

## FULL PROGRAMME

**FRIDAY, JUNE 1**

<b>0700 - 1800</b>	Registration	<b>Lower Level Convention Centre Barrington Suite, Delta Barrington</b>
<b>1000 - 1600</b>	Partners' Hospitality Suite Open	
<b>0700 - 0830</b>	Instructional Course Lectures (concurrent sessions)	
	ICL-01: Adult Reconstruction	<b>Mariner 2</b>
	ICL-02: Trauma	<b>Mariner 3</b>
	ICL-03: Sports Medicine	<b>Mariner 4</b>
	ICL-05: Spine	<b>Highland 9</b>
	ICL-06: Foot and Ankle	<b>Mariner 5</b>
<b>0800 - 0930</b>	Breakfast for Partners of New Members	<b>Barrington Suite, Delta Barrington</b>
<b>0845 - 0900</b>	CORS Welcome and Opening Remarks: Erin Boynton - CORS President	<b>Port Royal C</b>
<b>0900 - 2030</b>	Exhibits Open	<b>Metro Centre</b>
<b>0900 - 1030</b>	CORS Sessions	
<b>0900 - 1030</b>	<b>Session 1: Bone, Ligament, Tendon – Moderators: Kevin J. Deluzio, Mark Glazebrook</b>	<b>Highland 6/7</b>
<b>Paper 001 0900-0906</b>	Functional Adaptation of Bone: Interactive Effects of Diet and Mechanical Loading Environment <sup>2</sup> <i>C. Lorincz, R. Zernicke, Calgary, AB</i>	
	Functional duality of bone is most appropriately demonstrated by the skeletons' ability to "functionally adapt" to the surrounding physical environment. Diets high in saturated fat and sucrose (HFS) have been shown to adversely affect bone, whereas mechanical loading stimulus, if applied appropriately, can augment bone growth. To examine these environmental parameters, female mice were divided into dietary cohorts (HFS and Starch), and sub-divided into loading groups (control, sham, loaded) for 10 weeks. Upon sacrifice, tibial morphometrical and mechanical properties were assessed and compared. A diet effect was observed as mice fed a HFS diet had significantly reduced structural properties when compared to mice fed a starch diet. A loading effect was observed within the HFS cohort as mice undergoing loading in the HFS cohort had improved structural properties versus controls within their dietary grouping but reduced properties when compared to mice undergoing loading on a starch diet.	
<b>Paper 002 0906-0912</b>	Cell-Based Gene Therapy to Promote Fracture Healing <sup>2</sup> <i>R. Li, E. H. Schemitsch, D. J. Stewart, H. P. von Schroeder, Toronto, ON</i>	
	PURPOSE: To develop a cell-based VEGF gene therapy to accelerate fracture healing. METHODS: A 10 millimeter segmental bone defect was created in a rabbit tibia and the fracture was plated. 5.0 X 10 <sup>6</sup> fibroblasts	

were transfected with pcDNA-VEGF (using SuperFect) and delivered via impregnated gelfoam into the fracture site. Experimental groups were: 1) Transfected fibroblasts with VEGF (n=7), 2) Fibroblasts alone (n=7), and 3) PBS only (n=7). The animals were sacrificed and fracture healing specimens collected at 10 weeks post surgery. RESULTS: Radiological, histological and MicroCT evaluation showed that tibial fracture healing was improved in group 1. Numerous positively stained (CD31) vessels were shown in the VEGF group. CONCLUSIONS: These results indicate that cell-based VEGF gene delivery has significant osteogenic and angiogenic effects.

**Paper 003**  
**0912-0918** Pathomechanics of Sprains and Strains: Changes in Molecular State Due to Collagen Fibre Overextension<sup>2</sup>

*T.L. Willett, R. S. Labow, J. M. Lee, Halifax, NS*

This study investigated changes in collagen molecular state due to overextension damage (sprains and strains), gaining insight into tissue degeneration and cellular detection of damage. Overextension results in intermolecular sliding. Tendon rupture increases susceptibility to proteolysis. These observations and contemporary theory led to the hypothesis that sub-rupture tendon overextension would result in reduced thermal stability. Methods: Tendons (steer tails) each provided a control and an overextension specimen. Specimens were overextended on a mechanical testing system (1%/s strain rate). Two groups were used: 1-cycle and 5-cycles. Denaturation temperature (Td; thermal stability measure) was measured using hydrothermal isometric tension testing. Results: Overextension significantly reduced the stability of the collagen (p<0.0001) and 5-cycles had a greater effect than 1-cycle (p=0.03). Td of controls was 64.5±1.0degC. After 1-cycle, Td dropped to 63.2±1.0degC and, after 5-cycles, Td dropped to 61.8±2.0degC (p<0.0001). Conclusion: The molecular state of collagen is altered by overextension damage (intermolecular sliding liberates specific domains), reducing Td in our experiments by 10% of the expected range (37 - 65degC). These domains may be key targets in degeneration and cell-collagen signaling.

**0918-0924** Discussion

**Paper 004**  
**0924-0930** Interactive Effects of Aging and Caloric Restriction on Bone Structure and Mechanical Properties<sup>2</sup>

*Z. Westerbeek, R. Hepple, R. Zernicke, Calgary, AB*

We investigated how an ad libitum (AL) diet and 40% caloric restriction (CR) with nutrient supplementation, beginning at 3.5 months of age, interacted with the aging process to influence bone development. Male Fischer 344 X Brown-Norway rats (F344 BN) were divided into two dietary groups, AL or CR. The diet groups were compared based on age groups defined as a percentage survival rate (100%, 70%, and 35%). Tibiae were assessed using microcomputed tomography, mechanical testing, and ash analysis. Results showed that the CR diet resulted in a significantly lower total body mass compared to the AL diet group, across all ages. With aging, both diet groups showed a general increase in structural properties and a decrease in material properties. Furthermore, material and structural properties changed proportionately between both diet groups. Comparisons between diet groups, revealed a significant decrease in most structural properties, but no significant changes in material properties with CR. After normalization to body mass, structural properties were significantly greater in the CR group when compared to the AL group. Therefore, a CR diet with 40% restriction at 14 weeks, with nutrient supplementation did not negatively impact tibial geometrical and mechanical properties in aging F344 BN rats.

**Paper 005**  
**0930-0936** Initial Failure in Hip Fractures Occur in the Superolateral Cortex: Evidence from an *ex-vivo* Model  
*P. Guy, P. Crompton, P. M. de Bakker, T. R. Oxlund, Vancouver, BC, S. L. Manske, Calgary, AB*

Purpose: Evidence suggests that femoral neck fractures initiate in the superolateral cortex, where it is significantly thinner in older than younger individuals (Mayhew, et al. Lancet 2005). Thus, we sought to determine the relative time-course of crack initiation and propagation during a simulated hip fracture.

**Paper 006**  
**0936-0942** Feasibility of Using Cell-Based Gene Transfer in a Segmental Defect Model<sup>2</sup>  
*R. Li, E. H. Schemitsch, D. J. Stewart, H. P. von Schroeder, Toronto, ON*

We sought to establish whether gene transfected fibroblasts can be delivered to a fracture site and express genes. METHODS: A 10 millimeter segmental bone defect was created in a rabbit tibia. The fracture was stabilized with a plate. Experimental rabbits received 5.0 X 10<sup>6</sup> CMTMR labeled or VEGF transfected fibroblasts in 1 ml PBS via gelfoam at the fracture sites. The animals were sacrificed at 7 days (n=4), 14 days (n=4) and 21 days (n=4) post surgery and the fracture site specimens were collected for analysis. RESULTS: Fluorescently labeled cells with CMTMR were found. In the VEGF group, VEGF immunostaining was positive, visible bone formation was revealed by VonKossa staining and numerous vessels were shown by CD31 positive staining (brownish black); the VEGF protein was detected by ELISA. CONCLUSIONS: This data encourages further development of approaches using cell based VEGF gene transfer to promote fracture healing.

