OREF MIDWEST REGION
RESIDENT RESEARCH SYMPOSIUM
Friday, April 23, 2021

University of Iowa
Virtual Resident Research Symposium

Hosted by:
J. Lawrence Marsh, MD
Chair, Professor
Carroll B. Larson Chair of Orthopedics
University of Iowa Hospitals and Clinics
Department of Orthopedics and Rehabilitation

Table of Contents

About OREF:
The Orthopaedic Research and Education Foundation (OREF) was founded in 1955 to ensure an expanding base of knowledge and effective, evidence-based treatment protocols for orthopaedic surgeons to continually improve patient care. Since its founding, OREF has funded nearly $150 million in research and educational grants and awards that benefit all of orthopaedics. For more information about OREF grants and awards, please visit www.oref.org. Follow OREF on its Facebook page (OREFtoday) and on Twitter (@OREFtoday).

OREF MIDWEST REGION
RESIDENT RESEARCH SYMPOSIUM
SUMMARY AGENDA
Friday, April 23, 2021

7:00 a.m. – 7:05 a.m.	**Welcome and Introduction** J. Lawrence Marsh, MD Chair, Professor Carroll B. Larson Chair of Orthopedics University of Iowa Hospitals and Clinics Department of Orthopedics and Rehabilitation
7:05 a.m. – 7:10 a.m.	**OREF Welcome** Lee Grossman Chief Executive Officer Orthopaedic Research and Education Foundation
7:10 a.m. – 8:10 a.m.	**Session I – Resident Research Presentations & Discussion** **Moderator: Michael Willey, MD**
	Break
8:20 a.m. – 9:20 a.m.	**Session II – Resident Research Presentations & Discussion** **Moderator: Cass Igram, MD**
	Break
9:30 a.m. – 10:05 a.m.	**Session III – Resident Research Presentations & Discussion** **Moderator: Lindsey Caldwell, MD**
	Break
10:10 a.m.–10:15 a.m.	**Introduction of the Keynote Speaker** J. Lawrence Marsh, MD Chair, Professor Carroll B. Larson Chair of Orthopedics University of Iowa Hospitals and Clinics Department of Orthopedics and Rehabilitation
10:15 a.m.–10:50 a.m.	**Keynote Address** *Establishing Education and Performance Standards for Orthopaedic Surgeons* Michael S. Bednar, MD Chief, Division of Hand Surgery and Professor Residency/Fellowship Program Director, Hand Surgery Department of Orthopaedic Surgery and Rehabilitation Loyola University Medical Center
10:50 a.m.–11:10 a.m.	**Awards Presentation and Closing Remarks**

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KEYNOTE SPEAKER

Michael S. Bednar, MD

Chief, Division of Hand Surgery and Professor,
Residency/Fellowship Program Director, Hand Surgery
Department of Orthopaedic Surgery and Rehabilitation
Loyola University Medical Center

Dr. Bednar graduated from the University of Pennsylvania in 1982 with a BA in biochemistry and from the Harvard Medical School in 1986. He did his surgical internship at the Pennsylvania Hospital in Philadelphia (1986-1987), his orthopaedic surgery residency at the Hospital for Special Surgery in New York (1987-1991), and his hand and microvascular surgery fellowship at the Indiana Hand Center in Indianapolis (1991-1992). Since 1992, he has been on the faculty of the Stritch School of Medicine, Loyola University, Chicago, where he is currently Chief, of the Division of Hand Surgery and professor, Department of Orthopaedic Surgery. He is also chief of hand surgery at the Hines VA Hospital, an attending surgeon at the Shriners' Hospital for Children, Chicago, and attending consultant at Shirley Ryan Ability Laboratory. Dr. Bednar's research focuses on tendon transfers for tetraplegia, pediatric hand issues, hand trauma, and biomechanics of the muscles of the forearm. Dr. Bednar was elected to the board of directors of the American Board of Orthopaedic Surgeons in 2014 and currently serves as president.

Judges

Matthew D. Beal, MD
Northwestern Medicine
Feinberg School of Medicine

Jessica Hanley, MD
Medical College of Wisconsin

Lukas Nystrom, MD
Cleveland Clinic Foundation

Justin C. Siebler, MD
University of Nebraska Medical Center

Emily Wagstrom, MD
Hennepin Healthcare

Moderators

Lindsey Caldwell, MD
University of Iowa

Jessica Goetz, PhD
University of Iowa

Cass Igram, MD
University of Iowa

Cesar De Cesar Netto, MD
University of Iowa

Ericka Lawler, MD
University of Iowa

Michael Willey, MD
University of Iowa

OREF Midwest Region Resident Research Symposium
DETAILED AGENDA
Friday, April 23, 2021

