



THIRD ANNUAL

OREF VIRTUAL NATIONAL

RESIDENT RESEARCH SYMPOSIUM

Wednesday, November 8, 2023

5:30 p.m. CST

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About OREF:

The Orthopaedic Research and Education Foundation (OREF) is a charitable 501(c)(3) organization committed to improving lives by supporting excellence in orthopaedic research through its grant funding and research education programs. As an independent nonprofit, OREF strives to improve clinical care and patient outcomes by advancing innovative research, developing new investigators, and uniting the orthopaedic community in promoting musculoskeletal health. Visit oref.org or follow OREF on X (@OREFtoday).

**OREF NATIONAL
RESIDENT RESEARCH SYMPOSIUM
SUMMARY AGENDA**
Wednesday, November 8, 2023

5:30 p.m. – 5:40 p.m.	Welcome and Introductions Joshua J. Jacobs, MD President-Elect Orthopaedic Research and Education Foundation Thomas P. Sculco, MD President Orthopaedic Research and Education Foundation Lee Grossman Chief Executive Officer Orthopaedic Research and Education Foundation
5:40 p.m. – 6:20 p.m.	Session I – Resident Research Presentations and Discussion Moderator: Joshua J. Jacobs, MD Break
6:25 p.m. – 7:05 p.m.	Session II – Resident Research Presentations and Discussion Moderator: Joshua J. Jacobs, MD Break
7:10 p.m. – 7:40 p.m.	Session III – Resident Research Presentations and Discussion Moderator: Joshua J. Jacobs, MD Break – <i>Judges and Presenters - Please submit your scores at this time.</i>
7:45 p.m. – 8:15 p.m.	Keynote Speaker Leadership in Orthopaedic Surgery Research – Serendipity and Say Yes James R. Ficke, MD, FACS, FAAOS, Colonel (retired) US Army Robert A. Robinson Professor, Orthopaedic Surgeon-in-Chief Department of Orthopaedic Surgery Johns Hopkins Hospital
8:15 p.m. – 8:20 p.m.	Awards Presentation Thomas P. Sculco, MD
8:20 p.m. – 8:25p.m.	Closing Remarks Lee Grossman, MD

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KEYNOTE SPEAKER



**James R. Ficke, MD, FACS, FAAOS,
Colonel (retired) US Army**

**Robert A. Robinson Professor, Orthopaedic Surgeon-in-Chief
Department of Orthopaedic Surgery
Johns Hopkins Hospital**

Dr. James R. Ficke is the Robert A. Robinson Professor and Chair of the Department of Orthopaedic Surgery at The Johns Hopkins Medical Institution. He has an active surgical practice in the Johns Hopkins Hospital. He recently served as a member of the Committee on Trauma and Chair of the Disaster Committee, American College of Surgeons.

Dr. Ficke completed his BS degree in Engineering at West Point; MD at Uniformed Services University; and residency in orthopaedic surgery at Tripler Army Medical Center in Honolulu. He completed an AO fellowship in trauma in Munich, Germany, and foot and ankle in Dallas.

Retired after 30 years of service in the United States Army, his last military assignment was Chair of the Department of Orthopaedics and Rehabilitation at San Antonio Military Medical Center at Fort Sam Houston. He also served the U.S. Army Surgeon General as the senior advisor for Orthopaedic Surgery and extremity injuries for seven years. While on Active Duty, he deployed to Iraq as Senior Orthopaedic Surgeon-in-Country, and Deputy Commander for the 228th Combat Support Hospital. He also served as the Chief of Staff for the Surgeon General's Dismounted Complex Blast Injury Task Force, and the Army Lead for the DoD/VA Extremity Trauma and Amputee Center of Excellence Development Group. He served as Chair or Co-Chair of the Steering Committee for the DoD Peer Reviewed Orthopaedic Research Program for eight years. He currently holds research grants with DoD and NIH and his primary research focus areas are clinical outcomes in post-traumatic ankle arthritis, National Trauma Systems Development, Resident Research Training (T32), and Disaster Response Improvement.

He has received the Society of Military Orthopaedic Surgeons' COL Brian Allgood Memorial Leadership Award as well as the Surgeon General's Major General Lewis Aspey Mologne Award for excellence in military academics, education and clinical care. He is a Legionnaire in the Infantry Order of St. Michael and a Distinguished Member of the Army Medical Regiment. In 2018, he received the Johns Hopkins Award for Advancement of Women in Science and Medicine, and the Boy Scouts of America Leaders in Healthcare Award.

