulting in the production of degrading enzymes and disruption of the matrix."

"We know that tears generally occur in a degenerated tendon, so we want to know why it degenerates," he explains. "We are currently evaluating the role of the matrix metalloproteinases (mmps) – enzymes which degrade the matrix; studies have shown that the mmps are higher



**Dr. Ian Lo, Upper Extremity Section**

in patients with rotator cuff tears." (This information has been gathered from biopsies on tissue from patients having shoulder surgery. But for obvious reasons, very few human biopsies have been done on patients early in the disease process).

Dr. Lo is working on this project with investigators Dr. JB Rattner and Dr. Nigel Shrive, Faculty of Medicine and Faculty of Engineering. "We are developing an animal model of supraspinatus tendonitis, and we hope to place loads on those tendons – both in vivo and in vitro – to determine if they lead to cell damage, the production of mmps and matrix damage."

If that is the case, says Dr. Lo, the news is good, "because there may be natural and synthetic inhibitors available to prevent the disease process". The next step in his research would be to study those inhibitors in an animal model. "I think this is a very long term study", he comments. "Our focus is to understand the causes of rotator cuff tears in hopes of preventing them." 📄

# Sixth Annual Orthopaedic Research Symposium

Once a year, the members of the Division of Orthopaedic Surgery gather together informally to exchange information on their various sub-specialties and current research projects. This year, there was a broad spectrum of topics ranging from the microscopic to the macro-economic, with presentations on ligament architecture, surgical procedures, movement, and medication use.

Dr. Ian Lo started things off by revealing that ligaments are proving to be lot more complex than previously thought. He has been investigating their cellular makeup, using the ACL and MCL of sheep. Ligamentous tissue is grouped into bundles of collagen fibres – fascicles – running parallel, which, at first glance, appear hypo-cellular. But, explained, Dr. Lo, elongated cells between the fascicles, which were assumed to be inert, in fact appear to be connected by gap junctions. The gap junctions, he said, allow the passage of materials from cell to cell. "They may be important in tissue injury and repair."

Most ligament research has been done using thin frozen sections, but Dr. Lo looked at thick sections as well. "This helped to establish the relationship between cells." He has found that there are long cytoplasmic processes extending perpendicular to the cells which connect from row to row as well. He surmised that these findings may apply to tendons, the outer annulus fibrosis of the intervertebral disc, and peripheral meniscus, which have a similar cellular organization.

Dr. Benno Nigg, of the Human Performance Laboratory of the Faculty of Kinesiology observed that there were some surprising results in the findings of several research projects related to the stability of the human foot and the role of orthotics. In one

study, he had a runner sampling five different orthotics, the two chosen by the runner as most comfortable had completely different mechanical values. In another study, he found to his surprise that the correlation between comfort and pronation was 0.92. "I think our joints are made to pronate," he commented. Other studies revealed that our locomotion system seems to have a mind of its own, "a preferred movement path for a specific task" which is largely independent of external influences. "What we can do is work with muscle activity," he says. His conclusions centred on the idea that it is the small muscles of the feet that offer us most of our stability. "The optimal orthotic minimizes both unnecessary joint movement and muscle activity," he suggests.

For four years now, paediatric orthopaedic surgeon Dr. Jim Harder and his colleagues, sponsored by the Rotary Clubs of Calgary and Edmonton, have headed off to Cuenca, Ecuador, for an extended week of orthopaedic service, operating on children of the region whose families are too poor to access health care through normal channels. They connect to the local Rotary Club in hopes of perpetuating their work, says Dr. Harder, as well as "to set an example, to show that Canadians are sympathetic to those in poverty, and to raise awareness of poverty among the wealthy of Peru."

He noted that there are many dislocated hips there, as a result of the way mothers traditionally carry their children, but is hopeful the team's influence will help to change that. There is an educational component to this annual mission as well, he says. "One of the objectives is to train local people to do some of this surgery."

Trauma surgery brings its own challenges, one major concern is

acute respiratory distress syndrome (ARDS) during large bone stabilization with intramedullary nailing (IM nailing). Dr. Jim Powell and his colleagues – Drs. Mohanty, Musso, Traboulsi, Mullen and Belenkie – are interested in reducing the risk of ARDS. Using a dog model they experimented with the addition of a venous filter to the procedure. Each of 12 animals was given an embolic load, and six were also given a 'trap' filter. "With no filter the pulmonary artery pressure jumped significantly" said Dr. Powell; "with the filter, the pressure jump was quite a bit smaller. Even the filters that didn't fit very well were shown to reduce the size and quantity of embolic load on the lungs." The group concluded that a retrievable filter with a system to remove accumulated marrow content might be useful for trauma patients undergoing IM nailing.

