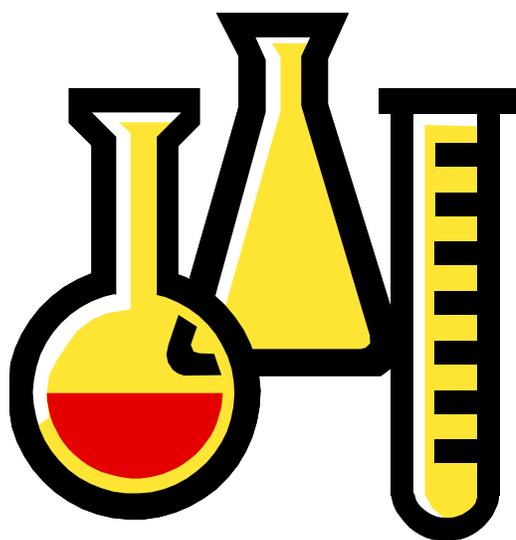


THE OHIO STATE UNIVERSITY

33rd Annual
Mallory-Coleman
Resident Research Day



Friday, April 8, 2005
7:30 am

Blackwell Hotel
OSU Campus

PROGRAM

- 7:45 am Welcome and Introduction
- 8:00 am Scott Van Aman, M.D.
“Mid-Term Results of Arthroscopic Synovectomy For The Treatment Of Patellar Clunk Syndrome”
- 8:15 am Brad Bernacki, M.D.
“The Cost And Efficacy Of Preoperative Autologous Blood Donation In Total Knee Arthroplasty: A Retrospective Review of 181 Patients”
- 8:30 am Roman Sibel, M.D.
“Biomechanical Analysis Of Distal Biceps Tendon Repair Methods”
- 8:45 am John Dawson, D.P.M.
“Patient Controlled Continuous Local Anesthetic Infusion For Pain Management After Rearfoot Or Ankle Surgery”
- 9:00 am Eric Pifel, M.D.
“Revision and Re-operation Rate In Tibialis Allograft Anterior Cruciate Reconstructions: A Series Of 69 Grafts with At Least 2 Year Follow-up”
- 9:15-9:30 Break
- 9:30 am Jonathan Smerek, M.D.
“The Popliteal Hiatus Extension Tear Of The Lateral Meniscus”
- 9:45 am Jeremy Mathis, D.O.
“Prospective Evaluation of Intra-articular Damage In Primary And Revision Anterior Cruciate Ligament Reconstruction”
- 10:00 am Benjamin Hackett, M.D.
“A Magnesium Injectable Formulation Adheres Bone To Bone And Tendon To Bone”
- 10:15 am Peter Maurus, M.D.
“The Reverse-Cyclops Lesion: A Cause Of Anterior Knee Impingement”
- 10:30 am Joseph Leith, M.D.
“Single Surgeon Experience With A Posterior-Stabilized, Constrained Modular Knee System for Difficult Primary And Revision Total Knee Arthroplasty”
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- 10:45 am Joseph Hanna, M.D.
“Acute Hip Arthroplasty For The Treatment Of Intertrochanteric Fractures In The Elderly”
- 11:00 am Break
- 11:15 am James Goulet, M.D., Visiting Professor and Moderator
“The Evolution Of Fracture Fixation: If It’s Broken, Why Change The Way We Fix It?”
- 12:15 Lunch
- 1:30 pm Wesley Sutter, D.V.M.
“Comparison Of Hematologic Values And Transforming Growth Factor-B And Insulin-like Growth Factor Concentrations In Platelet Concentrates Obtained By Use Of Buffycoat and Apheresis Methods From Equine Blood”
- 1:45 pm Robert Gorsline, M.D.
“An Implantable, Biodegradable, Three Dimensional Nanofiber Scaffold That Supports Chondrocyte Growth And Development”
- 2:00 pm David Kaplansky, D.P.M.
“Fresh Frozen Talar Allograft Transplant For Large Osteochondral Defects Of The Talus”
- 2:15 pm Angela Pedroza, ATC, M.S.
“Effect Of Shoe-Surface Coefficient Of Friction On Completing An Agility Task”
- 2:30 pm Akikazu Ishihara, BVSc
“Association Between Subjective Lameness Grade And Kinetic Gait Parameters And Their Variability In Equine Induced Forelimb Lameness”
- 2:45 pm Alicia Bertone, D.V.M., Ph.D.
“Articular Cartilage And Subchondral Bone Repair Using A Biodegradable Polymer Matrix And Instrumentation System”
- 3:00 pm End of Day
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MALLORY-COLEMAN DAY

Mallory-Coleman resident research day was established by Drs. Thomas Mallory and Carl Coleman in 1972 in memory of Katherine Virginia Mallory and Sally Jo Coleman.

This research day was established in order to encourage the development of ideas related to research in orthopaedic surgery and related basic sciences.

Each year, a distinguished visiting professor from an outside institution is invited to moderate and analyze the resident presentations and provide constructive criticism and commentary.

This year we are honored to have Dr. James Goulet with us as the 2005 Mallory-Coleman Visiting Professor

Past Visiting Professors:

2004 Steven Arnoczky, D.V.M.
2003 Joseph Buckwalter, M.D.
2002 Victor Goldberg, M.D.
2001 James Urbaniak, M.D.
2000 Douglas Jackson, M.D.
1999 Douglas Dennis, MD
1998 Thomas Einhorn, MD
1997 Larry S. Matthews, MD
1996 Gary Friedlander, MD
1995 James Herndon, MD
1994 Clement B. Sledge, MD
1993 Eric L. Radin, MD

2005 MALLORY-COLEMAN VISITING PROFESSOR AND MODERATOR:

JAMES GOULET, M.D.



Dr. Goulet is currently a Professor of Surgery and the Head of the Section of Orthopaedic Trauma at the University of Michigan, where he has been on faculty since 1987. He graduated from Middlebury College in Vermont in 1997 then went on to Cornell University, where he received his medical degree. He completed his internship in general surgery at St. Lukes-Roosevelt Hospital in New York City and a residency in orthopaedic surgery at the Hospital for Special Surgery. He then completed a fellowship in trauma orthopaedic trauma surgery at the University of California at Davis.

He currently serves on the editorial board of the Journal of Orthopaedic Trauma and is a reviewer for several other journals such as the Journal of Bone and Joint Surgery and Clinical Orthopaedics and Related Research. He also serves on several committees of the American Academy of Orthopaedic Surgeons, including the Executive Committee of the Board of Counselors, the Council of Academic Affairs, the Continuing Medical Education Committee, and the Committee on Evaluation. He is also a member of the Education Committee of the Orthopaedic Trauma Association. Dr. Goulet is also an examiner for the American Board of Orthopaedic Surgery.