7:00 a.m. – 7:05 a.m.	**Welcome and Introductions** J. Lawrence Marsh, MD Chair, Professor Carroll B. Larson Chair of Orthopedics University of Iowa Hospitals and Clinics Department of Orthopedics and Rehabilitation
7:05 a.m. – 7:10 a.m.	**OREF Welcome** Lee Grossman Chief Executive Officer Orthopaedic Research and Education
	Session I – Resident Research Presentations & Discussion **Moderator: Michael Willey, MD**
7:10 a.m. – 7:15 a.m.	*Microwave Ablation Epiphysiodesis: A Cadaveric Porcine Study* Kyle J. Miller, MD, University of Wisconsin
7:15 a.m. – 7:20 a.m.	*Biomechanical Evaluation of Transverse Patella Fracture Fixation Using Headless Screws: A Comparison of Suture versus Cable as a Tension Band* Justin Bric, MD, Medical College of Wisconsin
7:20 a.m. – 7:25 a.m.	*Acceptance and Commitment Therapy Delivered via a Mobile Phone Messaging Robot to Decrease Postoperative Opioid Use in Patients with Orthopedic Trauma: Randomized Controlled Trial* Edward Rojas, MD, University of Iowa
7:25 a.m. – 7:30 a.m.	**Question and Answer**
7:30 a.m. – 7:35 a.m.	*Predicting Early Mortality in High-Risk Hip Fracture Patients Based on Time to OR: A Multicenter Study* Michael McHugh, MD, University of Michigan
7:35 a.m. – 7:40 a.m.	*Clubfoot Relapse Rates in Idiopathic Clubfoot Using the Ponseti Method: 65-years of Data from a Single Institution* Malynda Wynn, MD, University of Iowa
7:40 a.m. – 7:45 a.m.	*Distal Tibiofibular Syndesmotic Widening in Progressive Collapsing Foot Deformity (PCFD)* Chris Cychosz, MD, University of Iowa
7:45 a.m. – 7:50 a.m.	**Question and Answers**
7:50 a.m. – 7:55 a.m.	*Potential for Local Delivery of Resveratrol via a Multifunctional Nanofiber Scaffold to Mitigate the Anti-Osteogenic Effects of Cigarette Toxins via the Aryl Hydrocarbon Receptor Pathway* Danielle Sunae Chun, MD, Northwestern University
7:55 a.m. – 8:00 a.m.	*Comparison of K-Wire Insertion Using Oscillatory and Unidirectional Drilling Modes Under Constant Thrust Force* Jack W. Weick, MD, University of Michigan

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8:00 a.m. – 8:05 a.m.	*The "Fight Bite" Saline Joint Loading Test* Morad Chughtai, MD, Cleveland Clinic Foundation
8:05 a.m. – 8:10 a.m.	Question and Answer
8: 10 a.m. – 8:20 a.m.	Break
	Session II – Resident Research Presentations & Discussion **Moderator: Cass Igram, MD**
8:20 a.m. – 8:25 a.m.	*Dose of Preoperative Opioid Prescriptions Affects Outcomes After Total Knee Arthroplasty* E. Bailey Terhune, MD, Rush University Medical Center
8:25 a.m. – 8:30 a.m.	*Perioperative Counseling Reduces Opioid Use Following Primary Total Joint Arthroplasty* Christopher N. Carender, MD, University of Iowa
8:30 a.m. – 8:35 a.m.	*The Effect of Surgical Staff Intra-Operative Turnover on Operative Times and Complication Rates for Elective Primary Arthroplasty* James Cardinal, MD, University of Iowa
8:35 a.m. – 8:40 a.m.	Question and Answer
8:40 a.m. – 8:45 a.m.	*Applying the 2013 and 2018 MSIS Consensus Definitions to Determine Rates and Risk Factors of Culture-Negative Periprosthetic Joint Infections* Jacob Henrichsen, MD, University of Iowa
8:45 a.m. – 8:50 a.m.	*Effect of Nutritionist Referral on Weight Loss in Obese Patients Seeking Total Joint Arthroplasty* Viktor Tollemar, MD, University of Michigan
8:50 a.m. – 8:55 a.m.	*Documented Penicillin Allergies Should Not Preclude Use of Pre-Operative Cefazolin in Hip and Knee Arthroplasty* Brian Kurcz, MD, Southern Illinois University
8:55 a.m. – 9:00 a.m.	Question and Answer
9:00 a.m. – 9:05 a.m.	*Perioperative Corticosteroids Reduce Severity of Dysphagia Following Anterior Cervical Spinal Fusion? A Meta-analysis of Randomized Controlled Trials* Stefan Garcia, MD, University of Michigan
9:05 a.m. – 9:10 a.m.	*Improving the Safety of Shoulder Arthroscopy in the Beach-Chair Position: A Prospective Randomized Trial Investigating the Effect of Compression Stockings on Cerebral Desaturation Events in High-Risk Patients* *Andrew Golz, MD, Loyola University Medical Center*
9:10 a.m. – 9:15 a.m.	*Greater Sports Participation in Adolescence is Associated with Development of Proximal Femoral Cam Morphology: A Prospective Evaluation of 317 Individuals* Elizabeth J. Scott, MD, University of Iowa

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9:20 a.m. – 9:30 a.m.	**Break**
	Session III – Resident Research Presentations & Discussion **Moderator: Lindsey Caldwell, MD**
9:30 a.m. – 9:35 a.m.	*Suture Tape Reinforced Human Dermal Allograft Used for Superior Capsule Reconstruction Demonstrates Improved Ability to Withstand Elongation* Cody Lee, MD, University of Chicago
9:35 a.m. – 9:40 a.m.	*Augmented Immunomodulation of Endogenous Marrow-Derived Stem Cells in the Setting of ACL Rupture* Chris Vasileff, MD, Beaumont Orthopaedic Surgery Residency, Royal Oak & Taylor
9:40 a.m. – 9:45 a.m.	*ACL Graft Preparation with Vancomycin Has No Effect on Patient Reported Outcomes, Graft Rupture Rates, and Chondrocyte Viability Following Primary ACL Reconstruction* Alan Shamrock, MD, University of Iowa
9:45 a.m. – 9:50 a.m.	**Question and Answer**
9:50 a.m. – 9:55 a.m.	*Validating the Safety of a Hyperosmolar Saline Irrigation Fluid in Arthroscopic Knee Surgery* Lasun Oladeji, MD, University of Missouri Columbia
9:55 a.m. – 10:00 a.m.	*Barriers for Medical Students from Non-Stereotypical Identities Considering Orthopedic Surgery Careers: A Qualitative Investigation* Katherine Gerull, MD, Washington University in St. Louis
10:00 a.m. – 10:05 a.m.	**Question and Answer**
10:05 a.m. – 10:10 a.m.	**Break**
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Microwave Ablation Epiphysiodesis: A Cadaveric Porcine Study

Kyle J. Miller, MD
University of Wisconsin

Purpose: Evaluation of microwave ablation (MWA) as a method for proximal tibia epiphysiodesis.