**0942-0948** Discussion

**Paper 007**  
**0948-0954** Viability of an Explant Model for Studying Articular Cartilage  
*C. Panaro, K. Bagnall, R. Barley, N. Jomha, Edmonton, AB*

Articular cartilage (AC) samples were obtained from the femoral condyles of total knee arthroplasty patients. The dowels consisting of full-depth AC were cultured in a variety of different media formulations (DMEM/F12, CGM (chondrocyte growth medium)) as well as PBS (phosphate buffered saline). After having determined the best medium for cartilage maintenance, a second study with a broader range of end-points was undertaken. All dowels collected were then grown for 0, 4, 8 or 12 weeks in DMEM/F12 and CDM (chondrocyte differentiating medium). At each time interval, the dowels were evaluated for viability (live/dead stain), general morphology (trichrome stain), distribution of matrix proteins and proteoglycans (aggrecan, Types I and II collagen – immunofluorescence). The DMEM/F12 medium produced the highest cell viability and the explants stained well for general morphology, distribution of matrix proteins and proteoglycans. This explant model appears to be promising for studying articular cartilage.

**Paper 008**  
**0954-1000** Contractile Properties are Enhanced in Joint Capsule Cells from Rabbit Knees with Post-traumatic Contractures<sup>2</sup>  
*K. Hildebrand, D. Hart, M. Zhang, Calgary, AB*

The hypothesis is that cells isolated from capsules of joints with contractures will contract collagen gels at a faster rate when compared to cells obtained from capsules of joints free of contractures. The capsules were obtained from three rabbits with post-traumatic contractures of one knee and an unoperated contralateral (normal) knee. Cells were mixed with neutralized bovine collagen and cast into wells. The areas of the gel were measured immediately after release (0 hr), and 1 hr, 2 hr, 3 hr and 4 hr post-release. In

all cases the collagen gel contraction was larger for the contracture capsule cells when compared to the control capsule cells. The patterns of the contraction over the 4 hours post release were similar for contracture and control groups. Future work will determine whether there is an exaggerated response to TGF-beta1 in the contracture cells when compared to normal joint capsule cells.

**Paper 009**  
**1000-1006** Quantification of Matrix-Component Gene Expression in Monolayer Expanded Chondrocytes<sup>2</sup>  
**C. Secretan, K. Bagnall, R. Barley, N. Jomha, H. Shum, Edmonton, AB**

Articular cartilage (AC) has a poor innate healing capacity following significant injury. Autologous chondrocyte implantation is a repair technique which utilizes in vitro-expanded chondrocytes combined with a periosteal patch. The chondrocytes are enzymatically digested from arthroscopically harvested tissue at an initial surgery and expanded in monolayer culture prior to implantation at a second procedure. Unfortunately, in vitro expanded chondrocytes appear unable to retain their fundamental phenotype resulting in dedifferentiated cells which produce a matrix of inferior quality. This study compares the matrix-component gene expression profiles of chondrocytes in their native chondrons and through multiple divisions in monolayer culture. The goal of this study is to better understand the process of chondrocyte dedifferentiation and to compare matrix-component gene expression during cellular expansion in vitro. We observed that following removal from the extra-cellular matrix and plating in monolayer culture the chondrocytes experienced an up regulation of collagen I. In contrast, there was a stepwise decrease in collagen II with each successive passage until p8-p9. Aggrecan expression only decreased minimally as the cells were passaged. Rapid dedifferentiation of monolayer cultured chondrocytes is a persistent barrier to AC tissue engineering including ACI.

**1006-1012** Discussion

**Paper 010**  
**1012-1018** Potential Mechanism of Orthopaedic Implant Wear Particle Induced Apoptosis of Osteoblasts *in-vitro*  
**S. Gyomerey, M. Butcher, J. de Beer, S. Shaughnessy, M. Winemaker, Hamilton, ON**

Peri-implant osteolysis after total joint arthroplasty is a major cause of implant loosening. Cellular responses to wear particles have been reported to play a role in aseptic loosening due to their cytotoxic nature to cellular components. We previously demonstrated wear particle induce cellular responses suggestive of apoptosis in primary bone forming cells. Our current results would strengthen this idea by demonstrating induction of expression and activity of caspase 3 involved in apoptosis in cells incubated with wear particles. In addition, titanium wear particles may induce apoptosis through the intrinsic pathway by direct cellular effects rather than through the extrinsic TNF $\alpha$  pathway. Delineating the mechanism by which wear particles induce apoptosis in immature osteoblasts will allow for the selection and/or development of inhibitors to the process of aseptic loosening by targeting a specific pathway.

**Paper 011**  
**1018-1024** Mast Cells and Neuropeptides in Human Elbow Joint Capsules<sup>2</sup>  
**K. Hildebrand, D. Hart, P. Salo, M. Zhang, Calgary, AB**

The hypothesis is that mast cell numbers and neuropeptide containing nerve fibres are increased in the elbow joint anterior capsule of patients with post-traumatic contractures when compared to normal capsules. Capsules were obtained from 2 patients with contractures following radial head fractures and

2 organ donor elbows free of contractures. Double-labelling with specific antibodies to the mast cell marker chymase and the neuropeptide CGRP was used. The number of chymase positive mast cells was 6x greater in the contracture capsules when compared to normal capsules. In the contracture capsule, chymase positive mast cells represented 39% of total cells while in control capsules they represented 7% of total cells. The number of CGRP positive nerve fibres was increased 3x in the contracture capsule when compared to normal capsule. More subjects are needed to determine whether the mast cell and neuropeptide nerve fibre findings can be generalized to larger numbers.

**1024-1030** Discussion

**0900 - 1030** **Session 2: Joints and Arthritis – Moderators:** **Port Royal C**  
**Michael J. Dunbar, James A. Johnson, Mr. John**  
**Getty, British Orthopaedic Association**  
**President**

**Paper 012** Cryoprotectant Permeation Into Intact Porcine Articular Cartilage<sup>2</sup>  
**0900-0906** **N. Jomha, A. Abazari, J. A. W. Elliott, G. K. Law, L. E. McGann, K. Rekieh,**  
*Edmonton, AB*

Effective cryopreservation of articular cartilage (AC) could improve clinical results of osteochondral allografting and provide a useful treatment alternative for large cartilage defects. Vitrification (a form of cryopreservation) incorporates high concentrations of cryoprotectant agents (CPAs) and rapid cooling rates to preserve cells in suspended animation without detrimental ice formation. Effective vitrification requires high concentrations of CPAs within the cartilage matrix but the time-dependent toxicity of CPAs hinders their usefulness. The objective of this experiment was to determine the CPA permeation parameters for four commonly used CPAs in order to limit CPA exposure toxicity in future experiments. Full thickness 10mm diameter porcine osteochondral dowels were used to determine the permeation rate of four CPAs (DMSO, propylene glycol, ethylene glycol, and glycerol). Preliminary results indicate ethylene glycol had the most rapid permeation, followed by DMSO, propylene glycol and glycerol respectively. Permeation rates were time and temperature dependent. Cryoprotectant agent permeation into intact porcine AC can be calculated using the method described in this study and this information will markedly improve our ability to create novel vitrification solutions.

**Paper 013** Neuromuscular Pattern Differences During Gait Among Asymptomatic  
**0906-0912** Controls and Those With a Range of Knee OA Severity<sup>2</sup>  
**L. Diamond, M. Dunbar, C. Hubley-Kozey, W. Stanish, Halifax, NS, K. J.**  
*Deluzio, Kingston, ON*

The purpose of this study was to characterize the neuromuscular patterns associated with different severities of knee osteoarthritis (OA). Forty-five patients with moderate OA, 37 with severe OA and 38 asymptomatic controls underwent a complete gait analysis with only the electromyographic (EMG) findings presented in this abstract. All EMG waveforms were analyzed for group differences using PCA followed by an ANOVA (group by muscle) for the PCA scores for each muscle group. The PCA analysis of the EMG waveforms revealed statistically significant differences ( $P < 0.05$ ) in patterns among the three groups and between muscles within the three muscle groups tested. The neuromuscular differences found among groups during gait demonstrate that the role of the musculature surrounding the knee is altered slightly in those with moderate OA and altered drastically in those with end-stage OA compared to asymptomatic subjects, reflecting a

progression. The differences are consistent with the severe group adopting a strategy to increase dynamic stability and reduce medial joint loading. The moderate OA group illustrates a trend toward adopting this pattern but with only very subtle differences from asymptomatic subjects. These neuromuscular alterations have implications with respect to muscle function and may assist in defining severity.