He also has extensive teaching experience having served as the Director of Orthopaedic Undergraduate Education at the University of Michigan as well as acting as an advisor for numerous medical students and a thesis advisor for several bioengineering Ph.D. candidates.

Dr. Goulet has published over 35 articles in peer reviewed scientific journals and has given over 50 presentations, both nationally and internationally. He is the authors of 11 book chapters and almost 60 abstracts. He has presented over 80 scientific papers and over 30 scientific exhibits.



*Scott Van Aman, M.D.
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State University*

MID-TERM RESULTS OF ARTHROSCOPIC SYNOVECTOMY FOR THE TREATMENT OF PATELLAR CLUNK SYNDROME

Authors: Scott Van Aman, M.D, Peter Edwards, M.D., Michael McShane, M.D., David Halley, M.D., Peter Maurus, M.D., Michelle McKinley, B.S., Jodi Hartman, M.S., Christopher Malinky, B.S.
Presenter: Scott Van Aman, M.D.

Despite the advent of second-generation posterior-stabilized TKA designs, patellar clunk syndrome remains a painful complication following TKA. This study assesses the efficacy of arthroscopic synovectomy as a treatment option.

Twenty cases of patellar clunk syndrome were treated by arthroscopic synovectomy at a mean 2.4 years after TKA. Upon retrospective review, one case was lost-to-follow-up and another was deceased. Ten cases were revised (mean time-to-revision, one year). The remaining eight cases were evaluated at a mean follow-up of 5.7 years.

No significant difference in demographics, mean time-to-arthroscopy, and mean pre-arthroscopic HSS scores was observed between the unrevised and revised groups. Pre- and post-arthroscopy HSS scores were not significant in the unrevised group. TKA survivorship was 47.4 percent, with a revision rate of 52.6 percent. Intraoperative review (3 revised, 7 unrevised cases) revealed generalized hypertrophic synovitis in all cases, however, only five cases (2 revised, 3 unrevised) exhibited a prominent fibrous nodule at the proximal patellar pole and quadriceps tendon junction. No significance between intraoperative findings and revision incidence was observed.

Patellar clunk syndrome without concurrent generalized hypertrophic synovitis is rare. Because it occurs in both the patellofemoral and tibiofemoral joints, complete resection may be difficult, potentially compromising successful treatment. The efficacy of arthroscopic synovectomy, therefore, is unpredictable in the presence of generalized hypertrophic synovitis. Furthermore, arthroscopic treatment may not be successful if the underlying cause is related to surgical technique or prosthetic design. In these cases, component revision may be necessary to totally resolve the symptoms.



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THE COST AND EFFICACY OF PREOPERATIVE AUTOLOGOUS BLOOD DONATION IN TOTAL KNEE ARTHROPLASTY: A RETROSPECTIVE REVIEW OF 181 PATIENTS

Authors: Brad Bernacki, M.D., John Mowbray, M.D., Richard Fankhauser, M.D.

Presenter: Brad Bernacki, M.D.

Background: A retrospective chart review was performed at a community hospital in an attempt to investigate the cost and efficacy of preoperative autologous blood donation in total knee arthroplasty (TKA). Transfusion rates ranging from 4% to 46% have been reported in unilateral TKA (Keating et al, 1998). Preoperative autologous blood donation (PAD) has been the most commonly used blood conserving modality in this setting. This method has also been associated with high cost, inconvenience, wastage of autologous donated blood, phlebotomy-induced anemia, and uncertain efficacy in nonanemic patients. This study investigates the hypothesis that autologous blood donation prior to unilateral, primary total knee arthroplasty is a costly and nonefficacious method of reducing allogenic blood transfusions in the general patient population.

Patients and Methods: This study comprises a retrospective analysis of 181 patients, 54 (30%) men and 127 (70%) women, who underwent consecutive, unilateral, primary TKA between March 2003 and December 2003 at a community hospital. The age, gender, diagnosis, preoperative hemoglobin, number of patients transfused, number of autologous units donated, received, and discarded, and reasons for transfusions (if documented) were recorded and analyzed.

Results: Of the 181 patients in the study, 25 (14%) patients were transfused with 14 autologous and 33 allogenic units of blood. Forty-six patients (26%) pre-donated 55 units of autologous blood. Patients who pre-donated blood had a 30% rate of transfusion; whereas, those patients who did not pre-donate blood had an 8% rate of transfusion. Age was also strongly correlated to postoperative transfusion with 77% of those transfused age 65 or older. Twenty-one of the 111 (19%) patients age 65 or older received a transfusion, while only 4 of the 70 (6%) patients younger than age 65 received a transfusion. Only 25% of the donated blood was utilized, resulting in the wastage of the remaining 75%, at a cost of \$218.33 per unit to the hospital; this equates to \$8951.53 in wasted blood products in primary TKA alone, at one hospital, during the study period.

Conclusion: Based on this retrospective review, the vast majority of the pre-donated blood was wastefully discarded. Also, patients age 65 or older had a significantly higher transfusion rate.



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BIOMECHANICAL ANALYSIS OF DISTAL BICEPS TENDON REPAIR METHODS

Authors: Roman Sibel, M.D., Grant Jones, M.D., Christopher Kaeding, M.D., Alan Litsky, M.D., Sc.D.
Presenter: Roman Sibel, M.D.

Background: The distal biceps brachii tendon inserts on the posterior-ulnar aspect of the bicipital tuberosity. It's principal function is forearm supination.

Hypothesis: Repair of ruptures of the distal biceps tendon to the anterior aspect of the tuberosity would compromise forearm supination.

Study Design: Controlled laboratory study.

Methods: Matched pairs of fresh cadaveric upper extremities were prepared for repair of the distal biceps tendon using either anterior or posterior reattachment with transosseous suture fixation. Specimens were tested on an MTS machine with intact distal biceps insertion and following repair. A load cell at the distal radial-ulnar joint measured resultant elbow flexion and forearm supination torque produced by 100N force applied to the proximal aspect of the tendon.

Results: No significant differences in torque were found between pre-repair and either post-reconstruction technique.

Conclusions: The anterior or posterior reconstruction technique demonstrated equivalent biomechanical results.