Spearheading a revitalized technique for hip arthroplasty – the 'Birmingham hip' as it is known – Dr. Jim MacKenzie has assembled data on the first 65 patients who have had the procedure done in Calgary's pilot project. Dr. MacKenzie explained that the procedure had fallen out of favour several decades ago as its outcomes were not reliable. However, a team of surgeons in Birmingham, England continued to refine the procedure, using newer and better prosthetic devices, to the point where they were having significant success.

As Dr. MacKenzie pointed out, the Birmingham hip prosthesis replaces only the top of the femoral head, and, being larger than the prosthesis used in a traditional total hip arthroplasty (THA), offers greater stability to the joint. He suggested that the forces on the Birmingham prosthesis were also different, and less likely to cause its loosening. One of the benefits of this technique is that recipients are able

*continued on page 6*

to return to their normal lifestyle, whereas THA patients are told to restrict their physical activities to non-impact sports. Dr. MacKenzie did note that this was the traditional recommendation, and that it was not actually known if such restrictions were necessary, although he pointed that the smaller head of the THA prosthesis offers less stability. He also said that although the Birmingham procedure has been in existence for at least 12 years in Britain, long-term results are not available, since the current Birmingham prosthesis has been in use for only six years.

At the macro level, Dr. Cy Frank delivered the findings from Phase I of the Alberta Improvements in Musculoskeletal (MSK) Disorders Study, an analysis of the use of COX2 inhibitors – the latest generation of anti-inflammatory medications (NSAIDs) – such as Vioxx and Celebrex. “The use of NSAIDs [which are harder on the stomach] didn’t go down much when the COX2s were introduced,” said Dr. Frank. Prescriptions for such drugs are costing the province more than \$9 million a year, and they wanted to know why, and whether the drugs were worth it.

“We discovered that MSK disorders, which are grossly underreported as reasons for patient visits, account for 28 percent of physician billings”, he said. “with joint and back disorders as the numbers one and two reasons for prescriptions.” This first phase of the research also revealed that as many as 9 percent of patients who were prescribed NSAIDs and 15 percent who were prescribed COX2s were at risk of serious side effects. “The goal of this study is to help the physician get it right,” he said. “This is going to form the research platform for the Alberta Bone and Joint Health research program; we will analyze data on all MSK disorders in the province in order to reduce gaps and improve bone and joint health care to be the best in the world.”

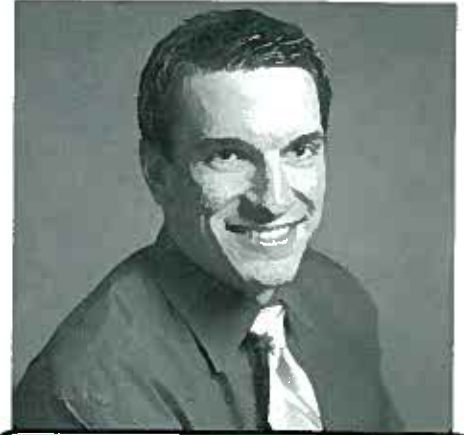
# Comparing Surgical Procedures for Traumatic Wrist Fractures

In ‘the good old days’, fixing a fractured bone was simply a matter of putting the pieces back together, placing the involved body part in a cast, and waiting for the injury to heal. But as we learn more and more about the intricacies of the healing process, we know that all fractures are not alike and that all bones don’t heal the same; to respond to these circumstances, orthopaedic surgery is continually becoming more sophisticated. Take broken wrists, for example. Dr. Jeremy Reed, a third-year resident in Orthopaedics at the U of C, is conducting a clinical study comparing two methods of fixing a certain type of wrist fracture. “It’s not just your average fracture,” says Dr. Reed. “We’re looking at high energy injuries: falls from heights, motor vehicle accidents – ones with many bits and pieces.”

Dr. Reed’s initial literature search found more than one hundred papers on this topic. He discovered that very little good research had been done to date. In response to this he assembled a research team consisting of himself as lead investigator, two staff surgeons, and a statistician.