Significance: Limb length discrepancy (LLD) affects a significant portion of the world's population. Pediatric LLD is treated surgically using methods which are user dependent and have associated complications. Radiofrequency ablation has been investigated for epiphysiodesis but possesses size and tissue limitations. MWA may overcome these limitations.

Methods: 3-month-old pig hindlimbs were obtained. Using a lateral approach and fluoroscopic guidance, three 2 mm diameter tunnels 2 cm apart on the proximal-distal axis were drilled. One of two MWA probes (NeuWave PR, LK) was inserted proximal, within, or distal to the physis. Ablation times were varied. Temperature probes were monitored in adjacent tunnels. Thermal imaging characterized ablation patterns. Cone beam CT visualized steam formation. Samples were sectioned to quantify gross and histologic zones of ablation. 3D computer modeling was conducted.

Results: PR probes placed within the physis for 140 seconds and distally for 180 seconds showed favorable ablation profiles without articular or adjacent tissue damage. Thermal imaging and CT revealed ablation zones consistent with observed damage. 3D modeling corroborated these observations.

Conclusion: MWA demonstrates promise for safe and reproducible epiphysiodesis in the treatment of LLD.

Biomechanical Evaluation of Transverse Patella Fracture Fixation using Headless Screws: A Comparison of Suture versus Cable as a Tension Band

Justin Bric, MD
Medical College of Wisconsin

Purpose: A previous study reported superior biomechanical behaviors of headless over standard headed screw fixation in transverse patella fractures. The objectives of this study are to further explore the biomechanics of headless screws with FiberWire Suture versus braided cable as a tension band. We hypothesize there is no difference in selected biomechanical properties between suture and cable tension band techniques.

Methods: A transverse osteotomy was created in six matched pairs of fresh-frozen cadaver knees. Knees randomly received fixation with headless compression screws plus a cable tension band, or headless screws plus a suture tension band. Each knee was mounted onto a servo-hydraulic load frame and tested non-destructively up to 150 N and destructively up to 1000 N. A motion analysis system was used to track the interfragmentary motion.

Results: The difference in gap displacement under 150 N between the two groups was not statistically significant. In the destructive test the mean strength was 648±185 N for suture and 784±228 N for cable (p=0.24). Regression analysis shows relative bone density is a significant predictor for fixation strength (p=0.02)

Conclusion: There was no significant difference in fixation strength or fragment displacement between suture and cable tension band techniques when using headless screws. Fixation strength was significantly affected by bone density.

Acceptance and Commitment Therapy Delivered via a Mobile Phone Messaging Robot to Decrease Postoperative Opioid Use in Patients with Orthopedic Trauma: Randomized Controlled Trial

Edward Rojas, MD
University of Iowa

Purpose: This study aimed to evaluate the effects of Acceptance and Commitment therapy (ACT) delivered via automated mobile messaging on postoperative opioid use and patient-reported outcomes (PROs) orthopedic trauma patients.
Significance: Reducing narcotic use and treating pain adequately is essential to providing good patient care.

Methods: Adult patients at level 1 trauma center undergoing operative fixation of a traumatic fracture and use text messaging were eligible. Patients were randomized either the intervention group (twice-daily mobile messages communicating an ACT-based intervention 2 postoperatively), or the control group (no messages). Baseline PROs were completed. Follow up at two weeks after surgery consisted of an opioid medication pill count and postoperative PROs. The number of tablets used and PRO scores were compared between groups.

Results: Seventy-six, 38 per group, completed the study. The ACT group used an average of 26.1 tablets versus 41.1 by controls, resulting in a 36.5% reduction by the intervention (P=.004). ACT group subjects reported lower postoperative Patient-Reported Outcome Measure Information System Pain Intensity scores (mean 45.9) than control group subjects (mean 49.7, P=.04).

Conclusions: An ACT-based intervention delivered via mobile messaging in the acute postoperative period decreased opioid utilization and resulted in lower pain intensity scores after 2 weeks.

Predicting Early Mortality in High-Risk Hip Fracture Patients Based on Time to OR: A Multicenter Study

Michael McHugh, MD
University of Michigan

Purpose: To identify optimal time cut-offs for hip fracture surgery in high-risk patients.

Significance: Understanding how to best manage hip fracture patients with higher risk profiles can improve treatment plans and decrease morbidity, mortality, and overall economic burden.

Methods: Demographics, comorbidities, and mortality scores (Elixhauser, ECI) were collected upon ED admission. Timing to OR was categorized (0<6, 6<12, 12<24, 24<36, 36+ hours). In-hospital as well as 30, 60, and 90-day mortality were aggregated. Optimal ECI high-risk cut-offs were determined by ROC curve analyses and Youden index. Mortality comparisons were then made across time to surgery categories for the high-risk cohort and optimal timing to surgery was investigated.

Results: 915 patients were considered high-risk based on a determined ECI cut-off of 4 and were associated with increased mortality rates across all time to OR categories and at all measured time points compared to the low-risk cohort. Significantly decreased 60-day and 90-day mortality rates were associated with high-risk patients operated under 12 hours (p=.01, p=.041). High-risk patients who underwent surgery in under 12 hours had better chances of survival at 90 days (OR: 1.43; p=.034).

Conclusions: Hip fracture surgery within 12 hours was associated with lower early mortality rates among high-risk patients.

Clubfoot Relapse Rates in Idiopathic Clubfoot Using the Ponseti Method: 65-years of Data from a Single Institution

Malynda Wynn MD
University of Iowa

Purpose: The purpose of this study was to determine relapse rates of patients with congenital idiopathic clubfoot using the Ponseti method spanning 65-years of practice.

Significance: The Ponseti method is widely recognized as the most effective treatment for clubfoot. However, relapses still occur and may result in significant long-term morbidity for patients if not managed appropriately. Despite this, no current literature discusses long-term rates of relapse.

