Orthopaedic Visiting Professor
March 29-30, 2012

Dr. Carlo Bellabarba
Professor of Orthopaedics and Neurosurgery
University of Washington
Director, Spine Program
Harborview Medical Center
Seattle, Washington
CARLO BELLABARBA, MD

"My patient care philosophy is to treat each patient as if he or she were a family member and to use the full extent of my research and clinical experience to tailor a treatment program to each patient’s unique clinical situation."

Dr. Bellabarba graduated with honors in Biochemistry and Medicine from McGill University before completing his orthopaedic residency at Rush Presbyterian-St. Luke’s Medical Center in Chicago and fellowships in Spine, at Northwestern University, and Orthopaedic Trauma at the Florida Orthopaedic Institute of Tampa General Hospital. He is now Professor of Orthopaedics, Sports Medicine and Neurological Surgery, and Director the Spine Surgery Fellowship Program at the University of Washington. He also serves as Director of the Orthopaedic Spine Service at Harborview Medical Center.

Dr. Bellabarba’s clinical practice involves the surgical management of the full range and complexity of spine conditions, from the upper cervical spine to the sacrum. These include spine trauma; degenerative spine conditions such as stenosis and disc pathology; spine deformity such as scoliosis, kyphosis and spondylolisthesis; spine infections; spine tumors; and minimally invasive spine surgery and motion-sparing treatments. His research activities are focused on gaining a practical perspective on improving the diagnosis and treatment of complex spine conditions through high-quality clinical research. This is achieved through objective evaluation of new and established procedures and instruments for spine surgery.

In this context, Dr. Bellabarba teaches a wide range of spine-related topics to a broad audience of healthcare professionals, including medical students, orthopaedic and neurosurgical residents, fellows and practicing spine surgeons with orthopaedic and neurological surgery backgrounds.

It is a great pleasure and honor to welcome Dr. Bellabarba to McGill as our 2012 Orthopaedic Visiting Professor.

JOSEPH MILLER, BSC, MSC, MD, FRCSC

(1930-1990)

Dr. Joseph Miller was born in Edmonton, Alberta, Canada, and received all of his formal education in that city, graduating from the University of Alberta with a B.Sc. degree in 1952, and M.Sc. degree in 1954, and an M.D. degree in 1955. He interned at the Montreal General Hospital and then spent two years at the London Hospital in England, serving as a middle registrar in orthopaedic surgery and trauma. He returned to Canada, taking a fellowship in pathology, and completed his training in orthopaedic surgery at McGill University in 1962.

Dr. Miller’s first academic position was at the University of Illinois in Chicago. He spent two years on the faculty there and began his career by showing the traits that were to characterize the rest of his life. The graduating class of 1963 recognized him as the most outstanding clinical teacher on the faculty. He also began his scholarly activities, when he was assigned the job of directing the Muscular Dystrophy Clinic. He rapidly devised new techniques of treating patients who had this condition, and the children and their families became totally devoted to him, as he was to them. By the time he moved back to Montreal, he was recognized throughout the world as one of the outstanding authorities in the field.

In 1966, Dr. Miller was appointed Orthopaedic Surgeon-in-Chief at the Montreal General Hospital. He spent the rest of his career in that institution. From 1981 until 1986, he served as Chairman of the Division of Orthopaedic Surgery at McGill University, having been given the rank of Professor of Orthopaedic Surgery.

Jo Miller’s impact was as a scientist and as a person. He had an inquiring mind and intense curiosity. Although he was interested in many things, he concentrated on biomechanics, with an emphasis on the design of implants and on the interface between bone and either cement or the prosthetic surface. His creative activity resulted in equipment for the injection of cement. He was never satisfied with the status quo, and his ideas were always far in advance of clinical practice. He obviously still had a great deal of superb science to carry out.

In his inter-professional relationship with both his colleagues and patients he was sympathetic, understanding, and witty in all of his dealings. His residents used him as a role model. He was a truly brilliant teacher; the debates between Dr. Miller and his peers in the implant field were certainly entertaining, but, even more importantly, they informed the orthopaedic profession in an unforgettable way.

Dr. Miller died suddenly on March 1st, 1990, at the age of fifty-nine.
PROGRAM

WEDNESDAY, MARCH 28

19h00 “Meet the Professor Dinner” (Restaurant Tablée Vin)
(R2-R3-R4-R5)

THURSDAY, MARCH 29

MORNING Montreal General Hospital, Osler Amphitheater (A6.105)
Moderator: Dr. Robert Turcotte
07h30 “Multidisciplinary Surgical Grand Rounds”
Presentation by Dr. Carlo Bellabarba
Topic: “Complex sacral fractures with spino-pelvic dissociation”
08h30 Case Presentations
10h15 Coffee Break
10h30 Case Presentations
11h00 Jo Miller Guest Lecture
Presentation by Dr. Carlo Bellabarba
Topic: “The evolution of occipito-cervical trauma over 15 years”
12h00 Lunch and poster presentations, Livingston Hall (L6.500)

AFTERNOON Montreal General Hospital, Osler Amphitheater (A6.105)
Moderator: Dr. John Antoniou
13:00 Resident Research Paper Competition
Jury: • Dr. Carlo Bellabarba
• Dr. Jake Barralet
• Dr. Marie Gdalevitch
14h50 Coffee Break
15h00 Research Paper Competition (cont’d)
19h00 Annual Dinner (St-James’s Club)
Allocation of Eugene Rogala Prizes

FRIDAY, MARCH 30

MORNING Jewish General Hospital, Block Amphitheater (Pavilion B, Room 106)
Moderator: Dr. David Zukor
08h30 Case Presentations
10h45 Coffee Break
11h00 Case Presentations
11h30 Presentation by Dr. Carlo Bellabarba
Topic: “Controversies in spine trauma”
12h00 Discussion

The Royal College of Physicians and Surgeons of Canada has contributed to the sponsorship of our meeting through a Continuing Medical Education Grant

McGILL DIVISION OF ORTHOPAEDIC SURGERY

CHIEF OF DIVISION: DR. ROBERT TURCOTTE
PROGRAM DIRECTOR: DR. REGGIE HAMDY
RESEARCH DIRECTOR: DR. JANET HENDERSON
RESIDENCY PROGRAM RESEARCH DIRECTOR: DR. JOHN ANTONIOU

ADULT ORTHOPAEDIC SERVICES

Jewish General Hospital .......... Dr. David Zukor
Montreal General Hospital..... Dr. Robert Turcotte
St-Mary’s Hospital............... Dr. Ronald Dimentberg

PAEDIATRIC ORTHOPAEDIC SERVICES

Shriners Hospital for Children-Canada .......... Dr. Jean A. Ouellet (Assistant Chief of Staff)
Montreal Children’s Hospital.......................... Dr. Thierry Benaroch (Site Director)

RESEARCH FACULTY

Shriners Hospital for Children-Canada .......... Dr. Francis Glorieux
Montreal General Hospital..... Dr. Dennis Bobyn
Royal Victoria Hospital ............ Dr. Thomas Steffen
Dr. Lisbet Haglund
Jewish General Hospital .......... Dr. Jackson Mwale

FELLOWS

Dr. Nabil Al Assaf (Paediatrics) Dr. Saeed Koaban (Sports)
Dr. Abdulrahman Al Garni (Arthroplasty) Dr. Felipe Rossel Troncoso (Spine)
Dr. Waleed Awwad (Spine) Dr. Jeff Toreson (Oncology)
Dr. Romain Dayer (Paediatrics)