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State University*

PATIENT CONTROLLED CONTINUOUS LOCAL ANESTHETIC INFUSION FOR PAIN MANAGEMENT AFTER REARFOOT OR ANKLE SURGERY

Authors: John Dawson, DPM, Jason Glover, DPM, Alan Block, DPM
Presenter: John Dawson, M.D.

More than 40% of ambulatory patients undergoing orthopedic surgery procedures experience moderate to severe postoperative pain at home. Perioperative regional or local anesthetic blocks can provide hours of analgesia after foot and ankle surgery. However, after block resolution, ambulatory patients must rely on oral narcotics to control pain. Narcotics are associated with undesirable side effects, such as nausea and vomiting, sedation, and pruritis. The patients were randomly assigned to receive a preoperative popliteal block and postoperative oral narcotics or a preoperative popliteal block, postoperative oral narcotics, and a patient controlled local anesthetic delivery pump that infuses 0.5% bupivacaine continuously into the surgical site. The patients were contacted postoperatively to determine the level of pain control, the need for oral narcotics, and the presence of any side effects. The objectives of this study were to determine if patient controlled infusion of local anesthetic into the surgical site decreases the following: postoperative pain, oral narcotic requirements, narcotic-related side effects, and sleep disturbances for patients undergoing rearfoot or ankle surgery.



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REVISION AND REOPERATION RATE IN TIBIALIS ALLOGRAFT ANTERIOR CRUCIATE RECONSTRUCTIONS: A SERIES OF 69 GRAFTS WITH AT LEAST 2 YEAR FOLLOW-UP

Authors: Christopher Kaeding, MD, Eric Pifel, MD, Angela Pedroza, MS
Presenter: Eric Pifel, M.D.

It is estimated that each year there are approximately 300,000 anterior cruciate ligament reconstructions (ACL) are performed in the United States each year. Of these, it is estimated that 40% are done using allograft tissue. There are few studies which have looked at the complication rates of soft tissue allografts as ACL reconstruction grafts. This is a series of 69 consecutive tibialis posterior or anterior allografts used in ACL reconstruction. Retrospectively, failure and re-operation rate were evaluated with a mean follow-up of 26.6 months. These results were then correlated to demographics, type of graft/graft preparation, and tissue bank. Overall, the re-rupture rate was 7%, increased laxity rate of 2%, and a re-operation rate of 17%. All re-ruptures were from a single tissue bank. The only other difference in failure versus non-failures was age with the failure group averaging 12 years younger. Tibialis allografts are a viable option for ACL reconstruction. However, patient, donor, and tissue bank selection may be more important than previously expected.

THE POPLITEAL HIATUS EXTENSION TEAR OF THE LATERAL MENISCUS

Authors: Jonathan Smerek, M.D., Steven Eddy, B.S., Joseph Leith, M.D., Christopher Kaeding, M.D.
Presenter: Jonathan Smerek, M.D.

The popliteus tendon attaches to the lateral meniscus as the posterosuperior and posteroinferior popliteomeniscal fascicles and contributes to the dynamic stability of the lateral meniscus. Meniscal tears can occur at this periphery and result in locking episodes with the knee in full flexion. Despite these clinical symptoms, the tear is frequently missed on MRI evaluation. In this study, we define the clinical, MRI and arthroscopic findings of this rare lateral meniscal detachment, as well as the clinical results after meniscal repair.

Eleven knees in ten patients were identified by the senior author (C.K.) at the time of arthroscopy with detachment tears of the lateral meniscus at the popliteal hiatus. Meniscal repair was undertaken either with a standard inside-out arthroscopic repair or all inside repair with bioabsorbable rapid lock suture devices. Nine knees in eight patients were available for clinical follow-up in regards to function, pain, return to play, and satisfaction with the meniscal repair.

Only 3 of 9 (33%) of MRIs demonstrated the popliteal hiatus tear prior to arthroscopy. 2 of 9 (22%) of knees had failure of the repair, resulting in subsequent repeat arthroscopy and partial meniscectomy. 1 patient complained of continued locking episodes after repair. All failures and continued locking were noted in patients who underwent repair with the rapid lock devices. 8 of 8 patients noted return to pre-injury sport and activity after the repair. 8 of 8 (100%) of the patients were satisfied with the surgery and would recommend the surgery.

When evaluating patients who present with locking episodes of the knee in flexion and a normal MRI exam, the surgeon should be suspicious for a popliteal hiatus tear of the lateral meniscus. Patients who undergo repair of the tear with inside-out technique can be expected to do well with regards to resolution of their locking symptoms and return to activity.



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PROSPECTIVE EVALUATION OF INTRA-ARTICULAR DAMAGE IN PRIMARY AND REVISION ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Authors: Jeremy Mathis, D.O., Angela Pedroza, ATC, M.S., Christopher Kaeding, M.D.
Presenter: Jeremy Mathis, DO

Purpose: The goal of this study was to evaluate and report the prevalence of articular and meniscal damage found at the time of primary and revision anterior cruciate ligament reconstruction.

Methods: The Multicenter Orthopaedic Outcome Network (MOON) enables orthopaedic surgeons from different regional areas to collect and share data on patients who undergo knee ligament surgery. We reviewed the senior author's (CK) database from 1990 to 2000, as well as the MOON database for all of 2001, which included the intraarticular findings of 1,919 consecutive patients undergoing either primary or revision anterior cruciate ligament (ACL) reconstruction (1,838 primary and 81 revision surgeries.) The articular cartilage lesions were classified according to Outerbridge by each of the participating surgeons. To qualify as a significant cartilage lesion, it had to be either grade III or grade IV, or grade II greater than 50% of the surface in question. Meniscal damage was defined as either damaged or not. Intra-articular findings of both the cartilage and the meniscus were prospectively documented on standard reporting forms and entered into the database.

Results: All knees had complete ACL tears at the time of surgery. Of a total of 1,919 patients, 81 (4%) had revision ACL reconstruction. The age ($p=0.75$) and gender ($p=0.31$) composition was not found to be significantly different between the primary and revision groups. The rates of lateral femoral condyle ($p<0.001$), lateral tibial plateau ($p=0.004$), medial femoral condyle ($p=0.015$), medial tibial plateau ($p<0.001$), patella ($p<0.001$), and trochlea ($p=0.008$) damage were significantly higher in the revision group. The rate of medial meniscus damage was not significantly different between the two groups ($p=0.043$), and the rate of lateral meniscus damage was marginally higher in the primary surgery group ($p=0.051$). The most common lesion in a patient undergoing either primary or revision ACL reconstruction was damage to the medial femoral condyle (23.9% in the primary group, and 35.8% in the revision group) followed closely by damage to the lateral femoral condyle (15.5% in the primary group, and 33.3% in the revision group).

