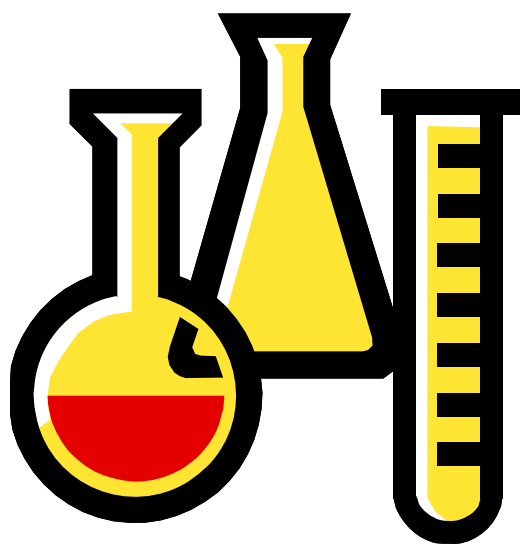


THE OHIO STATE UNIVERSITY

*44th Annual
Mallory-Coleman
Resident Research Day*



Friday, June 3, 2016

Fawcett Center
OSU Campus



THE OHIO STATE UNIVERSITY

WEXNER MEDICAL CENTER

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 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.

Past Visiting Professors:

2015 Javad Parvizi, MD
2014 Leesa Galatz, MD
2013 Howard An, MD
2012 Regis O'Keefe, MD
2011 Henrik Malchau, MD
2010 Freddie Fu, MD
2009 James Heckman, MD
2008 Cato Laurencin, MD
2007 William Garrett, MD
2006 Peter Stern, MD
2005 James Goulet, MD
2004 Steven Arnoczky, DVM
2003 Joseph Buckwalter, MD
2002 Victor Goldberg, MD
2001 James Urbaniak, MD
2000 Douglas Jackson, MD
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

2016 MALLORY-COLEMAN VISITING PROFESSOR AND MODERATOR:

JULIE SWITZER, MD



Dr. Julie Switzer is an assistant professor at the University of Minnesota, Department of Orthopaedic Surgery. Her clinical and research interests include trauma, geriatric orthopaedic trauma, and diseases of bone metabolism such as osteoporosis. She is currently the Director of the Geriatric Orthopaedic Trauma Program at Regions Hospital.

Dr. Switzer is the course director of a biannual Geriatric Fracture Course, held in St. Paul since 2006. She has worked with her specialty societies in teaching courses nationally including at the Orthopaedic Learning Center in Rosemont, IL, the Annual Meeting of the American Association of Orthopaedic Surgeons (AAOS), and most recently the Annual Meeting of the American Orthopaedic Association. She has served as a committee member for national organizations such as the AAOS Women's Health Issues Advisory Board, National Osteoporosis Foundation, Ruth Jackson Orthopaedic Society, and the American Society for Bone and Mineral Research. Dr. Switzer has published articles and has conducted many presentations on topics as varied as geriatric trauma, wilderness orthopaedics, pelvic fractures, and osteoporosis.

Dr. Switzer's education and training are as follows:

Medical School: Stanford University – 1994

Internship in Surgery: University of Washington, Seattle – 1995

Residency in Orthopaedic Surgery: Univ. of Washington, Seattle – 1999

Fellowship in Sports Medicine: Vail Valley Medical Center – 2000

PROGRAM

- 7:00 am **Welcome and Introduction**
- 7:15 am **Darren Plummer, MD**
“Adverse Local Tissue Reactions Secondary to Corrosion at the Head-Neck Junction in Metal on Polyethylene Bearings”
- 7:30 am **Bryan Van Dyke, DO**
“First Metatarsal Head Osteochondral Defect Treatment with Particulated Juvenile Cartilage Allograft Transplantation”
- 7:45 am **Christopher McCarthy, MD**
“Screw Stripping Peak Torque Comparison”
- 8:00 am **Yoni Blau, MD**
“Patients Lost to Follow-up in Hand and Upper Extremity Surgery: Who is at Risk?”
- 8:15 am **Andrew Foster, MD**
“Safe Suture Anchor Insertion for Anterior and Posterior Hip Labral Repair”
- 8:30 am **Carman Quatman, MD, PhD**
“Traffic in the Operating Room: Pulse of the OR”
- 8:45 am **Travis Frantz, MD**
“Large-magnitude Pelvic and Retroperitoneal Tissue Damage Predicts Organ Failure”
- 9:00 am **Benjamin Leger-St-Jean, MD**
“ACL Reconstruction Using a Combination of Autograft and Allograft Tendon: A MOON Cohort Study”
- 9:15 am *Break*
- 9:30 am **Adam Gerber, MD**
“Excisional Matrixectomy, An Effective Procedure Forgotten in Time, or a Lost Treasure? A Retrospective Case Series of the Fowler Procedure”
- 9:45 am **John Erickson, DO**
“Treatment of Chronic, Stable Slipped Capital Femoral Epiphysis via Surgical Hip Dislocation with Combined Osteochondroplasty and Imhauser Osteotomy”
- 10:00 am **Ryan McNeilan, MD**
“The Biceps Button Can be Safely Used to Anatomically Repair Distal Biceps Tendon Ruptures Through a Two Incision Technique: A Cadaveric Study”
- 10:15 am **Sohrab Virk, MD**
“Reimbursement and Charges Related to a 90-day Episode of Care for One- or Two- Level Anterior Cervical Discectomy and Fusion”
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- 10:30 am **Sean Sutphen, DO**
"The Direct Anterior Approach has a Lower Rate of Deep Infection than the Limited Incision Direct Lateral Approach in Primary Total Hip Arthroplasty"
- 10:45 am **Marissa Jamieson, MD**
"Expected Time to Return to Athletic Participation Following Stress Fracture in Division I Collegiate Athletes"
- 11:00 am **Adam Martin, MD**
"Hand Surgery Questions on the Orthopaedic In-Training Examination: Analysis of Content and Reference"
- 11:15 am **Craig Udall, MD**
"Diabetes is Not Significantly Associated with an Increased Risk of Venous Thromboembolism After Foot or Ankle Surgery"
- 11:30 am **Thai Trinh, MD**
"Radiographic Assessment of Anatomic Risk factors Associated with Acute, Lateral Patellar Dislocation In The Immature Knee"
- 11:45 am **Lunch**
- 12:30 pm **Julie Switzer, MD, Professor and Moderator**
"Geriatric Polytrauma"
- 1:30 pm **Ryan Colley, DO**
"The Effect of Blocking Screws on Union of Infraisthmal Femur Fractures Stabilized with a Retrograde Intramedullary Nail "
- 1:45 pm **Amy Speeckaert, MD**
"A Comparison of Barbed Suture Versus Traditional Techniques for Muscle Belly Repair"
- 2:15 pm **Darren Plummer, MD**
"Oral And Intravenous Tranexamic Acid Are Equivalent At Reducing Blood Loss Following Total Knee Arthroplasty"
- 2:30pm **Josh Troyer, MD**
"Anterior Cruciate Ligament Reconstruction in Patients Over Age 60"
- 2:45 pm **Travis Frantz, MD**
"Patient Specific Injury Profiles Predict Organ Failure in Multiply Injured Patients"
- 3:00 pm **Sohrab Virk, MD**
"Adipokines in Spinal Fusion: Do they play a role?"
- 3:15 pm **Steven Brown, MD**
"MRI in Idiopathic, Stable, Slipped Capital Femoral Epiphysis: Evaluation of Contralateral Pre-slip"
- 3:30 pm **End of Day**
-



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ADVERSE LOCAL TISSUE REACTIONS SECONDARY TO CORROSION AT THE HEAD-NECK JUNCTION IN METAL ON POLYETHYLENE BEARINGS

Authors: Darren R Plummer, MD, MBA, Craig J Della Valle, MD, Richard A Berger, MD, Wayne G Paprosky, MD, Scott M Sporer, MD, Joshua J Jacobs, MD

Presenter: Darren Plummer, MD

INTRODUCTION:

Adverse local tissue reactions (ALTR) related to corrosion at the head-neck junction in metal-on-polyethylene (MOP) bearings have been described with increasing frequency. Diagnosis and appropriate management, however, is not well understood. The purpose of this report is to describe our experience with the diagnosis and management of this complication.

METHODS:

We identified 27 patients who were revised for an ALTR secondary to corrosion at the modular femoral head-neck taper with a MOP bearing. Patients presented at a mean of 4.3 years (range, 0.4 to 25 years) after their index procedure. Patients were treated with debridement and a modular bearing exchange, with use of a ceramic femoral head with a titanium sleeve in 23 of the 27 cases. Student's t-test was used to compare pre and postoperative metal ion levels with significance set at a p-value of < 0.05.

DATA AND RESULTS:

Preoperative serum cobalt levels were elevated to a greater degree than were chromium levels in all cases, with a mean cobalt of 11.2 ppb (range, 1.1 to 49.8) and chromium of 2.2 ppb (range, 0.2 to 9.8). Repeat metal ions (measured in 16 of 18 patients with > 2 year follow up) showed a significant decrease in serum cobalt to a mean of 0.33 ppb (range 0.18 to 0.6) (p = 0.004), and chromium to a mean of 0.51 ppb (range 0.1 to 1.4) (p = 0.001). Recurrent ALTR was noted in one case where a metal as opposed to a ceramic head was used.

DISCUSSION:

The diagnosis of ALTR secondary to corrosion at the head-neck taper in patients with a MOP bearing is associated with serum cobalt levels of > 1 ppb with cobalt levels consistently elevated above chromium. Retention of a well-fixed stem and modular exchange to a ceramic head leads to resolution of symptoms and decreases in metal ion levels.

Funding: Internal Department funding

DISCLOSURES:

Disclosures: Plummer: none; Berger: Consultant- Microport, royalties-Zimmer; Sporer: Consultant-Smith & Nephew, Zimmer; Research support- Central DuPage Hospital, Zimmer; Royalties, financial or material support from publishers- SLACK Incorporated; Paprosky: Royalties- Zimmer; Speakers bureau/paid presentations- Zimmer, DePuy, Medtronic, Stryker; Consultant- Stryker, Zimmer, DePuy, Medtronic; Royalties, financial or material support from publishers- Lippincott; Della Valle: consulting for Biomet, Depuy, Smith&Nephew; Research support from Biomet, CD Diagnostic, Smith&Nephew, Stryker; Scientific Advisory Board/Stock/Options/Travel from CD diagnostics; Jacobs: Research support- Medtronic Sofamore Danek, Nuvasive, Zimmer; Stock- Implant Protection

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Bryan Van Dyke, DO is a resident in Orthopaedics at Doctors Hospital

FIRST METATARSAL HEAD OSTEOCHONDRAL DEFECT TREATMENT WITH PARTICULATED JUVENILE CARTILAGE ALLOGRAFT TRANSPLANTATION

Authors: Bryan Van Dyke, DO; Gregory Berlet, MD; Justin Daigre, MD; Christopher Hyer, DPM, MS; Terrence Philin, DO

Presenter: Bryan Van Dyke, DO

INTRODUCTION:

Focal damage to articular cartilage and the supporting subchondral plate, commonly referred to as an osteochondral defect (OCD), can be a cause of joint pain and subsequent decreased range of motion. There are few studies specifically describing these lesions in the first metatarsophalangeal (MTP) joint, where they are traditionally grouped into hallux rigidus. There exists an opportunity for early detection and intervention with the intent to prevent deterioration and improve patient outcomes. One contemporary treatment concept is to harness particulated juvenile articular cartilage allograft to restore articular cartilage. The aim of our study was to review the results of patients that had undergone this procedure for first metatarsal head OCDs.

METHODS:

A retrospective, of a consecutive case series was studied utilizing the records of three foot and ankle surgeons. Inclusion criteria included all adult patients who were a minimum of one year post surgery and consented to participate. Patient demographics and preoperative visual analog scale (VAS) pain level were recorded from a standardized intake sheet. From the operative note the OCD size and location was recorded, as well as any concomitant procedures.

At a minimum follow up of one year we obtained objective measurements of arthritis grade and subjective considerations of pain and function. At a minimum of one year follow up we obtained weight bearing foot radiographs, first MTP range of motion as measured clinically, grade of hallux rigidus utilizing the Coughlin and Shurnas, VAS pain level, Foot Function Index (FFI) questionnaire, the American Orthopaedic Foot and Ankle Society (AOFAS) Hallux Metatarsophalangeal-Interphalangeal scale, and an overall patient satisfaction score.

DATA AND RESULTS:

We found 9 patients that met the inclusion criteria, 4 males and 5 females. The average age was 41 years old (± 12 , Range 21-65). The mean and median average preoperative VAS pain score was 57.50 (± 18.32 , Range 30-80) and 65, respectively. Four of the nine OCDs were located centrally on the first metatarsal head. The average OCD size intraoperatively was 30 mm² (Range 16-49). The average time since surgery was 3.26 years (± 1.21 , Range 1.41-5.62). The postoperative patient results were exceptionally positive. Average first MTP dorsiflexion was 41.78° (± 20.70 Range 6-70). The average postoperative hallux rigidus classification was grade 2 (range 1-3). The mean and median average VAS pain score improved to 5.22 (± 8.44 , Range 0-20) and 1, respectively. The average AOFAS score was 88 (± 16 , range 52-100). The average FFI score was 8.04 (± 12.60 , range 0-30.59). All but one patient was satisfied with their results.