RESIDENTS

R5
Dr. Dr. Dr. Dr. Dr.
Maamon Al Jonaid
Mitchell Bernstein
Ali Esmail
Miah Radulescu
Hasan Sawan
Pascale Thibadeau

R4
Dr. Dr. Dr. Dr. Dr.
Abdulaziz Al Maawi
Saleh Al Sulaimani
Melissa Colless
Nicholas Desy
Christopher Haydon
Matthew Mann

R3
Dr. Dr. Dr. Dr. Dr.
Wassim Aldebeyan
Saeed AlQahtani
Khalid Alshwekh
Ahmed Amlaa
Alberto Carli
Adam Cota

R2
Dr. Dr. Dr. Dr. Dr.
Sarantis Abatzoglou
Fahad Abduljabbar
Anthony Albers
Abdulaziz Al-Jurayyan
Olivier Beaulieu-Lauzon

R1
Dr. Dr. Dr. Dr. Dr.
Christopher De Jesus
Abishek Kumar
Asim Malhdom
Hans Peter van Lancker
Andrew Crapser

Dr. Mohammad Al Zahrani
Abdulrahman Al Khelaifi
Maxime Beaumont-Courteau
Ryan Coughlin
Andrew Crapser

Dr. Isabelle Mousseau
Thierry Pauyo
Joseph Carl III
Feras Waly
Stephen Yang

Dr. Alexandre Pagé
Zeeshan Sardar
Diana Young

ORAL PRESENTATION SCHEDULE

13h30-13h40 A ten-year analysis of the Orthopaedic Trauma Association. Research Funding Program.
N. DESY

13h40-13h50 Immediate-long term outcome of agility total ankle arthroplasty.
M. RADULESCU

13h50-14h00 Comparison of biomechanical characteristics of three arthroscopic knots: the Pretzel knot, the SMC knot and the Square knot.
H. SAWAN

14h00-14h10 Treatment of Sanders II calcaneal fractures using minimally invasive open reduction and percutaneous screw fixation.
P. THIBAUDEAU

14h10-14h20 Giant cell tumor arising in the distal tibia.
S. ALSULAIMANI

14h20-14h30 Native knee alignment in osteoarthritic patients.
C. HAYDON

14h30-14h40 Distal ulna fractures: A biomechanical comparison of locking versus non-locking plate constructs.
M. COLLINS

14h40-14h50 Changing surgeons changes outcome of contralateral total joint arthroplasty.
M. MANN

14h50-15h10 COFFEE BREAK

15h10-15h20 Clinical, radiographic, and metal ion comparison of 36mm, 40mm and 44mm metal-on-metal total hip arthroplasty.
S. ABATZOGLOU

15h20-15h30 Analysis of MRI MARS studies, metal ion levels and radiographic parameters in patients with the ASR prosthesis.
K. ALSHEIKH

15h30-15h40 Porous titanium scaffold promote bone regeration of long bone critical sized defect in rodent model.
S. ALQAHTANI

15h40-15h50 Manipulating casts in the early post-injury period following distal radius fractures does not affect fracture stability.
A. CARLI

15h50-16h00 Frequency of multiple tarsal coalitions.
A. PAGÉ

16h00-16h10 A randomized control trial evaluating effectiveness of a synthetic BPM-2 fragmentin achieving lumbar interbody fusion: 12 month results of a multicenter, blinded Canadian study.
Z. SARDAR

Please note that EACH presentation should be
7 MINUTES and 3 MINUTES will be for
QUESTIONS AND DISCUSSION.
A TEN-YEAR ANALYSIS OF THE ORTHOPAEDIC TRAUMA ASSOCIATION RESEARCH FUNDING PROGRAM
Nicholas M. Desy, MD; Mitchell Bernstein, MD; Bogdan A. Matache; Todd O. McKinley, MD; Edward J. Harvey, MD, MSc, FRCSC

INTRODUCTION The Orthopaedic Trauma Association (OTA) established a research funding program in 1990. Through competitive grant applications, the OTA funds clinical and basic science projects conducted by residents and faculty. The funding amounts are significantly smaller than other granting agencies. Performance characteristics of the program have yet to be fully examined. We sought to determine if a subspecialty society has the capability to direct their research by comparing their output with other agencies. We also aimed to identify various research parameters that could affect grant success.

METHODS Grants were identified through the OTA online archive. The title of each grant and the principle investigator’s name were used to search across seven scientific databases for associated publications. A similar protocol identified any abstracts presented at three major orthopaedic meetings. Information was also sought through direct contact through the OTA directorate. The data was sorted based upon the type of research divided into three categories: resident, faculty basic science (basic science), or faculty clinical (clinical).

RESULTS From 2000 to 2009, $3,507,050 was awarded through 131 grants: 59 resident, 39 basic science and 33 clinical. There were 202 publications: 45 resident, 84 basic science and 73 clinical. Forty-one percent of resident grants were published, compared with 80% basic science and 67% clinical. The likelihood of a grant being published was 3.85 times higher if it was a basic science project compared with a resident (p=0.008; CI: 1.41-10.49); however, clinical studies were not predictive of publication success compared with basic science or resident projects. The cost per resident publication was $13,111 compared with $13,353 for basic science and $24,594 for clinical. There was no relationship between the amount funded and the likelihood of the project being published. The mean impact factor (MIF) per publication for resident, basic science and clinical were similar (2.4 vs. 3.3 vs. 2.6; p=0.189). Forty-nine percent of resident abstracts were presented at a national meeting versus 77% of basic science and 61% clinical. If the project was presented at a meeting, it is 10.4 times more likely to be published (p=0.000015; CI: 3.59-30.18).

CONCLUSION Over the study period, the publication output for funded projects was substantial. Faculty directed basic science studies had the highest publication rate. All three groups published in similar impact peer-reviewed journals. The MIF for all groups was 2.9, which is comparable to the National Institutes of Health (MIF = 5.5) and the American College of Gastroenterology (MIF = 6.7), considering that the MIF for orthopaedic journals is 1.4. The mean cost per publication was $17,712, which appears substantially lower than the NIH cost. The OTA is an important source of orthopaedic trauma research funding.
INTERMEDIATE-LONG TERM OUTCOME OF AGILITY TOTAL ANKLE ARTHROPLASTY

Mihail Radulescu, Adrian Cartaleanu, Monika Volesky, Ruth Chaytor

INTRODUCTION  Ankle fusion is arguably the gold standard for end stage ankle arthritis. ST fusion is required in 5% of cases at 5 years. The nonunion rate after ankle arthrodesis is 10%. The concerns about ankle fusion are: functional outcome, incomplete pain relief, nonunion/malunion and long-term effects on adjacent joints.

Mobile bearing total ankle arthroplasty is an alternative to ankle fusion.

There are a few published studies on long outcome of the Agility prosthesis. The short-term risks related to Total Ankle Replacement are perioperative problems and early revisions. The long-term risks are subsidence and wear.

Our objectives are to determine the medium and long term outcome of the Agility total ankle prosthesis, the prevalence and cause of revisions.

MATERIAL & METHODS  20 primary TAA in 19 patients, between 2002 - 2004 and 13 revisions between 2003-2010 done by 2 foot and ankle surgeons. There were one death and one lost to f/u.

Mean follow-up was 78 mo (11 - 109 mo).

The outcome measures are: validated questionnaires/scores, clinical and radiographic exam.

Inclusion criteria are: age more than 45, end stage symptomatic ankle arthritis > 6 months, failure of non operative treatment measures.

Exclusion criteria are: severe foot or ankle deformity/malalignment, active or prior infection in the ankle, severe obesity (BMI> 40), medical conditions precluding safe surgery, neuro-muscular disease, severe osteoporosis, talus osteonecrosis.