Conclusions: Evidence from this study indicates that cartilaginous damage is found at a significantly greater rate in revision versus primary ACL reconstruction- the most common lesion being that of the medial femoral condyle. In addition, while there are statistically higher rates of damage to the articular cartilage of all surfaces of the knee, there does not appear to be a significantly greater rate of meniscal damage seen at the time of revision surgery.



Ben Hackett, M.D. is a PGY4 Resident in Orthopaedics at The Ohio State University

A MAGNESIUM INJECTABLE FORMULATION ADHERES BONE TO BONE AND TENDON TO BONE

Authors: Benjamin Hackett, MD, Alicia Bertone, DVM, Ph.D., Alan Litsky, M.D., Sc.D., T. Lally

Presenter: Benjamin Hackett, M.D.

HYPOTHESIS: A biodegradable monopotassium phosphate (54%), magnesium oxide (33%), tricalcium phosphate (9%), C/12H/22O/11 (4%) injectable formulation will adhere bone and tendon to bone.

INTRODUCTION: Injectable biodegradable fillers and cements can provide an osteoconductive matrix to fill bone defects during the bone repair process. Depending on the characteristics of the material, potential exists for structural support and delivery of osteoinductive and cell based therapies.¹ Degrading magnesium alloys as implants for osteosynthesis have demonstrated an osteoproliferative effect in vivo and enhanced mineralized bone area compared to degradable polymers.² Magnesium [Mg]-based products offer other potential advantages, such as a resorption profile more compatible with normal bone healing², low toxicity, and controllable radiodensity. Current formulations of injectable calcium [Ca] phosphate compounds are biocompatible, but most show prolonged presence even in normal highly vascular trabecular bone³ and may be associated with lethal embolization⁴.

To date, adhesive properties have not been reported or claimed for experimental or commercial bone fillers or cements. The specific goal of this study was to determine if an injectable Mg-based formulation had adhesive properties for bone to bone and tendon to bone using clinically relevant models and comparison to a Ca-based commercial product. Biomechanical studies were performed using a canine cadaver model of anterior cruciate ligament repair and femur fracture. Tissue adhesion was quantified with mechanical pull-out and three-point bending studies

METHODS: Sixteen knee joints with femurs and Achilles tendons from 8 mid-sized dogs were harvested and three tissue specimens for testing were prepared.

ACL Model: A) *Bone to Bone.* Patellar bone-tendon grafts were formed and the patella bone press-fit into a 7mm diameter bone tunnel drilled in the femur at the ACL footprint to mimic human ACL reconstruction. (Fig 1-Femur) B) *Tendon to Bone.* Achilles tendon grafts were placed through a 7mm diameter tibial bone tunnel initiated at the ACL footprint and exiting the lateral tibial cortex to mimic human ACL reconstruction.

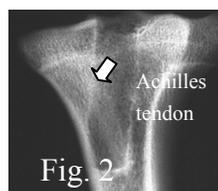
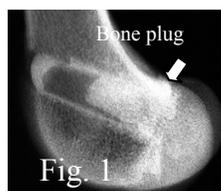


Fig 2-Tibia) Implants were not used to augment these repairs. The tendon ends served as the anchor for pull out mechanical testing. Treatment groups were: 1) Press-fit (Control; n=16); 2) Ca-based injectable formulation (n=8) [Negative paste control]

[Norian Skeletal Repair System- Synthes, Paoli, PA]; 3) Mg-based injectable formulation [Bone Solutions, Inc. Dallas, TX]. Limbs were paired for groups 2 and 3. Product was prepared and injected into the bone defects surrounding the bone or tendon grafts in the bone tunnels and allowed to cure overnight. Grafts were mechanically tested in tension for peak load to failure at 1mm/sec.

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A MAGNESIUM INJECTABLE FORMULATION ADHERES BONE TO BONE AND TENDON TO BONE, CONTD.

Fracture Model: A 1cm long oblique osteotomy was made in the midshaft of the femur diaphysis and four materials tested to secure the fracture in reduction: 1) Blood clot [freshly clotted equine blood]; 2) cyanoacrylate [Ross Super Glue Gel- Ross Products, Columbus, OH]; 3) Ca-based injectable formulation [Norian Skeletal Repair System- Synthes, Paoli, PA]; 4) Mg-based injectable formulation [Bone Solutions, Inc. Dallas, TX]. Additionally, four intact femurs were tested to failure. Groups 3 and 4 were tested in paired limbs. Groups 1 and 2 were tested in paired limbs; one half before and one half after application of the paste products in groups 3 and 4. First tested products were readily removed by scraping. Injectable pastes and cyanoacrylate were applied liberally to the



fractured bone ends, held together for 15minutes until hardened, and allowed to cure overnight. (Fig 3) Femurs were tested in 3-point bending under displacement control at 0.1mm/sec for peak load to failure. Stiffness and stress to failure were calculated from the slope of the linear portion of the load deformation curve and after estimation of bone area at the fracture with calipers. Fractures which fell apart before testing were recorded as 0 N to failure.

Data in the ACL model were analyzed with the paired Student’s t-test for calcium vs magnesium formulations and for press fit vs formulation. Data in the fracture model were analyzed with a 1-factor ANOVA for treatment group. Significance was set a $p < 0.05$.

RESULTS: In the ACL model, both the Ca-based formulation and the Mg-based formulation had significantly greater pull out force than press-fit (friction) within the tunnel for both patellar bone and Achilles tendon ($p < 0.003$). The Mg-based formulation had the greatest adhesive properties, significantly greater than the Ca-based formulation for both bone (2.5-fold; $p < 0.003$) and tendon (3.3-fold; $p < 0.009$). (**Table 1**)

Table 1. ACL Model – Peak mean (+/- SEM) tensile load (N) to failure. [Different letter superscripts are different; $p < 0.003$]

Groups	Press-fit	Ca-based Formulation (Norian™)	Mg-based Formulation (BoneSolutions)
Bone-Bone	41.6 +/- 16.8 ^a	427.7 +/-103.9 ^b	1025.6 +/-118.2 ^c
Tendon-Bone	12.9 +/- 0.03 ^a	101.6 +/- 23.1 ^b	338.2 +/-69.9 ^c

In the fracture model, blood clot and Ca-based formulation had no adhesive properties (0 N load to failure) in all specimens. Blood clot was unable to hold the two ends of the femur in apposition. The Ca-based product held the femur ends in apposition, but separation occurred prior to testing. Mg-based formulation and cyanoacrylate failed at significantly greater loads than Ca-based formulation or blood clot ($p < 0.00001$) and cyanoacrylate failed at significantly greater loads than the Mg-based formulation (127 N vs 37.7 N, respectively; $p < 0.01$). Intact femurs failed at much greater loads. Bone adhesives achieved $< 10\%$ of original bone strength. (**Table 2**)

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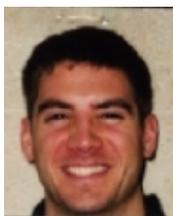
A MAGNESIUM INJECTABLE FORMULATION ADHERES BONE TO BONE AND TENDON TO BONE, CONTD.