**Paper 014**  
**0912-0918** The Correlation Between External Peak Knee Adduction Moment and the Ratio of Medial-to-Lateral Compartment Compression in Subjects With Knee Osteoarthritis<sup>2</sup>

*T. Jenkyn, T. Bhatnagar, T. Birmingham, London, ON*

Introduction: Patients with knee osteoarthritis (OA) experience a larger than normal peak knee adduction moment during walking. Adduction moment is a commonly used proxy measure for medial compartment compression. However, the correlation between these measures has not yet been quantified. Method: Optical motion analysis was performed on 30 patients receiving high tibial osteotomy to realign the knee due to osteoarthritis immediately pre-op and at 6 months post-op. An optimization model of the internal knee structure calculated the medial-to-lateral compartment ratio of compressive loads. This was correlated to the adduction moment calculated from the motion analysis. Results: Peak M[add] decreased from  $2.53 \pm 1.32$  to  $1.63 \pm 0.81$  [%body weight\*ht] ( $p < 0.001$ ). The peak MLR decreased from  $2.63 \pm 1.08$  to  $1.52 \pm 0.56$  [unitless] ( $p < 0.001$ ). There was a moderate correlation between M[add] and MLR with the Pearson  $R^2 = 0.457$  ( $p = 0.014$ ). Conclusions: These results suggest that adduction moment is an acceptable proxy for quantifying the internal compressive loading in the knee. However, further research is required with a larger sample size to increase confidence in this proxy measure in a clinical setting.

**0918-0923** Discussion

**Paper 015**  
**0923-0929** Effect of Distal Radius Fracture Alignment on Forearm Rotation<sup>2</sup>

*G. Fraser, L. M. Ferreira, J. A. Johnson, G. J. W. King, London, ON*

Eight fresh cadaveric specimens were utilized in this in-vitro study to examine the effects of various simulated distal radius fracture malalignments on forearm rotation. An osteotomy was created just proximal to the distal radioulnar joint and a custom made 3-degree of freedom in-line modular implant designed to simulate distal radius fracture deformities was secured in place. This allowed for accurate adjustment of dorsal angulation, dorsal displacement, and radial shortening both independently and in combination. The study was divided into 2 parts, the first phase examining the effects of distal radius deformity and the second sectioned the TFCC and repeated the testing, reviewing the effects of a progressive soft tissue injury in conjunction with distal radius deformity. Dorsal angulation of  $30^\circ$  led to significant restriction in both pronation and supination, dorsal displacement of 10mm reduced the amount pronation and radial shortening up to 5mm had no statistical significance on rotation. Sectioning the TFCC restores the kinematics to the pre-injured state, eliminating any significant loss in rotation, when examining the single contributions of a simulated fracture. Combined factors are required in order to see a significant reduction of motion for a sectioned TFCC.

**Paper 016**  
**0929-0935** Reliability of Lower Limb Frontal Plane Alignment Measures Obtained With a Computer Software Programme

*E. Sled, T. D. V. Cooke, P. Costigan, M. Lam, L. Sheehy, Kingston, ON, M. Nevitt, San Francisco, CA, D. Felson, Boston, MA*

The purpose of this study was to determine the reliability of lower limb alignment measures obtained from digital radiographs using a computer software program. Measurements of lower limb frontal plane alignment were obtained from over 3000 full limb digital radiographs of both limbs of persons 'at risk' for developing knee osteoarthritis. Three trained clinicians used the software program to locate femoral and tibial bone landmarks from which measures of alignment and bone lengths could be computed. To assess the reliability of these measurements, 100 randomly assigned digital radiographs, representing 200 limbs, were selected from the complete data set for a repeated analysis carried out two weeks after completion of the first measurements. Random effects 2-way analysis of variance models were applied to estimate interclass and intraclass correlation coefficients (ICC). High reliability measures were obtained for the Hip-Knee-Ankle (HKA) angle (inter-reader reliability: ICC=0.995; intra-reader reliability: ICC= 0.998). Reliability for additional femoral and tibial angles ranged from 0.839 to 0.998. For bone lengths, ICC values ranged from 0.993 to 0.995. All measurements were highly reliable. The outcome supports the use of computer programs for analysis of lower limb alignment.

**Paper 017**  
**0935-0941** Association Between Foot Progression Angle and Knee Adduction Moment in Osteoarthritis: A Cross-Sectional Study Using Two Analytical Techniques<sup>2</sup>  
**D. Rutherford, C. Hubley-Kozey, W. Stanish, Halifax, NS, K. Deluzio, Kingston, ON**

The purpose of this study was to determine the association between net external knee adduction moment (KAM) characteristics and foot progression angle (FPA) in asymptomatic individuals (n=58), those with moderate (n=54) and severe osteoarthritis (n=54) through discrete variable and Principal Component Analysis (PCA). Three-dimensional (3D) motion and ground reaction force data were recorded during gait where the discrete variable, peak KAM, was extracted for the interval (30-60%) of the gait cycle. PCA was used to extract the predominant waveform features (Principal Components (PC)). Pearson Correlations were calculated for the FPA and both the derived PC-scores and peak KAM. No relationship between FPA and peak KAM was found across the groups using discrete variable analysis. The PCA results suggest a toe out FPA was moderately correlated to a decreased KAM (PC2) during 30-60% of the gait cycle for asymptomatic and moderate OA individuals only.

**0941-0946** Discussion

**Paper 018**  
**0946-0952** The Effect of Total Knee Replacement Surgery on Muscle Strength and Patient Function<sup>2</sup>  
**G. Hatfield, M. Dunbar, C. Hubley-Kozey, Halifax, NS, K. J. Deluzio, Kingston, ON**

Purpose: To compare strength and recruitment of periarticular knee muscles in subjects with severe osteoarthritis (OA) one week before and one year after total knee replacement surgery (TKR). Methods: 28 subjects performed maximum voluntary isometric contractions for six exercises. Torque and surface electromyograms (EMG) from the gastrocnemius, quadriceps and hamstring were recorded. Exercises included knee extension and flexion at mid range and closed-pack positions and plantarflexion with knee extended. Subjects completed WOMAC questionnaires to assess function. Results: By one year post-TKR only knee extension with the subject's knee at 45° showed a significant (p<0.05) torque increase. EMG amplitudes increased for the quadriceps and hamstrings (p<0.05), but the relative contributions of each muscle did not change, excepting rectus femoris. Within each exercise, some subjects increased their torque, but almost as

many decreased. WOMAC scores for pain, stiffness, and function improved significantly. Conclusion: TKR is becoming common as a treatment for OA, but few studies have examined muscle strength before and after, which impacts patient function and the lifespan of the implant. The results provide evidence that post-TKR management must address strength deficits in addition to subjective assessments of improved symptoms to measure success.

**Paper 019  
0952-0958** Detecting Differences Between Asymptomatic and Osteoarthritic Gait is Influenced by Changing the Knee Adduction Moment Model<sup>2</sup>  
*R. Newell, C. L. Hubley-Kozey, W. D. Stanish, Halifax, NS, K. J. Deluzio, Kingston, ON*

The objective of the study was to determine if changing the biomechanical model at the knee would affect the ability to detect differences between OA and asymptomatic gait. The gait of 44 asymptomatic and 44 moderate OA subjects was measured. The adduction moment was calculated using three different biomechanical models. The adduction moment waveforms were compared between groups for various portions of the gait cycle for all three models. The choice of biomechanical model changed the overall magnitude and shape of the adduction moment waveform. These changes affected the ability to detect group differences using commonly reported parameters of the adduction moment. Group separation was achieved (regardless of model) when analyzing the magnitude of the adduction moment across the entire stance phase and the mid-stance portion of the gait cycle. Group differences that are not model dependent may be important in understanding the pathomechanics of OA and evaluating interventions.