DISCUSSION  Our Revision rate of 65% at 7 years is higher than the rates published in literature (24% at 5yrs) with Agility prosthesis.

CONCLUSION  Total ankle arthroplasty can improve patient functional status on intermediate and long term follow-up.

Progressive radiographic lucency around talar component is a concern that needs monitoring.

Subtalar OA can progress even after total ankle replacement.

Long-term function is a concern.

Neither fusion nor arthroplasty is a great option for young ankle OA patient.
COMPARISON OF BIOMECHANICAL CHARACTERISTICS OF THREE ARTHROSCOPIC KNOTS; THE PRETZEL KNOT, THE SMC KNOT AND THE SQUARE KNOT

Hasan Sawan, Zeeshan Sardar, Moreno Morelli

PURPOSE Arthroscopic knot tying is an integral part of arthroscopic shoulder surgery and therefore surgeons performing arthroscopic shoulder surgeries should be proficient in such knot-tying techniques. The ideal knot would have satisfactory loop security, knot security, easy slidability, slack free configuration and a low profile on the tissues. We compare two commonly used knots, the SMC (Samsung Medial Centre) knot and the Square knot, with a relatively newer type of knot; the Pretzel Knot. The “Pretzel” knot is a type of a flip knot that is simple to learn and prepare and pretzel shape is easily visualised to confirm correct knot technique. Potential advantages of Pretzel knot include easy slidability because of only two half hitches and low profile. It is also easy to teach and learn.

METHOD The Pretzel knot was compared with two commonly used arthroscopic knots; the SMC knot and the Square Knot. Four different suture materials were used to also detect the effect of suture material on knot characteristics for the three knot configurations; (1) No. 2 HIF (CONMED, Polyethylene), (2) No. 2 Force Fiber (Stryker, Ultra High molecular Weight Polyethylene), (3) No.2 Ulbrabraid (Smith&nephew), (4) No. 2 FiberWire (Arthrex), (5) No. 2 Johnson & Johnson. Five knots of each type were tied by the same senior surgeon with each of the different suture materials accounting for a total of 25 knots for each knot type.

RESULTS Our preliminary results show that the square knot is significantly stronger to the other two knots because of the higher load to failure and higher resistance. There were no statistically significant differences in the weight, failure to load and resistance between the Pretzel knot and the SMC knot. There was significant difference in the weight of the Pretzel knot when compared to the Square knot with the SMC knot being lighter.
TREATMENT OF SANDERS II CALCANEAL FRACTURES USING MINIMALLY INVASIVE OPEN REDUCTION AND PERCUTANEOUS SCREW FIXATION

Pascale Thibaudeau, Pierre-Philippe Zaharia, Edward J. Harvey, Rudy Reindl, Gregory K. Berry

INTRODUCTION The current North American standard of care for Sanders II displaced intra-articular calcaneal fractures (DIACFs) is open reduction and internal fixation (ORIF) with perimeter plating using an extended lateral approach. This technique allows for optimal visualization of the posterior facet and anatomic reduction, but is associated with a high rate of wound complications given tenuous blood supply. A delay in surgical management is often necessary to allow the soft tissues to settle, leading to prolonged hospital stay or increased number of clinic visits. Since 2004, a percutaneous technique has been used at the McGill University Health Center for fixation of Sanders II calcaneal fractures, regardless of subtype. It allows for earlier fracture fixation and theoretically is associated with less wound complications. However, this technique can lead to incongruent reduction of the articular surface owing to suboptimal visualization. We present the preliminary results of a cohort of patients treated with minimally invasive open reduction and percutaneous screw fixation between 2004 and 2009.

METHOD Our cohort consisted of 8 calcaneus fractures in 8 patients (6 males, 2 females). Average age at index procedure was 46 (range, 30 to 65). At minimum 2-year follow-up, functional outcomes were recorded using the SF-36, Visual Analog Scale, AOFAS hindfoot score, and Maryland foot score. Medical records were reviewed to identify intra- and post-operative complications. Quality of reduction and presence of degenerative changes were assessed on plain radiographs and CT scan.

RESULTS There were 4 type A and 4 type B Sanders II fractures. Time from injury to fixation ranged from 4 to 23 days (median 7.5 days). At average follow-up of 3.7 years (range, 2.8 to 4.7), the mean SF-36 was 46 and VAS, 55.6. Mean AOFAS hindfoot score was 68 and Maryland foot score, 72. Mean Böhler angle was 23° (range, 10° to 33°) and Gissan’¾’s, 111° (range 102° to 128°). Analysis of the post-operative CT scans demonstrated 1 anatomic reduction, 6 near-anatomic reductions, and 1 approximate reduction. Complications included claw toes in 1 patient and post-traumatic subtalar arthritis in 2 patients. No wound complication was recorded. Six patients underwent removal of hardware in the clinic.

CONCLUSION A total of 34 patients have been treated with this technique between 2004 and 2009 at our institution. We present preliminary results on the first 8 patients recruited for our cohort study. Functional outcomes as recorded with the Maryland Foot Score and AOFAS hindfoot score are similar to those reported in the literature for standard ORIF. On the norm-based SF-36, 5 of 8 patients scored within 1 standard deviation of the mean for a normal population. Radiographic analysis revealed that the angle of Gissane and the Böhler angle were restored in the majority of patients. Although it is too early to formulate definitive conclusions, we feel that percutaneous screw fixation is a valuable technique for Sanders II calcaneal fractures, especially in patients at high risk for wound complications.
GIANT CELL TUMOR ARISING IN THE DISTAL TIBIA
AlSulaimani SA, Ferguson P, Wunder J, Isler M, Mottard S, Werier J,
Deheshi B, Dion N, Ghert M, Turcotte RE,

PURPOSE To assess the management and outcome of distal Tibia GCT.

MATERIAL AND METHODS retrospect chart review Patients with distal Tibia GCT managed in Canadian bone tumor centers.

RESULTS 32 patients were recorded between 1991 and 2010. The mean follow up was 5 years (1–16). The mean age was 34 yrs (15-63). Radiographic grading, 3 were grade 1, 19 in grade 2,9 in grade 3 and (2 unknown). The mean largest diameter was 3.3cm (1-12 cm). 5 presented with minimally displaced fractures (4 extra articular). Mean Initial MSTS 27 (23-35) and Mean initial TESS 77.74 (45-100). All lesions were managed with curettage. High Speed Burring was used for 32 pts. Hydrogen Peroxide was used on 3 pts, phenol in 5 pts and liquid nitrogen in one. Pulsated lavage was recorded in 11 pts. The cavity was filled with cement only in 5, cement and allograft in 3,15 had morselized auto/allograft including 4 with the addition of strut allografts. 14 were supplemented with internal fixation. None received radiotherapy. Post-operative complications included one infection and one non-union.

9 patients developed local recurrence. They were all managed with additional curettage. Cement was used in 8 and morselized allograft in one. None required additional internal fixation and one received post-operative radiotherapy. No complication was recorded in this group.

3 pts developed a second local recurrence. Again all were curetted without internal fixation and cement was used in 2. One also got radiotherapy. No complication occurred. No lung metastases developed.

At latest follow up 29 were alive without evidence of disease, 2 were alive with disease and 1 pt died from an unrelated cause. The mean final MSTS score was 32 (25-35) and the mean TESS final score was 88 (35-100).