Methods: Patients with congenital idiopathic clubfoot treated at a tertiary care institution from 1948-2013 were retrospectively reviewed. Rate of relapse over a 65-year time period was determined. Multivariate analysis was used to assess factors with a significant effect on relapse rate.

Results: 1,012 patients were included, 1,581 clubfeet. Patients who did not receive prior treatment, a relapse rate of 11.9% was observed and patients who did receive prior treatment, 19.7%. Age, gender, family history, unilateral versus bilateral clubfoot, prior treatment, and tenotomy did not have a statistically significant effect on relapse rate. A higher number of casts required for correction (>7) and brace non-adherence have a statistically significant effect on relapse rate ($p<0.0001$).

Conclusions: The Ponseti method is a safe and effective non-operative treatment for congenital idiopathic clubfoot with consistent results when rigorously applied.

Distal Tibiofibular Syndesmotic Widening in Progressive Collapsing Foot Deformity (PCFD)

Chris Cychosz, MD
University of Iowa

Purpose: This study aimed to assess and correlate the severity of the foot and ankle offset (FAO) as a marker of progressive PCFD with the amount of distal tibiofibular syndesmosis (DTFS) widening and to compare it to controls.

Methods: 62 symptomatic patients with PCFD and 29 controls who underwent standing weightbearing computed tomography (WBCT) examination were included. FAO (%) and DTFS area measurements (mm^2) were performed. Values were compared between patients with PCFD and controls, and Spearman correlation between FAO and DTFS area measurements was assessed.

Results: Patients with PCFD demonstrated significantly increased FAO and DTFS measurements in comparison to controls. A mean difference of 6.9% ($P < .001$) in FAO and 10.4 mm^2 ($P = .026$) in DTFS was observed. Significant correlation was identified between the variables, with a Þ of 0.22 ($P = .03$). DTFS area measurements were highest when FAO values were between 7% and 9.3%, with mean (SD) values of 92.7 (22.4) mm^2.

Conclusion: We found patients with PCFD to demonstrate increased DTFS area measurements compared to controls, with a mean difference of approximately 10 mm^2. Our study findings suggest that chronic lateral impingement in patients with PCFD can result in a negative biomechanical impact on syndesmotic alignment, with increased DTFS stress and widening.

Potential for Local Delivery of Resveratrol via a Multifunctional Nanofiber Scaffold to Mitigate the Anti-Osteogenic Effects of Cigarette Toxins via the Aryl Hydrocarbon Receptor Pathway

Danielle Sunae Chun, MD
Northwestern University

Purpose: To clarify the contribution of the aryl hydrocarbon receptor (Ahr) pathway on the anti-osteogenic effects of cigarette smoke on bone formation and to evaluate the therapeutic potential of locally delivered resveratrol (an Ahr antagonist) via a novel nanofiber scaffold to mitigate these effects in an *in vivo* model of ectopic bone formation.

Significance: Cigarette smoke contains toxic Ahr ligands (e.g., dioxin) that adversely impacts bone quality and regenerative capacity; increasing the risk of nonunion or delayed union in orthopaedic patients. There is a need for the development of a novel bone graft substitute that is efficacious, safe, and has the potential to be used as a therapuetic to prevent the adverse effects of cigarette smoke.

Method: Forty-eight female C57BL/6 mice were chronically exposed to control (DMSO), dioxin, or cigarette smoke extract (CSE). Mice underwent bilateral intramuscular hindlimb implantation of an osteoinductive scaffold containing nanofiber matrices alone or one incorporated with resveratrol. After 8 weeks of treatment exposure, mice were euthanized and hindlimb ectopic bone formation from the scaffolds was assessed via plain radiographs and microCT to compare differences in bone volume (BV) between treatment groups.

Results: In mice implanted with nanofiber scaffold alone, systemic exposure to dioxin resulted in decreased ectopic BV relative to control treatment mice (1.04 mm^3 vs 2.44mm^3, $p<0.05$). However, mice implanted with resveratrol incorporated scaffolds showed no difference in ectopic BV between dioxin and control treatments (2.10 mm^3 vs 2.27 mm^3, $p=0.30$). A similar trend was seen in CSE vs control mice but this was not statistically significant.

Conclusion: Resveratrol incorporation within the nanofiber scaffold allowed for sustained release of resveratrol at the site of bone formation and this local treatment was shown to partially reverse the anti-osteogenic effects of dioxin on ectopic bone formation.

Comparison of K-Wire Insertion Using Oscillatory and Unidirectional Drilling Modes Under Constant Thrust Force

Jack W. Weick, MD
University of Michigan

Purpose: Compare heat generation, torque, and drilling depth during Kirschner-wire (K-wire) insertion under unidirectional and oscillatory drilling

Significance: K-wires are commonly drilled into bones for fracture fixation, arthrodesis, and cannulated screw placement. A drawback of K-wires is the high friction produced during insertion placing the bone at risk of thermal osteonecrosis. Oscillatory drilling has been proposed as a method of reducing heat generation. However, there is limited data on comparison of drilling methods.

Methods: *Ex-vivo* bovine bone drilling tests were conducted with 2.0mm K-wires. Eight holes were drilled on each bone sample under unidirectional and oscillatory modes. Constant thrust force was applied on the drill using a machine-based construct for 20 seconds. Bone temperature rise, torque, and drilling depth were compared between drilling modes.

Results: Oscillatory drilling mode showed significantly lower peak temperature (141.1^{o}C unidirectional vs. 107.9 ^{o}C oscillatory, $p<0.001$), higher peak torque (12.7 Ncm unidirectional vs 15.1 Ncm oscillatory, $p=0.040$) but similar average torque (6.5Ncm unidirectional vs 7.6Ncm oscillatory, $p=0.118$), and decreased drilling depth (4.5mm unidirectional vs 3.5mm oscillatory, $p=0.002$) during the same drilling time.