Table 2. Mean (+/- SEM) biomechanical properties to failure in femur osteotomies repaired with potential bone adhesives. [Within parameter, different symbols are different p<0.01]

Groups	Peak Load (N)	Peak Stress	Stiffness (N/mm)
Blood Clot	0±0*	0±0*	0±0*
Ca-based Formulation (Norian™)	0±0*	0±0*	0±0*
Mg-based Formulation (BoneSolutions)	37.7±8.9**	0.09±0.01**	148.7±35.4**
Cyanoacrylate	127.0±27.9§	0.3±0.03§	783±94.1§
Intact Femur	1455.8±127†	4.18±0.17†	666.8±65.3†

DISCUSSION: In bone and tendon pullout from a bone tunnel, paste formulations provided some adhesion due to cement properties (ie hardened filler). However, the Mg-based formulation had additional, significant, and substantial adhesive properties of over 1000 N in bone that should exceed forces put on the construct in vivo. In femur fracture reconstruction, the magnesium formulation provided bone adhesion, although less than the positive control glue. Cyanoacrylate is not biodegradable and impairs bone healing.

CONCLUSION: A biodegradable monopotassium phosphate and magnesium oxide injectable formulation adhered bone and tendon within bone tunnels sufficiently to significantly augment, or potentially be used independently, in ACL reconstructions. Adhesion of bone ends may be sufficient to contain fracture fragments in comminuted fracture repair and may be useful if osteoconduction and biodegradation profiles complement fracture healing as anticipated.



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THE REVERSE-CYCLOPS LESION: A CAUSE OF ANTERIOR KNEE IMPINGEMENT

Authors: Peter Maurus, M.D., Christopher Kaeding, M.D.
Presenter: Peter Maurus, M.D.

The Cyclops lesion is a well-known complication following anterior cruciate ligament (ACL) reconstruction, estimated in 1-10% of reconstructions. Typical symptoms involve a loss of extension averaging 16°. Loss of extension due to the Cyclops lesion does not respond to physical therapy and must be managed surgically.

We have seen a previously unreported lesion in the intercondylar notch after ACL reconstruction. This “reverse-cyclops” lesion has the clinical and histological appearance of a Cyclops lesion, but appears within the intercondylar notch and not at the tibial insertion of the graft. We are reporting our experience with this “reverse-cyclops” lesion.

We have seen six patients with this condition; five males and one female with an average age of 23.5. These patients presented with anterior knee discomfort with activity and loss of extension in their operative knees at an average of 10.5 months out from ACL reconstruction which was refractory to physical therapy. All required arthroscopic exploration and debridement. Intra-operatively, all six patients had a fibrous nodule in the intercondylar notch that impeded extension. One patient had a small tear in the posterior horn of the lateral meniscus. One patient required an open posterior capsular release to regain full extension; this patient was 2 years and 8 months out from her index operation and had long standing loss of extension. All four patients returned to full activity without pain at an average of 2 months status post debridement.

We believe that the reverse-cyclops lesion should be considered as a cause for activity related knee pain and loss of extension in patients with ACL reconstructions. We recommend early arthroscopic evaluation for any knee that has pain refractory to physical therapy.



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SINGLE SURGEON EXPERIENCE WITH A POSTERIOR-STABILIZED, CONSTRAINED MODULAR KNEE SYSTEM FOR DIFFICULT PRIMARY AND REVISION TOTAL KNEE ARTHROPLASTY

Authors: Joseph Leith, M.D., Adolph Lombardi, M.D., Keith Berend, M.D.,
Thomas Mallory, M.D., Joanne Adams, B.F.A.
Presenter: Joseph Leith, M.D.

Objectives: Difficult primary and revision total knee arthroplasty (TKA) with constrained knee systems is becoming more common. Modular systems are critical to success. We retrospectively reviewed 421 difficult primary and revision TKA cases performed by a single surgeon (AVL) using a modular posterior-stabilized, constrained component (PSC).

Methods: Between July 1992 and December 2003, 421 consecutive TKA using a PSC system were performed in 394 patients. Forty-seven cases were primary, 11 were conversion, 271 were revision, 90 were reimplantation, and 2 were part of an intramedullary total femoral replacement. Eighty-six patients died during follow-up.

Results: Follow-up averaged 3 years in surviving patients. The pre-operative Knee Society (KS) and Hospital for Special Surgery (HSS) clinical scores averaged 48.0 and 57.0 respectively, and improved to 79.0 and 75.0 postoperatively. Incidence of manipulation was 9.5%. Aseptic revision of one or more components occurred in 22 cases (5.2%) with 5 (1.2%) related to arthrofibrosis, 4 (1.0%) aseptic loosening, 4 (1.0%) extensor mechanism dysfunction, 3 (0.7%) instability, 2 (0.5%) soft tissue impingement, 3 (0.7%) periprosthetic fracture and 1 (0.2%) malignant tumor. Septic failure occurred in 8 (8.9%) reimplantation cases and in 14 (4.2%) others.

Discussion: The authors present a single surgeon experience using a PSC modular knee system to address difficult primary and revision TKA. It is clear from this review that a PSC modular knee can adequately address bone loss and ligamentous instability to restore function. In this study, failure due to aseptic loosening and instability was low with each occurring in 1%.