DISCUSSION/CONCLUSION Giant cell tumor involved rarely the distal tibia. Curettage was possible in all but with a significant incidence of recurrence. Ultimate function was found to be very good.
**NATIVE KNEE ALIGNMENT IN OSTEOARTHRITIC PATIENTS**

**C Haydon, K Smith, M Tanzer**

**BACKGROUND** Current knee arthroplasty techniques are based on restoring a neutral mechanical axis, however this may not represent native alignment in patients with knee osteoarthritis. The purpose of this study was to describe the native pattern of alignment in patients that develop osteoarthritis.

**METHODS** One hundred consecutive patients undergoing total or medial unicompartmental knee arthroplasty, with no degenerative or traumatic changes on the contralateral side, were identified. Radiographs were reviewed by a single independent observer. Anatomic and mechanical alignment was measured on full length weight bearing radiographs of the lower extremity for the affected and unaffected joints.

**RESULTS** Sixty-three patients demonstrated primary varus on the non-degenerative side. This alignment was due to a varus proximal tibial angle of 94.1°. Of the varus degenerative knees, 76% (58 of 76) demonstrated primary varus alignment on the non-degenerative side. Twenty-six patients demonstrated valgus alignment on the unaffected side, while only 12 were classified as neutral. Valgus deformities were more subtle than varus deformities.

**CONCLUSIONS** Patients with knee osteoarthritis may demonstrate mechanical and anatomic alignment that differs from the general population, which should be taken into consideration when planning total arthroplasty procedures.

**LEVEL OF EVIDENCE** Therapeutic Level IV. See Instructions to Authors for a complete description of levels of evidence.
DISTAL ULNA FRACTURES: A BIOMECHANICAL COMPARISON OF LOCKING VERSUS NON-LOCKING PLATE CONSTRUCTS

Collins M, Hines J, McGrail S, Steffen T, Martineau PA

PURPOSE To determine biomechanical properties of plating options for distal ulna fractures.

METHODS Fourth generation ulna sawbones were osteotomized and fixed with four different constructs: 2 plates (a straight 2.7mm LCD plate and a 2.4mm t-plate) were used with both non-locking and locking screws. The sawbones underwent non-destructive tests to determine construct stiffness in flexion, extension and lateral bending. The final testing included cyclical loading in axial torsion to failure.

RESULTS Straight plates were stiffer than the t-plates for flexion and extension (p=0.001) and lateral bending. Non-locking constructs were stiffer in flexion/extension and locking constructs stiffer in lateral bending. Non-locking plates underwent significantly more cycles to failure in axial torsion than the locking plates (p=0.002). The mechanisms of failure were unique to each type of fixation.

CONCLUSION These results do not show any clear biomechanical advantage of locked plating for fractures of the distal ulna. The increased stiffness associated with locked plating likely contributed to earlier and more pronounced failure mechanisms with repetitive axial torsion.
We assessed whether patients who were dissatisfied with their previous joint arthroplasty, done by another surgeon, would have continued dissatisfaction or would have normal improvements in outcome scores of the contralateral joint arthroplasty.

We adjusted for sex, number of comorbidities, ASA score, Charlson score and diagnosis of depression using MANOVA. All patients had a statistically significant improvement in either their Harris Hip Score or Knee Society Score, their Western Ontario and McMasters Universities Osteoarthritis Index and their Short Form 36 health questionnaire.

We found a significant difference having slightly worse outcomes scores using the KSS for TKA when there was a higher Charlson score.

Joint arthroplasties for the contralateral joint should be offered to patients who have had a suboptimal outcome without fear of a recurrent suboptimal outcome.
ANALYSIS OF MRI MARS STUDIES, METAL ION LEVELS AND RADIOGRAPHIC PARAMETERS IN PATIENTS WITH THE ASR PROSTHESIS

Alsheikh K, Saradar Z, Algarni A, Antoniou J

BACKGROUND The Articular Surface Replacement (ASR) prosthesis has received a lot of attention in the recent few years because of the high failure rate (12% - 25% at 5 years) reported at some centres leading to recall of the ASR implant from the market. These failures have been attributed to a few different factors. Some of them relate to the positioning of the implant during the surgery, while others relate to the properties of the implant itself. Metal debris from wear of the implant have been linked to adverse reactions in soft tissues surrounding the joint]. At our centre we have a high success rate with these implants so far. This gives a unique opportunity to analyze patients that have not had failure of the implant. We aim to compare patients with ASR resurfacing who have symptoms (pain, limitation of range of motion, limitation in activities) versus those that are asymptomatic.

PURPOSE The purpose of our study is to analyze three different diagnostic modalities in patients who have the ASR prosthesis. This was a retrospective study of 39 patients with a minimum of a 2 year follow-up that were operated on by the same surgeon at the Jewish General Hospital in Montreal, Canada.

METHODS The patients will be divided into 2 groups; (1) patients who have symptoms, (2) patients who do not have any symptoms. Within the symptomatic group, the patients will be further sub-divided into 3 groups; (1) patients who have symptoms of pain, (2) patients with limitation of activities, (3) patients with both. For all patients we will be analyzing three main diagnostic modalities; (1) Findings reported by a licensed radiologist on MRI (Magnetic Resonance Imaging) MARS (Metal Artefact Reduction Sequence) studies of the hip and pelvis of the patient, (2) metal ion levels, (3) X-ray findings. X-rays parameters of the pelvis and associated hip will be assessed using the EBRA software.

RESULTS We hypothesize that patients with symptomatic metal on metal ASR implants will have more findings of soft-tissue reactions on MRI MARS when compared to those without symptoms. We also hypothesize that there will be a difference in implant positioning as measured on EBRA between symptomatic and asymptomatic ASR implants. We hypothesize that there will be a difference in metal ion levels obtained from the two groups.

CONCLUSION Assessing a patient with a symptomatic hip joint arthroplasty represents a complex problem. It would be invaluable for the orthopaedic clinician to be able to identify the source of the symptoms. This would give us more insight into the pathophysiology behind the symptomatology associated with ASR implants potentially leading to treatment strategies that are less invasive than revision surgeries.
CLINICAL, RADIOGRAPHIC AND METAL ION COMPARISON
OF 36mm, 40mm AND 44mm METAL-ON-METAL
TOTAL HIP ARTHROPLASTY
S Abatzoglou, N Papadopoulos-Gosselin, GN Manoudis, L Epure,
DJ Zukor, OL Huk, J Antoniou

PURPOSE Cobalt-Chromium alloy for metal-on-metal (MM) hip prostheses
have superior wear resistance compared to the conventional polyethylene-on-
metal prostheses, making it a more suitable alternative for younger patients. The
potential carcinogenic effect of metal ions, mainly Cobalt (Co) and Chromium
(Cr), found in the blood of patients with MM hip prostheses is a serious cause
of concern. Tissue damage can be induced by oxidative stress. Total anti-oxidant
status (TAS), total peroxides (TP), and nitrotyrosine (NT) are all oxidative stress
markers (OSM) thought to be affected by Cr and Co levels. As larger head
bearings encourage fluid film lubrication and consequently decrease wear, we
hypothesize that metal ion levels as well as oxidative stress markers may correlate
with greater wear rates, smaller head bearings and increased physical activity.

METHOD We followed 90 patients undergoing total hip arthroplasty (THA)
with different head sizes of Cobalt-Chromium-Molybdenum (Mo) prostheses
(34 patients for 36mm group, 42 patients for the 40mm group and 14 patients
for the 44mm group). Patients’ follow-up occurred at year 0.16, 0.33, 1 and
2. Patients with bilateral hip involvement, concurrent metal hardware, multiple
co-morbidities, inflammatory joint disease or infection were excluded from this
study. Whole blood samples collected at each follow-up visits were analysed
by inductively coupled plasma-mass spectrometry (ICP-MS) to determine the
levels of Co, Cr and Mo. Serum NT levels were quantified using Nitrotyrosine-
EIA essay whereas Total Peroxides concentration were measured with Biomedica
OxyStat assay and TAS with the Oxford Biomedical total anti-oxidant power kit.
Radiographic analysis was performed using Einzel-Bild-Roentgen-Analyse (EBRA)
cup software. During each visit, patients’ clinical outcomes were recorded with
calculation of Harris Hip Scores (HHS) and University of California Los Angeles
Activity Scores (UCLA).