Conclusions: Unidirectional drilling results in significantly greater peak temperatures compared to oscillatory drilling, though unidirectional is able to drill greater depths with constant force.

The “Fight Bite” Saline Joint Loading Test

Morad Chughtai, MD
Cleveland Clinic Foundation

Purpose: To optimize the saline load test for detecting traumatic metacarpophalangeal joint arthrotomies, which commonly occur with fight bites.

Significance: Recognizing MCPJ capsular disruption can be challenging. Saline loading offers an inexpensive point-of-care test to detect arthrotomies, if appropriately optimized.

Methods: 79 cadaveric MCPJs were included. Arthrotomies were created using an 11-blade stab incision, followed by a blunt probe. Using a 3cc syringe with 0.1mL markings, methylene-blue dyed saline was injected. Extravasation volume was recorded. Test sensitivity was calculated. Multivariable regression analyses determined if age, laterality or joint ROM affected volume.

Results: The mean (range) volume injected to identify MCPJ arthrotomy of all fingers, the thumb, index, long, ring, and small fingers were 0.18mL (0.1mL to 0.4mL), 0.16mL (0.1mL to 0.3mL), 0.19mL (0.1mL to 0.3mL), 0.21mL (0.1mL to 0.4mL), 0.17mL (0.1mL to 0.3mL), and 0.16mL (0.1mL to 0.3mL). Age, laterality and joint ROM were not significantly associated with arthrotomy volume ($p>0.05$, each). Volumes of 0.3mL and 0.32mL detected arthrotomies at 95% and 99% sensitivity across all MCPJs. None required an injected volume >0.4mL to detect arthrotomy.

Conclusion: 0.3 mL carries a 95% sensitivity for MCPJ arthrotomy detection. This offers another diagnostic tool to orthopaedists when evaluating a potential MCPJ arthrotomy.

Dose of Preoperative Opioid Prescriptions Affects Outcomes after Total Knee Arthroplasty

E. Bailey Terhune, MD
Rush University Medical Center

Purpose/Significance: Preoperative opioids are associated with increased complications after total knee arthroplasty (TKA), but the dosing threshold that constitutes this risk is unknown. We hypothesized that complications after TKA would increase with preoperative opioid dose.

Methods: Primary TKA patients in the Humana claims database were identified. Opioids prescribed 3-months prior to TKA were converted to milligram morphine equivalents (MME). Patients were stratified based on daily opioid dose: Tier 1) <10 MME, 2) 10-25, 3) 25-50, 4) >50. Each tier was matched 1:1 to non-opioid users. Complications and relative risks (RR) were analyzed.

Results: 20,019 patients using preoperative opioids were identified and matched. ED visits and readmissions within 90-days were significantly higher in opioid users in all tiers (RR of ED visit: 1.25, 1.28, 1.34, 1.25; RR of readmission: 1.13, 1.17, 1.22, 1.19, respectively). Rates of PJI were increased in opioid users in Tiers 2-4 in a dose-dependent manner (RR 1.37, 1.39, 1.50, respectively). Tier 4 patients had an increased risk of revision surgery (RR 1.44) at 2 years.

Conclusions: Preoperative opioid use is associated with increased complications after TKA. Just two 5mg hydrocodone tablets daily significantly increases ED visits and readmission. Higher doses increase risk of PJI and revision surgery.

Perioperative Counseling Reduces Opioid Use Following Primary Total Joint Arthroplasty

Christopher N. Carender, MD
University of Iowa

Purpose: Perform an interventional, telehealth-based randomized controlled trial evaluating the effect of perioperative counseling on opioid consumption following primary total joint arthroplasty (TJA).

Significance: Perioperative counseling may reduce postoperative opioid consumption.

Methods: Patients were randomized into three groups: 1. Control group, no perioperative counseling; 2. Intervention group, preoperative educational video; 3. Intervention group, preoperative educational video and postoperative acceptance and commitment therapy (ACT). Opioid consumption, defined by morphine milligram equivalents and refills, was evaluated daily for 14 days and at 6 weeks postoperatively. Intention to treat analyses were performed.

Results: 183 patients were analyzed (63 in Group 1, 55 in Group 2, and 65 in Group 3). At 2 weeks postoperatively, there was no difference in opioid consumption between Groups 1, 2, and 3 ($p>0.05$ for all). At 6 weeks postoperatively, Groups 2 and 3 had consumed significantly less opioids than Group 1 ($p=0.04$, $p<0.001$). Group 3 patients were less likely to obtain an opioid refill relative to Group 1 patients ($p=0.04$). Groups 2 and 3 ceased opioid consumption a median of 6 days and 2 days sooner than Group 1, respectively ($p<0.001$, $p=0.03$).

Conclusion: Perioperative opioid counseling significantly decreases the quantity and duration of opioid consumption following primary TJA.

The Effect of Surgical Staff Intra-Operative Turnover on Operative Times and Complication Rates for Elective Primary Arthroplasty

James Cardinal, MD
University of Iowa

Purpose: To evaluate the effect of intraoperative surgical staff turnover on operative times and complication rates for primary joint arthroplasty (TJA).

Significance: Non-orthopedic literature has demonstrated an association between surgical staff turnover and increased operative times, however the effect of intraoperative staff turnover in TJA is poorly understood.

Methods: Operative timepoints, surgical staff, postoperative complications, and length of stay (LOS) were collected from medical records for 2,216 primary TJAs. Univariant analysis was performed to evaluate effect of intraoperative surgical staff turnover on operative times and complication rates.

Results: Intraoperative scrub turnover occurred in 51.4% of cases and correlated with significantly longer operating (134.9 vs 126.6 minutes, $p<0.0001$), total OR (164.9 vs 155.8 minutes, $p<0.0001$), and TSC times (206.2 vs 200.2 minutes, $p=0.0115$). There were similar complication rates (2.7% vs 2.0%, $p=0.2974$).