DISCUSSION:

At an average of 3.26 years postoperatively, patients had improved pain, did not show significant progression of their first MTP joint degeneration, and were satisfied with their results. Potential areas for improvement in this study would be a larger sample size and increased follow up time. We believe particulated juvenile cartilage allograft is a valuable tool for surgeons to use in treating articular defects. Encouraged by these results, increased suspicion for these lesions may allow for successful identification and surgical intervention.

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FIRST METATARSAL HEAD OSTEOCONDRA DEFECT TREATMENT WITH PARTICULATED JUVENILE CARTILAGE ALLOGRAFT TRANSPLANTATION, CONTD.

Presenter: Bryan Van Dyke, DO

REFERENCES:

- Wuelker et al.* A case of osteochondritis dissecans at the first metatarsal head. **Foot and Ankle Surgery.** 2: 105-107, 1996
- McNeil DS, Baumhauer JF, Glazebrook MA.* Evidence-Based Analysis of the Efficacy for Operative Treatment of Hallux Rigidus. **Foot Ankle Int.** 34(1):15-32, 2013
- Adkisson et al.* The Potential of Human Allogenic Juvenile Chondrocytes For Restoration of Articular Cartilage. **Am J Sports Med.** 38(7):1324-1333, 2010
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ACKNOWLEDGEMENTS:

Special thanks to Emily Stansbury and Carrie Sexton with the OhioHealth Research Institute at Orthopedic Foot and Ankle Center.

DISCLOSURES:

This study was not funded, and there are no disclosures.



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SCREW STRIPPING PEAK TORQUE COMPARISON

Authors: Chris McCarthy, MD; Kari Stammen; Alan Litsky, MD, ScD

Presenter: Chris McCarthy, MD

INTRODUCTION:

One of the more common orthopaedic surgical procedures is hardware removal spanning all subspecialty practices for a variety of reasons including elective and non-elective cases. Stripped screws cause not only frustration for the surgeon but more importantly, can increase the morbidity for the patient requiring local bone and soft tissue destruction to remove the problematic screws. This may lead to altered post-operative restrictions requiring some patients to limit weight bearing. Previous studies evaluating "two-finger tightness" using 3.5 mm cortical screws with hexagonal heads have shown peak torque values to screw stripping to be 2.73 ± 0.56 N-m¹ and another study showed values between 0.332 N-m and 0.343 N-m². We aimed to compare the peak torque of 2.7 mm, 3.5 mm, and 5.0 mm star head screws to the known peak torque values for 3.5 mm hexagonal cortical screw heads. Our hypothesis is that the star drive heads would have higher peak torque values to screw stripping for each respective size as compared to hexagonal head geometry.

METHODS:

Each of the 2.7 mm, 3.5 mm, and 5.0 mm star head screws were secured into their respective locking plates and torqued firmly by hand before being placed in a vice. Five 2.7 mm, one 3.5 mm, and one 5.0 mm star head screws were used. A MTS Systems Corporation (Eden Prairie, Minnesota) torque machine was then used with the respective screwdriver shafts inserted into the respective screws. The machine was set to turn the screwdriver shaft at a rate of 0.5 degrees per second for a total range of the machine's ability of 100 degrees.

The torque values for each screw were obtained, and peak torque as well as yield values recorded. Also, we visually assessed and recorded any deformation seen with the screw-screwdriver constructs. Paired t-test was used for statistical significance.

DATA AND RESULTS:

A total of five 2.7 mm locking star-drive screws were available for peak torque valuation after their respective heads were stripped. The peak torque values are seen in Table 1. The mean peak torque was 0.2022 N-m with a standard deviation of 0.0556 N-m (range 0.1054 N-m – 0.2418 N-m).

With attempted screw stripping for the 3.5 mm and 5.0 mm star drive screws, one screw was used in each type and failure occurred at the screwdriver itself just proximal to the screw-screwdriver junction with yielding in the rotational direction corollary to the direction of torque. This occurred at 0.7796 N-m with then peak torque of screwdriver failure at 0.8795 N-m for the 3.5 mm screw, and yielding occurred at 1.8894 N-m for the 5.0 mm screw.

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SCREW STRIPPING PEAK TORQUE COMPARISON, CONTD.

Presenter: Chris McCarthy, MD

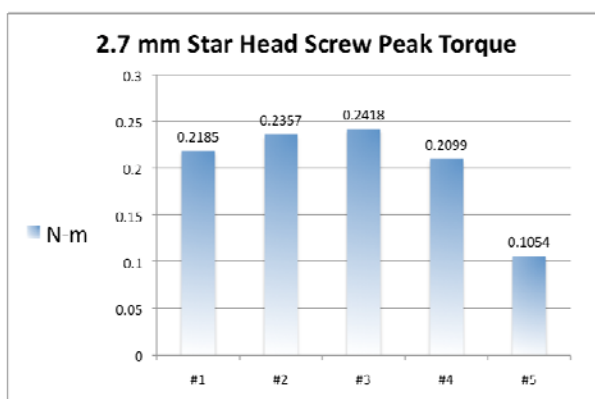


Table 1.—Peak torque values for 2.7 mm screws (N-m)

DISCUSSION:

In hardware removal surgery, the ability for screws to withstand torque applied by the surgeon is paramount to a successful and smooth surgery while limiting patient morbidity caused by difficult removal due to stripped screws. Previous studies have demonstrated peak torque values for commonly used 3.5 mm cortical screws with hexagonal heads^{1,2}. This study demonstrates the peak torque values for 2.7 mm locking screws which have star designed heads for the screw-screwdriver interface to be significantly lower than the previously reported data on 3.5 mm hexagonal head peak torques ($p=0.003$). However, in our study, we were not able to strip 3.5 mm nor 5.0 mm star head screws. The peak torque values were exponentially higher for those screws as compared to the 2.7 mm screws with failure of the screwdriver itself in the 3.5 mm screw testing and yielding of the 5.0 mm screw overcoming the capacity of the machine. We infer that star drive screw-screwdriver interfaces are significantly more tolerant to higher torque than their hexagonal head design equivalents.

Future studies are needed with larger numbers of screws to directly compare each screw size, hexagonal versus star heads. We posit that manufacturers may consider uniform screw head designs to be star drive style to provide stronger interfaces for surgeon torque intraoperatively.

REFERENCES:

1. Acker, AB et al. Two-Finger Tightness: What Is It? Measuring torque and reproducibility in a simulated model. *J Orthop Trauma*. 2015 Nov 30.
2. Wilkofsky IG et al. How Repeatable Is Two-Finger Tightness When Used To Tighten Bone Screws? *J Hand Surg Eur Vol*. 2014 Nov;39(9):1007-8.

DISCLOSURES:

None



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PATIENTS LOST TO FOLLOW-UP IN HAND AND UPPER EXTREMITY SURGERY: WHO IS AT RISK?

Authors: Yoni M. Blau, MD; Yoseph A. Rosenbaum, MD; X. Shawn Liu;
Hannah K. Fox; Alex C. DiBartola; Kanu S. Goyal, MD

Presenter: Yoni Blau, MD

INTRODUCTION:

Patient follow up is an important part of medicine and this is especially true in orthopaedic surgery. In orthopaedics post-operative follow up is essential to the care of the patient. Post-operative follow up includes simple suture removal to wound care to complicated rehabilitation protocols. Without proper follow up the patient's activities cannot be progressed and complications cannot be recognized and/or treated appropriately. The purpose of this study is twofold. First to determine the incidence of post-operative patient loss to follow-up and second to identify patients that may be at high risk of loss of follow-up after hand and upper extremity surgery. We hypothesize that there will be a correlation with loss of follow-up and demographic variables in surgical hand and upper extremity patients.

METHODS:

This study is a retrospective chart review of all surgical patients seen through the Hand and Upper Extremity Center at The Ohio State University Wexner Medical Center from July 2014 through June 2015. Inclusion criteria are: surgery performed/staffed by an attending of the Hand and Upper Extremity Center, surgery performed either at OSUWMC (OSU Outpatient Surgery Center, OSU Main Hospital, or OSU East Hospital), all procedures including elective and non-elective. Exclusion criteria are patients who: are prisoners, are scheduled to follow up outside of OSU, are currently still being followed, underwent bedside procedures, died before follow-up was complete, have Veterans Association Insurance or unknown insurance status at the time of billed procedure. The charts were reviewed for patient compliance with post-surgical clinic follow-up. Multiple demographic variables, such as insurance type, length of follow up period, age, and gender were analyzed to determine if any correlation existed that could predict a high risk patient. Variables were described with proportions and compared using logistic regression analysis. Odds ratios and confidence intervals were calculated with a p-value ≤ 0.05 signifying statistical significance.

DATA AND RESULTS:

There were 2,834 surgical cases (2,467 patients) performed from July 2014 through June 2015. 2,636 surgical cases (2,277 patients) met inclusion and exclusion criteria. There was an overall loss to follow-up rate of 29%. Patients lost to follow-up based on insurance type were 19%, 23%, 24%, 41%, 49% for worker's compensation, Medicare, private insurance, Medicaid, and self-pay respectively. All of these groups were significantly different ($p < 0.05$) when compared to privately insured patients when adjusted to the other variables, with the exception of worker's compensation ($p = 0.10$). Patients with expected short term follow-up were lost at a rate of 27%. When compared to short-term follow-up, expected mid-term and long-term follow-up patients were lost at a rate of 36% and 21% respectively ($p = 0.005$, $p = 0.019$). Age also played a role, with patients under 30 years of age being lost to follow-up at a rate of 44% when compared to patients 30-64 years old (28%, $p < 0.0001$) and 65 and older (16%, $p < 0.0001$). Males had a higher rate of loss of follow-up, 35%, when compared to females (24%, $p < 0.0001$).

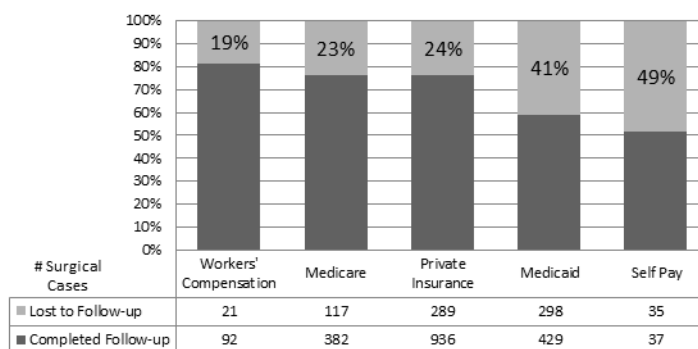
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PATIENTS LOST TO FOLLOW-UP IN HAND AND UPPER EXTREMITY SURGERY: WHO IS AT RISK?

Presenter: Yoni Blau, MD

Percentage of Patients Completed and Lost to Follow-up



DISCUSSION:

Surgical follow-up is important to patient care and outcomes. Multiple demographic variables were found that can identify high risk patients, which may allow surgeons to proactively educate these patients on the importance of follow-up. This is clinically significant as this will improve patient care and outcomes for post-surgical patients. Risk factors included: Self Pay, Medicaid, and Medicare insurance, younger age, midterm follow-up period, and male gender.

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1. Berg, et al. *J Hand Surg Am.* 37(1):42-6, 2012 Jan
2. Zelle, et al. *J Orthop Trauma.* 29(11):510-5, 2015 Nov
3. Choi, et al. *World J Orthop.* 6(1):150-5, 2015 Jan
4. Sielatycki, et al. *Spine.* 40(24):1934-40, 2015 Dec

ACKNOWLEDGEMENTS:

Thank you to Afshin Shirzad for pulling the raw data from the EMR

DISCLOSURES:

None



Andrew Foster, MD is a resident in Orthopaedics at The Ohio State University

SAFE SUTURE ANCHOR INSERTION FOR ANTERIOR AND POSTERIOR HIP LABRAL REPAIR

Authors: Andrew Foster, MD; John Ryan, MD; Thomas Ellis, MD; J. Flom

Presenter: Andrew Foster, MD

INTRODUCTION:

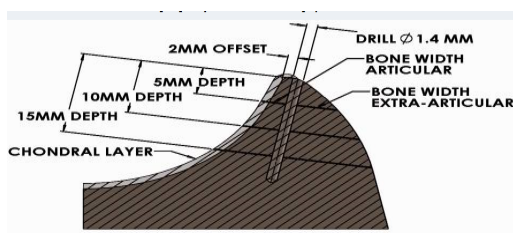
Labral tears are the most common pathology identified in patients undergoing hip arthroscopy and are the most common cause of mechanical symptoms¹. Recently, improved arthroscopic techniques have allowed for suture anchor repair of the hip labrum. However, the procedure is technically challenging due to the restricted angles of anchor insertion, concavity of the acetabular articular surface and relatively narrow column of bone in the anterior and posterior acetabulum. Failure of anchor insertion can occur by penetration of the intra or extra-articular acetabulum.