RESULTS Using Mann-Whitney U test, preliminary results failed to show
statistical difference in metal ions concentration between each of our study group
at any given follow-up time. For the HHS correlation, we found a coefficient of
0.20 (P=0.0009) for Co, 0.19 (P=0.0018) for Cr and – 0.08 (P=0.2293) for Mo.
For the UCLA correlation, a coefficient of 0.27 (P=0.0001) was found for Co, 0.23
(P=<0.001) for Cr and -0.06 (P=0.3637) for Mo. Plasma markers for oxidative
stress also show no statistical correlation with metal ion concentration. For the
36mm, 40mm and 44mm groups, the mean cup inclination angle was of 41°,
43° and 40° respectively.

CONCLUSION Femoral head size in patients with MM THA does not significantly
alter the metal ion concentration and the resulting inflammatory response to those
metal ions. Patients showed similar clinical improvement at 2 years of follow-up in
all 3 groups studied regardless of their Co and Cr concentration.
POROUS TITANIUM SCAFFOLD PROMOTE BONE REGENERATION OF LONG BONE CRITICAL SIZED DEFECT IN RODENT MODEL

Saad AlQahtani, C Gao, Ed Harvey, Janet Henderson

PURPOSE Reconstruction of skeletal defects arising from traumatic injuries or surgical resection imposes a major challenge to orthopaedic surgeons. Currently available strategies using autologous or allogeneic bone grafts to promote bone healing are inadequate. This study evaluated the potential of a novel porous titanium scaffold to promote bone regeneration of long bone critical sized defects in rodent models.

METHOD Five mm critical-sized segmental defects were generated in the femoral diaphysis of 20, five months old Fischer rats (mass 250±20g) and stabilized using a polyethylene plate and K wires. A novel porous titanium scaffold independently developed at the National Research Council of Canada was implanted in the skeletal defect, whereas control rats received no implants. Bone regeneration around and within the scaffold was analyzed by histological assessment using Von Kossa, alizarin red and methylene blue, radiography and micro-computed tomography (Micro CT) at postoperative 12 weeks.

RESULT The porous titanium scaffold has a microscopic structure similar to native bone. Radiography revealed that the porous titanium promoted bone callus formation at postoperative 12 weeks, while the control group showed no callus formation. Micro CT demonstrated extensive bony ingrowth and wide-spread bone-titanium interface.

CONCLUSION The novel porous titanium scaffold shows promise as a potential substitute to bone grafts for bone reconstruction in patients with critical sized defects.
INTRODUCTION The optimal immediate treatment of minimally displaced distal radius fractures (DRF) remains up for debate. Initial circumferential casting (CC) has historically been cautioned due to the possibility of acute or subacute cast complications that would lead to subsequent manipulations (splitting, trimming, recasting) that could compromise fracture stability. However, there is no documentation in the literature identifying which patients are most likely to have cast complications and if such complications necessarily lead to loss of reduction. The purpose of this retrospective study was to determine if patient and fracture characteristics are correlated with cast complications, and if subsequent cast manipulations performed in the first two weeks post fracture lead to loss of reduction.

METHODS Hospital records and radiographic data for a three-year period were reviewed to identify consecutive patients who presented to the emergency department of a tertiary care hospital with DRFs and were treated with CC. The following variables were retained for analysis: patient age, gender, polytrauma, fracture classification (AO), type of physician performing initial reduction and treatment, cast complication in first 2 weeks following reduction, type of manipulation performed (cast split, trimmed or replaced). Radiographs at the time of reduction, 2 weeks and 6 weeks post reduction underwent analysis by two independent observers who were blinded to the presence/absence of cast complications. At each timepoint, the radial inclination, ulnar variance and volar tilt were measured. A loss of fracture stability from the initial reduction at either 2 or 6 weeks was defined as the presence of any of the following: 10 degrees change in inclination, 5 degrees change in tilt, >3mm change in variance. A logistic regression was then performed to identify predictive variables for cast modifications and loss of reduction at 2 or 6 weeks.

RESULTS 317 patients presented with DRFs over a 3 year period. 21 were excluded either due to receiving initial treatment elsewhere or not having complete radiological follow up. Overall, 31% of patients experienced cast related complications within the first 2 weeks of treatment. 22% of patients required their cast to be manipulated. No complications necessitated immediate surgical intervention. Regression analysis revealed that only the presence of polytrauma was significantly predictive of requiring cast alterations within the first 2 weeks post injury. With regard loss of reduction, only patient age and fracture classification were found to be significantly predictive. Requiring cast alterations was not found to be predictive of loss of reduction.

CONCLUSION Circumferential casting in the acute setting of DRFs reduces the workload of an orthopedic department. This study demonstrates that, following a successful initial reduction, early manipulations of distal radius casts are safe procedures that do not contribute to loss of fracture stability. Polytrauma patients that are unlikely to be able to report cast complications in the early postinjury period should be splinted initially.
FREQUENCY OF MULTIPLE TARSAL COALITIONS
Alex Paqé, Neil Saran

INTRODUCTION Multiple tarsal coalitions have been described in the past to occur in as many as 20% of patients diagnosed with a tarsal coalition. It is strongly recommended to obtain a CT or MRI prior to treatment of a symptomatic tarsal coalition in order to rule out a case of multiple coalition that would alter the treatment plan. The purpose of this study was to determine the frequency of multiple coalitions seen in patients diagnosed with tarsal coalitions at the Montreal Shriners Hospital.

METHODS A retrospective chart and radiographic review of all patients diagnosed with tarsal coalitions at the Shriners Hospital since 2003 was performed. Patients with congenital limb anomalies associated with multiple coalitions and those without advanced imaging were excluded. CT scan and MRI data were utilized in order to determine the frequency of multiple coalitions.

RESULTS 44 patients with tarsal coalitions were included. There were a total of 68 coalitions in 63 feet. Bilateral coalitions occurred in 19/44 (43%) of patients. Of the 68 coalitions, there were 36 (53%) talocalcaneal, 31 (45%) calcaneonavicular and 1 (2%) talonavicular coalitions. Of the 63 feet, there were 7 (11%) with multiple coalitions. Of 44 patients, 4 (9%) had multiple coalitions of which 3 were bilateral.

CONCLUSION In patients with “idiopathic” tarsal coalitions, the frequency of multiple coalitions appears to be 9%.
A RANDOMIZED CONTROL TRIAL EVALUATING EFFECTIVENESS OF A SYNTHETIC BPM-2 FRAGMENT IN ACHIEVING LUMBAR INTERBODY FUSION: 12 MONTH RESULTS OF A MULTICENTER, BLINDED CANADIAN STUDY

Z. Sardar, P. Jarzem

SUMMARY This is a multicenter, prospective, randomized, blinded control trial (Evidence Level: I) comparing effectiveness of B2A Peptide Enhanced Ceramic Granules (Prefix) and iliac crest autograft (Control) in achieving fusion in patients undergoing Transforaminal Lumbar Interbody Fusion (TLIF). Our results indicate that at 12 months, the higher concentration of prefix achieved higher fusion rate than control and was equivalent to control in terms of functional scores. Prefix groups had less morbidity at 6 weeks and did not have any lasting complications.