Intraoperative circulator turnover occurred in 20.4% of cases and correlated with significantly longer operating time (139.1 vs 128.7 minutes; $p<0.0001$), total OR time (170.2 vs 157.9 minutes, $p<0.0001$), TSC time (214.3 vs 200.1 minutes; $P<0.0001$), and LOS (2.04 vs 1.76 days; $p<0.0016$). There were similar complication rates (2.2% vs 2.4%, $P=0.7736$).

Conclusion: Minimizing surgical staff turnover may lead to increased OR efficiency and shorter LOS in primary TJA.

Applying the 2013 and 2018 MSIS Consensus Definitions to Determine Rates and Risk Factors of Culture-Negative Periprosthetic Joint Infections

Jacob Henrichsen, MD
University of Iowa

Background: Periprosthetic joint infection (PJI) is the most and third-most common reason for revision total knee arthroplasty (TKA) and total hip arthroplasty (THA), respectively. Antibiotic treatment relies on culture-positive (CP) results. In this study, rate of culture-negative (CN) PJI was determined by 2013 MSIS International Consensus Meeting and 2018 MSIS criteria. Patient-specific risk factors for CN PJI were assessed.

Methods: 409 revision TKA and THA for PJI from 2013-2017 were retrospectively identified. Clinical data collected. PJI was defined via 2013 and 2018 MSIS criteria; 233 (57%) cases met 2013 criteria and 261 met 2018 criteria. CN and CP PJI cohorts were compared.

Results: 12% CN rate (19 TKA, 8 THA) using 2013 MSIS criteria. In CN cases, 41% had pre-culture antibiotics (vs. 29% CP; p=0.197). Previously-revised vs. primary joints showed greater CN incidence (17% vs. 9%; p=0.083), presence of purulence was significantly greater in CN cases (89% vs. 62%; p=0.007). Using the 2018 MSIS criteria, 28 additional cases (10 THA, 18 TKA; 79% CN) met criteria. In addition, 2018 MSIS criteria identified significantly more CN cases compared to 2013 MSIS guidelines (p≤0.001).

Conclusion: The 2018 MSIS criteria were found to be more sensitive in identifying CN PJI compared to the 2013 MSIS ICM criteria (19% vs. 12%, respectively). Risk factors for CN infection included prior revision surgery and administration of antibiotics prior to aspiration.

Effect of Nutritionist Referral on Weight Loss in Obese Patients Seeking Total Joint Arthroplasty

Viktor Tollemar, MD
University of Michigan

Purpose: We aim to assess the effect of pre-operative nutritionist referral on obese patients seeking primary total joint arthroplasty, hypothesizing that referred patient will achieve greater weight loss compared with controls.

Significance: Total joint arthroplasty in obese patients have been associated with longer hospital stays, higher healthcare costs, and increased rate of perioperative complications. To mitigate these risks, University of Michigan joint arthroplasty surgeons routinely refer morbidly obese patients to a licensed nutritionist for weight loss counseling.

Methodology: Weight loss achieved by patients referred to a nutritionist were compared against a historical matched control group that was not referred. Patients were matched based on sex, age, and BMI. Statistical significance was determined using two-tailed t-tests with a P-value cutoff of <0.05.

Results: 274 referred patients and 174 matched controls were included in analysis. Patients who were referred to a nutritionist achieved significantly greater average BMI decrease (1.5 kg/m^2) compared to controls (0.8 kg/m^2) by their surgical date or 6 months after first contact ($P = 0.01$). Additionally, referred patients were 10% more likely to go on to total joint arthroplasty compared with controls.

Conclusion: Routine pre-operative referral to a nutritionist is effective in promoting weight loss and improving surgical candidacy.

Documented Penicillin Allergies Should Not Preclude Use of Pre-Operative Cefazolin in Hip and Knee Arthroplasty

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Introduction: Current clinical practice guidelines for surgical prophylaxis in major joint and spine surgeries favor cefazolin. Current guidelines recommend administration of IV vancomycin or IV clindamycin in patients with documented major reaction to PCN. One promising strategy is to administer an intravenous test-dose while the patient is intubated.

Methods: A database search from a single surgeon was performed over a 5-year period, between the years of 2013 and 2017 for all primary and revision total hip and knee arthroplasties.

Results: 3.6% (85) patients had an acute post-operative infection, 3.2% receiving cephazolin, 2.8% receiving cephazolin and vancomycin, 4.1% receiving clindamycin, 18.2% receiving clindamycin and vancomycin. 13.7% were allergic to penicillin. 169 (41.4%) of the patients with an allergy received cephazolin, only 1 (0.6%) patient with a listed penicillin allergy had a documented reaction to the antibiotic.

Conclusion: There is an increased risk of infection receiving clindamycin versus cefazolin for pre-operative prophylaxis. Patients with a penicillin allergy can be safely given cefazolin, with only one patient having an allergic reaction. The benefits of cefazolin administration in patients with a penicillin allergy outweigh the risks associated with administration of an alternative antibiotic.

Perioperative Corticosteroids Reduce Severity of Dysphagia Following Anterior Cervical Spinal Fusion? A Meta-analysis of Randomized Controlled Trials

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Purpose: To determine whether perioperative corticosteroid administration reduces dysphagia after anterior cervical spine procedures.

Significance: The anterior approach to the cervical spine is commonly used to treat cervical pathology. It is, however, associated with high rates of dysphagia. Perioperative corticosteroid administration has been advocated to decrease dysphagia rates; its efficacy remains uncertain.

Methods: We conducted a meta-analysis of randomized controlled trials to determine the efficacy of perioperative corticosteroid administration in reducing postoperative dysphagia. We conducted this study as per the guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement. The methods of our review are consistent with the Cochrane Handbook for Systematic Reviews of Interventions.