The goal of this study was to define the bone thickness in relation to the articular surface at various depths along the anterior and posterior acetabular rim and to define safe portals for anchor insertion in these regions.

METHODS:

Six fresh frozen adult cadaveric pelvises were dissected free of the soft tissues, including the labrum. The right and left acetabuli were utilized. Each pelvis was mounted onto a jig with custom guide which simulated skin portals at each of three standard arthroscopy portals: mid-anterior (MA), distal anterolateral (DALA) and posterolateral (PL). Clock face positions were marked.

A 1.4-mm drill bit with a 2-mm offset straight drilling guide referenced from the articular surface was used to simulate typical anchor insertion. The MA and DALA portals were used to drill the 3 o'clock and 4 o'clock positions, and the PL portal was used to drill the 8 o'clock to 11 o'clock positions. A custom caliper was then used to measure the distance from articular chondral surface to drill (articular width) as well as the distance from drill to extra-articular surface (bone width, extra-articular).



Measurements were taken at 5, 10 and 15 mm depths from the labral insertion and measured parallel to the acetabular face, which was defined as the distance along a perpendicular line between drill and articular/extra-articular surface.

DATA AND RESULTS:

Table I summarizes the measurements taken at various depths and rim positions. In general, the distance to the articular surface increases as depth increases.

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SAFE SUTURE ANCHOR INSERTION FOR ANTERIOR AND POSTERIOR HIP LABRAL REPAIR, CONTD.

Presenter: Andrew Foster, MD

The total acetabular bone thickness was largest at the 4 o'clock and 8 o'clock positions. Posterior positions demonstrate relatively constant articular distance from the drill bit. For the posterior positions, the PL portal only was used. Use of the MA or DALA portals resulted in extra-articular surface perforation as drill penetration increased.

The smallest distance between the drill hole and articular surface and the largest distance between drill hole and the extra-articular surface were both at the 4 o'clock position. No significant difference between the MA and DALA portals were noted for the anterior positions. Unlike other rim positions, at which the distance to the articular surface increases with increasing depth, the distance to the articular surface at 4 o'clock remains relatively thin at 10 and 15 mm. In 6 of the 12 specimens, the drill hole penetrated into the acetabular fossa between 10 and 15 mm.

Table I.

Summary of measurements taken at various depths and rim positions

Twelve hip specimens		Articular side of acetabulum			Extra-articular side of acetabulum		
Portal	Clock position	Depth			Depth		
		5 mm	10 mm	15 mm	5 mm	10 mm	15 mm
MA	5	2.23±.65	3.31±1.20	5.15±1.90	3.18±1.08	5.26±1.65	6.05±2.18
	4	1.62±.74	2.30±.96	1.39±2.00	10.66±2.27	12.95±1.63	13.64±2.44
DALA	3	2.60±.87	3.80±2.37	6.59±4.09	3.10±2.14	4.84±2.64	4.78±2.82
	4	1.61±.48	1.98±1.07	2.51±2.42	7.94±3.91	10.88±3.78	11.47±3.44
PL	8	2.73±.78	5.43±1.76	8.55±2.63	4.38±1.57	7.23±2.29	9.91±3.77
	9	2.29±.64	4.70±1.49	8.19±2.13	4.04±1.40	5.58±1.95	6.15±2.62
	10	2.10±.79	4.14±1.40	7.45±2.18	3.40±1.92	4.96±2.30	6.38±2.75
	11	2.75±.80	5.34±1.18	9.05±2.21	3.28±1.34	4.38±1.52	5.44±1.93

DISCUSSION:

Our study confirmed the results of a previous study, namely that anterior and posterior rim position have relatively thin bone². Both the MA and DALA portals can be safely used for drilling anterior rim positions. At the 4 o'clock position, the distance from drill hole to articular surface remains quite thin throughout the entire drill depth.

Posterior positions can be safely drilled using the PL portal with relatively good bone margin. The MA and DALA portals should not be used when drilling posterior positions as this resulted in extra-articular surface penetration in our model. In all specimens, increased extra articular bone is noted at the lower positions, corresponding to the ischial and pubic flare.

Our study emphasizes the need for precise anchor placement on the acetabular rim. Specifically, surgeons should be aware of the thin acetabular rim at the anterior and posterior positions, especially at 4 o'clock, where the distance to the articular surface remains small even with increasing depth. Surgeons can safely use either the MA or DALA arthroscopy portals for anterior labral repair and PL portal for posterior repairs.

REFERENCES:

1. Safran M. et al. *J Am Acad Orthop Surg*; 18: 338–45. 2010
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DISCLOSURES:

Funding by Pivot Medical, Sunnyvale, CA.



Carmen Quatman, MD, PhD is a resident in Orthopaedics at The Ohio State University

TRAFFIC IN THE OPERATING ROOM: PULSE OF THE OR

Authors: Carmen Quatman, MD, PhD.; Alex DiBartola; James Darnley; Zachery Denham; Priya Patel; Andrew Glassman, MD; Joel Mayerson, MD; Laura Phieffer, MD; Thomas Scharschmidt, MD; Susan Moffatt-Bruce, MD, PhD

Presenter: Carmen Quatman, MD, Ph.D.

INTRODUCTION:

Surgical site infections (SSI) are a challenging problem faced by many surgical specialties. More than 500,000 SSIs occur annually in the United States, constituting a rate of approximately 2.8 per 100 operations. High rates of operative room traffic may contribute to surgical air contamination and SSIs.

SSIs have been studied extensively in the preoperative, intraoperative and postoperative settings. While several factors have been identified to increase the risk of SSIs, the number of people in the OR, frequency of OR door openings and amount of time the sterile cart is open are all modifiable risk factors that have been associated with higher rates of contamination and SSIs. The pre-incision period of a surgical case, from when the sterile case cart is opened to the initial incision, is often an overlooked part of procedures when it comes to surgical site infection prevention.

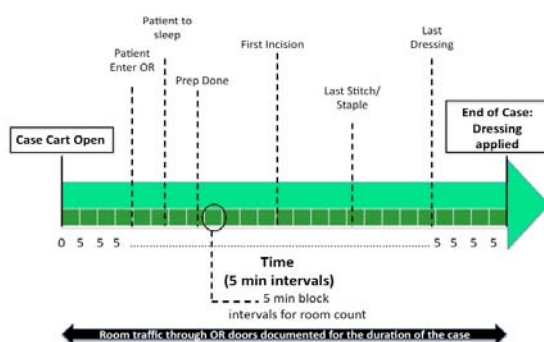
The purpose of this study was to evaluate room traffic patterns in orthopaedic implant surgery procedures to 1) determine the length of time the case cart was open prior to incision, 2) compare room traffic frequency before and after surgical incision and 3) determine if time of day had an effect on room traffic. The hypothesis tested was that room traffic would be higher prior to surgical incision compared to after incision and that time of day would not affect room traffic frequency.

METHODS:

From June-August of 2015, operating room (OR) traffic was evaluated in orthopedic implant procedures in the ORs at a high volume academic hospital system. Cases were collected during procedures performed by 5 different, fellowship trained, orthopaedic surgeons. One of four trained observers evaluated OR room traffic behavior including time of sterile case cart opening to dressing placement, case length, number of people in the OR at 5 minute intervals, and door openings (Fig 1).

Observed cases were placed in one of three categories based on the sterile pack opening time: 6:00-9:59, 10:00-13:59, and 14:00-17:59.

Figure 1. Data collection chronology



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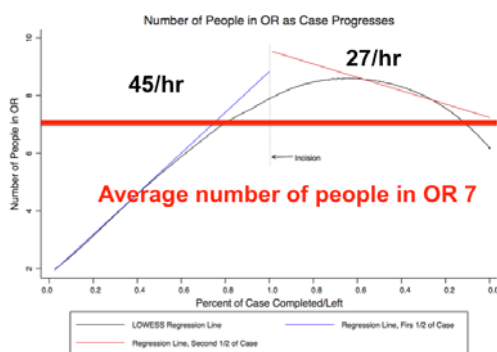


TRAFFIC IN THE OPERATING ROOM: PULSE OF THE OR, CONTD.

Presenter: Carmen Quatman, MD, Ph.D.

DATA AND RESULTS:

OR traffic was significantly greater during the pre-incision period (45.0 ± 12.8), than during the post-incision period (26.6 ± 12.8) ($p < 0.0001$). The average number of people in the OR was $6.9 (\pm 2.7)$. Less people were in the OR during the pre-incision period (5.2 ± 2.8) compared to post-incision period (8.2 ± 1.8) ($p < 0.0001$; Fig 2). On average the case cart was open $91.5 (\pm 31.2)$ min, prior to the incision. Case carts were open for over an hour prior to incision in 91% of cases.



ANOVA revealed no statistically significant difference among time of day groups (6:00-9:59 ($n=29$), 10:00-13:59 ($n=10$), and 14:00-17:59 ($n=7$)) as it relates door openings per min (room traffic rate) ($p = 0.9237$) or mean number of people in the OR ($p = 0.3560$). Pearson's correlation revealed no correlation between case start time and room traffic rates ($p = 0.6129$, $r^2 = 0.0059$) or between case start time and mean number of people in the OR ($p = 0.3435$, $r^2 = 0.0214$). Room traffic frequency increased with contaminated case carts, missing equipment, change in operative plans and decline in patient status.

DISCUSSION:

OR traffic embodies the pulse of the OR environment; increasing with breakdown in systems, communication or decline in patient status. Room traffic during orthopaedic implant cases is quite high with more than 1 door opening every 2 minutes. Interestingly, the highest frequencies of room traffic occurred prior to the incision but after case carts were opened and case carts were usually opened greater than one hour prior to incision. Strategies to decrease room traffic in orthopaedic implant cases may help improve room traffic rates and potentially decrease SSI risk factors.

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- ACKNOWLEDGEMENTS:** Authors thank Dr. Susan Moffatt-Bruce for project guidance and intramural funding from OSU Patient Safety and Quality Department.

DISCLOSURES:

None



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LARGE-MAGNITUDE PELVIC AND RETROPERITONEAL TISSUE DAMAGE PREDICTS ORGAN FAILURE

Authors: Travis Frantz, MD; Greg Gaski, MD; Scott Steenburg, MD; Teresa Bell, PhD
Todd McKinley MD

Presenter: Travis Frantz, MD

INTRODUCTION:

Pelvic and retroperitoneal trauma is a major cause of morbidity and mortality in multiply injured patients. The Injury Severity Score (ISS) has been criticized for underrepresenting and inaccurately defining mechanical injury. The influence of pelvic injury volume on organ dysfunction and multiple organ failure (MOF) has not been described. Through the use of CT, this investigation sought to precisely define volumes of mechanical tissue damage by anatomic region and examine its impact on organ failure. It sought to answer the questions of (1) Do patients with MOF have a greater volume of pelvic and retroperitoneal tissue damage when compared with those without MOF? (2) In patients who sustained pelvic trauma, does the magnitude of pelvic injury differ in patients with MOF? (3) Does the magnitude of organ dysfunction correlate with pelvic tissue damage volume?

METHODS:

Seventy-four multiply injured patients aged 18 to 65 years with an ISS ≥ 18 admitted to the intensive care unit for a minimum of 6 days with complete admission CT scans were analyzed. Each identifiable injury in the head/neck, chest, abdomen, and pelvis underwent volumetric determination using CT to generate regional tissue damage volume scores. Primary outcomes were the development of MOF as measured by the Denver MOF score and the degree of organ dysfunction by utilization of the Sequential Organ Failure Assessment (SOFA) score. Mean pelvic and retroperitoneal tissue damage volumes were compared in patients who developed MOF and those who did not develop MOF using Student's t-test. Among patients who sustained pelvic injuries, we compared mean volume of tissue damaged in patients who developed MOF and those who did not. We assessed whether there was a correlation between organ dysfunction, as measured by the SOFA score as a continuous variable, and the volume of pelvic and retroperitoneal tissue damage using the Pearson product-moment correlation coefficient.

DATA AND RESULTS:

The average volume of tissue damage was greater in patients with MOF when compared with those without (MOF: 685.667 ± 1081.344 ; non-MOF: 195.511 ± 381.436 ; mean difference 490.156 cc [95% confidence interval (CI), 50.076 - 930.237 cc], $p = 0.030$) (Figure 1). Among patients who sustained pelvic injuries, those with MOF had higher average tissue damage volumes than those without MOF (MOF: 1322.000 ± 1197.050 ; non-MOF: 382.750 ± 465.005 ; mean difference 939.250 [95% CI, 229.267 - 1649.233], $p = 0.013$).