INTRODUCTION Single level TLIFs a commonly performed procedure due to the high prevalence of degenerative disc disease (DDD). Fusion failure is a challenging problem that can lead to ongoing back pain, dependence on pain medication and inability to return to work. The current graft standard (iliac crest) is associated with increased morbidity. B2A is a 45 amino acid synthetic active fragment of the BMP-2 molecule that has proven efficacy in achieving fusion in animal models and may have a better safety profile compared to other BMPs.

METHODS Patients were randomized to 3 groups: iliac crest bone graft, Prefix concentration 150μg and Prefix concentration 750μg. 24 patients (9 Control, 8 Prefix 150, 7 Prefix 750) with DDD at L2-S1 requiring TLIF were enrolled between 2009-2010. The patients had preoperative screening low back pain or leg pain of at least 6cm using a 10cm visual analog back pain scale (VAS) and had at least 20 points (40%) on the Oswestry Disability Index (ODI). Outcome measures included ODI, VAS, and fusion outcome as assessed by CT and dynamic flexion and extension x-rays (interpreted by an independent, blinded radiologist). Patients were evaluated at 6 weeks, 3, 6 and 12 months after surgery.

RESULTS Mean blood loss during surgery was higher (p=0.038) in the control group (569ml) than both Prefix 150 (364ml) and Prefix 750 (314ml). There was no difference in length of hospital stay between the 3 groups. Prefix 750 had the highest fusion rate (100%) compared to control (78%) and Prefix 150 (50%) at 12 months. At 6 weeks, the mean ODI was 41 for control, 27.7 for Prefix 750 and 32.2 for Prefix 150. While, at 12 months, the mean ODI was 24.4 for control, 31.1 for Prefix 750 and 29.7 for Prefix 150. 100% of patients maintained or improved neurological scores in Prefix 750 compared with 89% for control and 50% for Prefix 150. 2 patients had transient elevation of liver enzymes and 1 had wound infection. Complications were evenly distributed amongst the groups.

CONCLUSION Prefix provides a safe alternative to iliac crest bone graft. Prefix 750 showed superior fusion rate to autograft at 12 months for TLIF and avoids the initial morbidity associated with iliac crest graft. Prefix and control were equivalent in improving ODI at 12 months.
CHONDROADHERIN FRAGMENTATION AS A BIOMARKER FOR DISC DEGENERATION

Bashar Alkhatib, Peter Roughley, Jean Ouellet, Lisbet Haglund

INTRODUCTION Disc degeneration has been strongly associated with back pain. At present, little is known about the molecular mechanisms involved in the degeneration of IVDs and how these may differ from normal turnover of the tissue. As a result, a biomarker for disc degeneration has not yet been identified and we propose chondroadherin (CHAD) fragmentation as a potential marker. CHAD is primarily found close to cells, where it can interact with collagen fibrils of the ECM and molecules at the cell surface, so providing a mechanism for regulating cell metabolism and ECM structure.

The aims of this study were to determine whether CHAD fragmentation is unique to disc degeneration, and to characterize the cleavage site within CHAD at which fragmentation occurs.

METHOD CHAD fragmentation was studied using SDS-PAGE and western blotting in combination with specific antibodies. Characterization of the cleavage site was achieved by fractionating a degenerate surgical disc sample using SDS-PAGE. Gel portions containing the CHAD fragment were excised and identified by mass spectrometry. An anti-neoepitope antibody was raised to recognize the cleavage site sequence.

RESULTS AND DISCUSSION Evidence for proteolytic degradation of CHAD was observed in adult discs showing degeneration but not in tissue from a macroscopically normal disc. Furthermore, the higher the degree of degeneration seen in the disc, the higher the amount of CHAD fragmentation. Upon analysis with the anti-neoepitope antibody, it was apparent that CHAD fragmentation occurred at the same cleavage site in degenerate discs from apparently healthy donors, surgical samples from adults with disc degeneration, and adolescents with scoliosis. Normal tissue samples showed no anti-neoepitope antibody binding, confirming that CHAD fragmentation at this site was not present in the healthy disc.

CONCLUSION CHAD fragmentation can be used as a biomarker to distinguish normal aging from disc degeneration. This evidence can be used to develop a potential immunoassay to screen the serum of at-risk patients and detect early disc degeneration.
We report the outcome of hybrid ASR-total hip replacement in 16 patients which was performed by the same surgeon between February 2004 and February 2010. Of the 16 hips, 12 hips were revised for failed resurfacings and 4 hips were primary hybrids.

The mean length of follow-up was five years (2 to 10). There were no deaths and none of the patients was lost to follow-up. None of the hips underwent any further revision. Functional Harris hip scores, radiological assessment using the EBRA method and metal ions were recorded.

The results of the hybrid group were compared with those of a control group of age matched patients. In the latter group there were 500 resurfacings performed during the same period by the same surgeon.

The outcome of the hybrid group was comparable with that of the resurfacing group. Long-term follow-up is advocated to monitor the outcome of these cases.
VALIDATION OF AN EX-VIVO INTERVERTEBRAL DISC MODEL FOR THE TESTING OF NUCLEAR REPLACEMENT SURGERIES


BACKGROUND Ailments caused by biological and biomechanical changes within the intervertebral disc (IVD) include annular tears, loss of disc height, disc herniation, for which the gold standard in surgery consists in the arthrodesis of the affected level. Nuclear replacement consists of a promising surgical alternative that would allow the preservation of disc biomechanics, however it poses 2 major problems: nuclear replacement material extrusion and non physiologic axial load distribution stress. For these reasons, nuclear replacement remains an experimental approach requiring further biomechanical validation. To address this, we have designed an ex-vivo IVD model that can serve the dual purpose of biomechanical testing device and surgery practice tool.

METHODS A mold was designed through 3D modelling software (SolidworksTM) with measurements based on lower lumbar anthropometrics, constructed through rapid prototyping, yielding a two-part IVD composed of a nucleus pulposus (NP) and an annulus fibrosus (AF). Assembled with bi-concave endplates, the model produced a simplified motion segment with decreasing height anterior to posterior to mimic the lordotic curve. The selection of appropriate silicone materials for the IVD were based on Young’s modulus values obtained from the literature: 0.5-2MPa (NP), 3-12MPa (AF). The model was then subjected to symmetrical static loads and 6 degrees of freedom range of motion (RoM) testing (Flexion/Extension, Lateral Bending, Axial Rotation) to assess its ability to reproduce IVD mechanical behavior. Emphasis was placed on compressive stiffness values, load-displacement curves and radial bulge measurements.

RESULTS Our mold yielded a disc with a total surface area of 1938 mm2, with a 1:1 AF/NP ratio and a 17 mm height. From the 8 silicones we subjected to unconfined compressive axial load we retained four that we labeled AF1 (2.4-2.9 MPa), AF2 (4.8-7.0MPa), NP1 (0.60-0.68MPa), NP2 (1.4-1.5MPa). We then produced 4 IVD models based on the various combinations of NP and AF and obtained the following stiffness values: 2.1- 2.7MPa (AF1/NP1), 3.0-3.8 MPa (AF1/NP2), 3.2 4.6 MPa (AF2/NP1), 4.7-7.2 MPa (AF2/NP2). Load-displacement curves for the models were comparable to those observed for human lumbar discs. Radial bulge percentage increase for a 30% axial compression ranged between 25 and 31%.