The traditional way of surgically repairing a multiply-fractured wrist is to insert pins into the bones percutaneously – through the skin – using x-ray guidance. Six weeks or so later, the pins are removed as an outpatient procedure. This ‘tried and true’ method was compared with a new, more invasive technique. The new technique involves cutting the wrist open under general anaesthesia and permanently attaching plates to the bones.

“Our goal was to look at people working years, people who need function to carry on with their livelihood and support their family,” Dr. Reed explains.



Dr. Jeremy Reed, Orthopaedic Resident

The patients were seen at an outpatient clinic by an independent hand therapist who did not know which type of surgery they had had. They were assessed on functional outcome, range of motion, grip strength and x-ray measurements.

“We found that in regard to functional outcome, there was no difference between the two groups. But in terms of range of motion, there were some small, yet statistically significant differences between the two methods when the new type of repair was compared to the old.”

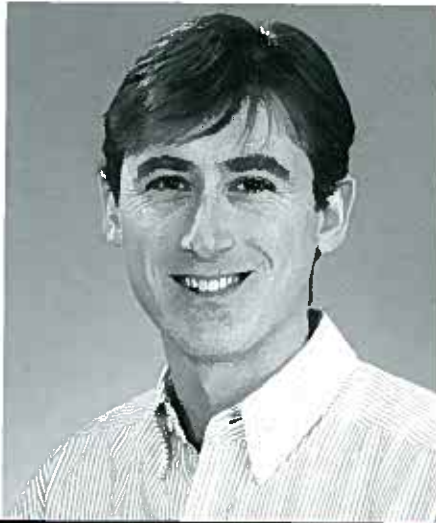
Dr. Reed looked at a total of 38 patients, a rather small sample, he acknowledges. “Evidence-based studies need large numbers to be conclusive. This type of study may contribute to a surgeon’s decision-making process, but it’s not the final word.” In fact, it was not intended to be. “The other reason the study was performed was to provide pilot data for a larger, prospective, randomized study with appropriate numbers. That’s what I’m most proud of; we now have data to design a future study that will offer a solid conclusion to this long-time question.”

# Tracking Elbow Injuries

**E**pidemiology is an important aspect of health care, as well as health care management. Among other things, it helps us decide as a society where to concentrate our medical research and health care dollars. Orthopaedic surgeon Dr. David Sheps, who is currently doing his Master's degree in epidemiology, is looking into the incidence of elbow injuries in Calgary, and what percentage of patients have complications from these injuries.

This may sound like a fairly simple and straightforward project, but the reality is quite complex. "I'm still trying to establish where the data is going to come from," says Dr. Sheps. "We have no way of tracking outpatients and patients in private practices, so I'm hoping to use Calgary Health Region billing data."

He is hopeful that this small study will lead to better understanding of




**Dr. David Sheps, Orthopaedic Fellow**

elbow injuries and complications and to more research and the establishment of better benchmarks. "The point of this is to establish the frequency of complications, and

then to be able to use those numbers throughout North America."

As he explains, "We know that complications occur, but we don't know why or how often they occur. For example, if the frequency is 100 per thousand, there might be something about that particular injury that generally results in complications."

Elbow injuries are not all that common – there are generally fewer than 1000 annually in Calgary – so there is very little epidemiological information available. Dr. Sheps hopes to change that. After completing an orthopaedic fellowship in sports related knee and shoulder problems, he decided that he wanted to work on what we might see as the less glamorous sibling of the major body joints, and to pursue related opportunities for teaching and research. He hopes to have the results of the study by June 2005. 

## ACKNOWLEDGEMENTS

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• Hip Hip Hooray • Institute of Musculoskeletal Health and Arthritis (IMHA) • Joint Injury and Arthritis Research Group (JIARG) / Bone and Joint Health Institute • National Sciences and Engineering Research Council (NSERC)  
• The Arthritis Society • Western Orthopaedic Arthritis Research Foundation (WOARF)

## ORTHOPAEDIC FACULTY

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A Abdeen, S Bitting, M Di Silvestro, P Dooley, D Goel, K Johnston, R Korley, I Le, M Lincoln, D Longino, K Lundine, D Malish, B Pedersen, S Puloski, J Reed, A Sidky, T Woods