Organ dysfunction (SOFA score) correlated with higher volumes of pelvic tissue damage ($r = 0.570$, $p < 0.001$). The same degree of correlation was not appreciated for other body regions (head/neck, chest, and abdomen).

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LARGE-MAGNITUDE PELVIC AND RETROPERITONEAL TISSUE DAMAGE PREDICTS ORGAN FAILURE, CONTD.

Presenter: Travis Frantz, MD

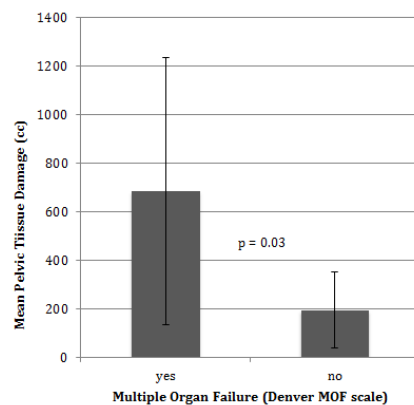


Fig. 1 Patients that developed MOF had higher mean pelvic and retroperitoneal tissue damage volume scores than those that did not succumb to MOF.

DISCUSSION:

This investigation demonstrated that greater degrees of pelvic and retroperitoneal tissue damage calculated from injury CT scans in multiply injured patients is associated with more severe organ dysfunction and an increased risk of developing MOF. The same results were not appreciated for other body regions. Early identification of polytrauma patients at risk of MOF allows clinicians to implement appropriate resuscitative strategies early in the disease course. Improved stratification of injury severity and a patient's anticipated clinical course may aid in the planning and execution of staged orthopaedic interventions. Future avenues of study should incorporate the ischemic/hypoperfusion component of pelvic injury in conjunction with the mechanical component presented here for improved stratification of multiply injured patients at higher risk of MOF.

REFERENCES:

None

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DISCLOSURES:

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Benjamin Léger-St-Jean, MD is an Orthopaedic Sports Medicine Fellow at The Ohio State University

ACL RECONSTRUCTION USING A COMBINATION OF AUTOGRAFT AND ALLOGRAFT TENDON: A MOON COHORT STUDY

Authors: Benjamin Léger-St-Jean, MD; James E. Darnley, BS; Angela D. Pedroza, MPH; David C. Flanigan, MD; Christopher C. Kaeding, MD; Robert A. Magnussen, MD, MPH

Presenter: Benjamin Léger-St-Jean, MD

INTRODUCTION: ACL reconstruction with hamstring autografts less than 8.5mm in diameter is associated with worse patient reported outcome scores and increased risk of revision surgery compared with reconstructions performed with larger grafts. One proposed solution to small autograft harvest is to create a hybrid graft by augmenting autografts with allograft tissue to increase graft diameter. The purpose of this study is to compare hybrid autograft/allograft ACL reconstruction to autograft ACL reconstruction.

METHODS: From the years 2002-2009, 34 patients were identified from a prospectively collect database as having undergone hybrid ACL reconstruction. 27 of the 34 (79.4%) patients had a two-year follow-up. These 27 patients were matched by age (within one year) and sex with 27 patients that underwent hamstring autograft ACL reconstruction during the same period. At the two year mark, revision surgery risk and patient reported outcome scores were compared between the two groups.

RESULTS: The average age for the hybrid and matched groups was 20.9 ± 7.0 . Both the hybrid group and the control group had 17 males to 10 females. There was no significant difference in pre-operative patient reported outcome scores, meniscus tears or cartilage lesions between the two groups. Graft size was larger in the hybrid group ($9.5 \pm 0.6\text{mm}$) than in the autograft group ($8.4 \pm 0.9\text{mm}$) ($p < 0.001$). At two years post-operative, patient reported outcome scores were similar between the hybrid group and the autograft group. Revision surgery was required in 5 (18.5%) of patients that underwent hybrid reconstruction compared to 2 (7.4%) of those that underwent autograft reconstruction ($p=0.26$).

DISCUSSION: The purpose of using the hybrid ACL graft was to address the potentially higher rate of failure of smaller sized grafts using the quadruple hamstring technique by creating a larger graft. Paradoxically, we found that hybrid grafts had a trend towards higher failure rates, although this difference was not significant due to the fact that the study was underpowered for this outcome. This supports findings by Diduch et al. that Hybrid grafts tend to fail at a higher rate. In our study, patients who underwent ACL reconstruction with hybrid hamstring grafts and hamstring autografts reported similar patient-reported outcome scores at two years post-operative. This contrasts with Diduch's study in which patients with hybrid grafts had less favorable outcome scores. Although additional studies are required to confirm these results, hybrid ACL grafts do seem to fail at higher rates than traditional autografts and do not appear to be a good solution to augment smaller grafts.

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EXCISIONAL MATRIXECTOMY: AN EFFECTIVE PROCEDURE FORGOTTEN IN TIME OR A LOST TREASURE?: A RETROSPECTIVE CASE SERIES OF THE FOWLER PROCEDURE

Authors: Adam Gerber, DPM; Erik Monson, DPM

Presenter: Adam Gerber, DPM

INTRODUCTION:

Excisional matrixectomy for permanent removal of an ingrown toenail (onychocryptosis) has been described in the literature since 1887 and published by numerous authors with varying techniques from soft tissue to bony resection. With the advent of chemical matrixectomy some have written off excisional procedures as less effective. We present a series of 103 cases (91 with onychocryptosis and 12 with onychomycosis) using the excisional matrixectomy technique described by A. W. Fowler with similar results. To our knowledge this is the largest study to date using this technique first described in 1958.¹⁻² The overall satisfaction rate was 86% including both groups who had matrixectomy for ingrown toenails and fungal toenails. When compared head to head, patients who had the procedure for onychocryptosis were statistically more satisfied with the procedure than those treated for onychomycosis alone, 92% compared to 50% respectfully. (OR 11.667, CI 1.5983 to 85.1606, $p > 0.05$).

METHODS:

A total of 68 patients (44F, 24M) underwent excisional matrixectomy from May 2013 – August 2015. Patients under the age of 18, and those who had an excisional matrixectomy by different technique were excluded. A phone survey with an average follow up time of 18 months (7-33 months) was conducted. A 65% response rate was obtained and included 30 females and 14 males for a total of 103 matrixectomies. The ACFAS universal Foot and Ankle Scoring System: Forefoot, was modified to obtain subjective parameters for the survey. Medical records were reviewed and cross examined with the results from the survey. Results recorded included the ingrown recurrence rate, nail regrowth, laterality, digit #, indication, plain film radiograph pathology, infection rate, and overall satisfaction. An odds ratio (OR) was calculated and a 95% confidence interval with a confidence coefficient of ± 1.96 was used to calculate the standard of error of the $\ln(OR)$ to find the upper and lower limits on the log scale. Using the EXP function in excel we found the inverse of \ln to normalize the scale.

DATA AND RESULTS:

Prior to surgery 58% of all surveyed patients had some form of conservative therapy ranging from prior nail avulsion or chemical matrixectomy (36%), to antibiotic therapy with or without nail trimming (22%). Of the 91 matrixectomies performed for onychocryptosis (with or without a fungal component) 79% were performed on the hallux nail, 44% of these were on the medial nail fold, and 28% each were performed on the lateral nail fold and the total nail. Ingrown recurrence rate was 7.7%. Post-operative infection was 19% and was determined by the need for antibiotics ≥ 1 week post-operatively including drainage, redness, and/or pain beyond reasonable time thresholds. The overall male to female ratio for ingrown toenail procedures including those not in the survey was 37 and 98 respectfully. Radiographic analysis did show a 37% preponderance for phalangeal abnormality.

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EXCISIONAL MATRIXECTOMY: AN EFFECTIVE PROCEDURE FORGOTTEN IN TIME OR A LOST TREASURE?: A RETROSPECTIVE CASE SERIES OF THE FOWLER PROCEDURE, CONTD.

Presenter: Adam Gerber, DPM

DISCUSSION:

While chemical matrixectomy has become a popular go to method for ingrown nail treatment, the risk of caustic burn and/or delayed procedural side effects including drainage continue to present the need for other treatment options with safer results. We attempt to provide an effective, safe alternative to chemical matrixectomy. Kayalar et al had a 9.8% recurrence rate on a modified Winograd procedure³, while Gerritsma-Bleeker had equal recurrence rates in direct comparison of phenol vs excisional matrixectomy while having shorter postoperative periods of erythema and purulent exudate.²

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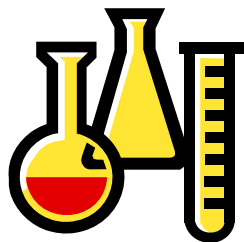
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DISCLOSURES:

No financial conflicts exist.



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TREATMENT OF CHRONIC, STABLE, SLIPPED CAPITAL FEMORAL EPIPHYSIS VIA SURGICAL HIP DISLOCATION WITH COMBINED OSTEOCHONDROPLASTY AND IMHAUSER OSTEOTOMY

Authors: John B. Erickson, DO; Walter P. Samora, MD; Kevin E. Klingele, MD
Presenter: John Erickson, DO

INTRODUCTION:

Severity of residual deformity following SCFE is directly related to early hip DJD. Restoration of proximal femoral morphology during the treatment of SCFE optimizes outcome. Recent treatment, including the modified Dunn procedure, restores anatomy with significant risk for AVN. The Imhauser osteotomy is a safe and effective way to treat patients with residual deformity. Full restoration of anatomy is difficult in hips with severe deformity and significant metaphyseal prominence. The purpose of this study is to evaluate effectiveness and safety of combined Imhauser osteotomy and osteochondroplasty via surgical hip dislocation approach in both acute and delayed settings.

METHODS:

Retrospective chart review was performed on a consecutive series of patients who underwent Imhauser osteotomy and osteochondroplasty via surgical hip dislocation for treatment of chronic, stable SCFE. Patients were divided into acute or delayed treatment groups based on whether the osteotomy was performed as the initial slip treatment. Demographics, operative details, radiographs, and complications were recorded. Variables were analyzed and statistical analysis performed.

DATA AND RESULTS:

Nineteen patients (15 male, 4 female, average 13.7 years) with chronic, stable SCFE treated with a combined Imhauser osteotomy and osteochondroplasty via surgical hip dislocation approach were reviewed. Six osteotomies were performed acutely in combination with in-situ pinning, 13 were delayed at least 6 months after in-situ pinning (average 21.7 months). Two hips had labral tears that required repair. Mean follow up 15.3 (delayed) and 19.3 (acute) months. Average improvement in slip angle was 40.7 (delayed) and 50.2 (acute) degrees ($p=0.0916$), final postoperative slip angle averaged 15.8 (delayed) and 17.8 (acute) degrees ($p=0.544$). Femoral neck length and greater trochanteric height were similar between both groups. Average alpha angle at final follow-up measured 55.8 (delayed) and 60.8 (acute) degrees ($p=0.542$). One patient (acute) had hardware failure within 2 weeks of osteotomy requiring revision ORIF. One patient (delayed) required bone grafting and revision ORIF for nonunion at the osteotomy site. No cases of AVN were identified.

DISCUSSION:

Imhauser osteotomy combined with osteochondroplasty via surgical hip dislocation approach is a safe and effective treatment of moderate-severe, stable SCFE performed in both the acute and delayed setting. Proximal femoral anatomy can be restored, labral pathology addressed, and the physis stabilized with minimal complication or AVN risk. Restoration of proximal femoral morphology may improve long term hip function and prevent or delay early DJD.

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TREATMENT OF CHRONIC, STABLE, SLIPPED CAPITAL FEMORAL EPIPHYSIS VIA SURGICAL HIP DISLOCATION WITH COMBINED OSTEOCHONDROPLASTY AND IMHAUSER OSTEOTOMY, CONTD.

Presenter: John Erickson, DO

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DISCLOSURES:

None



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THE BICEPS BUTTON CAN BE SAFELY USED TO ANATOMICALLY REPAIR DISTAL BICEPS TENDON RUPTURES THROUGH A TWO-INCISION TECHNIQUE: A CADAVERIC STUDY

Authors: Jonathan D. Barlow MD; Ryan McNeilan MD; Amy Speeckaert MD; Corey Beals MD; Hisham Awan MD

Presenter: Ryan McNeilan, MD

INTRODUCTION:

No consensus has been reached on the most effective anatomic approach or fixation method for distal biceps repair. Recent studies have demonstrated that the distal biceps can be more anatomically repaired with the two incision technique¹. Biomechanical studies have demonstrated that when the biceps is repaired anatomically, supination strength is improved, especially in terminal supination¹. Traditional methods of fixation of the distal biceps with the two incision technique can be cumbersome and may require additional exposure. Biomechanical studies have indicated that a bone tunnel repair may not be as strong as cortical button fixation². A more technically straightforward technique to safely and anatomically repair the biceps to the radial tuberosity would be advantageous. It is our hypothesis that, using a cortical biceps button through a two incision technique, 1) the distal biceps tendon can be safely repaired, as measured by proximity of the guide pin to the posterior interosseous nerve (PIN) and the recurrent radial artery of the forearm (RRA) and 2) the distal biceps tendon can be repaired to its anatomic position on the tuberosity.