From March 2020 thru June 2021, as a partnership between the Maryland State Department of Health, University of Maryland Medical System, and Johns Hopkins Health System, he organized and directed the Baltimore Convention Center Field Hospital as part of the Unified Maryland COVID-19 response. This organization provided care for over 1,400 inpatients; over 2,400 antibody infusions to treat persons with COVID; over 100,000 tests, and over 110,000 vaccinations, and was the longest continually operating such Alternate Care Site in the United States.

Judges

OREF Research Grants Committee Members

President

Thomas P. Sculco, MD
Hospital for Special Surgery

Eric R. Henderson, MD
Dartmouth-Hitchcock Medical Center

Joshua J. Jacobs, MD
Rush University Medical Center

Matthew J. Silva, PhD
Washington University in St. Louis

Timothy Wright, PhD
Hospital for Special Surgery

Moderator

Joshua J. Jacobs, MD
Rush University Medical Center

**OREF National Resident Research Symposium
DETAILED AGENDA**

Wednesday, November 8, 2023
Program commencing at 5:30 p.m. CST

5:30 p.m. – 5:40 p.m.

Welcome and Introductions

Joshua J. Jacobs, MD
President-Elect
Orthopaedic Research and Education Foundation

Thomas P. Sculco, MD
President
Orthopaedic Research and Education Foundation

Lee Grossman
Chief Executive Officer
Orthopaedic Research and Education Foundation

Session I – Resident Research Presentations & Discussion

Moderator: Joshua J. Jacobs, MD

5:40 p.m. – 5:45 p.m.

Culture Expansion Affects Stem Cell Secretome

Ryan Furdock, MD – Case Western Reserve University/University Hospitals
Cleveland Medical Center

5:45 p.m. – 5:50 p.m.

Fracture Related Infections After Low-Velocity Ballistic Tibia Fractures: What Do Cultures Show?

Nainisha Chintalapudi, MD – Carolinas Medical Center/Atrium Health

5:50 p.m. – 5:55 p.m.

Epidemiology and Video Analysis of Hamstring Injuries in the National Basketball Association

Samuel Roswell Huntley, MD – University of Miami

5:55 p.m. – 6:00 p.m.

Bisphosphonate Chaperones Effectively Target the Enthesis Without Impairing Soft Tissue-to-Bone Repair Integrity

Brendan Shi, MD – University of California, Los Angeles

6:00 p.m. – 6:05 p.m.

Liposomal Bupivacaine Does Not Decrease Post-Operative Pain in Patients with Intracapsular Femoral Neck Fracture Treated with Hemiarthroplasty: A Double-Blinded Randomized, Controlled Trial

Mitchell Ng, MD – Maimonides Medical Center

6:05 p.m. – 6:10 p.m.

Early Clinical Outcomes of Osteochondral Allograft for Capitellar Osteochondritis Dissecans in Adolescent Athletes

Junho Ahn, MD – University of Texas Southwestern Medical Center

6:10 p.m. – 6:20 p.m.

Question and Answers

6:20 p.m. – 6:25 p.m.

Break

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**OREF National Resident Research Symposium
DETAILED AGENDA**

Wednesday, November 8, 2023

Session II – Resident Research Presentations & Discussion

Moderator: Joshua J. Jacobs, MD

- 6:25 p.m. – 6:30 p.m. *Attrition Amongst Residents Entering US Orthopedic Surgery Residency Programs: Analysis of National GME Census Data*
Katherine Gerull, MD – Washington University in St. Louis
- 6:30 p.m. – 6:35 p.m. *Does Cement Mixing Technique Affect Surgical Exposures to Contaminants and Operating Room Exposures to Volatile Organic Compounds?*
Edwin Chaharbakhshi, MD – West Virginia University
- 6:35 p.m. – 6:40 p.m. *Intravenous Meloxicam versus Intravenous Ketorolac for Pain Control Following Total Joint Arthroplasty: A Randomized Controlled Trial*
David Constantinescu, MD – University of Miami
- 6:40 p.m. – 6:45 p.m. *Hormonal Contraceptives Protect Against Ligament Injuries in Female Athletes*
Christian Blough, MD – Cedars-Sinai
- 6:45 p.m. – 6:50 p.m. *Defining In Vitro and In Situ Thresholds for Tension Activated Repair Patches*
Bijan Dehghani, MD – University of Pennsylvania
- 6:50 p.m. – 6:55 p.m. *Etiology of Acute Extremity Pediatric Compartment Syndrome: A Retrospective Review*
Olivia A. Barron, MD – Baylor College of Medicine
- 6:55 p.m. – 7:05 p.m. Question and Answer
- 7:05 p.m. – 7:10 p.m. Break