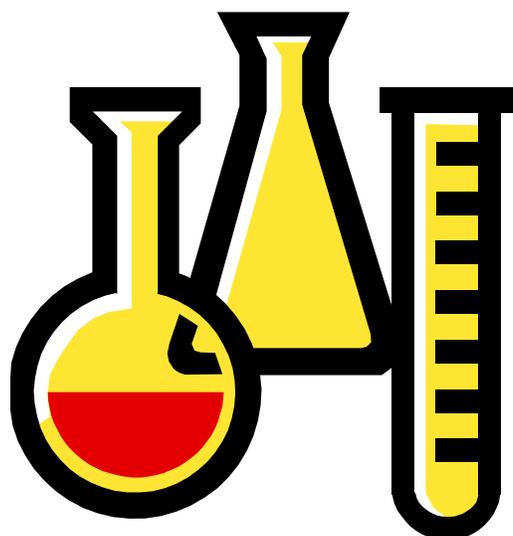
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ACUTE HIP ARTHROPLASTY FOR THE TREATMENT OF INTERTROCHANTERIC FRACTURES IN THE ELDERLY

Authors: Keith Berend, M.D., Thomas Smith, D.O., Joseph Hanna, M.D.,
Adolph Lombardi, M.D., Thomas Mallory, M.D.

Presenter: Joseph Hanna, M.D.

Abstract: Osteosynthesis for intertrochanteric fractures in elderly patients yields acceptable results. Arthroplasty has been advocated to allow early weight bearing and avoid fixation failure. This study reviews clinical results, implant, and patient survivorship in a consecutive group of hip arthroplasties performed for intertrochanteric fracture. All cases of primary hemiarthroplasty and total hip arthroplasty (THA) performed for acute intertrochanteric fracture were reviewed. Thirty-four patients were identified with 29 THA and 5 bipolar. A cemented primary component was used in 9 and a calcar-replacing component in 25. All cases utilized an anterolateral approach. Age at surgery averaged 80.2 years (range 65-92). Follow-up averaged 35 months for living patients. Twenty-six patients (76.5%) died during the follow-up period; patient survivorship was 23.5% at 12 years. Average time from arthroplasty to death was 3.5 years. There were 5 subsequent surgeries or dislocations (14.7%). Of 29 THA, 4 dislocations occurred (13.8%). One reoperation was performed for infection. Acute intertrochanteric fracture is associated with a very high early mortality rate in this and other series. It appears a 15% orthopaedic complication rate and high mortality rate at up to 12 years follow-up accompany performing an arthroplasty in this setting. Dislocation is higher than in primary THA. These results do not support the routine performance of THA in these cases, and expenditure of excess resources on THA in these situations does not appear warranted. Thus THA should be reserved for unusual cases in which osteosynthesis is very likely to fail.





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COMPARISON OF HEMATOLOGIC VALUES AND TRANSFORMING GROWTH FACTOR-B AND INSULIN-LIKE GROWTH CONCENTRATIONS IN PLATELET CONCENTRATES OBTAINED BY USE OF BUFFYCOAT AND APHERESIS METHODS FROM EQUINE BLOOD

Authors: Wesley Sutter, DVM, Andris Kaneps, DVM, Alicia Bertone, DVM
Presenter: Wesley Sutter, DVM

The objective of this study was to adapt and compare two methods of autologous platelet rich plasma (PRP) procurement currently used in human medicine. Our hypothesis was that PRP from both methods would have increased platelet numbers and growth factors relative to whole blood.

One liter of blood was collected from 15 horses in ACD blood collection bags. PRP was prepared using continuous centrifugation with a commercially available auto-transfusion system (CC) and by buffy coat method using a commercially available blood collection kit and centrifuge (BC). Samples of whole blood platelet poor plasma, and PRP from each system were submitted to the laboratory for measurement of WBC, PCV and platelet count. Samples of PRP and whole blood were frozen at -80C for ELISA analysis of growth factors b1 and b2 (TGF-b1 and TGF-b2). Prior to assay samples were treated with a 1:10 dilution of mammalian protein extraction reagent (Pierce). Significance was set at $p < 0.5$.

Automated collection of PRP from whole blood was attempted using the CC system but PRP could not be obtained. Therefore a manual method was used to collect PRP in horses with this system. Each run processed approximately 350ml of whole blood producing an average volume of 45ml of PRP. The BC method consisted of proprietary adapted falcon tubes and centrifuge. This method utilized 50ml of blood producing 5ml PRP per tube. Four tubes were collected per horse yielding 20ml of PRP. Platelet concentration (mean, \pm std) was increased 9.8 \pm 4.8 times (BC) and 5.2 \pm 1.8 times (CC) compared to venous blood. The PCV in PRP was 63.6% \pm 8.0% (BC) and 9.9% \pm 5.5% (CC). WBC counts (10^3 cells/dl) were 34.4 \pm 17.7 (BC) and 36.4 \pm 10.3 (CC). TGF-b1 concentrations (ng/ml) in PRP were 17.1 \pm 7.3 (BC) and 22.0 \pm 12.6 (CC). TGF-b1 concentrations in PRP were significantly higher using both methods than that of whole blood $p < 0.001$, but there was not statistical significance between PRP methods $p = 0.143$. TGF-b2 concentrations (ng/ml) in PRP were 1.0 \pm 0.8 (BC) and 4.9 \pm 2.2 (CC). TGF-b2 concentrations in PRP were significantly higher using CC ($p = 0.009$), but not using the BC method ($p = 0.474$). Overall, TGF-B1 was concentrated in PRP 3.0 \pm 0.6 times (BC) and 4.3 \pm 2.0 times (CC) that of whole blood. TGF-b2 was concentrated in PRP 1.1 \pm 0.4 times (BC) and 3.5 \pm 1.1 times (CC) that of whole blood. Platelet concentrations were not significantly associated with PRP growth factors (BC TGFb1: $p = 0.5$, TGFb2: $p = 0.7$ and CC TGFb1: $p = 0.07$, TGFb2: $p = 0.06$). However, WBC count of BC PRP was significantly correlated with TGF-b1 concentrations ($r = 0.681$ & $p = 0.001$)

The results of this study indicate that equine PRP can be easily produced using proprietary human platelet sequestration methods. These PRP methods may provide the equine surgeon with another technique to improve tissue healing. The CC method, while resulting in lower platelet concentrations than the BC method, resulted in higher TGF-b2 concentrations statistically. The biologic effect of these differences is unknown. Further studies need to be done to evaluate clinical methods for estimation of PRP growth factor levels and other growth factors in PRP as well as the biologic dose effect of these growth factors on tissue healing.



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AN IMPLANTABLE, BIODEGRADABLE, THREE DIMENSIONAL NANOFIBER SCAFFOLD THAT SUPPORTS CHONDROCYTE GROWTH AND DEVELOPMENT

Authors: Robert Gorsline, M.D., Alicia Bertone, D.V.M.

Presenter: Robert Gorsline, M.D.