**Paper 020  
0958-1004** Multi-Segment Foot Model for Detection of Abnormal Foot Kinematics During Walking Gait  
*T. Jenkyn, K. Anas, C. Dombroski, S. Robbins, London, ON*

Motion analysis (MA) is a useful tool for quantifying joint abnormalities accompanying osteoarthritis. However, current practice does not allow the joints of the foot to be measured since the foot is treated as a single rigid segment. A multi-segment kinematic foot model was developed and applied to a healthy population during normal walking and gait intentionally disrupted by a high arch orthotic. The foot was defined as five rigid segments: hindfoot, midfoot, medial and lateral forefoot and the hallux. 30 healthy subjects (11 male, 19 female; mean age 27.7 years, range 19-53) were examined and three angles reported: hallux-medial forefoot (HA) and hindfoot-midfoot (HFA) in the sagittal plane, and height-to-length ratio of the medial-longitudinal arch (MLA; normalized to zero in quiet standing). HA was not significantly changed between normal and disrupted conditions: from  $8.5^\circ \pm 6.4^\circ$  to  $8.6^\circ \pm 7.4^\circ$  ( $p=0.88$ ). The HFA plantar-flexion significantly increased from  $0.5^\circ \pm 3.3^\circ$  (normal) to  $2.9^\circ \pm 4.4^\circ$  (disrupted;  $p<0.01$ ). The MLA was significantly increased (arch raised) from  $0.004 \pm 0.018$  (normal) to  $0.017 \pm 0.021$  (disrupted;  $p<0.01$ ).

**1004-1008** Discussion

**Paper 021  
1008-1014** Changes in Hip and Ankle Mechanics are Related to Moderate Knee Osteoarthritis<sup>2</sup>  
*J. Astephen, M. J. Dunbar, Halifax, NS,, K. J. Deluzio, Kingston, ON*

Gait analysis provides insight into the mechanical factors of knee osteoarthritis (OA) by quantifying the dynamic loading and alignment of the joints of the lower extremity. Gait analysis was performed on a group of 44

patients with moderate knee OA, and on a group of 60 asymptomatic subjects. Peak parameters extracted from the gait waveform patterns of the three-dimensional hip and ankle joint angles and moments were compared between the two groups. The peak hip extension moment, the peak hip adduction moment, the peak hip internal and external rotation moments, and the peak ankle dorsiflexion and plantarflexion moments were all reduced in the knee osteoarthritis population compared to the asymptomatic population. Differences in knee joint loading patterns with moderate knee osteoarthritis have been previously reported, but these data suggest that changes in the mechanical environment of all lower extremity joints are associated with early stages of knee osteoarthritis.

**Paper 022**  
**1014-1020** Elevated Intracompartmental Pressure and Muscle Injury: An Experimental Study Using Intravital Videomicroscopy<sup>2</sup>

**A. Lawendy, A. Badhwar, A. Bihari, D. Gray, N. Parry, D. Sanders, London, ON**

Elevated intracompartmental pressure (ICP) results in tissue damage and microcirculatory dysfunction. This study measured the effects of increased ICP on skeletal muscle microcirculation, inflammation and cell viability using intravital videomicroscopy. Twenty adult male Wistar rats were randomized to 4 groups: the control group (control), and 3 experimental groups with elevated ICP maintained for 15 (15m), 45 (45m), or 90 (90m) minutes. Compartment pressure was continuously monitored and controlled between 30–40mmHg. The Extensor Digitorum Longus muscle was studied using intravital videomicroscopy to measure perfusion, inflammation, and injury. With increased duration of elevated ICP, perfusion was decreased, inflammation increased, and the proportion of injured cells increased. Interestingly, as little as 15 minutes of 30 mmHg ICP caused irreversible muscle damage and microvascular dysfunction. A severe inflammatory response accompanies elevated ICP, the importance of which is unknown.

**Paper 023**  
**1020-1026** The Influence of Knee Flexion Contracture on Trunk Kinematics During Gait

**K. Harato, H. Matsumoto, T. Nagura, T. Otani, Y. Suda, Y. Toyama, Yokohama, Japan**

The purpose of this study was to investigate the effect of knee flexion contracture on trunk kinematics during gait. Ten healthy women, averaged 62 years, participated in this study. Subjects were tested at our laboratory with use of gait analysis system which consisted of eight retro-reflective markers (placed at bilateral acromion, anterior and posterior superior iliac spine, and iliaccrest), and five cameras. Unilateral (only right side) knee flexion contractures of 0, 15, and 30 degrees were simulated by using a hard brace. All subjects performed walking trials at their preferred speed with or without simulation. We evaluated walking velocity (m/s) and trunk kinematics (degrees). As a result, simulated knee flexion contracture significantly influences physiological trunk kinematics in each plane in our study. In the coronal plane, lateral bending to the contracture side was restricted, and this fact indicated that the lumbar spine may bend convexly to knee contracture side. In the sagittal plane, trunk anterior inclination significantly increased at 30 degrees contracture, which may lead to decrease of lumbar lordosis. In addition, knee flexion contracture decreased left rotation in the axial plane. These facts may result in "Knee-Spine Syndrome".

**1026-1030** Discussion

**1030-1100** Poster Session and Break with Exhibitors

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**Metro Centre**

**1100- 1230** Symposium #1: Raising the Bar: Tools other than a goniometer and the WOMAC for assessing the outcomes of the next generation of knee replacements **Port Royal C**

**1230-1330** CORS Business Meeting **Mariner 3**  
Lunch with Exhibitors **Metro Centre**

**1330-1500** Women in Orthopaedics Luncheon - Depuy **Highland 8**

**1330-1500** **Session 3: Arthroplasty Combined –** **Port Royal C**  
**Moderators : Bas A. Masri, Erin L. Boynton,**  
**CORS President, John Harris, Australian**  
**Orthopaedic Association President**

**Paper 024** Range of Motion After Total Hip Resurfacing and Total Hip Arthroplasty: A  
**1330-1336** Single-Blind Randomized Clinical Study<sup>2</sup>  
*M. Lavigne, J. Girard , S. Mottard , A. Roy ,P. A. Vendittoli Montreal, QC*

Restoration of normal ROM has been proposed as an advantage of hip resurfacing (SRA) over THA . However, the head-neck diameter ratio would in theory allow more ROM with THA ( ratio 2:1) versus SRA ( ratio 1.3-2.0:1).60 SRA and 62 THA were evaluated at minimum of 12 months. No significant differences (p>0.05) were found in the total arc of motion (SRA=204.2°, THA=196.5°), arc of rotation (SRA=47.7°, THA=44.3°), flexion-extension arc (SRA=118.1, THA=120.1), abduction-adduction arc (SRA=43.1°, THA=42.9°).In theory, ROM should have been greater in THA. Fear of instability may have limited ROM recovery potential in THA. Since pre operative soft tissue contracture is an important factor influencing post operative ROM, the complete capsular release performed during SRA may have been an advantage of this technique

**Paper 025** Predictors of Femoral Neck Fracture Following Hip Resurfacing: A Cadaveric  
**1336-1342** Study<sup>2</sup>  
*E. Davis, M. Olsen, E. Schemitsch, J. Waddell, C. Webber, Toronto, ON*

We aimed to establish if radiological parameters, such as DEXA and quantitative CT could predict the risk of sustaining a femoral neck fracture following hip resurfacing. This study suggests that a patient's risk of femoral neck fracture following hip resurfacing is most strongly correlated with total mineral content at the head/neck junction and bone mineral density. This biomechanical data suggests that the risk of post-operative femoral neck fracture may be most accurately identified with a pre-operative quantitative CT scan through the head/neck junction combined with the femoral neck width.

**Paper 026** The Accuracy of Radiographs in Measuring Femoral Neck-Shaft Angulation  
**1342-1348** and Femoral Component Angulation Following Hip Resurfacing Arthroplasty<sup>2</sup>  
*E. Davis, P. Gallie, M. Olsen, E. Schemitsch, J. Waddell, Toronto, ON*

The purpose of the study was to assess the accuracy of plain digitized radiographic images for measurement of neck-shaft and stem-shaft angles in hip resurfacing arthroplasty. Patient malposition during radiographic imaging can contribute to erroneous neck-shaft and stem-shaft angle results. Significant intra- and inter-observer variation was noted in the measurement of neck shaft angle however, variation was less marked for measurement of stem shaft angle.