Session III – Resident Research Presentations & Discussion

Moderator: Joshua J. Jacobs, MD

- 7:10 p.m. – 7:15 p.m. *Outpatient Spine Surgery in the Medicare Population: Trends in Hospital Outpatient and Ambulatory Surgical Center Utilization, 2010-2021*
Alex Kane Miller, MD – Beaumont Hospital, Royal Oak
- 7:15 p.m. – 7:20 p.m. *Danger Zone in Anterolateral Plate Fixation of the Distal Tibia – A 3D CT Angiography Model*
Brendon Mitchell, MD – University of San Diego
- 7:20 p.m. – 7:25 p.m. *Identifying Anterior Cruciate Ligament Injuries Through Automated Video Analysis of In-Game Motion Patterns*
Gergo Merkely, MD, PhD – Harvard Combined Orthopedic Residency Program
- 7:25 p.m. – 7:30 p.m. *The Relationship Between the Timing of Knee Osteoarthritis Diagnoses and Arthroscopic Partial Meniscectomy*
Semran Thamer, MD – University of Texas at Austin, Dell Medical School
- 7:30 p.m. – 7:40 p.m. Question and Answer
- 7:40 p.m. – 7:45 p.m. Break
Judges and Presenters - Please submit your scores at this time.

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OREF National Resident Research Symposium
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7:45 p.m. – 8:15 p.m.	Keynote Speaker <i>Leadership in Orthopaedic Surgery Research – Serendipity and Say Yes</i> James R. Ficke, MD, FACS, FAAOS, Colonel (retired) US Army Robert A. Robinson Professor, Orthopaedic Surgeon-in-Chief Department of Orthopaedic Surgery Johns Hopkins Hospital
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Culture Expansion Affects Stem Cell Secretome

Ryan Furdock, MD

Case Western Reserve University/University Hospitals
Cleveland Medical Center

Purpose: We sought to characterize the production of osteoarthritis (OA) relevant cytokines and growth factors in culture expanded bone-marrow mesenchymal stem cells (BM-MSCs) preparations.

Significance: Little is known about the cytokine profile (secretome) of culture expanded BM-MSCs. Cytokine production is a major contributor to BM-MSCs' potential efficacy in treatment of OA.

Methods: Two different BM-MSC sources were grown from passage 1 through passage 4 ($P_1 \rightarrow P_4$) and followed for their specific secretome phenotype with time. Luminex Multiplexing was utilized to document the change in secretome with each passage to determine the importance of culture conditions and phenotype of purified BM-MSCs.

Results: There was significant difference between the two different hMSC preparations, which may be defined by their growth conditions. BM-MSCs grown in medium C sustained their phenotype and immunomodulatory potential. BM-MSCs grown in R medium secreted fewer anti-inflammatory cytokines and lost their secretome profile with subculture.

Conclusion: Cytokines and growth factors are a major component of BM-MSC function that have been overlooked in much of the current literature. Our study is among the first to characterize the OA relevant cytokine and growth factor profiles of this injectable therapeutic option.

Fracture Related Infections After Low-Velocity Ballistic Tibia Fractures: What Do Cultures Show?

Nainisha Chintalapudi, MD
Carolina Medical Center Atrium Health

Purpose: Identify risk factors for developing a culture positive infection in operative ballistic tibia fractures and to report on the microbiology of intraoperative culture results obtained during debridement.

Significance: Ballistic tibia fractures have deep infection rates ranging from 2-14%, however there is limited information regarding their microbiology.

Methods: A retrospective review was performed of 128 adults with operative low-velocity ballistic tibia fractures, from 2011-2020. We excluded injuries with large tissue defects or concomitant vascular injuries. All patients received Cefazolin prophylaxis. Demographics, injury and surgical characteristics, wound management, and cultures were abstracted.

Results: The culture positive infection rate was 12.8% (12/94) with 55% of organisms not susceptible to first generation cephalosporins. The most common isolate was *Streptococci* (50%) then gram negative rods (33.3%), and anaerobes (25%). There were no identifiable risks for FRI. 41.6% of patients required a second debridement where 40% of cultures were positive for *Enterococcus*.

Conclusions: We found a high infection rate with 55% of organisms not susceptible to standard of care prophylaxis and no difference in baseline or surgical characteristics between FRI cohort and patients without infections. Consideration should be given to broader prophylaxis or local antibiotic treatment in the management of low-velocity ballistic tibia fractures.