DISCUSSION Overall, we were able to reproduce the viscoelastic properties of an IVD. Values obtained for compressive stiffness were under what could be expected for a lumbar disc, but remain comparable. Together, the measurements obtained for radial bulging under compressive load and the curves that resulted from RoM testing suggest the need for fiber-reinforcement of the AF, which would have an effect on the disc’s tensile properties.
INTRODUCTION Untreated scoliosis progresses with age and there are currently few non-operative therapies for severe scoliosis. To avoid pulmonary morbidities of surgery, the ideal treatment will include fusion-less correction to maintain spinal growth and motion. We hypothesized that the anabolic segment (1-34) of parathyroid hormone related peptide (PTHrP) has potential as a non-surgical anabolic agent to regulate osteogenic cell recruitment and curtail curve progression. To test these and other therapies, an animal model that adequately mimics the human disease must be characterized. The study will characterize the Fgfr3-/- mouse as an improved animal model of early onset scoliosis and investigate PTHrP as a controlled release anabolic agent to promote bone formation in the concavity and limit scoliotic curve progression in Fgfr3-/- mice.

EXPERIMENTAL METHODS Fgfr3-/- and wildtype mice were radiographed over time with posterior-anterior and lateral views. Mice were euthanized at 4 to 25 weeks and processed for micro-computed tomography (micro-CT) and histology to compare apical vertebral parameters such as vertebral and inter-vertebral disc (IVD) morphology, micro architecture, vertebral rotation, and cellular activity. In the second stage to test PTHrP efficacy, fifty Fgfr3-/- mice will be radiographed posterior-anterior at 8 week to determine the location and baseline severity of scoliotic curvature. A pellet containing PTHrP (1-34) or placebo will be inserted intramuscularly adjacent to the spine at the level of the scoliotic apical vertebra. Curves will be monitored bi-weekly using radiography and spines harvested at 16 weeks for micro-CT and histological evaluation.

RESULTS Fgfr3-/- mice developed scoliosis by 8 weeks which progressed until the end of the study, reaching a maximum Cobb angle of 40.9±18 and 98% incidence by skeletal maturity. Micro-CT analysis of Fgfr3-/- vertebral bodies revealed poorer micro architecture of the convex side and concave IVD compression. Vertebral body height was greater on both concave and convex sides, with convex being comparatively greater. Histological analysis of bone mineralization and cartilage supported micro-CT data. Pellet effectiveness will be evaluated based on a percent change in curvature from the baseline Cobb angle measurement. Repeated measurements of scoliosis severity in both groups are expected to reveal decreased progression in the PTHrP treatment group, with histology supporting these results.

CONCLUSION Because the model features spontaneous scoliosis, we see it as more clinically relevant than surgically induced scoliosis. Fgfr3-/- mice are an animal model that are inexpensive, non-invasive, and closely reproduce the disease. This model will be used to test novel biological therapies to serve as non-surgical alternatives in progressive early onset scoliosis, with PTHrP having promise as one such therapy.
THE ROLE OF MAST CELLS IN BONE TISSUE REGENERATION

Michael H. Wang, Michael B. Sullivan, Janet E. Henderson, Paul A. Martineau

PURPOSE Skeletal reconstruction is currently limited by the availability of donor tissues used in autologous bone graft transplantation. Since mast cells have an innate ability to home in on injury sites, mast cells are a potential adjunct therapy and drug delivery mechanism to augment bone regeneration. However, previous research has neither established the role of mast cells in bone healing nor the timing of their involvement. Therefore, the current study has two objectives: 1) Demonstrate whether bone regeneration is disturbed in mast cell-deficient (c-kit mutant) mice; and 2) Establish the timing of bone healing in wildtype and mutant.

METHOD Wildtype and mutant C57Bl6/J mice underwent bilateral femoral cortical defect surgeries to investigate bone regeneration. Mice were euthanized at post-operative zero, two, four, and six weeks. Femurs were extracted for analysis using micro-computed tomography (Micro-CT) and histology to assess bone healing. Micro-CT examined the micro-architecture of the healing cortex, while histology identified cellular contributions, including osteoblast activity, mineralization, and the presence of mast cells. A non-parametric Mann-Whitney U-test with a significance value of $\alpha=0.05$ was used to evaluate the difference in bone healing between wildtype and mast cell deficient mice at each of the time points.

RESULTS At baseline post-operative zero weeks, wildtype and mutant have the same bone volume fraction (BV/TV), a measure of bone healing. Compared to baseline, both genotypes showed significantly higher BV/TV at post-operative two and four weeks. Compared to mutants, wildtype femurs had significantly higher BV/TV at post-operative two weeks and both achieved similar BV/TV by post-operative four weeks. This indicates that wildtype regeneration was completed by week two and mutant regeneration by week four. Histology is preliminary but mineralization stains support Micro-CT data.

CONCLUSION Bone regeneration still proceeds in the absence of mast cells. However, there is a delay in the bone healing of mast cell deficient mice compared to wildtype mice. This delay in bone regeneration warrants histological investigation to further strengthen Micro CT data and possibly suggest a molecular explanation for this phenomenon, such as delayed osteoblast recruitment.
INTRODUCTION Back pain is a fairly common problem, which affects a large portion of the population across all ages and has an impact on quality of life. Intervertebral disc degeneration is the single most common implicated cause of back pain. Presently there is no medical treatment or therapeutic agent to address this problem and surgery is the only offered option. Intervertech 1 (IVT-1), currently being patented by Intervertech Inc, represents a novel peptide produced in mammals. It has the ability to heal injured tissues and increase cell resistance to hypoxic episodes. The aim of this study was to determine how nucleus pulposus (NP) and annulus fibrosus (AF) cells respond to different Intervertech 1 concentrations when cultured in a 3-dimensional system consisting of an alginate scaffold.

MATERIALS AND METHODS Adult bovine tails (2-3 years old) were obtained. AF and NP cells were isolated and were resuspended in 1.2% alginate in 0.15M sodium chloride at a concentration of 2 million cells per ml. Droplets of cell suspension were released into 102 mM calcium chloride solution and left to polymerize for 5 minutes. The beads were placed at a density of 5 beads/well. Alginate beads were stabilized for 5 days and then exposed to 5nM-400nM of IVT-1 in DMEM supplemented with 25μCi of 35S-sulfate / ml for 48 hours to determine aggrecan synthesis. At the end of culture period, media was collected and dialyzed exhaustively against RO water followed by cold chase with 1M MgSO4 to remove unincorporated 35SO4. Counts per minutes (CPM) reads were normalized to control and expressed as an arbitrary value.

RESULTS In both cell types proteoglycan synthesis increased with dosage in culture up to 10 nM, then tended to plateau between 25 nM and 50 nM but increased at 100nM and 200 nM (Fig. 1). Maximal response was at 200 nM but declining thereafter. At all time points, the levels of proteoglycan synthesis by AF cells were greater than by NP cells.

CONCLUSION Intervertech 1 is a small peptide involved in a wide variety of physiological functions. This study indicates that IVT-1 is able to stimulate proteoglycan synthesis in bovine disc cells cultured in a 3-D system. Intervertech 1 stimulates AF cells to produce more proteoglycan than NP cells. One major advantage of Intervertech 1 over recombinant growth factors for therapeutic use is the large saving in cost.
INTRODUCTION  Intervertebral disc (IVD) degeneration is a common cause of back pain, which has a negative impact on the quality of life of the patient. It is crucial to understand the interplay between mechanobiology, disc composition and metabolism in order to understand the underlying cause of disc degeneration and to be able to study ways to regenerate the degenerate disc. To address such questions, a bioreactor has been developed that facilitates organ culture of intact human discs in a controlled dynamically loaded environment. The bioreactor is used in combination with an isolation method which maintains the integrity of the intervertebral discs by preserving the non-calcified part of the cartilage endplate. In this study, stress profilometry was used to evaluate optimal loading platen design for the bioreactor.