1348-1353 Discussion

**Paper 027**  
1353-1359 The Accuracy of Digital Templating in Uncemented Total Hip Arthroplasty  
**M. Winemaker, J. de Beer, P. Gamble, Hamilton, ON**

Digital radiography has replaced traditional radiography in many hospitals yet little is known regarding the accuracy of this new technology in THA templating. Our study analyzed the reproducibility and reliability of computer templating in primary uncemented THA as compared to standard on-lay templating techniques with hardcopy radiographs from a digital source. Forty patients undergoing THA had preoperative digital radiographs taken which included an AP pelvis with a 50mm magnification marker placed in the groin, AP hip, and a cross-table lateral. Hardcopies of digitized radiographs were printed and a traditional templating technique using 120% magnified on-lay transparent templates was performed. Digital templating was performed using OrthoView Software (Bono, 2004). Templating was conducted by two staff surgeons and one resident. Intra-observer and inter-observer effects were calculated. There was a significant difference between the accuracy of acetabular cup templating between techniques, likely as a result of the ability of computer templating to adjust for magnification error. Computer templating was able to accurately predict postoperative leg-length discrepancy, abduction angle and horizontal offset. Overall, computer templating was found to be a reproducible and reliable technique for uncemented THA.

**Paper 028**  
1359-1405 The Effects of Total Knee Replacement Surgery on Biomechanical and Neuromuscular Gait Parameters  
**C.L. Hubley-Kozey, K. J. Deluzio, M. Dunbar, R. S. Newell, Halifax, NS**

The purpose of the study was to determine changes in frontal plane loading and neuromuscular responses pre-and post unilateral total knee replacement (TKR) during walking. Gait was measured for 34 patients prior to TKR surgery and one-year post-surgery. 3-D kinematics, kinetics and electromyographic (EMG) patterns from seven lower-limb muscles were recorded while walking at their self-selected speed. Principal component analysis was applied to the pre-and post-TKR waveforms. T-tests and ANOVA models tested pre-post TKR differences and muscle differences ( $p < 0.05$ ). Walking velocity significantly increased from the pre-TKR ( $0.9 \pm 0.23$  m/s) to the post-TKR ( $1.07 \pm 0.21$  m/s). There were significant magnitude and shape differences between the pre-and-post-TKR knee adduction and EMG waveforms. The results show improved function with increased walking velocity, and more importantly, differences with respect to joint loading and muscle function. These changes have implications for improved joint loading, reduced risk of muscle fatigue and decreased metabolic costs associated with walking.

**Paper 029**  
1405-1411 Cement Curing and Static Mechanical Strength During *in-vivo* Pig Femoral Arthroplasty  
**S. Hunt, S. Seal, C. Stone, St. John's, NL**

The cure-stage of bone cement is an important variable that is decided at the time of surgery. Late-cure stage cement is more viscous and requires greater force on the part of the surgeon to insert the femoral prosthesis. We have compared two cementing techniques, femoral component insertion into early-cure stage cement and insertion into late-cure stage cement in an *in vivo* model. Bilateral arthroplasties – using only the femoral component - were performed *in vivo* on paired porcine femora. The femora were harvested and cross-sectioned in preparation for strength testing. Performance was measured by peak load required to push the femoral prosthesis and surrounding cement mantle free of the cancellous bone. Femoral component

insertion into late-cure stage cement required statistically significant higher loads for push-out when compared to component insertion into early-cure stage cement.

**1411-1415** Discussion

**Paper 030**  
**1415-1421** The Effect of Implant Stem Length on Bone Strains in the Distal Ulna<sup>2</sup>  
**R.L. Austman, B. J.B. Beaton, C. E. Dunning, K. D. Gordon, G. J.W. King, C. E. Quenneville** London, ON

The purpose of this study was to investigate the effect of implant stem length on distal ulnar bone strains. Strain gauges were applied to eight cadaveric ulnae at six locations along their lengths. Loads (5-30N) were applied to the ulnar head while strains were recorded. The ulnar head was removed and the loading procedure repeated for cemented stainless steel stems 3 and 7cm in length. Other stem lengths between 3 and 7cm were tested in 0.5cm intervals with a 20N load applied only. In general, distal bone strains increased as stem length decreased. The native strains were different from all stem lengths for the four distal-most gauges ( $p < 0.05$ ). The 3cm stem strains were closer to the native strains than the 7cm for all loads at gauges overtop of the stem. Overall, the 3cm stem produced the highest strains, and thus would likely result in less distal ulnar bone resorption after implantation.

**Paper 031**  
**1421-1427** Evaluation of Sensitivity of Knee Soft Tissue Tension<sup>2</sup>  
**G. Mackenzie, D. Chess, S. Deshpande, J. Johnson, A. Kedgley,** London, ON

Optimal soft tissue tension maximizes function following total knee arthroplasty (TKA). Composite tibial component thickness is a prime determinant of soft tissue tension. Polyethylene inserts generally allow for 2-3 mm incremental changes. This study analyzed the effect of 1-mm incremental changes in polyethylene thickness on soft tissue tension. Computer assisted TKA was performed on eight cadaveric knees. The knees were moved through a full range of motion. Flexion data were recorded using the navigation software, and compartment loads recorded using an instrumented tibial insert. Compartment loads increased with increasing insert thickness. Peak loads showed a reduction after reaching a maximum level with further increase in insert thickness (seven of eight specimens). Six of eight specimens showed an incremental increase in loads greater than 100N. The high sensitivity of compartmental loads to a 1-mm thickness increase is significant and has not been previously appreciated.

**Paper 032**  
**1427-1433** Synovial Fluid Constituents Affect Polyethylene Wear in Total Knee Replacements<sup>2</sup>  
**J. Brandt, K. Charron, S. MacDonald, J. Marr, J. Medley, L. Zhao,** London, ON

An attempt was made to identify synovial fluid (SF) characteristics that may be responsible for the boundary lubrication in the joint with the goal to develop a more clinically relevant lubricant. Twenty samples of SF were drawn from twenty patients and analyzed. Specific protein constituents and osmolality were then compared to three calf sera frequently used in knee wear testing. There was significant difference in PE wear rates between the three calf-sera. BCS and NBC did not have clinically relevant levels of specific protein constituents. This study strongly suggests that current standards for total knee wear testing should be revised to enable more controlled wear testing under more clinically relevant conditions. It is suggested to be of particular importance when new bearing materials, such as cross-linked PE's, are evaluated and proposed for clinical application.

1433-1437 Discussion

**Paper 033** The Effect of Anatomical Landmark Selection on Registration Accuracy in  
1437-1443 Computer-Assisted Elbow Surgery<sup>2</sup>

**C.P. McDonald, B. J. B. Beaton, J. A. Johnson, G. J. W. King, T. M. Peters,**  
London, ON

Accurate implant alignment with the flexion-extension axis of the elbow is important following elbow replacement arthroplasty. To assist with alignment, surface data can be acquired from the patient intraoperatively and registered to a pre-operative image. This study investigated the effect of intraoperative sampling area on registration accuracy. We hypothesized that a low registration error can be achieved by acquiring surface data from areas unlikely compromised due to injury and readily available to the surgeon during typical surgical exposures. CT images of 20 cadaveric distal humeri were acquired. Registration to the CT image was performed for 39 landmark combinations. Using only data from the posterior shaft and proximal medial supracondylar column, a registration error of  $1.1 \pm 0.2$  mm and  $0.4 \pm 0.2^\circ$  was achieved. These landmarks are located proximal to the articular surface, readily available surgically, and unlikely compromised due to distal humeral fractures, non-unions or bone loss due to severe erosive arthritis. Overall, this study demonstrates the promise for a successful registration of the contralateral normal elbow to physical surface data of the diseased or injured elbow using only a small portion of undamaged bone structure.

**Paper 034** Computer-aided Hip Resurfacing Using Rapid Prototyping

1443-1449 **M. Kunz, R. E. Ellis, L. Ploeg, J. Rudan, Kingston, ON**

For hip resurfacing arthroplasty, precise planning and implantation of the components is necessary for long-term success. Earlier studies have shown that a computer-assisted technique can achieve higher accuracy than conventional technique. However, many of the proposed computer systems add additional complexity, time and cost to the surgery. This study investigated the use of rapid prototyping as an accurate, fast and cost-effective solution for computer-aided hip resurfacing.