Epidemiology and Video Analysis of Hamstring Injuries in the National Basketball Association

Samuel Roswell Huntley, MD
University of Miami

Purpose: To characterize the epidemiology and performance outcomes of hamstring injuries (HSIs) in the National Basketball Association (NBA) and analyze the mechanism of HSI through video analysis.

Significance: This study can be used to determine risk factors for and mechanisms of HSI in the NBA.

Methods: HSIs that occurred in the NBA from 2019-2022 were identified. Demographic and performance data were recorded. Video analysis of 45 players determined the mechanism of HSI.

Results: 181 HSIs were identified in the NBA 2019-2022 seasons. HSIs occurred most often during games (79.6%) and were mostly sustained by guards (65.7%). Players injured their left hamstring most frequently (59.6%; $p=0.044$). Players missed an average of 5.5 games after injury. Within 3 months of returning to play, 16.0% reinjured their ipsilateral hamstring and 5.0% injured their contralateral hamstring. Higher-performing players and those aged over 30 sustained the greatest deficits in performance. Video analysis revealed most injuries were noncontact (62.2%) and occurred as a player initiated a plant/jump movement with the injured extremity (41.9%).

Conclusions: HSIs in the NBA lead to a decline in player performance especially in older and higher-performing players, higher-performing players have higher rates of reinjury, and most injuries occur while jumping or landing.

Bisphosphonate Chaperones Effectively Target the Enthesis Without Impairing Soft Tissue-to-Bone Repair Integrity

Brendan Shi, MD

University of California, Los Angeles

Purpose: We hypothesized that Osteoadsorbative Fluorogenic Sentinel-3, a novel compound utilizing a bisphosphonate targeting and cathepsin K-dependent release mechanism would localize to the site of tendon-bone repair without affecting the integrity of tendon-bone repairs.

Significance: While growth factors have been shown to improve enthesis organization, there remains a lack of appropriate delivery strategies.

Methods: Achilles tendon-to-bone repair or sham surgery was performed on 12-week-old mice. Animals undergoing repair were divided into 3 groups: (1) repair with local OFS-3 administration, 2) repair with systemic OFS-3 administration, and (3) repair without OFS-3. Serial in vivo fluorescent imaging was used to localize the biodistribution of OFS-3. Repaired hindlimbs were harvested at 6 weeks after surgery and evaluated biomechanically and histologically.

Results: Animals that received either local or systemic OFS-3 after Achilles repair demonstrated higher repair site epifluorescence than those in the sham surgery cohort at all time points ($p < 0.001$). There was no difference in failure load between repaired hindlimbs that received OFS-3 versus saline. There was no difference in tissue size or collagen organization between animals that received OFS-3 versus saline.

Conclusion: OFS-3 successfully targeted the site of Achilles tendon-to-bone repair without affecting the biomechanical properties or histologic appearance of the repair

Liposomal Bupivacaine Does Not Decrease Post-Operative Pain in Patients with Intracapsular Femoral Neck Fracture Treated with Hemiarthroplasty: A Double-Blinded Randomized, Controlled Trial

Mitchell Ng, MD

Maimonides Medical Center

Purpose: This study aims to evaluate the effect of liposomal bupivacaine on patients with intracapsular hip fractures undergoing hemiarthroplasty on 1) post-operative pain, 2) function and 3) overall hospital course.

Significance: Liposomal bupivacaine is a long lasting local anesthetic agent developed for use in the surgical setting to decrease post-operative pain.

Methods: This was a single center, randomized prospective double-blinded study of 50 patients with isolated intracapsular femoral neck fractures from 2018-2022 treated with hip hemiarthroplasty. The study group included 25 patients treated with intra-operative Exparel/bupivacaine injections, while control included 25 patients treated with intra-operative bupivacaine injection only. Primary outcomes were visual analogue scale (VAS) pain, total morphine milligram equivalents (MME), delirium and time-to-ambulate with physical therapy.

Results: There was no significant difference found in any outcomes measured between liposomal bupivacaine relative to controls. There was no difference in average post-operative pain scores (2.26 vs 2.7 VAS; $p=0.34$), MMEs (11.73 vs 9.98 MME; $p=0.71$), and post-operative day of discharge (4.00 vs 3.88 days; $p=0.82$).

Conclusion: Our results suggest liposomal bupivacaine is not associated with improved postoperative pain, function or shorter hospital course following hip hemiarthroplasty. Given the cost of liposomal bupivacaine over standard pain modalities, it is worth re-evaluating its use.