METHODS:

Ten fresh frozen cadaveric upper extremity specimens were procured for evaluation in the present study. A two incision distal biceps repair of an iatrogenically created tear was performed. A 2.4 mm guide pin was placed through the anatomic insertion of the biceps tendon in bicortical fashion. Following placement of the bicortical guide pin, the proximity of the PIN and the RRA to the guide pin was measured using a caliper. The guide pin was then removed, and an Arthex distal biceps button™ was then utilized to complete the repair. The location of repair was manually visualized, documented, and finally mapped using a still digital photograph. If a difference existed from the repair and the anatomic insertion of the distal biceps, this was measured and documented.

DATA AND RESULTS:

The average distance from the tip of the guide pin to the PIN nerve was 11.4 mm (range: 8-14 mm). The nerve passed volar to the exit point of the guide pin in all patients, and pronation increased the distance from the guide pin to the nerve in all specimens. The average distance from the tip of the guide pin to the RRA was 12.5 mm (range: 8-19 mm).

The distal biceps tendon was repaired to the anatomic insertion site on the radial tuberosity using the biceps button technique in all specimens. Using the previously described quadrant system, all tendons were repaired in the "anatomic" quadrants³. There were no repairs that were placed outside the tuberosity or ulnar to the radial tuberosity (non-anatomic) repairs.

DISCUSSION:

Modern implants, including suture anchors, cortical buttons, and interference screws, have made a single incision technique possible and simplified the overall technical difficulty. Drawbacks have included nerve injuries and lack of an anatomic restoration which has been shown to affect terminal supination strength. The two-incision technique, in contrast, facilitates a more anatomic repair and greater supination strength but has drawbacks of increased rate of heterotopic ossification and the cumbersome nature and potential complications of creating the bone tunnel and trough. Therefore, our hypothesis was that the distal biceps tendon could be safely and

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THE BICEPS BUTTON CAN BE SAFELY USED TO ANATOMICALLY REPAIR DISTAL BICEPS TENDON RUPTURES THROUGH A TWO-INCISION TECHNIQUE: A CADAVERIC STUDY, CONTD.

Presenter: Ryan McNeilan, MD

anatomically repaired to the radial tuberosity using a two-incision, cortical button technique. No previous study has used a bicortical button for repair of the distal biceps tendon in a two-incision technique.

In this cadaveric study, the biceps tendon was safely repaired onto the radial tuberosity, with an average distance of 11.4 mm from guide pin to the PIN (range: 8-14 mm). The RRA was also found to be in near proximity to the tip of the guide pin, at an average of 12.5 mm (range: 8-19 mm). While there is no defined “safety margin” from the tip of the guide pin to these anatomic structures in the two-incision approach, it does fall within the 11-16 mm “safe distance” previously described for single incision repairs⁴. In addition, the distal biceps was anatomically repaired to the tuberosity using the two-incision biceps button technique. In all specimens, the biceps was repaired to the “anatomic” location as described, which is ulnar to the ridge of the biceps tuberosity.

Limitations to this study include its cadaveric nature and the potential alteration of the pin to structure distance measures caused by the dissection needed to identify the structures of interest.

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ACKNOWLEDGEMENTS:

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DISCLOSURES:

None



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REIMBURSEMENT AND CHARGES RELATED TO A 90-DAY EPISODE OF CARE FOR ONE OR TWO LEVEL ANTERIOR CERVICAL DISCECTOMY AND FUSION

Authors: Sohrab S. Virk MD, MBA; Frank M. Phillips MD; Safdar N. Khan MD

Presenter: Sohrab Virk, MD, MBA

INTRODUCTION:

Bundled payments represent a single payment for services during an episode of care for a surgical procedure. Anterior cervical discectomy and fusion (ACDF) and associated 90-day costs have been suggested as a “bundle” amenable to such a payment structure; however, little data regarding costs related to this procedure and subsequent care are available. The goal of our study was to quantify and delineate reimbursement associated with a one to two level ACDF procedure.

METHODS:

The Medicare 5% national sample administrative database was used to catalog clinical and financial data associated with the day of surgery and the 90-day postoperative period for patients undergoing a one- to two-level ACDF procedure from 2005 to 2012. We simultaneously queried the database for total knee replacement as a means to compare the payments and verify the reliability of our analysis.

The clinical and financial data for each patient were followed starting on the day either CPT-63075 or CPT 22554 (codes for an ACDF) was entered on their chart. Current Procedural Codes (CPT), Diagnosis Related Group (DRG) and International Classification of Diseases (ICD-9) codes were collected from this date to 90 days after their index procedure. CPT and DRG codes unrelated to the primary cervical diagnosis were excluded. CPT and DRG codes related to revision surgeries/readmissions, rehabilitation services, dysphagia and neuromonitoring were grouped in order to perform a subset analysis. The analysis was repeated in a similar fashion for total knee replacement (TKR).

A one-way ANOVA analysis was used to compare variations in payment in geographic areas and across different years in which the procedures were performed. If any results were significant we performed a post-hoc analysis using paired student t tests between each group. The p value was adjusted in the post hoc analysis using the Bonferroni correction.

DATA AND RESULTS:

Four thousand five hundred and six patients underwent a one- or two-level ACDF procedure and met study inclusion criteria. The total reimbursement for 4,506 patients with ACDF procedures was \$69,469,550, or \$15,417 per patient (+/- \$947, median = \$15,589) from the day of operation to 90 days after the index procedure. The CPT codes with the largest total reimbursement were CPT-63075 (Discectomy, anterior, with decompression of spinal cord and/or nerve root(s), including osteophytectomy; cervical, single interspace), CPT-22845 (anterior instrumentation; 2 to 3 vertebral segments), CPT-22554 (arthrodesis, anterior interbody technique, including minimal discectomy to prepare interspace; cervical below C2), CPT-22851 (Application of intervertebral biomechanical device(s) (for example, synthetic cage(s), threaded bone dowel(s), methylmethacrylate) to vertebral defect or interspace), and CPT-22551 (arthrodesis, anterior interbody, including disc space preparation, discectomy, osteophytectomy, and decompression of spinal cord and/or nerve roots; cervical below C2). The top 5 CPT codes accounted for 15.79% of the total reimbursement.

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REIMBURSEMENT AND CHARGES RELATED TO A 90-DAY EPISODE OF CARE FOR ONE OR TWO LEVEL ANTERIOR CERVICAL DISCECTOMY AND FUSION, CONTD.

Presenter: Sohrab Virk, MD, MBA

The surgeon and anesthesia related CPT codes represented 18.07% and 2.35% of reimbursement, respectively. These codes include reimbursement for all CPT codes related to surgical procedures as well as anesthesia related work. The total reimbursement to hospitals for inpatient care represented 74.73% of total reimbursement.

The average reimbursement per patient differed by geographic region ($p < 0.001$). Our post-hoc analysis showed there is a statistically significant higher reimbursement for the West as compared to the Northeast ($p = 0.002$) and Midwest ($p = 0.039$). This same post-hoc analysis showed that Southern reimbursement was statistically significant higher than the Northeast ($p = 0.043$). The average reimbursement per patient in each year from 2005 to 2012 showed a trend towards increased reimbursement from 2005 to 2012 ($p = 0.082$).

There were a total of 77,380 patients who met our inclusion criteria for Total Knee Replacements between 2005 and 2012. The overall reimbursement for these patients was \$1,350,359,472 or \$17,451 per patient.

DISCUSSION:

This study is the first report we are aware of for 90-day reimbursement/patient for one- to two-level ACDF procedures in a Medicare cohort. Payments had a statistically significant variation among geographic locations. Our study provides a reimbursement benchmark for one- to two-level ACDF procedures and understanding the payments relative to costs will help providers understand whether a bundled payment for the ACDF procedure is economically viable. Furthermore, the significant portion of reimbursement allocated to hospital's emphasizes the need for scrutiny of resources allocated within an inpatient setting.

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DISCLOSURES:

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EXPECTED TIME TO RETURN TO ATHLETIC PARTICIPATION FOLLOWING STRESS FRACTURE IN DIVISION I COLLEGIATE ATHLETES

Authors: Timothy Miller MD; Marissa Jamieson MD; Sonsecharae Everson ATC;
Courtney Siegel, ATC

Presenter: Marissa Jamieson, MD

INTRODUCTION:

Stress fractures are extremely common in track and field athletes and often lead to a significant time away from sport. Though much has been published on the diagnosis and treatment of bony stress fractures, very few high-quality studies have documented the expected time to return to athletic participation following stress fractures in elite athletes. The Kaeding-Miller(KM) classification system is the first to include both clinical and radiographic parameters and has been validated for intra and inter-observer reliability, but has not yet been validated for its prognostic value. The purpose of this study was to evaluate and determine the expected time to return to sport in collegiate track and field athletes. We hypothesized that time to return to athletic activity following stress fractures would vary uniformly dependent upon the site and severity of the stress fracture.

METHODS

A retrospective chart review was performed on all athletes diagnosed with a bony stress injury based on imaging at a single Division I collegiate men's and women's track and field/cross-country team over a 3 year period. The site and severity of the injury were recorded and graded based on the KM Classification System. The senior author graded all of the injuries. Time to return to full unrestricted athletic participation was correlated with the site, severity grade, and gender. T-tests and a one way ANOVA were used for statistical analysis.

<u>Kaeding-Miller</u>	<u>Pain</u>	<u>Radiographic Findings</u> (CT,MRI,Bone Scan or X-ray)
I	-	Imaging evidence of Stress FX
II	+	Imaging evidence of Stress FX
III	+	Non-displaced fracture line
IV	+	Displaced Fracture (> 2 mm)
V	+	Nonunion

DATA AND RESULTS:

Fifty-seven stress fractures were diagnosed in 38 athletes over a 3-year period. Thirty-seven of these injuries occurred in women; 20 in men. Mean time to return to participation in women was 13.9 weeks and 11.2 weeks in men ($p=0.068$) Ten athletes sustained recurrent or multiple stress fractures. Thirty-three stress fractures occurred in the tibia, 10 in the 2nd through 4th metatarsals, 3 in the 5th metatarsal, 6 in the tarsal bones, 2 femur, and 5 in the pelvis. There were 31 grade II stress fractures, 11 grade III stress fractures, and 2 grade V stress fractures that occurred bilaterally in the same patient. There were no Grade IV stress fractures diagnosed in this cohort of patients. No significant differences in time to return to sport were noted based on stress injury location or whether the stress fracture was classified as grade II or III.

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EXPECTED TIME TO RETURN TO ATHLETIC PARTICIPATION FOLLOWING STRESS FRACTURE IN DIVISION I COLLEGIATE ATHLETES, CONTD.

Presenter: Marissa Jamieson, MD

Mean time to return to sport based on injury site and Kaeding-Miller injury grade

Site	Mean Time to Return (weeks)	Significance
Pelvis	13.25	
Tibia	13.1	
Tarsal	13	P= 0.99
2 nd -4 th Metatarsal	12.7	
5 th Metatarsal	11.7	
Femur	12	
Grade		
II	12.3	P= 0.42
III	14.1	
V	17	

DISCUSSION:

Stress injuries to bone occur frequently in track and field athletes. Based on the data collected on a single collegiate track and field team over a period of 3 seasons, the expected time to return to full unrestricted athletic participation following diagnosis of a stress fracture is 12 to 13 weeks for all injury sites. The majority of injuries occurred in women and there was a trend towards longer recovery time in women. Greater severity of injury based on the Kaeding-Miller classification system correlated with increased time to return to participation. The ability to correlate the severity of the injury with time to return to recovery is crucial for management and can help guide the athletes' rehabilitation as well as their expectations.

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DISCLOSURES:

None.



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HAND SURGERY QUESTIONS ON THE ORTHOPAEDIC IN-TRAINING EXAMINATION: ANALYSIS OF CONTENT AND REFERENCE

Authors: Adam Martin MD; Andrew Shacklett MD; Craig McMains MD; Hisham Awan MD

Presenter: Adam Martin, MD

INTRODUCTION:

The American Academy of Orthopaedic Surgeons (AAOS) created and implemented the first in-training exam in 1963 with the purpose of monitoring the training of orthopaedic surgery residents.^{1,2} The exam is administered annually and now consists of approximately 275 questions covering 12 domains of orthopaedic surgery. For many programs the OITE has become a relative indicator of the quality of education provided to their residents.

Marker et al³ previously analyzed 5 years (2002-2006) of OITE questions classified as hand surgery. Authors reported on content and sources for OITE questions. The purpose of this study was to provide a comprehensive analysis of the Orthopaedic In-Training Examination's (OITE's) hand surgery questions and question sources.

Knowledge regarding the topics and resources utilized for OITE hand questions is an important aid in creating or improving residency programs' hand education curricula. An understanding of question content and sources should enable efficient learning and improved scores on this section of the examination.