**Paper 035** Total Knee Arthroplasty Improves Gait Symmetry<sup>1</sup>

1449-1455 **J. Haverstock, Michael Dunbar, Allan Hennigar, Lorne Leahey, Halifax, NS**

1455-1500 Discussion

1330-1500 **Session 4: Spine and Tumour Combined – Highland 6/7**

**Moderators: Frank O'Dea, Brendan D. Lewis,**  
**Canadian Orthopaedic Association President**

**Paper 036** Interbody Fusion With Allograft and rhBMP-2 Leads to Consistent Fusion but  
1330-1336 Early Subsidence

**A. Sethi, W. Hakeos, S. Meisterling, R. Vaidya, R. Weir, C. Wybo, Detroit, MI**

A prospective study was performed to determine the effectiveness of rhbmp-2 in interbody fusion with machined allograft spacers. Seventy seven patients underwent interbody spinal fusion using allograft and instrumentation. In thirty-six patients rhBMP-2 was used with the allograft to aid the fusion process. Clinical and radiographic outcomes were assessed preoperatively and at every follow up visit. All patients in group 1 (rhBMP-2 with allograft) showed evidence of radiographic fusion at 6 months. In this group early lucency and subsidence of allograft was observed. The average

collapse in patients where subsidence occurred was 27% in anterior lumbar interbody fusion (13-42%) , 24% in transforaminal lumbar interbody fusion (13-40%) , and 53% in anterior cervical discectomy and fusion cases. Group 2 patients (allograft and demineralised bone matrix) averaged only 5% collapse. Although high rates of fusion were accomplished with allograft and rhBMP-2 (100%), significant subsidence occurred in greater than 50% of lumbar spine fusions and 30% of cervical spine cases.

**Paper 037**  
**1336-1342** Clinical Accuracy of Fluoroscopic Computer-Assisted Percutaneous Pedicle Screw Placement: a CT Analysis

*A. Zahrai, R. Rampersaud, B. Ravi, Toronto, ON*

A prospective computed tomographic (CT) analysis was performed in forty consecutive patients who underwent percutaneous pedicle screw placement and fusion. 159 titanium pedicle screws (L3-S1) were reviewed by three independent observers. All screws were placed using the two-dimensional FluoroNavTM system. The relative position of the screw to the pedicle was graded and the direction of breach was further classified as well as its trajectory. Correlation between observers was near perfect. The three observers rated 74.2%, 78.6%, and 78.0% of screws were completely contained within the pedicle. The majority (85.7%) of breaches were minor (<2mm) and more than half were lateral (54.3%). This technique was associated with an overall higher pedicle breach rate including a clinically significant medial breach. This study highlights the increased risk associated with percutaneous pedicle screw placement and calls for improved screw placement accuracy for minimal access instrumented fusions

**Paper 038**  
**1342-1348** Spinal Cord Compartment Syndrome in a Porcine Model of Distraction Injury

*M. Stiebel, P. Jarzem, Montreal, QC*

Linear spinal cord distraction, in animal models, leads to elevated intra-compartmental spinal cord pressure. We developed an in vitro model of distraction, with increasing tensile force, to demonstrate the relationship between the degree of spinal curvature and the proportional elevation of intra-compartmental pressure.

**1348-1353** Discussion

**Paper 039**  
**1353-1359** Preliminary Clinical Study of Smart Orthotic for AIS

*M.J. Moreau, D. L. Hill, E. Lou, J. K. Mahood, J. Raso, Edmonton, AB*

Efficiency of brace treatment for adolescent idiopathic scoliosis is correlated to how the brace has been worn. A smart orthotic was developed to maintain the interface pressure between the brace and body within the prescribed range during daily activity. Six scoliotic subjects, Cobb angle 31 +/- 5 degrees, who were new brace candidates were recruited. They used the system for 4 weeks: 2 weeks with monitoring only and 2 weeks with automatic feedback activated. The time that the pressure level was in target level range during the study period was increased from 53 +/- 9% to 68 +/- 14% with the feedback activated. This work helps brace candidates wear their braces more effectively and receive the most benefit from the brace treatment. As a result, all participated subjects maintained their Cobb angle within  $\pm 2$  degrees during the study period.

**Paper 040**  
**1359-1405** Brace Loads Pattern during Daytime and Nighttime Wear

*J.K. Mahood, D. Hedden, D. L. Hill, E. Lou, M. J. Moreau, J. Raso, Edmonton, AB*

A low power brace monitoring system which was developed from our group

was used to monitor brace wear tightness during daily activities. Twenty subjects had been recruited and followed up for 2 week study period. The brace loads that are collected continuously for at least 5 hours were included in the data analysis process. Daytime and nighttime wear patterns were evaluated separately. Among the 20 subjects, only 9 subjects' data during daytime and 11 subjects' data during nighttime were qualified for the analysis process. The average force ratios in hour 1 and hour 5 during daytime and nighttime were  $0.34 \pm 0.16$  (significance = 0.001) and  $0.15 \pm 0.24$  (significance = 0.06). This result showed that the brace tightness must be adjusted during daily in order to maintain the prescribed tightness.

**Paper 041**  
**1405-1411** Effect of VEGF Expression on Vertebral Growth Plates Following Hypoxic Stress<sup>2</sup>  
**S.K. Bisland**, C. Johnson, B. C. Wilson, Toronto, ON, S. Burch, San Francisco, CA

We observed from our previous studies that vascular-targeted photodynamic therapy (PDT) using benzoporphyrin derivative can up-regulate VEGF when applied to normal bone. We hypothesize that VEGF is up-regulated in response to PDT-induced hypoxic stress following shutdown of vessels within the tissue. VEGF in-turn promotes angiogenesis which in epiphyseal growth plates of long bones can lead to pre-mature vascularization of the physis and ossification. We further hypothesize that asymmetrical up-regulation of VEGF in spine, as would occur during a hypoxic event during spinal column growth, can lead to asymmetric growth plate closure and scoliosis. This study examines the response of PDT treatment of growth plates in long bones and spine with the intention of establishing models for limb length discrepancy (LLD) and scoliosis morphologically similar to idiopathic adolescent scoliosis. Thus far we have established LLDs of 4-6 mm and an 8 degree curve.

**1411-1416** Discussion

**Paper 042**  
**1416-1422** The Effect of the Growth Plate on Measurements of Rat-Tail Vertebral Biomechanical Behaviour<sup>2</sup>  
**M.R. Hardisty**, M. Akens, T. Skrinckas, C. M. Whyne, A. Yee, Toronto, ON

**Paper 043**  
**1422-1428** Evaluation of Quantitative MRI, Biochemical and Mechanical Properties of Trypsin-Treated Intervertebral Discs Under Physiological Compression Loading<sup>2</sup>  
**J. Antoniou**, G. Beaudoin, C. N. Demers, T. Goswami, F. Mwale, Montreal, QC, J. C. Iatridis, Burlington, VT

While disc degeneration has been implicated as a major etiologic component of low back pain, there has been relatively little study in developing an objective, accurate, non-invasive diagnostic tool in the detection and quantification of matrix changes in early disc degeneration. The aim of the present study was to establish the correlations between magnetic resonance (MR) parameters and the biochemical and mechanical properties of the nucleus pulposus (NP) undergoing targeted trypsin digestion and axial compression. Results support the concept that physiologic loading is an important confounder and that T1 $\rho$  is an essential parameter in efforts to develop quantitative MRI as a non-invasive diagnostic tool to detect and quantify matrix and material changes in early disc degeneration. Further studies are required to fully determine the potential of the T1 $\rho$  technique as a non-invasive diagnostic tool for disc degeneration.