## FELLOWS

A Al Arjani, M Al Hejji, A Almajed, I Assiri, J Chevalier, S Fong, D Sheps, G Swamy

## COLLABORATORS

S Edworthy, R Gill (Oxford University), V Lun, L Martin, J Matyas, L McGann, W Meeuwisse, R Rangayyan, JB Rattner, J Ronsky, J Tulip, P Wiley

## RESEARCH ASSISTANTS

L Elves, K Ford, H Hannaford, B Jones, ZZ Lafrenière, B Logan, T Sasyniuk, B Sobchak

## Upcoming Events

29th Annual Alberta  
Resident Research Day  
Bernard Snell Theatre Hall  
Edmonton, Alberta  
April 2, 2004

Surgeons' Day  
Libin Lecture Theatre  
Health Sciences Centre  
May 28, 2004

Canadian Orthopaedic Foundation  
Hip Hip Hooray  
National Annual Walk  
Calgary Location: Bowness Park  
May 30, 2004

Canadian Orthopaedic Association  
Annual Meeting and  
Canadian Orthopaedic Research  
Society Annual Meeting  
Telus Convention Centre  
Calgary, Alberta  
June 18 - 20, 2004

Orthopaedic Research Golf and  
Scientific Meeting Annual Event  
Glencoe Golf and Country Club  
September 13, 2004

Glen Edwards Day  
"The Calgary Shoulder & Elbow Course"  
Libin Lecture Theatre  
Health Sciences Centre  
September 23 - 26, 2004

5th Combined Meeting of the  
Orthopaedic Research Society  
Banff, Alberta  
October 10 - 13, 2004

Annual Paediatric Townsend Day  
Alberta Children's Hospital  
4th Floor Solarium  
October 15, 2004

Orthopaedic Research Society Meeting  
Washington, DC  
February 20-23, 2005

American Academy of Orthopaedic  
Surgeons Annual Meeting  
Washington, DC  
February 23-27, 2005

## HUDOS

**Ms. Sabina Bruehlmann, Dr. John Matyas and Dr. Neil Duncan** are recipients of the prestigious award by the International Society Study of Lumbar Spine (ISSLS). *Title of Research:* Collagen fibril sliding governs cell mechanics in the annulus fibrosis: an in situ confocal microscopy study of bovine discs (this paper will be presented at the ISSLS meeting in Portugal, Spring 2004). This was formerly known as the Volvo Award.

**Dr. Nick Mohtadi** was awarded one of six 2004 Institute of Musculoskeletal Health and Arthritis (IMHA) Quality of Life Research Awards. *Title of Research:* Arthroscopic electrothermal capsulorrhaphy versus open capsular shift for patients with shoulder instability: A multicentre randomized clinical trial. *Co-investigators:* **Dr. Robert Hollinshead and Dr. Gordon Fick** (IMHA is one of 13 Institutes of the Canadian Institutes of Health Research).

**Dr. David Hart** and team members were awarded the New Emerging Team Grant from the Institute of Gender and Health at Canadian Institutes of Health Research in May 2003. *Title of Research:* "Sex/Gender Influences on Musculoskeletal Health Across the Lifespan". *Co-investigators consisting of a transdisciplinary group within the Faculties of Medicine, Kinesiology and Engineering:* **Drs. Kevin Hildebrand, Nigel Shrive, Janet Ronsky, Susan Barr, Raylene Reimer, Darren Stefanyshyn, and Karl Riabowol.**

**Dr. Kevin Hildebrand** received a Career Research Award from the Health Research Foundation/Canadian Institutes of Health Research.

**Dr. Nigel Shrive** was reappointed as Killam Memorial Professor of the University of Calgary.

The following individuals were award recipients at the 2003 Annual Alberta Orthopaedic Resident Research Day: a) **Dr. Seth Bitting** was presented with the 1st Place Dr. Robert Townsend Scientific Award, b) **Dr. Ayesha Abdeen** was presented with the 2nd Place Linvatec Clinical Research Paper, c) **Dr. David Longino** was presented with the Dr. Gary Hughes Junior Resident Research Award and d) **Dr. Shannon Puloski** received an Honorable Mention for the Linvatec Clinical Research Paper.

**Dr. Kelly Johnston** received the AO North America Resident Trauma Research Support Program award in February 2004.

## Research Update

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