METHODS:

The authors evaluated the OITE over a 7-year period (from 2009-2015). The total number of questions was recorded for each year. Each question delineated as hand surgery by AAOS examination committee was then evaluated. The authors then calculated the weight of hand questions as percentage of entire OITE. Hand surgery related questions were further analyzed for content, imaging modalities, interventions, and cited references.

DATA AND RESULTS:

Hand related questions comprised 8.4% (157/1872) of the OITE questions. Each question was categorized into 9 proposed general teaching topics, the majority of which can be consolidated into the following 5 topic areas: fracture/dislocation (22.5%), tendon/ligament (17.2%), nerve (16.6%), congenital (11.2%), amputation (9.9%). Sub-categorical analysis demonstrated that the top 5 individual topics most tested were flexor pulley system, peripheral nerve injury, forearm fracture/dislocation, carpal/cubital tunnel syndrome, and distal radius fractures.

Trends existed in the recommended references, with 5 journals and 2 textbooks being consistently cited: *Journal of Hand Surgery American Volume*, *Journal of the American Academy of Orthopaedic Surgeons*, *The Journal of Bone & Joint Surgery American Volume*, *Journal of Hand Surgery British Volume*, *Hand Clinics*, and *Orthopaedic Knowledge Update* and *Green's Operative Hand Surgery*, respectively.

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HAND SURGERY QUESTIONS ON THE ORTHOPAEDIC IN-TRAINING EXAMINATION: ANALYSIS OF CONTENT AND REFERENCE, CONTD.

Presenter: Adam Martin, MD

DISCUSSION:

Performance on the OITE has been shown to correlate with passing rates on the American Board of Orthopaedic Surgery Part I written examination.^{3,4} The purpose of this study was to analyze 7 years of OITE questions involving hand surgery. We hope that this analysis enables orthopaedic surgery programs to develop an optimal hand surgery educational curriculum.

Provided that almost 90% of the total citations in this analysis were from journals, residents who are preparing for the OITE would benefit from reading the current literature. Furthermore, sub-categorical analysis indicates that study material should focus on the following topics: flexor pulley system, peripheral nerve injury, forearm fracture/dislocation, carpal/cubital tunnel syndrome, and distal radius fractures.

Based on our results, residents' study time and journal clubs should focus primarily on articles from *Journal of Hand Surgery American Volume*, *Journal of the American Academy of Orthopaedic Surgeons*, *The Journal of Bone & Joint Surgery American Volume*, *Journal of Hand Surgery British Volume*, and *Hand Clinics*. Furthermore, residents should dedicate their textbook reading to Orthopaedic Knowledge Update and Green's Operative Hand Surgery.

This study contributes valuable data to the existing literature to enable residents and instructors to enhance orthopedic hand surgery education curricula. Based on these data, a hand surgery-focused teaching curriculum could be developed or improved upon which can in-turn strengthen test performance and clinical practice.

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None.

DISCLOSURES:

The authors have no financial interests to disclose.



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DIABETES IS NOT SIGNIFICANTLY ASSOCIATED WITH AN INCREASED RISK OF VENOUS THROMBOEMBOLISM AFTER FOOT OR ANKLE SURGERY

Authors: Craig Udall, DPM; Erik Monson, DPM

Presenter: Craig Udall, DPM

INTRODUCTION:

The risk of venous thromboembolism (VTE) after foot and ankle surgery is considered low. There are certain factors that put the patient at a higher risk of developing VTE. Diabetes is one potential risk factor that may increase risk of VTE but has been debated in the clinical literature.

Lab studies have shown that clotting factors and platelet activity are elevated in diabetes. This has led many to consider diabetes a pro-thrombotic state. In the orthopedic and podiatric surgical literature, diabetes has been found as a significant risk factor in patients who have ankle fracture ORIF and other traumatic foot or ankle injuries.

We hypothesize that diabetes elevates the patient's risk for developing VTE after foot or ankle surgery.

METHODS:

This is a retrospective case series of 5,216 patients over a 15 year time period who had foot or ankle surgery by one of 5 surgeons. All inpatient and outpatient cases were included. ICD 9 codes were gathered through the data warehouse to identify cases of VTE. Thorough, individual chart review was performed on all documented VTE cases to verify actual events after surgery. Each patient had either duplex ultrasound or CT PE scan confirmed diagnosis. Other variables and risk factors were noted, such as obesity, oral contraceptive use, prior history of VTE, family history of VTE. Onset of symptoms and timing of diagnosis after surgery were noted.

The data was analyzed using the Chi-Squared test of independence for the variables, and p-values were obtained. 95% Confidence intervals of the odds ratio were calculated to test for statistical significance.

DATA AND RESULTS:

The incidence of true acute VTE, documented by diagnostic imaging within 3 months after surgery was 0.6% (33/5,216 patients). 1,596 (30%) of the 5,216 total patients were diabetic. 10 (30%) of those 33 patients who had a VTE event had diabetes at the time of surgery. The incidence of VTE in the diabetic patients was also 0.6% (10/1596). It was found that diabetes was not associated with elevated risk of VTE ($p=0.97$, OR 0.99, 95% CI 0.47-2.09).

Average time to onset of VTE after surgery date was 3.5 weeks (1 – 8 weeks). 30 of the 33 patients developed a post op DVT as determined by clinical and diagnostic diagnosis by duplex ultrasound scan, while 2 patients had a PE based on clinical and CTPE scan. 1 patient had developed a DVT and a PE in the same week.

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DIABETES IS NOT SIGNIFICANTLY ASSOCIATED WITH AN INCREASED RISK OF VENOUS THROMBOEMBOLISM AFTER FOOT OR ANKLE SURGERY, CONTD.

Presenter: Craig Udall, DPM

Average hemoglobin A1C in the diabetics who had a DVT was 6.93 (6.8-10.4), but statistical significance could not be determined due to incomplete documentation in the medical records in some of the patients. 13 patients underwent forefoot procedures, 5 had rearfoot surgery, 5 had midfoot surgery, and 3 patients had I&D. Interestingly, there were 7 patients who had ankle arthroscopy, with lateral ankle stabilization, tendon repair, or OCD repair. The incidence of VTE in the ankle arthroscopy group was 1.7% (7/402). Ankle arthroscopy was significantly associated with developing VTE ($p=0.0035$, OR 3.26, 95% CI 1.41-7.57).

12 of the 33 patients had documented obesity, but the BMI data was incomplete for all patients. 3 patients were prescribed aspirin 325mg after surgery as prophylaxis, and still developed a DVT post op. The other 30 patients were either not given any post op anticoagulation, or it was not documented in the chart. 6 of the patients were taking oral contraceptive pills, 1 had active cancer, and 1 patient had factor V leiden. Additionally, 3 patients had documented prior history of VTE. 6 were after inpatient surgery and the remaining 27 were elective outpatient procedures.

DISCUSSION:

Although some literature provides evidence to support diabetes as a risk factor, this large retrospective case series review ($n=5216$) showed that diabetes was not significantly associated with VTE events ($p=0.97$). The low incidence of VTE events (0.6%) is similar to the low incidence in other existing studies. Interestingly, ankle arthroscopy with or without associated tendon, cartilage, or ligament repair had a VTE incidence of 1.7% and was significantly associated with VTE events ($p=0.003$).

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DISCLOSURES:

None



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THE DIRECT ANTERIOR APPROACH HAS A LOWER RATE OF DEEP INFECTION THAN THE LIMITED DIRECT LATERAL APPROACH IN PRIMARY TOTAL HIP ARTHROPLASTY

Authors: Sean A. Sutphen DO; Keith R. Berend MD; Michael J. Morris MD; Adolph V. Lombardi Jr. MD; FACS
Presenter: Sean Sutphen, DO

INTRODUCTION:

There continues to be debate regarding the advantages and disadvantages of the direct anterior (DA) approach to primary total hip arthroplasty (THA). Faster recovery, better implant position, and lower risk of dislocation have been described with DA. In reviewing our practice experience with DA it was noted that the rate of deep infection appeared to be very low. The purpose of this study is to compare the rate of deep infection between DA and a less invasive direct lateral approach (LIDL) in a large consecutive series of primary THA.

METHODS:

A retrospective review of our institutional database identified 5732 primary THAs performed by 3 surgeons between 2007-2014. DA approach was used in 3550 hips and LIDL in 2168. Patient records were reviewed for reoperations as well as the indications for reoperation. Statistical analysis for risk of reoperation, infection or wound related complication, and deep infection was performed.

Table 1: Patient Demographics

Characteristic	Anterior Supine Intermuscular Approach	Less Invasive Direct Lateral Approach	P value
Patients	3052	1864	
Hips	3540	2162	
Gender by patient			1
Male patients	1458 (48%)	890 (48%)	
Female patients	1594 (52%)	974 (52%)	
Gender by hip			1
Hips in male patients	1668 (47%)	1016 (47%)	
Hips in female patients	1872 (53%)	1146 (53%)	
Mean age (years)	63 (± 12 , 18-95)	64 (± 12 , 17-96)	0.003
Mean height (inches)	67 (± 4 , 52-82)	67 (± 4 , 42-83)	0.038
Mean weight (pounds)	195 (± 48 , 95-455)	203 (± 53 , 75-450)	<0.001
Mean body mass index (kg/m ²)	30 (± 7 , 16-62)	32 (± 8 , 15-65)	<0.001

DATA AND RESULTS:

During the 8 year follow-up period there were 98 reoperations in the DA group (2.9%) and 77 in the LIDL group (3.6%; $p=0.09$ NS). Wound or infection related reoperation occurred in 32 DA THA (0.9%) versus 36 LIDL THA (1.2%; $P=0.01$). Deep infection occurred in 7 DA THA (0.2%) versus 21 LIDL THA (0.97%; $p<0.0001$).

Table 2: Results

Characteristic	Anterior Supine Intermuscular Approach (n=3540)	Less Invasive Direct Lateral Approach (n=2162)	P value
Reoperation, any reason	97 (2.7%)	76 (3.5%)	0.098
Reoperation, wound- or infection related	32 (0.9%)	36 (1.7%)	0.010
Deep infection	7 (0.2%)	21 (1.0%)	<0.001

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THE DIRECT ANTERIOR APPROACH HAS A LOWER RATE OF DEEP INFECTION THAN THE LIMITED DIRECT LATERAL APPROACH IN PRIMARY TOTAL HIP ARTHROPLASTY, CONTD.

Presenter: Sean Sutphen, DO

DISCUSSION:

While the overall reoperation rate was not significantly different, the risk of wound or infection related reoperation was significantly lower with DA THA compared with LIDL approach. Most notably, the risk of deep infection was statistically lower in the DA approach. Therefore, although multiple reports dispute and debate the advantages of the direct anterior approach, this study clearly demonstrates that this approach has a significantly reduced risk of deep periprosthetic infection.

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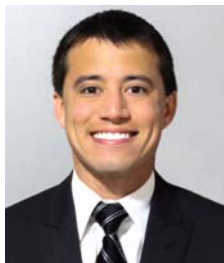
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DISCLOSURES:

KRB: Financial relations with Zimmer Biomet, Pacira Pharmaceuticals, Kinamed, Stryker, and Orthosensor

MJM: Financial relations with Zimmer Biomet, Pacira Pharmaceuticals, Kinamed, and Orthosensor

AVL: Financial relations with Zimmer Biomet, Pacira Pharmaceuticals, Kinamed, Stryker, Orthosensor, and Innomed



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RADIOGRAPHIC ASSESSMENT OF ANATOMIC RISK FACTORS ASSOCIATED WITH ACUTE, LATERAL PATELLAR DISLOCATION IN THE IMMATURE KNEE

Authors: Thai Q. Trinh MD; Andrew Mundy MD; Matthew C. Beran MD; Kevin E. Klingele MD

Presenter: Thai Trinh, MD

INTRODUCTION: Acute patellar dislocation remains a common injury in both adult and pediatric patients. Non-operative management has been advocated for patients without a history of recurrent instability. Operative management aims to correct anatomic risk factors predisposing to the development of recurrent instability. Although pathologic thresholds for consideration of operative management have previously been reported in adults, it is largely unknown if these thresholds are applicable to skeletally immature patients as there are limited reports on radiographic norms in this population. The purpose of the current study is to report morphological differences between skeletally immature patients with and without acute, lateral patellar instability..

METHODS: A retrospective review of all skeletally immature patients diagnosed clinically with acute lateral patellar dislocation who had undergone MRI imaging of the affected knee were included for analysis. A control group of patients without a history of patellar instability who had undergone MRI imaging of the knee within the same age range of the study group were identified. Six radiographic measurements were recorded and compared between groups: Lateral trochlear inclination (LTI), trochlear facet asymmetry (TFA), trochlear depth (TD), tibial tuberosity-trochlear groove (TT-TG), sulcus angle (SA) and patellar height ratio according to Insall-salvati.