Purpose: The purpose of this project is to develop a novel tissue engineered construct that can be implanted into articular cartilage defects to promote hyaline cartilage repair. The planned construct is a nanofiber scaffold that is biocompatible, biodegradable, and three dimensional. Our specific goal is to demonstrate that the material allows for chondrocyte growth and development, features that can furthermore be enhanced by adenoviral gene delivery. Our central hypothesis is that chondrocytes will demonstrate the ability to migrate within such a scaffold and assume a natural morphology, proliferate, and produce a hyaline like matrix. The goal of this initial stage of the project is to determine if chondrocytes can migrate into the material and to determine what cell seeding density and time frame is optimal for complete migration across the construct.

Methods: Polycaprolactone discs 25mm in diameter and 100-150 μ m in thickness were obtained from the Department of Materials Science and Engineering at The Ohio State University. The discs were formed using electrospinning and contained fibers 50-300nm in diameter spun to create an 80% porous three dimensional matrix. The 25mm polycaprolactone discs were incorporated into a Costar® 12mm Snapwell™ Insert and placed into a standard six well culture plate with Dulbecco's Modified Eagles Medium supplemented with L-Lysine and Penicillin/Streptomycin. The media in the bottom of the wells contained 40% Fetal Bovine Serum and the media within the insert contained 5% Fetal Bovine Serum. This established a gradient of Fetal Bovine Serum across the scaffold which served as a signal to drive cells into the membrane. Cells were seeded onto the Snapwell™ insert at densities of 5X10⁶, 1X10⁶, 2X10⁵ cells per well and were then cultured for 3, 5, 7, and 10 days. Constructs were then removed from the inserts and underwent cryosectioning and staining with Toluidene Blue, as well as staining with DAPI and Phalloidin Alexa-Fluoro 647 for imaging on a Confocal Microscopy system.

Results: Chondrocytes demonstrated complete migration across the matrix at 7 days when seeded at 1X10⁶ cells/well and at 2X10⁵ cells/well. The samples seeded at 5X10⁶ cells/well demonstrated a tendency to layer on top of the matrix and were slower to migrate into the material. At 10 Days, all cell seeding densities demonstrated near complete migration across the material.

Conclusion: Chondrocytes demonstrate the ability to completely migrate across a 150 μ m thick three dimensional matrix of polycaprolactone nanofibers at 7 days when seeded at a density of 1X10⁶ cells per well.



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FRESH FROZEN TALAR ALLOGRAFT TRANSPLANT FOR LARGE OSTEOCHONDRAL DEFECTS OF THE TALUS

Authors: David Kaplansky, D.P.M., Leonard Janis, D.P.M., Jacob Bos, D.P.M.

Presenter: David Kaplansky, D.P.M

Transchondral lesions of the talus have historically been treated by methods which resect the faulty cartilage and subsequently debride down to subchondral bleeding bone to allow for development of a hyaline-like fibrocartilage. Fibrocartilage is inferior to true hyaline cartilage and will almost always lead to future ankle arthrosis. Understanding the underlying biologic principles and application of new technology and surgical techniques have lead to recent advancement in treating transchondral lesions. This paper presents a relatively new technique utilizing fresh talar allograft as a transplant to replace large areas of defective articular cartilage on the talus. The graft, a composite of living cartilage and a layer of underlying living subchondral bone, provides a matrix with viable chondrocytes along with an osseous component that provides a surface for fixation and integration with the host. Short-term results of 20 talar allograft transplants prove this procedure to be effective for patients with appropriate age, activity level, and body habits based on retrospective foot and ankle score outcomes.

EFFECT OF SHOE SURFACE COEFFICIENT OF FRICTION ON COMPLETING AN AGILITY TASK

Authors: Christopher Kaeding, M.D., Angela Pedroza, ATC, M.S., Robert Heidt, M.D.

Presenter: Angela Pedroza, ATC, M.S.

Introduction: The rise of knee injuries may be linked to increased traction between the shoe and the underlying surface. Torg developed an overall risk criteria to injury based on injuries reported and surface condition. Heidt tested various shoes on various surface conditions and found that no shoe was safe on all surfaces. The prevalence of injury does not correlate to these findings, the authors suggested new injury criteria be established.

Purpose: The purpose of this study was to evaluate the subjective evaluation of performance and maximum forces experienced at various coefficient of friction (CoF) conditions.

Methods: 30 college-aged subjects (15 male, 15 female, mean age 22, mean weight 78 kg, mean height 174cm) completed 5 trials of 5 different CoF conditions in random order. The CoF used were: 0.3, 0.4, 0.5, 0.6, and 0.7 (referred to as condition 1 through 5 respectively). All subjects performed a validated functional agility maneuver over the force plate under the various CoF conditions. After each trial the subject

Continued on next page

EFFECT OF SHOE-SURFACE COEFFICIENT OF FRICTION ON COMPLETING AN AGILITY TASK, CONTD.

was asked to grade their ability to complete the task by using a Visual Analog Scale. Subjective scores were measured to the closest 0.1cm mark. Peak force, CoF max_{forceplate}, and time to complete the task data were also collected.

Results: Average peak force (calculated as percent body weight) was significantly less in conditions 1 (95% CI: 1.26 to 1.50) and 2 (95% CI: 1.56 to 1.88) compared to all other conditions ($p < 0.001$ and $p = 0.049$). Condition 3 (95% CI: 1.64 to 2.00), 4 (95% CI 1.71 to 2.03), and 5 (95% CI: 1.63 to 1.87) were not significantly different from one another. Time to complete task was significantly higher for condition 1 (95% CI: 2.91 to 3.35) compared to all other conditions. ($p < 0.001$). Time to complete task was significantly higher for condition 2 (95% CI: 2.50 to 2.86) compared to condition 4 and 5. ($p = 0.04$ and $p = 0.05$ respectively). Time to complete task was not significantly different between condition 3 (95% CI: 2.47 to 2.79), condition 4 (95% CI: 2.42 to 2.78) and condition 5 (95% CI: 2.43 to 2.75). CoF max_{forceplate} was significantly lower for condition 1 (95% CI: 0.13 to 0.15) and condition 2 (95% CI: 0.22 to 0.24) compared to all other conditions. ($p < 0.001$ and $p \leq 0.002$ respectively) CoF max_{forceplate} was not significantly different between condition 3 (95% CI: 0.24 to 0.28), condition 4 (95% CI: 0.25 to 0.29), and condition 5 (95% CI: 0.24 to 0.28). Subjective scores were significantly lower for condition 1 (95% CI: 0.40 to 1.58) and condition 2 (95% CI: 1.56 to 3.76) compared to all other conditions. ($p < 0.001$ and $p = 0.04$) Subjective scores were not significantly different between condition 3 (95% CI: 4.74 to 6.54), condition 4 (95% CI: 5.28 to 6.88), and condition 5 (95% CI: 4.67 to 6.23). Between subject variability was low across all conditions for peak force (≤ 0.2), CoF max_{forceplate} (≤ 0.003), time to complete task (≤ 0.4). Within subject variability was also low across all conditions for peak force (≤ 0.06), CoF max_{forceplate} (≤ 0.002), time to complete task (≤ 0.04). Variability decreased both between and within subject for time to complete task as the conditions increased from condition 1 through condition 5.