**Paper 044**  
**1428-1434** Characterization of Intervertebral Disc Cells Behavior in a Mouse Subcutaneous Model

**F. Mwale, J. Antoniou, O. L. Huk, G. Marguier, A. Petit, D. J. Zukor, Montreal, QC**

Although the etiology of low back pain is unclear, it is believed that intervertebral disc (IVD) degeneration plays a major role. In this study, we sought to determine if bovine IVD cells maintain their phenotype in a mouse subcutaneous injection model. Nucleus pulposus (NP) cells were isolated from adult bovine tails and injected subcutaneously in Balb/c nude mice. After 2 weeks, the mice were sacrificed, the implants harvested and analyzed histologically, for proteoglycan contents, and for gene expression. After injection in mice, bovine NP cells appeared to retain their native phenotype. The RT-PCR analysis revealed that NP cells expressed aggrecan, type I and type II collagens, and CD24, a specific marker for the NP phenotype. This mouse subcutaneous injection model, where NP cells can be embedded in matrices, recreates the features of the native IVD and avoids the need to use a disc degeneration model.

**1434-1438** Discussion

**Paper 045**  
**1438-1444** Effect of Photodynamic Therapy (PDT) on Bisphosphonate Pre-Treated Breast Cancer *in-vitro*<sup>2</sup>

**M.K. Akens, S. K. Bisland, A. Karotki, C. Whyne, B. C. Wilson, A. J. Yee, Toronto, ON**

Purpose: Bone is the preferred site of metastases in women with breast cancer, which can cause skeletal-related events (SRE<sub>i</sub>'s) such as pathologic fractures. Bisphosphonates are the current standard of care for treatment of metastatic bone disease by preventing further bone destruction. Photodynamic therapy (PDT) has been applied successfully as a non-radiative treatment for malignancies. In PDT, light is delivered to a tumour after the administration of a photosensitiser. Earlier pre-clinical studies in a metastatic rat model have shown that PDT reduced the tumour burden in the vertebrae. The goal of this investigation was to study the effect of PDT on bisphosphonate pre-treated cancer *in-vitro*.

**Paper 046**  
**1444-1450** Vertebral Strain Measurement: A Comparison of Image Registration vs. Finite Element Analysis<sup>2</sup>

**M.R. Hardisty, I. Sigal, T. Skrinikas, C. M. Whyne, Toronto, ON**

Purpose: To compare strains measured in a whole rat-tail vertebra by image registration (IM) with those predicted by solid finite element analysis (FEA). Quantification of bone strain allows better understand fracture risk, bone healing and turnover.

**Paper 047**  
**1450-1456** Versican G-3 Domain Influences Breast Carcinoma Metastases to Bone<sup>2</sup>

**M.K. Akens, B. B. Yang, A. J. Yee, Toronto, ON**

Purpose: Versican is a large extracellular proteoglycan that is expressed in a variety of tissues and primary malignancies including infiltrating breast carcinoma. It also appears that versican can inhibit intercellular adhesion of normal as well as malignant cells. With the observation of selectin-like properties of versican G3 the investigators hypothesize that versican G3 influences not only local tumour invasiveness but also systemic metastases including the spread to bony sites. The present study aimed to test the hypothesis of versican G3 associated metastatic invasiveness in a murine osteolytic metastatic model of human breast carcinoma.

**1456-1500** Discussion

**1500 - 1510** J.A. Nutter Award Presentation – Matthew Di Silvestro

**Port Royal C**

**1510 - 1540** Health Break and Poster Session with Exhibitors **Metro Centre**  
**Please visit the COA's industry partners in the Metro Centre**

**1540 - 1600** **Featured Speaker - R.I. Harris Memorial Lecture –** **Port Royal C**  
Dr. William R. Rennie: "Canadian Orthopaedic Surgery- a Decade (or two) On"

**1600 - 1730** **Symposium #2: Damage Control Surgery in Trauma- Where Does It Fit in Canadian Orthopaedic Surgery in 2007?** **Port Royal C**

**1600 - 1730** **Session 5 (concurrently with symposium): Upper Extremity and Sports Medicine – Peter B. MacDonald, Sylvain Gagnon** **Highland 6/7**

**Paper 048** Arthroscopic Revision of Failed Open Anterior Stabilization of the Shoulder  
**1600-1606** **R. Bicknell, P. Boileau, C. Chuinard, N. Jacquot, L. Neyton, J. Richou, Nice, France**

The purpose is to report the results of arthroscopic Bankart repair following failed open stabilization. We reviewed 22 patients with an average age of 31 years. There were 17 men and five women. The previous interventions consisted of 16 osseous transfers, three open Bankart repairs and three capsular shifts. Labral re-attachment and capsulo-ligamentous re-tensioning with suture anchors was performed in all cases. Nineteen patients were evaluated at an average follow-up of 43 months (range, 24-72). One patient had recurrent subluxations and two had apprehension. Eight patients (42%) were still painful. Elevation was unchanged and loss of external rotation was 6°. Nine patients returned to sport at the same level and all patients returned to their previous occupation. Eighty-nine percent were satisfied or very satisfied. The mean subjective shoulder value (SSV), Walch-Duplay, Rowe and UCLA scores were 83%±23%, 85±21, 81±23 and 30±7 points.

**Paper 049** Arthroscopic Rotator Cuff Repair With and Without Arthroscopic Acromioplasty in the Treatment of Full Thickness Rotator Cuff Tears<sup>2</sup>  
**1606-1612** **P.B. MacDonald, P. Lapner, J. Leiter, R. Mascarenhas, S. McRae, Winnipeg, MB**

The purpose of this prospective randomized clinical trial is to examine the effect of acromioplasty on the outcome of arthroscopic rotator cuff repair. After failed conservative management patients were randomly assigned to receive arthroscopic rotator cuff repair with or without acromioplasty. Arthroscopic cuff repair with acromioplasty (subacromial decompression) included division of the coracoacromial ligament and standard acromioplast technique. Post-operative data collection occurred at 3, 6, 12, 18 and 24 months and included patient ROM, WORC scores and complete ASES scores. Preliminary results, from 28 subjects, suggest rotator cuff repair with acromioplasty demonstrate a statistically significant improvement (<0.05) in QOL, based on WORC and ASES scores, compared to the non-acromioplasty group. Three non-acromioplasty patients (2 with Type III acromion) required revision surgery. Arthroscopic cuff repair with arthroscopic acromioplasty in the treatment of full thickness rotator cuff tears is recommended for patients with a Type III acromion.

**Paper 050** Arthroscopic Bristow: A New "Belt and Suspenders" Technique for the Treatment of Anterior Shoulder Instability  
**1612-1618** **R. Bicknell, P. Boileau, C. Chuinard, A. B. El Fegoun, Nice, France**

The purpose is to report a new technique for treatment of anterior shoulder instability with capsular deficiency. The technique comprises four steps: 1. Diagnostic arthroscopy. 2. Removal of a coracoid fragment. 3. Arthroscopic Bankart repair. 4. Tenodesis of the coraco-biceps tendon above the supscapularis tendon with an interference screw. We reviewed 36 patients (mean age 29 years) at a minimum one-year follow-up. Thirty-three patients (92%) were satisfied or very satisfied and three (8%) were disappointed. Post-operative mobility revealed no loss of elevation, a loss of external rotation with the arm at the side of nine degrees, a loss of external rotation in abduction of 15 degrees and no loss of internal rotation. The mean Duplay score was 87. Recurrent instability occurred in three patients (8%). There were no complications. This technique combines the theoretical advantages of the Bristow procedure and the "arthroscopic Bankart repair".

**1618-1623** Discussion

**Paper 051**  
**1623-1629** Difference In Outcome Between Bursal and Articular Partial Thickness Rotator Cuff Tears: One-Year Follow-Up Results

*R. Holtby, S. Misra, H. Razmjou, Toronto, ON, E. Maman, Tel-Aviv, Israel.*

The purpose of this study was to examine the Quality of Life (QOL) outcomes 12 months post-operatively in patients with partial thickness rotator cuff tears. Forty-four Articular (AT) and 49 Bursal tears (BT), were included in the analysis. There was no statistically significant difference between the two groups in pre-operative QOL outcome scores. Both groups showed significant improvement in three outcomes ( $p < 0.0001$ ) one year following surgery. However, the AT group was significantly less improved than the BT group in the ASES scores ( $p = 0.04$ ), Constant-Murley scores ( $p = 0.006$ ) and WORC ( $p = 0.01$ ). The results indicate that the quality of life improves significantly regardless of the tear site. The pattern of recovery however is different indicating that patients with Bursal tears show a higher degree of improvement in their functional measures.