Early Clinical Outcomes of Osteochondral Allograft for Capitellar Osteochondritis Dissecans in Adolescent Athletes

Junho Ahn, MD

University of Texas Southwestern Medical Center

Purpose: The aim of this study was to evaluate the outcome of young athletes following osteochondral allograft (OCA) for capitellar osteochondritis dissecans (OCD).

Significance: Capitellar OCD is an alteration of subchondral bone with the risk for instability and disruption of adjacent articular cartilage related to repetitive stress. Treatment outcomes with OCA is currently not well described.

Methods: Forty-two adolescent athletes (47 elbows) treated with OCAs were retrospectively reviewed. Pre- and post-operative patient-reported outcomes were obtained.

Results: The average age was 12.9 (1.5) years. Thirty-four (72.3%) were female, and average follow-up was 16.6 months. Gymnastics was the most common sport (72.3%) followed by baseball (19.1%). At final follow-up, 46 (97.9%) patients returned to sport. Of these, 27 (57.4%) returned to the same level of competition. Significant improvements were noted in Timmerman-Andrews score (56.1 vs. 88.8, $p<0.001$), qDASH (31.2 vs. 6.0, $p<0.001$) and range of motion (133.6° vs. 141.8° , $p=0.016$). The average PROMIS Pain score at final follow-up was 38.6 (7.9). Three (6.4%) graft failures occurred, two requiring revision surgery.

Conclusion: Treatment of capitellar OCD lesions with OCA is an effective treatment for larger defects with reliable return to sport and improvement in elbow function and pain.

Attrition Amongst Residents Entering US Orthopedic Surgery Residency Programs: Analysis of National GME Census data

Katherine Gerull, MD
Washington University in St. Louis

Purpose: We aimed to identify the overall rate of attrition amongst orthopedic surgery residents nationally, what specialties the residents who experience attrition from orthopedics ultimately pursue, and which risk factors are significantly associated with attrition from orthopedic surgery residency.

Significance: It is important for Graduate Medical Education (GME) programs to have insight into the rate of resident attrition and risk factors for attrition, so that trainee attrition can be avoided if possible.

Methods: We analyzed data from a national cohort of matriculating US medical students from 1993 to 2001 who entered orthopedic surgery GME and subsequently obtained ABMS board certification in Orthopaedics (retention) or obtained board certification in another specialty (attrition). Using a multivariable logistic regression, we identified variables independently associated with attrition from (vs. retention in) Orthopaedics.

Results: The overall rate of attrition from orthopedic residencies was 5.5%. Residents who experienced attrition often became board certified in other surgical disciplines, most commonly plastic surgery or general surgery. Women, first-generation college graduates and residents with an Asian/Pacific Islander ethnicity had increased risk of attrition.

Conclusion: The overall rate of attrition from orthopedic GME is comparable to other surgical subspecialties. Underrepresented residents are at greater risk of attrition than their peers.

Does Cement Mixing Technique Affect Surgical Exposures to Contaminants and Operating Room Exposures to Volatile Organic Compounds?

Edwin Chaharbakhshi, MD
West Virginia University

Purpose: Poly(methyl methacrylate) (PMMA) cement may be a source of contamination while also releasing harmful volatile organic compounds (VOCs) during preparation. We hypothesized that different cement mixing techniques have variability in terms of contamination and VOC exposure.

Significance: Prosthetic joint infections have been hypothesized to be related to bacterial adherence to cement particle plumes during preparation. VOCs from PMMA have been shown to be harmful in *in vivo* models suggesting occupational exposure should be limited in operating rooms (ORs). Comparing mixing techniques may yield an optimal method.

Methods: Open bowl, vacuum, and all-in-one mixing techniques were compared in an OR. Five tests with each technique were performed. Cements were pre-mixed with 1 gram of powder that illuminates under blacklight. Particle and VOC counters were positioned throughout the OR. Contamination events, distance to contamination, particle counts in air, and VOC concentrations were compared.

Results: All-in-one mixing systems had significantly shorter ranges of contamination from the mixing site ($p=0.03$), significantly less contamination sites ($p=0.04$), and significantly lower VOC concentrations ($p<0.05$) compared to open bowl and closed bowl vacuum mixing systems.

Conclusion: All-in-one mixing systems may be safer for patients and OR staff in regard to particle contamination and harmful VOC exposure.