DATA AND RESULTS: A total of 178 patients were included for analysis (study: n=108, control: n=70). The mean age for patients in the study and control groups were 13.7 and 12.1 years respectively ($p < 0.001$). Patients in the study group were observed to have statistically significant differences in all radiographic measurements of interest including a decreased LTI ($p < 0.001$), increased TFA ($p < 0.001$) and SA ($p < 0.001$). The mean trochlear depth was 3.4 mm and 5.6 mm for patients in the study and control groups respectively ($p < 0.001$). Patients in the study group were noted to have an increased patellar height ratio ($p < 0.001$) and TT-TG distance ($p < 0.001$).

DISCUSSION: Morphologic abnormalities may predispose skeletally immature patients to an increased risk for acute lateral patellar instability. Further research is needed to determine the clinical implications of these differences in order to optimize both surgical and non-surgical management. Other studies may be appropriate.

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THE EFFECT OF BLOCKING SCREWS ON UNION OF INFRAISTHMAL FEMUR FRACTURES STABILIZED WITH A RETROGRADE INTRAMEDULLARY NAIL

Authors: Bryan Van Dyke, DO; Ryan Colley, DO; Christina Ottomeyer, DO; Ryan Palmer, DO; Kevin Pugh, MD

Presenter: Ryan Colley, DO

INTRODUCTION:

Fractures of the distal femoral shaft present a challenge in terms of surgical fixation. Advances in intramedullary femoral nailing techniques have allowed for indirect reduction of fractures with less soft tissue disruption, while still providing the advantages of internal fixation. However, as the distal femoral shaft widens into the distal femoral metaphysis there is less inherent stability of this fixation construct, even with current reaming and interlocking fixation techniques. The addition of blocking screws can provide additional stability and can aid in the reduction of the fracture. We theorized that this additional stability and improved reduction would lead to improved union rates and time to fracture union.

METHODS:

We retrospectively reviewed all adult patients with femoral shaft fractures treated with intramedullary nailing at a single level I trauma center from 2005 to 2012. Of these 714 fractures in 699 patients, 119 were treated with a retrograde intramedullary nail and had complete radiographic follow up to union or secondary intervention. There were 47 fractures treated with the utilization of blocking screws and 72 fractures treated without blocking screws.

Fractures were further subdivided by AO classification. We recorded the number of weeks from surgery for radiographic union defined as bridging of three or more cortices on two orthogonal views. We recorded initial post-operative sagittal and coronal angulation. We also recorded sagittal and coronal angulation at final follow up or prior to any secondary intervention.

DATA AND RESULTS:

The average time to union was not statistically significantly different between the blocking screw and non-blocking screw constructs (21.1 weeks vs. 21.8 weeks). The union rates were also not statistically significantly different between blocking and non-blocking screw constructs (66% vs. 76%). This remained true when the fractures were subdivided by AO classification. Furthermore, there were no statistically significant differences in the postoperative alignment or the change in alignment in both the sagittal and coronal planes.

DISCUSSION:

We theorize that any potential difference between the two constructs may have been obscured by selection bias. Furthermore, we chose to define nonunion as any fracture that necessitated any secondary procedure which may have been too restrictive. Nonetheless, this data demonstrates non inferiority of treatment of distal femur fractures utilizing blocking screw techniques. A biomechanical study would help to verify the structural advantages of utilizing blocking screws. As infraisthmal and supracondylar femur fractures have less inherent stability than isthmal femoral shaft fractures, we encourage surgeons to treat these fractures with added attention. Blocking screws should continue to be considered a valuable tool for added construct stability.



THE EFFECT OF BLOCKING SCREWS ON UNION OF INFRAISTHMAL FEMUR FRACTURES STABILIZED WITH A RETROGRADE INTRAMEDULLARY NAIL, CONTD.

Presenter: Ryan Colley, DO

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DISCLOSURES:

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A COMPARISON OF BARBED SUTURE VERSUS TRADITIONAL TECHNIQUES FOR MUSCLE BELLY REPAIR

Authors: Kanu S Goyal, MD; Amy L Speeckaert, MD; Robert J Goitz; M Lance Tavana
 Presenter: Amy Speeckaert, MD

INTRODUCTION:

The use of barbed sutures in wound closure and tendon repair has previously been studied with improved results over traditional suture material. This study examines the use of barbed suture when used in muscle belly repair in a custom configuration by comparing it to traditional Mason-Allen, Modified Kessler and Figure of Eight configurations as well as a control configuration similar to that used with the barbed suture.

We hypothesize that muscle repair with barbed suture in a custom configuration will have a higher load to failure in comparison to other traditional suture repair techniques.

METHODS:

Twenty-five matched porcine psoas muscles were randomly assigned to repair by five different test groups: Figure of Eight with #1 Ethibond (Ethicon, City), Modified Kessler with #1 Ethibond, Mason-Allen with #1 Ethibond, Custom Configuration with #1 Ethibond, Custom Configuration with #2 Barbed PDS (Surgical Specialties Corporation, Vancouver, Canada)(Figure 1).

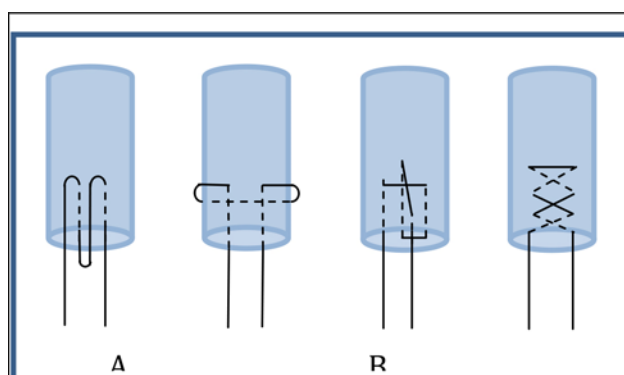


Figure 1. Representative illustration of various suture configurations

A: Figure of 8, B: Modified Kessler, C: Mason Allen, D: Custom Configuration

The suture size of Barbed PDS is determined by its outer diameter, however its strength is determined by that of its inner core. Therefore, the strength of a #2 Barbed PDS is thought to be comparable to that of a #1 Ethibond (<http://www.quilldevice.com/general-product-information>). The repair was performed on the cut edge of muscle, with the free end of the suture anchored to a fixed base, forming a single-sided repair. An Instron 8874 tensiometer (Instron, Norwood, MA) was used to linearly distract the repair to failure at 1 mm/s after a 1 Newton preload. We determined the load to failure and the distraction at 10 N of force for each test sample. We employed ANOVA for initial comparative analysis between the groups, and student's t-tests for post-hoc analysis.

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A COMPARISON OF BARBED SUTURE VERSUS TRADITIONAL TECHNIQUES FOR MUSCLE BELLY REPAIR, CONTD.

Presenter: Amy Speeckaert, MD

DATA AND RESULTS:

Muscle repair with barbed suture in a custom configuration had a statistically significantly greater load to failure than all other methods of muscle repair ($p < 0.01$). It also showed statistically significant less displacement at 10N of force than all other methods of repair ($p < 0.01$) except the Mason-Allen repair with #1 Ethibond ($p = 0.34$). Mode of failure for traditional techniques was suture pull-through with tissue loss while failure with the barbed suture was through suture pull-out without tissue loss.

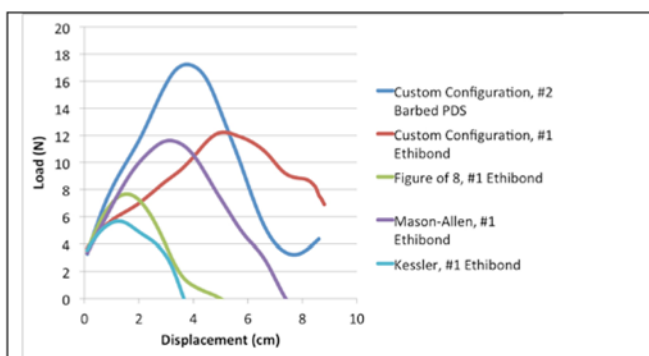


Figure 3. Mean load versus displacement plots for all five muscle repair techniques. The barbed suture in a custom configuration had the highest load till failure.

DISCUSSION:

This in vitro study demonstrates that this custom configuration with a barbed suture increases the load to failure and decreases displacement of the repair site at 10N of force. In addition, when the suture does pull out, it does so with minimal tissue loss.

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DISCLOSURES:

None.



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ORAL AND INTRAVENOUS TRANEXAMIC ACID ARE EQUIVALENT AT REDUCING BLOOD LOSS FOLLOWING TOTAL KNEE ARTHROPLASTY

Authors: YA Fillingham; Darren Plummer, MD; E. Kayupov; M. Moric M; TL Gerlinger; CJ Della Valle, MD

Presenter: Darren Plummer, MD

INTRODUCTION:

Tranexamic acid (TXA) is a synthetic antifibrinolytic agent successfully used intravenously (IV) to reduce blood loss following total knee arthroplasty (TKA). An oral formulation of the medication is available, at a fraction of the cost of the IV preparation. The purpose of this randomized controlled trial is to determine if oral TXA is equivalent to IV TXA in reducing blood loss in TKA.

METHODS:

In this double-blinded, placebo-controlled trial, 73 patients undergoing primary TKA were randomized to receive 1.95g of TXA orally two hours preoperatively or a 1g IV bolus prior to wound closure. The primary outcome was reduction of hemoglobin. Power analysis determined that 30 patients were required in each group to identify a 1.0g/dL difference between groups with an alpha of 0.05 and a beta of 0.90. Equivalence analysis was performed with pooled and Satterthwaite t-tests with a p-value of < 0.05 suggesting equivalence between treatments.

DATA AND RESULTS:

36 Patients received IV TXA, 32 oral and 5 were excluded for protocol deviations. Patient demographics were similar between groups suggesting successful randomization. There was no difference in the mean reduction of hemoglobin between the oral and IV groups (3.45g/dL vs 3.31g/dL; $p < 0.001$, equivalence). Similarly, total blood loss was equivalent for oral and IV administrations at 1267ml vs 1229ml ($p = 0.007$, equivalence). One patient in each treatment group was transfused, and no patients experienced a thromboembolic event.

DISCUSSION:

Oral TXA provides equivalent reductions in blood loss in the setting of primary TKA, at a cost of \$14 compared to \$47 to \$108 depending on the IV formulation selected. As approximately 700,000 primary TKA are performed in the United States annually, a switch to oral TXA could yield total cost savings of \$23 to \$67 million dollars per year for our health care system.

FUNDING:

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DISCLOSURES:

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THE OHIO STATE UNIVERSITY

WEXNER MEDICAL CENTER



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ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION IN PATIENTS OVER AGE 60

Authors: Joshua D. Troyer, MD; David C. Flanigan, MD; Christopher C. Kaeding, MD; Robert A. Magnussen, MD, MPH

Presenter: Joshua Troyer, MD

INTRODUCTION:

Anterior cruciate ligament reconstruction (ACLR) has consistently proven to be a reliable treatment for the patient with an ACL deficient knee and symptoms of instability. There have been several studies looking at outcomes of ACLR in older patients, but no studies that include only patients over 60 years of age at the time of reconstruction. We hypothesize that ACLR in this patient population yields excellent patient-reported outcome scores given proper patient selection.

METHODS:

A retrospective analysis of all patients over the age of 60 who underwent ACLR at our institution between 2006 to 2014 was performed. Demographics, injury details, imaging, operative technique, and postoperative course were obtained via chart review. Patients were subsequently contacted and each completed a questionnaire that included a Knee injury and Osteoarthritis Outcome Score (KOOS), Marx activity score, patient satisfaction with the operation, and details of any subsequent surgical procedures on the index knee.

DATA AND RESULTS:

Ten patients met inclusion criteria and all 10 were contacted at a mean of 4.4 years following ACLR (range: 1.3-9.4). Two of the 10 cases were revision ACLR procedures. The mean preoperative Kellgren and Lawrence grade was 1.1 (range 0 – 3). All 10 patients had a meniscal tear and partial meniscectomy was performed in each operation. All patients were satisfied with the results of their surgery. No patients underwent repeat surgery on the index knee. The median Marx activity score was 0 (range: 0 - 7). The mean and standard deviation of KOOS scores for pain, symptoms, activities of daily life, sport and recreation, and quality of life were 95.9 ± 3.6, 90.4 ± 8.2, 95 ± 6.1, 80.5 ± 18.5, and 79.7 ± 18.0, respectively.

DISCUSSION:

ACLR in patients over the age of 60 yields excellent results when performed for symptomatic instability in the absence of significant osteoarthritis. All patients in this retrospective cohort were satisfied with their knee and outcome scores compared favorably with those reported following ACLR in younger patient populations.

DISCLOSURES:

The authors have no relevant financial disclosures in the work or funding of this project.