MATERIALS AND METHODS  Human lumbar IVDs were obtained through Transplant Quebec. The spines were assessed by X-ray to evaluate degree of degeneration. Intact discs were prepared by parallel cuts through the adjacent vertebral bodies close to the end plates. Pictures of the disc were taken after processing and surface area was calculated with ImageJ software to calculate the load to be applied to generate pressures of 0.3MPa and 0.6MPa. Two platen sets were tested, full coverage of the whole disc and partial coverage of only the nucleus pulposus (NP) region. The discs were mounted between two platens and stress profiles were recorded at 0.3MPa and 0.6MPa static load. Vertical (V) and horizontal (H) stress profiles were generated for anterior-posterior (AP) and lateral diameters of the disc.

RESULTS  In young and healthy isolated discs, stress profiles for full coverage and partial covering platens were very similar to the stress profiles generated from the same disc with intact vertebral bone. The stress profiles showed uniform distribution of load over the entire diameter of the disc, even when only the central part was loaded. As expected, degenerate specimens, showed an uneven load profile with regions of perturbation, when loaded with full coverage platens. Loading the degenerate discs with partially covering platens resulted in very uneven load profiles and in failure of the cartilaginous endplates at the higher load.

CONCLUSION  A critical step in the development of a disc organ culture system that can be subjected to load is the validation of the various components of the bioreactor. We found that the choice of platens did not affect load distribution in young and healthy but seemed to be critical when loading degenerate discs. These stress profiles indicate that we are able to mimic an in vivo environment in degenerate samples using full coverage platens. Our findings indicate that that the choice of load platen is critical to provide in vivo-like load conditions when studying degenerate discs in organ culture.
POSTER

NOTE

POSTER

LINK-N PEPTIDE: A POTENTIAL AGENT FOR BIOLOGICAL REPAIR OF HUMAN INTERVERTEBRAL DISC

Gawri R, Antoniou J, Ouellet J, Steffen T, Roughley PJ, Haglund L, Mwale F

INTRODUCTION Back pain is a fairly common problem which affects a large portion of the population across all ages and has an impact on quality of life. Intervertebral disc degeneration is the single most common implicated cause of back pain. Presently there is no medical treatment or therapeutic agent to address this problem and surgery is the only offered option. Link-N peptide represents the 16 amino acid sequence from the N-terminus of the link protein that stabilizes the proteoglycan aggregates present in cartilage and disc. Link-N peptide is released from the link protein as a result of proteolysis, and has been suggested to play a role in matrix homeostasis by promoting new matrix synthesis. We evaluated its regenerative potential in intact human intervertebral discs.

MATERIALS AND METHODS Lumbar IVDs were obtained through Transplant Quebec. Discs from 7 individuals were harvested. Cells were isolated from nucleus pulposus (NP) and inner annulus fibrosus (iAF) regions of the discs, beaded in 1.2% alginate and exposed to 10-10000ng/ml Link-N peptide for 48 hours. Intact discs were prepared for organ culture. Link-N was conjugated with 5-TAMRA dye and injected into the disc. The distribution of Link-N in the medium and within the disc was studied to determine whether Link-N is retained in the disc. Discs from adjacent levels were injected in their NP region with 50μCi 35SO4 along with 1mg of Link-N. Sustained effect of Link-N was evaluated by injecting the disc with Link-N and injecting 35SO4 one week later. Proteoglycan synthesis was evaluated by measuring 35SO4 incorporation.

RESULTS NP and iAF cells beaded in alginate and exposed to Link-N peptide, showed increased proteoglycan synthesis in a dose dependent manner with the maximal response at 1000ng/ml Link-N. Fluorescently labelled Link-N peptide was injected into the discs to determine if Link-N is retained in the disc matrix or freely diffuses throughout the tissue and equilibrates with surrounding medium and was detectable in the medium at 24 hours and reached equilibrium after 48 hours. The fluorescent peptide was found in the NP and NP/iAF junction but not in the remaining AF. Discs injected with Link-N showed increased proteoglycan synthesis in the NP and iAF compared to control discs. Proteoglycan synthesis remained elevated after one week in Link-N injected discs compared to control discs suggesting a sustained effect.

CONCLUSION Link-N can promote proteoglycan synthesis not only in disc cells cultured in 3D constructs, but also in intact human discs. Link-N could be a promising candidate for biologically induced disc repair. Link-N is over 100 times less expensive than recombinant growth factors and could be an effective and cost-efficient therapy for retarding the ongoing degenerative process in early stage disc disease.
HIP RESURFACING ARTHROPLASTY WITH THE ARTICULAR SURFACE REPLACEMENT (ASR™) PROSTHESIS: A MID-TERM FOLLOW-UP

Grigorios N. Manoudis, Sarantis Abatzoglou, Avishai Reuven, David Zukor, Antoniou John

PURPOSE Hip resurfacing arthroplasty (HRA) has regained popularity since the introduction of the third generation of implants in the mid-1980s. HRA offers the advantages of conserved femoral bone stock, minimal wear and a reduced risk of dislocation due to the large diameter of the components. The purpose of this study is to define the mid-term survivorship and radiographic results in patients who underwent HRA.

METHODS 606 hips in 570 patients, 481 men and 89 women, who were treated with hip resurfacing arthroplasty using the Articular Surface Replacement (ASR™, DePuy Orthopaedics) from February 2004 to October 2009 were retrospectively reviewed. The mean age at the time of surgery was 54 years (range, 28 to 69 years). All patients were assessed with the Harris hip (HHS) and UCLA activity scores at routinely scheduled follow-up visits. Radiographic analysis was performed using Einzel-Bild-Roentgen-Analyse (EBRA) cup software. The levels of cobalt (Co) and chromium (Cr) were analyzed by inductively coupled plasma-mass spectroscopy in 142 patients. Statistical analysis was performed using the Mann-Whitney U test.

RESULTS The mean follow-up was 6.5 years (range, 2.2 to 7.3 years). The mean cup abduction angle was 44° (25°-63°) and the mean anteversion angle was 18° (7°-40°). Fifteen hips underwent revision surgery. The reason of revision was femoral neck fracture in 5 cases, 2 aseptic loosening of the cup and 2 of the femoral component, avascular necrosis with neck narrowing and collapse in 2 cases and 3 deep infections that required two stage revision. One patient was also revised because of high Co and Cr ion levels, 42 and 22 μg/l respectively, in an otherwise well functioning prosthesis.

The preoperative UCLA activity score and HHS with the ASR were 3 (1-10) and 43 (19-94), respectively. During the first year after surgery the ASR group demonstrated important improvement with UCLA activity score of 7 (2-10) and a HHS of 88 (28-99). After first year both, UCLA activity score and HHS reached a steady state. The Kaplan-Meier survivorship was 95.636% for revision for all causes.

Co ion levels increased significantly at the second year followed by a decrease from 3 to 5 years of follow-up. The level of Cr increased significantly in the second year of follow-up and remained stable thereafter up to 5 years of follow-up. No statistical differences in the levels of both Co and Cr were observed after 3 years post-operatively.

CONCLUSION Our results suggest that ASR hip resurfacing system provides durable and satisfactory clinical and radiological mid-term outcomes with low revision rate. Resurfacing arthroplasty appears to be efficient in decreasing pain and improving function and activity in young patients with advanced hip arthrosis. Despite reports from other series, in our hands ASR system has performed well in a carefully selected group of patients.
WE WISH TO EXPRESS OUR ACKNOWLEDGEMENT TO THE FOLLOWING SPONSORS

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