Intravenous Meloxicam versus Intravenous Ketorolac for Pain Control Following Total Joint Arthroplasty: A Randomized Controlled Trial

David S. Constantinescu, MD
University of Miami

Purpose: To evaluate the efficacy of IV meloxicam for postoperative pain management in total joint arthroplasty (TJA) compared to the standard of care, IV ketorolac.

Significance: Despite meloxicam demonstrating efficacy in reducing postoperative pain scores and opioid usage, few trials have compared it to other nonsteroidal anti-inflammatory drugs.

Methods: Patients scheduled for total hip or knee arthroplasty were randomized to receive either IV ketorolac or IV meloxicam. Both groups received a standardized multimodal pain management regimen alongside their respective drug assignments. Pain and nausea scores were assessed at 2 and 24 hours postoperatively.

Results: Between April 2022 and April 2023, 231 patients undergoing TJA were enrolled, with 105 patients in the standard group and 85 in the IV meloxicam group. No significant differences were observed between groups regarding pain at 2 (mean 3.3 vs. 3.3, $p=0.95$) or 24 hours (3.8 vs. 4.1, $p = 0.44$), nor in nausea at 2 (0.54 vs. 0.49, $p = 0.63$) or 24 hours (0.29 vs. 0.47, $p = 0.97$).

Conclusion: Intraoperative administration of IV meloxicam for TJA demonstrated no significant differences in pain management or nausea compared to IV ketorolac. However, the once-daily dosing schedule of IV meloxicam may offer a more convenient alternative.

Hormonal Contraceptives Protect Against Ligament Injuries in Female Athletes

Christian Blough, MD
Cedars-Sinai

Purpose: The purpose of this study was to investigate the effect of hormonal contraceptives (HC) on ligamentous injuries in female athletes.

Significance: Female athletes are at a 3 to 9 times greater risk of rupturing their anterior cruciate ligament (ACL) compared to similarly trained males playing the same sport. Relaxin receptors have been detected on female but not male ACLs, suggesting the same hormone that loosens the pubic symphysis during parturition may also predispose women to ligament injury via increased joint laxity.

Methods: High level female athletes were recruited and divided into two groups based on their HC status (HC vs non-HC). Serum relaxin and progesterone levels, knee laxity via KT-1000, and generalized hypermobility using the Beighton score were evaluated. Ligamentous injuries were continually tracked throughout their season.

Results: Athletes on HC had significantly less ligamentous injuries than non-HC athletes ($p < 0.05$). Serum relaxin levels were significantly greater in athletes not on HC compared to those on HC ($p < 0.05$). Athletes on HC demonstrate greater knee stability compared to non-HC athletes ($p < 0.05$) but there were no differences in general hypermobility between groups.

Conclusion: Data collected thus far suggests a protective relationship between hormonal contraceptives and ligamentous injuries in high level female athletes.

Defining *In Vitro* and *In Situ* Thresholds for Tension Activated Repair Patches

Bijan Dehghani, MD
University of Pennsylvania

Purpose: There is a need for annulus fibrosis (AF) repair strategies that quell inflammation, prevent matrix loss, and retain disc function. Our team has developed drug delivery devices in the form of fibrous scaffolds containing mechano-activated microcapsules (MAMC) that rupture (activate), releasing their inner contents when experiencing load - we termed them tension activated repair patch (TARP).

Significance: In this study we defined in vitro and in situ load dependent release profile for TARPs.

Methods: We performed cyclic tensile loading of the TARPs at physiological strain intervals (1800 cycles; 2%, 4%, 6%, 8% strain) (Fig. 1A and B). We also performed cyclic compression of a goat cervical spinal motion segment with a TARP sutured to the AF (1800 cycle, 300N force) (Fig. 2A and B). MAMC activation was manually counted using a top-down fluorescent microscope.

Results: Tensile loading of the TARP at 2%, 4%, 6%, and 8% strain resulted in activation of 15.1%, 31.4%, 39.1%, and 61.2% (normalized) respectively (Fig. 1C). In situ loading of the TARPs resulted in 28.0% activation of MAMC (Fig. 2C).

Conclusion: We demonstrated a load-dependent relationship between strain and MAMC activation *in vitro*. We also demonstrated proof of concept that this relationship translates *in situ*.