Results: A total of 7 studies (431 patients) were eligible for final inclusion, of which 247 patients received corticosteroids and 184 received placebo or control treatment. Moderate quality evidence demonstrated significant improvement in postoperative dysphagia rates (OR 0.35, 95% CI 0.20 to 0.63, $p < 0.05$). There was no significant difference between intravenous and local steroid administration ($p = 0.16$).

Conclusion: This meta-analysis found moderate-quality evidence supporting the use of perioperative corticosteroid administration as an adjunct to anterior cervical spinal procedures. Patients treated with corticosteroids have significantly decreased dysphagia severity.

Improving the Safety of Shoulder Arthroscopy in the Beach-Chair Position: A Prospective Randomized Trial Investigating the Effect of Compression Stockings on Cerebral Desaturation Events in High-Risk Patients

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Purpose: To determine if thigh-high compression stockings (CS) decrease cerebral desaturation events (CDEs) in obese patients undergoing shoulder arthroscopy in the beach chair position (BCP).

Significance: Devastating postoperative neurocognitive complications have been observed after elective shoulder arthroscopy in the BCP. The high cost and limited availability of continuous cerebral oxygen saturation monitoring may not be cost-effective. Data on more cost-effective CS is limited, especially for obese patients, who are at increased risk for CDEs.

Methods: 33 patients wore both CS and sequential compression devices (SCDs), and 33 patients in the control group wore SCDs alone. Cerebral oximetry was monitored using near-infrared spectroscopy.

Results: Nine patients (27%) in each group experienced CDEs. There was no difference between groups in terms of median number of CDEs per patient ($p = 0.286$), median time from induction of anesthesia to onset of CDE ($p = 0.791$), median time from upright positioning to onset of CDE ($p = 0.596$), mean CDE duration per patient ($p = 0.216$), median cumulative CDE duration ($p = 0.185$), and median maximal desaturation from baseline ($p = 0.354$).

Conclusion: CS did not decrease the incidence, frequency, or magnitude of CDEs in patients undergoing shoulder arthroscopy in the BCP.

Greater Sports Participation in Adolescence is Associated with Development of Proximal Femoral Cam Morphology: A Prospective Evaluation of 317 Individuals

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Purpose: To evaluate the influence of sport type and activity level on the development of cam-type femoroacetabular impingement (FAI) and acetabular dysplasia.

Significance: How participation in athletics in adolescence affects proximal femoral morphology is of growing interest.

Methodology: Adolescent Physical Activity Questionnaire (PAQ-A) was administered to participants at age 17. Athletes participating in high hip flexion-loading sports were grouped ("powersport" athletes) and compared to "non-powersport" athletes and "non-athletes". DXA scans were used to measure alpha angle (AA), head-neck offset ratio (HNOR), and lateral-center edge angle (LCEA) and compare longitudinally to age 23 years. Logistic regression evaluated odds of hip CAM morphology (AA >55º, HNOR <0.17) and dysplasia (LCEA<24º). Physical activity and hip measures from ages 17 to 23 years were examined with linear mixed models.

Results: Compared to nonathletes, powersport athletes had greater odds of cam morphology by AA (OR 2.93, 95% CI 1.02-8.41, p=0.04) and HNOR (OR 1.91, 95% CI 1.01-3.60, p=0.04) but not dysplasia. Non-powersport athletes and non-athletes were not significantly different (p>0.05). Higher physical activity level was associated with greater alpha angles (beta±SE=0.77±0.30, p=0.011), lower HNOR (-0.003±0.001, p=0.003) but not LCEA (p=0.74).

Conclusion: Participation in "powersports" during adolescence is associated with cam morphology but not acetabular dysplasia.

Suture Tape Reinforced Human Dermal Allograft Used for Superior Capsule Reconstruction Demonstrates Improved Ability to Withstand Elongation

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Purpose: To investigate the potential for a suture tape reinforcement technique to prevent elongation with repetitive use of a human dermal (HD) allograft used for superior capsule reconstruction (SCR) in a biomechanical model

Significance: It is unclear how shoulder overuse can contribute to HD allograft elongation and eventual superior glenohumeral translation following SCR.

Methods: Using 8 scapulae and humeri Sawbones models, SCR was performed using HD allografts. Four grafts were tested in the native state, and four tested reinforced with suture tape in a running 360° fashion around the allograft borders. Allografts were measured pre- and post-dynamic testing for length, width, and thickness. Specimens were affixed to an MTS machine allowing for uniplanar allograft orientation throughout testing. Specimens were preloaded to 10N and cyclically loaded to 100N at 15mm/s for 30 cycles.

Results: Reinforced allografts experienced a significantly smaller percent change in anterior and posterior length, medial and lateral width, and medial, central, and lateral thickness. Linear stiffness values for reinforced allografts were significantly greater than native allografts measured at cycles 1, 15, and 30 of dynamic testing.

Conclusion: The reinforcement technique described decreased HD allograft elongation, maintained graft thickness, and improved linear stiffness values following uniplanar cyclic loading in a biomechanical Sawbones model.

Augmented Immunomodulation of Endogenous Marrow-Derived Stem Cells in the Setting of ACL Rupture

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PURPOSE: Lower kynurenine-to-tryptophan ratio observed in synovial fluid of ACL rupture (ACLR) rats suggests decreased activity of tryptophan metabolizing enzyme, IDO, known to be secreted by MSCs to promote T-reg expansion and Th17 suppression. This study aims to characterize the immunomodulatory capacity of pharmacologically mobilized MSCs in conjunction with exogenously delivered IDO.

SIGNIFICANCE: Augmentation of MSC immunomodulation is an unexplored, potentially useful therapeutic to combat PTOA following ACLR.