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Travis Frantz, MD is a resident in Orthopaedic at The Ohio State University

PATIENT SPECIFIC INJURY PROFILES PREDICT ORGAN FAILURE IN MULTIPLY INJURED PATIENTS

Authors: Travis Frantz, MD; Greg Gaski, MD; Tyler McCarroll; Scott Steenburg, MD; Todd McKinley, MD

Presenter: Travis Frantz, MD

INTRODUCTION:

Multiply injured patients (MIPs) sustain a composite of mechanical tissue damage, ischemic tissue damage, and hemorrhage-associated hypoperfusion that is specific to the individual injury. Metabolic response to injury is also highly variable and patient-specific. Collectively, individual injury and response characteristics affect complications and outcomes. While some MIPs demonstrate an uneventful recovery, other MIPs with seemingly similar injuries develop complicated clinical courses punctuated by wounding problems (coagulopathy, infection, poor wound healing), systemic inflammatory response syndrome (SIRS), multiple organ failure (MOF), and death. Early identification of MIPs at risk for complicated clinical trajectories remains a diagnostic challenge. Current injury scoring systems are granular and do not account for patient-specific injury characteristics. In addition, these systems do not quantify patient response. They are of limited value in stratifying clinical trajectories and guiding treatment, including subsequent orthopaedic interventions. In this study, we explore a new paradigm by quantifying early (within 48 hours of trauma) individualized critical components of injury including mechanical tissue damage, magnitude and duration of shock, and acute metabolic response to establish a Patient-Specific Injury (PSI) score. We hypothesized that PSI scores would accurately stratify patient risk for MOF.

METHODS:

72 consecutive adult (18-65) MIPs (ISS > 18) admitted to the intensive care unit (ICU) for a minimum of 7 days were studied retrospectively. We collected vital signs and laboratory values during ICU admission, and accessed all admission imaging studies. Total body patient-specific mechanical tissue damage was quantified using a novel index (Tissue Damage Volume Score (TDVS)). TDVS calculates a volume (cm³) of every injury sustained by a patient based on measurements made from admission computed tomography (CT) scans and xrays. Total body TDVS was subdivided by tissue type and body region (head/neck, chest, abdomen, pelvis). Hypoperfusion was calculated by integrating elevated values of shock index (SI) (SI = heart rate/systolic blood pressure; SI > 0.9 is a validated marker of hypoperfusion) over time to yield a patient-specific metric termed Shock Volume (SV). Patient-specific metabolic response was measured by calculating the difference of mean pH for the first 48 hours after injury from normal (7.40). TDVS, SV, and pH deviation were integrated into a PSI score. PSI scores were compared to Sequential Organ Failure Assessment (SOFA) scores with linear regression to determine correlation between PSI profiles and organ failure. The SOFA score is a validated outcome instrument that measures organ failure in trauma patients and was utilized as the primary outcome in this study.

DATA AND RESULTS:

Total body PSI scores correlated well with organ dysfunction over the entire population (Figure 1 and Figure 2). Pelvic PSI scores correlated more closely with organ dysfunction. Chest PSI scores corresponded to organ dysfunction, but the variability was greater. There was minimal correlation between abdomen and Head/Neck PSI scores and organ dysfunction.

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PATIENT SPECIFIC INJURY PROFILES PREDICT ORGAN FAILURE IN MULTIPLY INJURED PATIENTS, CONTD.

Presenter: Travis Frantz, MD

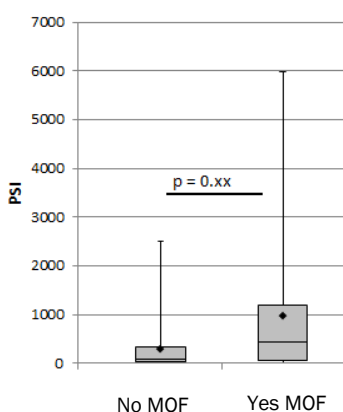


Figure 1: PSI score vs multiple organ failure (MOF)

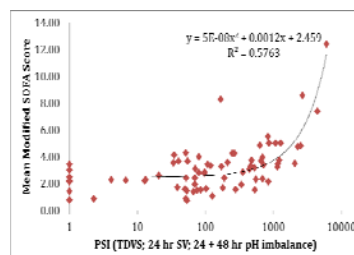


Figure 2: PSI vs magnitude of organ dysfunction (SOFA)

DISCUSSION:

It has been postulated that the magnitude of mechanical and ischemic tissue injury and resuscitation dictate patient response and orchestrate clinical trajectories in MIPs. Our data demonstrated that patient-specific indices measured early during the injury period (mechanical tissue damage, hypoperfusion, metabolic response) collectively predicted subsequent organ dysfunction on an individual basis. PSI scores in patients sustaining axial trauma, especially pelvis, were more accurate in predicting subsequent organ dysfunction. Such information could prove to be clinically relevant in timing interventions, including major orthopaedic operations. Although preliminary, this research offers a novel approach of applying personalized medicine to trauma patients in an effort to improve outcomes in MIPs.

ACKNOWLEDGEMENTS:

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ADIPOKINES IN SPINAL FUSION: DO THEY PLAY A ROLE?

Authors: Sohrab Virk MD, MBA; Alicia Bertone PhD; Hayam Hamaz Hussein PhD; Mari Kaido BS; Safdar Khan MD

Presenter: Sohrab Virk, MD, MBA

INTRODUCTION:

Adipokines are cell-signaling molecules secreted by white adipose tissue. While their role in inflammation, energy expenditure and glucose homeostasis are well established, there is still considerable controversy in regards to the effect that adipokines play in bone formation and degeneration. Our study aims to examine the temporal expression of three adipokines and Vascular endothelial growth factor (VEGF) within a spinal fusion bed in an animal model.

METHODS:

A total of 28 New Zealand white rabbits, approximately one year old underwent a posterior spinal fusion utilizing a standardized technique with modifications. At 1, 2, 3, 4, 5, 6 and 10 week time points after the index procedure four rabbits were sacrificed. At each time point two rabbits had a standardized bilateral fusion between transverse processes (BL group) and 2 rabbits had a unilateral fusion between transverse processes (UL). RNA was extracted from the fusion bed and polymerase chain reaction (PCR) was used to catalogue the gene expression of Leptin, Adiponectin, Resistin and VEGF at each time point. Relative quantitation of leptin, adiponectin, resistin and VEGF gene expression was analyzed using real-time quantitative PCR and results were reported as differences in the threshold cycle (ΔC_t) number between the target gene and the internal control reference gene, GAPDH. Fusion between vertebrae was confirmed through radiographs, histologic specimens as well as by manual palpation. Manual palpation at the vertebral level of interest was scored from 0 (no fusion) to 4 (completely fused). Radiographic fusions were scored from 1 (no fusion) to 3 (fused). All quantitative data was input into SPSS (SPSS Inc., Chicago, IL, USA) and analyzed utilizing either one way or two ANOVA analysis.



DATA AND RESULTS:

All rabbits completed the study and all data was collected on time. The average body weight of rabbits was 3.53 (\pm 0.38) kg. There were 13 male rabbits and 17 female rabbits. There was a significant effect of time (duration since surgery) on palpation score ($P < 0.0001$) with a trend towards lower palpation scores (more motion) in UL spines ($p > 0.05$). By 10 weeks, radiographic fusion was seen in all fused sites. There were statistically greater radiographic scores over time representing radiographic evidence of fusion over time ($p = 0.0003$).

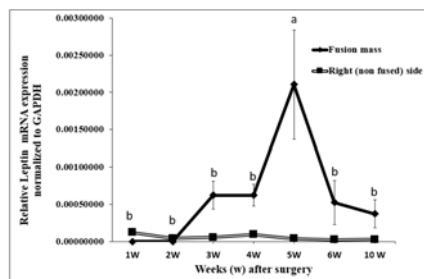
DATA AND RESULTS:

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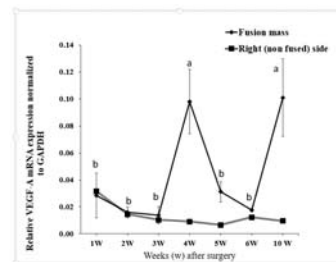


ADIPOKINES IN SPINAL FUSION: DO THEY PLAY A ROLE?, CONTD.

Presenter: Sohrab Virk, MD, MBA



Leptin PCR Results



VEGF PCR Results

DISCUSSION:

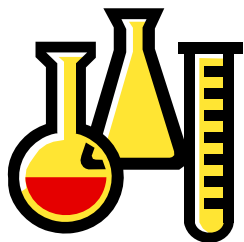
Our study indicates that there is a statistically significant variation in adipokine expression during the spinal fusion process. In particular, leptin expression spikes during the bony remodeling phase at 3-6 weeks. Adiponectin expression, contrastingly rises initially during the inflammatory phase only to fall shortly thereafter. When comparing expression profiles, there is evidence to suggest that the expression of leptin is upstream to that of VEGF. Our results further emphasize the importance of timing in activity and impact of osteoinductive factors for creating a spinal fusion. Leptin, for instance is initially down regulated in the first 2 weeks after the index procedure. Only during the reparative phase does leptin expression increase substantially. Similarly, VEGF may not be essential during the initial inflammatory period after the procedure, but rather angiogenesis is required during the remodeling process taking place after four weeks. Future research is required to understand the exact cascade of adipokine expression within humans at a local level in spinal fusion.

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MRI IN IDIOPATHIC, STABLE, SLIPPED CAPITAL FEMORAL EPIPHYSIS EVALUATION OF CONTRALATERAL PRE-SLIP

Authors: Julie Balch Samora, MD, PhD; Steven A. Brown, DO; Kevin E. Klingele, MD
Presenter: Steven A. Brown, DO

INTRODUCTION:

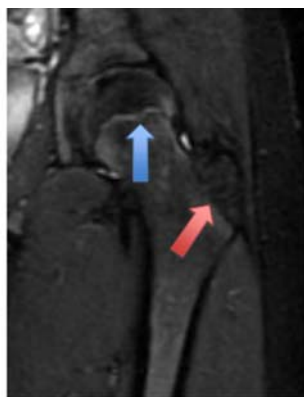
Slipped Capital Femoral Epiphysis (SCFE) is the most common hip disorder in adolescents. Sequential SCFE can occur in 20-80% of patients. Various risk factors, scoring systems and radiographic parameters attempt to predict a sequential slip. MRI findings for a "preslip" are well documented, however indications for prophylactic pinning of an asymptomatic hip are not definitive. The purpose of this study was to determine if MRI evaluation of the contralateral hip in patients presenting with unilateral SCFE could predict sequential, contralateral SCFE

METHODS:

A prospective, double-blinded study evaluated patients from 2011-2013 admitted for surgical management of unilateral SCFE. Inclusion criteria were as follows: evidence of unilateral SCFE and normal radiographs of the asymptomatic, contralateral hip. Exclusion criteria included: bilateral SCFE, endocrinopathies, renal disease, malignancy, previously treated hips, or contraindications to MRI. MRI of the asymptomatic hip was performed at the time of index procedure and the results were blinded to the treating surgeon. Patients were followed with serial radiographs until a contralateral slip occurred or until physeal closure. Demographics, SCFE classification, Posterior Slope Angle (PSA), and Modified Oxford Bone Score (MOBS) were recorded and statistical analysis performed.

DATA AND RESULTS:

69 patients were treated for SCFE within the time period, of which 33 were entered into the MRI study protocol. 29 of 33 patients (87.8%) had complete clinical and radiographic follow-up. Of these, five patients (15.2%) developed a sequential slip requiring in situ pinning at an average of 8.4 months after initial presentation. Six patients had positive MRI findings (presence of focal or diffuse physeal widening, synovitis, bone marrow edema). Four sequential slips had positive MR findings at the index procedure, two hips with positive MRI findings did not slip, and one sequential slip had a negative MR (sensitivity 80%, specificity 92.9%, PPV 66.7%, NPV 96.3%). Posterior Slope Angle (PSA) predicted 1 of 11 sequential slips (sensitivity 9.09%, specificity 81.4%, PPV 11.1%, NPV 77.8%) and the Modified Oxford Bone Score (MOBS) predicted 5 of 11 sequential slips (sensitivity 45.5%, specificity 93%, PPV 62.5%, NPV 87%). An open triradiate cartilage was present in 8 of 11 patients with sequential slips (sensitivity 72.7%, specificity 81.4%, PPV 50%, NPV 92.1%).



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MRI IN IDIOPATHIC, STABLE, SLIPPED CAPITAL FEMORAL EPIPHYSIS EVALUATION OF CONTRALATERAL PRE-SLIP, CONTD.

Presenter: Steven A. Brown, DO

Pre-slip: Coronal Fast Spine T2, the image of the left femoral head and neck. Note the high signal of the proximal femoral physis (blue) in comparison to the physis of the greater trochanter (red).

DISCUSSION:

In this series of patients, MRI findings consistent with a “pre-slip” were present in 66.7% of patients that eventually went on to a sequential SCFE. The ability of MRI to evaluate a concurrent, contralateral pre-slip prior to treatment of a unilateral slip would prevent “prophylactic” pinning of normal hips and indicate appropriate treatment for a destined slip.

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Visiting Professor and Moderator

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For coordinating the scientific presentations

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