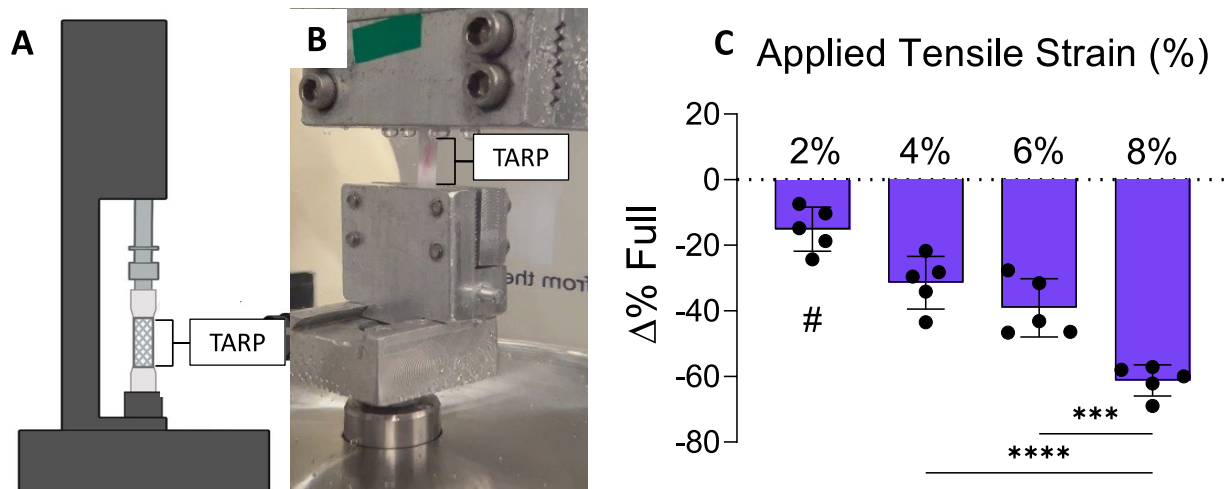


Fig 1. A. Schematic of cyclic tensile loading of TARPs **B.** Representative image of cyclic tensile loading of TARP **C.** Graph demonstrating activation of MAMC in negative-percent full, following variable strain.

Etiology of Acute Extremity Pediatric Compartment Syndrome: A Retrospective Review

Olivia A. Barron, MD
Baylor College of Medicine

Purpose/Significance: Pediatric acute compartment syndrome (ACS) is described as most caused by traumatic fractures (75%). This project analyzed the etiology of ACS diagnosed at a level I pediatric trauma center with the hypothesis that vascular etiology is a more common cause than previously described.

Methods: EMRs with ICD codes for compartment syndrome were retrospectively reviewed from 1/1/2010-1/9/2023. Each extremity was classified into one etiology: Vascular, Fracture, Non-Fracture Related Trauma, Iatrogenic, or Other.

Results: 129 patients and 147 extremities were diagnosed with ACS (29% upper extremity, 71% lower extremity). >90% received fasciotomies, and >80% underwent compartment checks. Overall, 39% were secondary to vascular etiologies, 34% fractures, 14% non-fracture trauma, 12% iatrogenic, and 1% other. Within vascular etiologies, the most common causes were cardiac arrest/shock (29%, n=17), cardiothoracic/interventional surgery (22%, n=13), and septic shock (19%, n=11). Within fracture etiologies, the most common causes were tibia fractures (48%, n=24), supracondylar or peri-elbow fractures (20%, n=10), and both bone forearm fractures (14%, n=7).

Conclusion: Contrary to prior studies, we found vascular etiologies were the most common cause of acute extremity compartment syndrome at a level 1 pediatric trauma center. Further research is required to analyze surgical and mortality outcomes across pediatric ACS etiologies.

Outpatient Spine Surgery in the Medicare Population: Trends in Hospital Outpatient and Ambulatory Surgical Center Utilization, 2010-2021

Alex Kane Miller, MD
Beaumont Hospital, Royal Oak

Purpose: To demonstrate procedural trends in outpatient spine surgery within the Medicare population and to quantify changes in outpatient volume after removal of a procedure from the “inpatient-only” list.

Significance: Recent emphasis has been placed on transitioning appropriately selected surgical procedures to hospital outpatient department (HOPD) and ambulatory surgical center (ASC) settings for improved efficiency.

Methods: The Medicare Physician Supplier Procedure Summary public-use files from 2010-2021 were queried for spine procedures within Healthcare Common Procedure Coding System (HCPCS) ranges 22010-22899 and 62380-63103. Procedures were referenced to each year’s Medicare ASC Covered Procedures List. Annual totals and changes in volume were calculated.