METHODS: Rats (*N*=48) underwent ACLR to evaluate the effects of mobilized MCSs on IDO1 and inflammatory cytokine expression profiles in the synovial fluid. Additionally**,** rats (*N*=160) underwent ACLR to assess the immunomodulatory influence of therapeutic IDO *in vivo* via gait analysis parameters known to correlate to pain and inflammation. Gait data was collected longitudinally prior to injury and at 3, 7, 10, and 14 days post-injury.

RESULTS: ACLR induced an increase in inflammatory markers including TNF-α and Fractalkine. Treatment with AMD3100, which induces MSCs recruitment, increased IDO within the injured joint while decreasing inflammatory markers. Gait analysis following ACLR demonstrates that AMD3100 and exogenous IDO exhibited normalizing effects on several gait parameters compared to control.

CONCLUSION: Increased MSC recruitment and exogenous IDO delivery following ACLR may be effective at modulating joint pain and inflammation associated with PTOA.

ACL Graft Preparation with Vancomycin Has No Effect on Patient-Reported Outcomes, Graft Rupture Rates, and Chondrocyte Viability Following Primary ACL Reconstruction

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Purpose: Determine the effect of vancomycin on chondrocyte viability and evaluate 2-year patient reported outcomes (PROs) and graft failure following primary ACL reconstruction (ACLR) stratified by vancomycin use.

Significance: ACL graft preparation with vancomycin may reduce rates of postoperative infection. However, the effect of vancomycin on PROs, graft failure, and chondrocyte viability following ACLR is poorly understood.

Methods: 408 primary ACLRs were retrospectively reviewed. PRO instruments were completed preoperatively and 6 months and 2 years postoperatively. Information regarding graft failure was collected at final follow-up. Additionally, bovine explant osteochondral plugs were treated with differing concentrations of vancomycin irrigant and stained with calcein acetoxymethyl to detect viable chondrocytes.

Results: The vancomycin cohort exhibited no difference in PRO scores preoperatively as well as at 6 months and 2 years following ACLR compared to patients who underwent ACLR without the use of vancomycin. Additionally, there was no difference observed in the rate of ACL graft failure between vancomycin (n=7; 2.5%) and non-vancomycin (n=4; 3.2%) treated grafts (p=0.676). Lastly, vancomycin was determined to not be toxic to chondrocytes at therapeutic doses.

Conclusion: Intraoperative graft preparation with vancomycin irrigant has no effect on PROs, graft failure rates, and chondrocyte viability following primary ACLR.

Validating the Safety of a Hyperosmolar Saline Irrigation Fluid in Arthroscopic Knee Surgery

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Purpose: To assess the safety of a hyperosmolar irrigation solution for arthroscopic knee surgery.

Significance: Arthroscopic procedures disrupt joint homeostasis when hyperosmolar synovial fluid is replaced by an isotonic irrigation fluid. Hyperosmolar fluids may minimize iatrogenic cartilage injuries, pain, and swelling postoperatively.

Methodology: Patients undergoing arthroscopic knee surgery were randomized to surgery with isotonic Lactated Ringer's (273mOsm/L) or hyperosmolar saline (593 mOsm/L). Outcomes included perioperative changes in blood pressure and knee girth, Visual Analogue Scale (VAS) pain scores, and narcotic pain medication consumption. Data from each cohort were pooled and analyzed for statistical significance ($P<0.05$).

Results: Forty-six patients underwent surgery with isotonic (N=23) or hyperosmolar (N=23) irrigation fluids. There were no significant differences in surgical duration, irrigation fluid used, knee girth, blood pressure, or VAS. Patients treated with hyperosmolar saline consumed less narcotic medication on postoperative day 3 (4.0 ± 7.6 mg vs. 15.5 ± 17.4 mg, $p=0.01$). Additional costs to the institution for the hyperosmolar irrigation solution were $34 per patient.

Conclusions: Hyperosmolar saline is safe and cost effective for use in arthroscopic knee surgery. Taken together with previous basic science, translational, and clinical studies; hyperosmolar saline irrigation fluid is promising alternative to traditional isotonic irrigation fluids for arthroscopy.

Barriers for Medical Students from Non-Stereotypical Identities Considering Orthopedic Surgery Careers: A Qualitative Investigation

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Purpose: To investigate barriers for medical students with non-stereotypical (non-white, non-male) identities considering orthopedic careers.

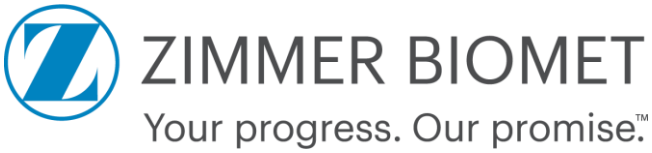
Significance: Orthopedics remains the least diverse medical-specialty, and entrenched gender and racial stereotypes exist about orthopedics. Therefore, we used qualitative methodology to identify identity-related barriers for non-stereotypical students.

Methods: We selected medical students from four Midwest schools using maximum-variation and purposive sampling strategies. Semi-structured interviews were conducted until thematic saturation was reached. Transcripts were analyzed using Grounded Theory methodology, a rigorous inductive qualitative analysis strategy.

Results: Thematic saturation was reached at 19 interviews (16 women, 12 underrepresented-minority students). Students' perceived barriers fell into two categories: (1) barriers in the residency application/selection process and (2) fears about a perpetual lack of belonging. Within the application/selection process, students feared implicit bias, and needing to overcome a disproportionate number of hurdles to be viewed as a competitive applicant. Long-term, students feared a perpetual lack of belonging, with concerns about scarce mentorship, limited career advancement, tokenism, and needing to sacrifice core aspects of their identity to fit-in.

Conclusion: This qualitative study illustrates several barriers that discourage non-stereotypical medical students from pursuing orthopedics. These perceived barriers offer specific opportunities for interventions that can make orthopedics more attractive to these students.

OREF gratefully acknowledges these Corporate Associates



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