**Paper 052**  
**1629-1635** Arthroscopic Treatment of Type II SLAP Lesions: Biceps Tenodesis as a Functional Alternative to Reinsertion

*R. Bicknell, P. Boileau, C. Chuinard, N. Jacquot, S. Parratte, C. Trojani, Nice, France*

The purpose was to review the results of biceps tenodesis and reinsertion in the treatment of type II SLAP lesions. This is a retrospective study of a continuous series of 25 patients. Ten patients with an average age of 37 years (range, 19-57) had a reinsertion of the biceps tendon to the labrum. Fifteen patients with an average age of 52 years (range, 28-64) underwent biceps tenodesis in the bicipital groove. In the reinsertion group, the average follow-up was 35 months (range, 24-69). Three patients underwent subsequent biceps tenodesis, three others were disappointed and four were very satisfied. The Constant score improved from 65 to 83 points. In the tenodesis group, the average follow-up was 34 months (range, 24-68). No patient required reoperation. One patient was disappointed, two were satisfied and 12 were very satisfied. The Constant score improved from 59 to 89 points.

**Paper 053**  
**1635-1641** Arthroscopic Repair of Large Rotator Cuff Tears: Prospective Follow-Up Using the Western Ontario Rotator Cuff (WORC) Assessment Tool.

*D. Legay, M. Forbes, M. Ripley, Dartmouth, NS*

Purpose: Patient outcomes for arthroscopic repairs rotator cuff repairs have been analyzed almost exclusively by means of a single post-operative follow-up date. The purpose of this study was to examine the results of arthroscopic

repairs of large rotator cuff tears performed by a single surgeon, both serially and at a two-year endpoint following surgery.

**1641-1645** Discussion

**Paper 054** The Impact of Waiting for Rotator Cuff Repair on Impairment, Function and Productivity<sup>2</sup>  
**1645-1651**

*J.C. Macdermid, G. Athwal, D. Drosdowech, K. Faber, London, ON*

This study evaluated the impact of surgical wait-list times .205 patients were evaluated by a blind evaluator and by self report when referred for surgical management of cuff tear (confirmed by ultrasound or MRI). Patients were assessed on a monthly basis prior to surgery (two year limit). ROM and strength were assessed by an independent evaluator; patient's self-reported comorbidity, functional status (WORC, SST), work limitations (WLQ-26) and work lost-time. Changes in health status were assessed using repeated measures ANOVA and GLM. The mean age of the population used was 56+/-11 years in which 74% were males and 26% females. Tear size was distributed amongst this population as small (0-1 cm {45%}), moderate (1-3cm 27%), large (3-5cm 23.2%) and massive (5+cm 15%). Patients had symptoms or an average of 14 months prior to referral. Despite this, decline in strength (p mental demands) (output demands > time management demands ). Loss in productivity exceeded 15%.

**Paper 055** Impact of Rotator Cuff and Superior Labral Pathology on Shoulder Biomechanics: (Examination Under Anesthesia)  
**1651-1657**

*H. Razmjou, M. Aarabi, R. Holtby, Toronto, ON, M. Aarabi, Sheffeld, UK*

The purpose of this case-control study was to assess the impact of rotator cuff and superior labral pathologies on glenohumeral translation and range of motion of the shoulder in comparison with normal shoulders. Subjects were matched by age, gender and hand dominance side. All subjects including the control group were examined under anesthesia. Forty-six females and 44 males with RC pathology and 27 men with SLAP pathology were compared with the control group. Rotator cuff pathology reduced range of motion of the affected side in all directions (p=0.02 to p<0.001). SLAP pathology caused stiffness in all directions (p<0.001) except external rotation at 90 degrees of abduction. There were no significant differences in glenohumeral glides between the normal and SLAP groups. However, the affected side of the patients with RC pathology had less laxity than normal population in anterior and posterior directions.

**Paper 056** The Effect of Cigarette Smoking on the Outcomes of Rotator Cuff Surgery  
**1657-1703** *J. Anderson, D. S. Drosdowech, K. J. Faber, J. C. MacDermid, London, ON*

This study evaluated the impact of smoking on the outcome of rotator cuff repair controlling for age, gender, and size of tear. A blind evaluator evaluated 250 patients at baseline and one year post-op. Smoking history was dichotomized into smoker and nonsmoker. Generalized linear modeling was used to determine the impact of smoking on surgical outcome using age, gender, tear size, and surgery type as covariates. The mean age of the population used was 56+/-11 years (males=70%, females=30%). All analyses indicated gender affected tear size, surgical outcomes and was associated with smoking status. Due to this confounding effect, males and females were separated for subsequent analysis. There was a significant negative effect on the 1-year outcomes of smokers (SST) in males (8.5 vs. 6.1 p=0.025); and a similar trend with the WORC (p=0.07). Results in females were not significant, but this subgroup sample was underpowered. Complex interrelationships exist between gender, age, physical demands and smoking

status. The existence of these confounding interrelationships may explain the mixed results seen in the literature. This large cohort established a negative impact of smoking on outcome, after controlling for covariates and confounders.

**1703-1707** Discussion

**Paper 057**  
**1707-1713** Rotator Cuff Tear Kinematics: An *in-vitro* Study of Rotator Cuff Tear and Repair Kinematics<sup>2</sup>

**B.J. Shore, G. S Athwal, D. S Drosdowech, K. J. Faber, J. A. Johnston, A. E. Kedgley, London, ON**

The purpose of this study was to determine the effects of simulated tears and repairs of the rotator cuff tendons on joint kinematics. This cadaveric study used 8 paired specimens. Cables were sutured to the rotator cuff tendons and deltoid. Loads were applied to the cables based on variable ratios of electromyographic (EMG) data and average physiological cross-sectional area (pCSA) of the muscles. An electromagnetic tracking device was used to provide real-time feedback of abduction angle, to which the loading ratio was varied correspondingly. Tears in the rotator cuff were generated. Rotator cuff tears caused alterations in glenohumeral kinematics. 2cm tear caused the humerus to consistently move posterior through the arc of abduction; however, as the tear increased to 4cm the humerus moved anteriorly, returning towards the intact state. Double row suture anchor repair more accurately reproduced the kinematics of the intact specimen compared to single row repair.

**Paper 058**  
**1713-1719** Arthroscopic Biceps Tenotomy and Tenodesis for Massive Irreparable Rotator Cuff Tears

**R. Bicknell, P. Boileau, C. Chuinard, Nice, France**

The purpose was to evaluate arthroscopic biceps tenotomy or tenodesis for massive irreparable rotator cuff tears. This is a retrospective study of 68 patients (mean age 68 years) with 72 irreparable rotator cuff tears treated with arthroscopic biceps tenotomy (39 cases) or tenodesis (33 cases), with a mean follow-up of 35 months. Fifty-three patients (78%) were satisfied. Constant score improved from 46 to 67 points ( $p < 0.001$ ). Presence of a healthy teres minor on preoperative imaging correlated with increased external rotation (40 vs. 18°,  $p < 0.05$ ) and higher Constant score ( $p < 0.05$ ). Three patients with a pseudoparalyzed shoulder did not benefit from the procedure and did not regain active elevation above horizontal. Fifteen patients with painful loss of active elevation recovered active elevation. There was no difference in Constant Score between tenotomy and tenodesis (61 vs. 73). A "Popeye" sign was clinically apparent in 24 tenotomy patients (61%). Two patients required reoperation.

**Paper 059**  
**1719-1725** Resurfacing Humeral Arthroplasty for Rotator Cuff Tear Arthropathy: Early Clinical Outcome

**D.S. Drosdowech, K. Iosipchuck, J. MacDermid, London, ON**

**1725-1730** Discussion

**1815 - 1915** Opening Ceremonies **Port Royal B**  
Featuring Presidential Guest Speaker Dr. Brian Day,  
President-Elect of the Canadian Medical Association

**Title: The Good Old Days**

**1915 - 2045** President's Welcome Reception **Metro Centre**