Results: A total of 12 procedure codes in the above range were included on the ASC list in 2010, which expanded to 58 in 2021. Within this timeframe, the compound annual growth rate (CAGR) of these procedures was 15.7% per year at ASCs and 9.9% per year for HOPDs. High growth of outpatient cervical surgery was observed after lifting inpatient-only restrictions; for HCPCS 22551 (anterior cervical discectomy and fusion, first interspace), growth of 383% and 303% was observed in HOPDs and ASCs, respectively.

Conclusion: A transition of previously inpatient-only procedures has contributed to recent growth of outpatient spine surgery in the Medicare population.

Danger Zone in Anterolateral Plate Fixation of the Distal Tibia – A 3D CT Angiography Model

Brendon Mitchell, MD
University of California, San Diego

Purpose: To use a novel 3D CT angiography (CTA) modeling technique to define the danger zone where the anterior tibial artery (ATA) is at risk during anterolateral plating of the distal tibia.

Significance: The ATA and closely associated neurovascular structures are at risk during percutaneous anterolateral plating of the distal tibia.

Methods: CTAs performed on ninety-two patients (150 lower extremities) were modeled with a 3.5mm LCP anterolateral distal tibia plate using Sectra ID7 software. The ATA was identified and the levels at which the artery intersected the plate were marked both proximally and distally.

Results: The ATA intersected the plate at a mean distance of 10.5 cm (CI 10.1 – 10.8) proximally, and distally at a mean distance of 4.6 cm (CI 4.4 – 4.9) from the central plafond. The ATA was at risk for injury as distally as hole number 1 and as proximally as hole 14 of the plate.

Conclusion: The ATA is at risk when percutaneously placing proximal screws in an anterolateral distal tibia plate. The danger zone for the ATA can be as close as 4.4 cm and as far as 10.8 cm proximal to the tibial plafond.

Identifying Anterior Cruciate Ligament Injuries Through Automated Video Analysis of In-Game Motion Patterns

Gergo Merkely, MD, PhD

Harvard Combined Orthopedic Residency Program

Purpose: To develop an automated video analysis system that uses AI to identify biomechanical patterns associated with ACL injury.

Significance: We demonstrated the feasibility of using AI to automatically evaluate in-game video footage and identify dangerous motion patterns.

Methods: 91 ACL injury and 38 control movement scenes from online available match recordings were analyzed. Videos were processed to identify and track athletes and to estimate their 3D poses. Geometric features, including knee flexion, knee and hip abduction, and foot and hip rotation, were extracted from the athletes' 3D poses. Further analysis examined whether providing clinical experts with the reconstructed 3D poses and their derived signals can increase their diagnostic accuracy.

Results: Our model decision interpretability and good performance ($F1 = 0.66 \pm 0.01$, $ROC\ AUC = 0.88 \pm 0.01$). The experiment examining two orthopaedic surgeons demonstrated improved diagnostic accuracy for ACL injury recognition when provided with system data, resulting in a 0.08 increase in combined F1 scores.

Conclusion: We successfully reconstructed the 3D motion of athletes from a single camera view and derived geometry-based biomechanical features from pose sequences. Our trained model can automatically detect ACL injuries with good performance and pre-label and highlight regions of interest in video footage.

The Relationship Between the Timing of Knee Osteoarthritis Diagnoses and Arthroscopic Partial Meniscectomy

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Purpose: This research assessed the timing of a knee osteoarthritis (OA) diagnosis in patients undergoing arthroscopic partial meniscectomy (APM). We hypothesized that a significant number of patients with knee OA underwent APM.

Significance: While APM is well supported for symptomatic meniscus tears in knees without OA, its efficacy in knees with OA is a topic of ongoing debate and has been challenged by numerous randomized control trials.

Methods: Data from a national claims dataset from 2016-2020 was used to determine if patients who underwent APM had a knee OA diagnosis within 12 months pre-APM, at time of APM, or a new diagnosis at 3, 6, and 12-months post-APM.

Results: 501,922 patients were included (mean age 54.0, 52% female). 304,051 (60.6%) had a knee OA diagnosis at the time of surgery. Of those who did not, 109,427 (55.3%) had a previous diagnosis of knee OA within 12 months preceding surgery, and 24,536 (12.4%), 15,596 (7.9%), and 13,301 (6.7%) were diagnosed with knee OA at 3, 6, and 12 months after surgery.

Conclusion: Despite evidence against APM in patients with knee OA, 55.3% had a previous diagnosis of OA within 12 months of surgery and 27.0% received a new diagnosis of knee OA within one year. It is clear from the findings of this study that high quality evidence is being ignored.

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