Conclusions: Time to complete the task decreased as the CoF increased up to the CoF of 0.5. Peak force, CoF max_{forceplate}, and the subjective score increased as CoF increased up to the CoF of 0.5. CoF of 0.5 or above does not significantly change the subject's ability to perform the cutting maneuver either subjectively or objectively. The CoF of 0.5 deemed adequate to complete the task for this study fell within the 'not safe' range described by Torg. However, our CoF measurement was the average CoF of the surface and not the release CoF described by Torg and Heidt. Our study is one of the first to study the effect of the CoF in vivo using a validated agility maneuver. More studies are needed to build on these findings to adequately establish criteria on safe shoe surface interactions.



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ASSOCIATION BETWEEN SUBJECTIVE LAMENESS GRADE AND KINETIC GAIT PARAMETERES AND THEIR VARIABILITY IN EQUINE INDUCED FORELIMB LAMENESS

Authors: Akikazu Ishihara, B.V.S.c., Alicia Bertone, D.V.M., Ph.D., Pavi J. Rajala-Schultz, D.V.M., Ph.D..

Presenter: Akikazu Ishihara, B.V.S.c

Abstract:

Objectives – To evaluate the sensitivity and repeatability of kinetic gait analysis using force plate in equine induced forelimb lameness.

Animals – 32 healthy adult horses.

Procedures – Variable forelimb lameness was created with an intra-articular lipopolysaccharide (LPS) -induced metacarpophalangeal joint synovitis model. Subjective lameness evaluation and scoring was performed for four time points (baseline, and 12, 18, 24 hours following the LPS-injection). Kinetic gait analysis using a force plate was performed at a trot for eight valid repetitions at each time point, and thirteen kinetic parameters were calculated. Repeated measures analyses were performed using eight repetitions for each kinetic parameter as the outcome and lameness grades, time points after LPS-injection, and order of the eight repetitions as explanatory variables. Sensitivity (Se) and specificity (Sp) of kinetic parameters in relation to subjective lameness scores were calculated. Between- and within-horse variability of the thirteen kinetic parameters were assessed by coefficient of variation (CV).

Results – Subjective lameness grades were significantly associated with the majority of kinetic parameters ($P < 0.005$). Vertical force peak and impulse had the lowest between- and within-horse CV and the highest correlation with subjective lameness grade. Vertical force peak had the highest Se and Sp in relation to lameness grade. Vertical force peak and impulse were significantly decreased even in horses with mild, subclinical, and recovered lameness.

Conclusion and Clinical Relevance – Of the kinetic gait parameters, vertical force peak and impulse have the best potential to reflect lameness severity and to potentially identify subclinical forelimb gait abnormalities.



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ARTICULAR CARTILAGE AND SUBCHONDRAL BONE REPAIR USING A BIODEGRADABLE POLYMER MATRIX AND INSTRUMENTATION SYSTEM

Authors: Bertone, Al; Orban, J., Grande, DA., Steckel, R., Kamei, SJ.,
Johnson, AL., Ishihar, A., Plouhar, P., Kapur, T., Schwartz, H.

Presenter: Alicia Bertone, D.V.M., Ph.D.

Abstract: In order to compare healing of full-thickness articular cartilage defects either left untreated or treated with a 15mm diameter VicrylTM nonwoven scaffold affixed to an 85/15 Polylactic acid [PLA]/Polyglycolic acid [PGA] or polydioxinone [PDO] fixation device, twenty horses were given two 15mm diameter full-thickness defects in the distal medial and proximal lateral facets of each trochlear groove. In 4 horses both defects were untreated (n=8). In 16 horses, treatments (implants) (n=8 each) were paired to untreated defects (n=16). The study was terminated at 12 weeks (10 horses) or 52 weeks (10 horses). Evaluations were made at baseline and 12 weeks (20 horses), 24 weeks and 52 weeks (10 horses) for incisional scores, gait, synovial fluid analysis, and radiographic assessment of the joint. At termination, joints were imaged using MRI, opened and photographed, evaluated for bone and tissue in the defect, and histologically sectioned. Horses in all groups tolerated the surgeries well, with no significant differences. At 12 weeks most defects were filled peripherally with a white firm tissue with a central cavitation, and in all cases histology demonstrated a central post drill hole with defect repair tissue consisting of fibrous tissue and some proteoglycan staining cartilaginous tissue. At 52 weeks most defects were mostly filled with a firm white tissue, with no observable differences between treatment groups. Both histology and MRI data demonstrated that most specimens no longer had a void or remaining implant and the repair tissue/subchondral bone interface was smooth and contiguous. No significant difference between untreated and 85/15 PLA/PGA or PDO defects could be qualitatively identified histologically. The results of this study demonstrate that surgical implantation of a VicrylTM nonwoven scaffold and an 85/15PLA/PGA or PDO fixation device is biocompatible with the joint, bioabsorbable, and can support long-term (1 year) articular cartilage repair.

*The Department of Orthopaedics would like to thank all
of the presenters for submitting their abstracts for the
33rd Annual Mallory-Coleman Research Day.*

*We would also like to thank the following for
making this research day a success:*

James Goulet, M.D.

Visiting Professor and Moderator

For lending his time and expertise for our research day

Thomas Mallory, M.D. and Carl Coleman, M.D.

For financial support of this program

Alan Litsky, M.D., ScD.

Director of Orthopaedic Research

For coordinating the scientific presentations

Pfizer, Inc.

For sponsoring breakfast and lunch

**Please Read Regarding Category I CME Credit
for This Presentation:**

The Department of Orthopaedics has been authorized by The Ohio State University Center for Continuing Medical Education to provide a total of **five credit hours** in Category I for this research day. In order to receive five credits, each attendee must complete the program evaluation/attendance form which will be available at the entrance to the auditorium throughout the day.